Longspine Thornyhead Random Stratified Trawl Survey off the West Coast of Vancouver Island, September 4-21, 2003

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LONGSPINE THORNYHEAD RANDOM STRATIFIED TRAWL SURVEY OFF THE WEST COAST OF VANCOUVER ISLAND, SEPTEMBER 4-21, 2003

by

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ABSTRACT

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The third of three initial relative biomass surveys for longspine thornyheads off the west coast of Vancouver Island, British Columbia, was completed September 4-21, 2003 covering a depth range from 500 to 1600 m. The 2003 survey design was very similar to that used for the 2002 survey, covering the same depth and area strata. The only major change substituted a randomized method of gathering species biological data for the length-stratified subsampling method used in 2001 and 2002. Bottom contact sensors identified when the net made contact with bottom and supplied the primary measure of tow duration for CPUE estimation. Net mensuration data during each tow were manually logged for the first 36 tows and a live serial data feed captured these data for tows 37-74. Sixty-six of the 74 tows were considered valid for biomass estimation, with 86% of the total catch weight of 24.1 tonnes consisting of six species (sablefish *Anoplopoma fimbria*, roughscale rattail *Coryphaenoides acrolepis*, longspine thornyhead *Sebastolobus altivelis*, shortspine thornyhead *Sebastolobus alascanus*, pectoral rattail *Albatrossia pectoralis* and Dover sole *Microstomus pacificus*). Biological samples were gathered from 18 species, with 312 of the 437 samples coming from the six most abundant species by weight. The relative biomass estimate for longspine thornyhead was 4,971 t with a relative error of 11% and is very similar to the 2002 estimate of 4,985 t. Biomass estimates for most of the other top 10 species by weight also had relative errors below 20%, suggesting that this survey also has the capacity to index other groundfish species.

RÉSUMÉ

Krishka, B.A., Starr, P.J., and Choromanski, E.M. 2005. Longspine thornyhead random stratified trawl survey off the West Coast of Vancouver Island, September 4-21, 2003. Can. Tech. Rep. Fish. Aquat. Sci. 2577: vi + 93 p.

La troisième des trois campagnes de relevés de la biomasse relative de sébastolobe à longues épines sur la côte ouest de l'île de Vancouver (Colombie-Britannique) a été réalisée du 4 au 21 septembre 2003; elle couvrait une gamme de profondeurs allant de 500 m à 1 600 m. La campagne de 2003 était conçue de façon très semblable au relevé de 2002, et couvrait les mêmes strates de profondeur et de région géographique. La seule différence importante a été le remplacement de la méthode de sous-échantillonnage stratifié selon la longueur, employée en 2001 et 2002, par une méthode randomisée de collecte de données biologiques sur les espèces. Des capteurs de contact avec le fond signalaient que le filet touchait le fond et fournissaient la première mesure de durée des traits pour l'estimation des CPUE. Pour les 36 premiers traits, on a consigné à chaque fois, manuellement, les mesures sur la performance du train de pêche, puis on a eu recours à la saisie directe des données en série pour les traits 37 à 74. Soixante-six des 74 traits ont été jugés valides pour l'estimation de la biomasse, 86 % du poids total des prises de 24,1 tonnes consistant en six espèces (morue charbonnière *Anoplopoma fimbria*, grenadier à écailles rudes *Coryphaenoides acrolepis*, sébastolobe à longues épines *Sebastolobus altivelis*, sébastolobe à courtes épines *Sebastolobus alascanus*, grenadier pectoral *Albatrossia pectoralis* et sole à petite bouche *Microstomus pacificus*). Des échantillons biologiques ont été prélevés sur 18 espèces; 312 des 437 échantillons provenaient des six espèces les plus abondantes en poids. L'estimation de la biomasse relative de sébastolobe à longues épines était de 4 971 t, avec une erreur relative de 11 %, ce qui est très proche de l'estimation de 2002, soit 4 985 t. Les estimations de la biomasse pour la plupart des dix autres principales espèces (en poids) présentaient aussi des erreurs relatives inférieures à 20 %, ce qui permet de penser que ce relevé a aussi la capacité d'indexer d'autres espèces de poissons de fond.

INTRODUCTION

Thornyheads in BC waters have been targeted commercially for over a decade and first appeared as incidental catches in commercial catch records in 1966. Schnute et al. (2004) provide a concise history of the longspine fishery.

Following the identification of longspine thornyhead (*Sebastolobus altivelis*) and shortspine thornyhead (*S. alascanus*) as good candidates for research survey biomass estimation off the BC coast (Schnute et al. 1999), Starr and Schwarz (2000) proposed using a random stratified trawl survey design for these species. Consultation with industry stakeholders, government and academic representatives refined the design which was implemented beginning in 2001 off the west coast of Vancouver Island.

The design, methods and preliminary results of the 2001 survey are found in Starr et al. (2002). The 2002 survey report (Starr et al. 2004) documents the addition of a seventh areal stratum (Region G - Quatsino), revised sampling strategies and targets, plus a comparison of the 2001 and 2002 results. Relative error estimates of thornyhead biomass for both surveys were well below the design target of 20% and the survey generated very similar relative biomass estimates in both years. The survey also appears to have utility as an index for other groundfish species such as sablefish (*Anoplopoma fimbria*) and two non-exploited rattail (grenadier) species.

The 2003 Thornyhead Biomass Survey is the final survey of a planned series of three surveys over the period 2001 to 2003. The F/V *Ocean Selector* completed the 2002 and 2003 surveys while the F/V *Viking Storm* carried out the initial survey in 2001. Changes in 2003 to the survey protocol include improved electronic data capture methods and a random methodology to select biological subsamples.

SURVEY OBJECTIVES

The 2003 survey objectives remain the same as previous years, namely:

1. To estimate the relative abundance of longspine thornyhead lying between a southern boundary defined by the Canada-US border north to 50° 30’ N within the 500-1,600 metre depth range. The target relative error of the longspine thornyhead biomass estimate is 20% $\left(RE = SE/\mu\right)$ (where μ is the biomass estimate from the survey and *SE* is the standard error of that estimate).
2. To estimate the distribution by size class and sex category of the longspine thornyhead population within the extent of the survey area, given the uncertainty that results from sampling with non-representative fishing gear.
3. To obtain quantitative biological information pertaining to selected finfish and invertebrate species.

METHODS

The methods used to collect the 2003 survey data follow the revised survey protocol detailed in Appendix A. We paraphrase the protocol below and note any differences. Buchanan and Orcutt (2004) also provide additional details within their internal report that may clarify sampling issues.

STRATUM DEFINITIONS

Survey strata comprise three depth zones (501-800 m, 801-1200 m, 1201-1600 m) and seven area zones (areas A-G) that cover the entire designated southern management area for longspine thornyhead off the west coast of Vancouver Island (DFO 2002; Figure 1). Twenty-one unique stratum combinations exist, with associated estimates of surface area and trawlable area (Table 1). Surface area estimates are derived from interpolated depth contours for BC waters. Areas of rough terrain and known obstacles in areas A-F were designated "untrawlable" based on advice obtained prior to the 2001 survey (Chris Roberts, commercial fishing skipper, pers. comm.). Trawlable area in these six strata is the stratum surface area minus the untrawlable area. Area G (Quatsino) was added to the survey design in 2002 without specifying untrawlable areas. Therefore the trawlable area for stratum G is equal to the stratum surface area.

VESSEL AND EQUIPMENT

The Canadian Groundfish Research and Conservation Society (CGRCS) chartered the commercial fishing vessel F/V *Ocean Selector* for the current survey, with Dave Clattenberg as skipper and fishing master again in 2003. The same vessel also completed the 2002 survey. Paul Starr (CGRCS) began the 2003 cruise as chief scientist and remained aboard for the first five days. Archipelago Marine Research Ltd. (AMR) supplied two staff (Dean Gaidica, Mike Orcutt) for catch and sample processing, while Fisheries & Ocean Canada (DFO) staff included Ed Choromanski who supervised catch sampling, and Brian Krishka as chief scientist in Paul Starr's absence. CGRCS contractor Nev Venables also came aboard to assist with sampling after the departure of Paul Starr. Daily communication via email and/or telephone kept Paul Starr informed of survey progress.

A standard Atlantic Western II box trawl (Figure 2; similar to the net used to capture thornyheads commercially) was purchased in 2001 specifically for this survey so that gear differences could be minimized among years. A second box trawl, constructed in 2002 for use aboard the F/V *Ocean Selector*, was supposed to have been built to the same specifications as the first net and was used for the 2002 survey. However, as a result of the change in survey vessel between 2001 and 2002, some differences arose in the way the net was constructed and rigged between these two years. The trawl nets aboard the F/V *Viking Storm* used a lighter footrope, less buoyancy on the headrope, shorter sweep wires and heavier warp cables (G. Workman, DFO, Nanaimo, pers. comm.). The survey planning team was not aware of these changes until the start of the 2003 survey. At that time, skipper Dave Clattenberg indicated that, in his opinion, these changes would have a very minor effect on longspine catchability. The same doors (Thyboron 107) were used in all three survey years. Schnute et al. (2004) incorrectly noted that different doors were used across survey years. The trawl net used in 2003 conformed to the 2002 configuration. Nevertheless, differences in the net design and configuration between 2001 and subsequent years have introduced a catchability change that cannot be quantified, as did the change in the survey vessel between 2001 and 2002.

The F/V *Ocean Selector* was equipped with SCANMAR net monitoring equipment (Scanmar AS, Norway, http://www.scanmar.no/) which displayed fishing characteristics of the net while a tow was in progress. Four sensors mounted on the net, plus associated receiver and processing equipment on the bridge provided real-time data for doorspread, headline height, water temperature at the net, water flow through the net, relative angle, and net depth. Wingspread measurements were not obtained in 2003 since only one Scanmar distance sensor was available. The vessel manager and the survey leader agreed to install this sensor on the

trawl doors to provide doorspread readings. The Scanmar depth sensor was attached to the headrope, requiring that headline height values be added to the sensor depth readings to obtain true depth. The depth sensor failed to record depths beyond 1240 m because the factory settings limited the sensor's range. Scanmar depth sensors are capable of recording greater depths when properly configured, but the sensor must be returned to Scanmar in Norway for adjustment. The Scanmar sensor that measured net speed and alignment was installed backwards on the net until the morning of Sept. 9th, providing incorrect water flow values through the net for tows 1-21. Resulting flow values for these tows should be ignored.

Continuous electronic data capture from the SCANMAR equipment was not established until halfway through the 2003 survey due to difficulties in obtaining the correct software in time for the vessel sailing. Frequent screen-captures of the SCANMAR display during this first part of the survey were used to provide a record of the sensor readings, using software which saved the display image as a compressed bitmap file. Screen captures were taken every 1-2 minutes from the time of winch lockup to the time that the net finally left bottom. Consecutive screen captures were not correctly incremented for some tows, which caused some of the initial files to be overwritten on the floppy disc until the problem was identified.

Electronic data capture was implemented beginning with tow 37 after installing a Furuno interlacer that merged serial output signals from the Global Positioning System (GPS) and SCANMAR sensors. Technicians from Port Hardy met the vessel in Winter Harbour to complete the interlacer installation. HyperTerm software captured the resulting serial data flow as a separate text file for each tow.

Manual Scanmar screen captures were continued at a reduced level for tows 37 to 74 as a backup in case electronic data capture failed. Screen captures for these tows were made 1) when net sensor readings indicated that the net reached bottom, 2) every 5-10 minutes during the tow, 3) when the winch released for net retrieval, and 4) when the net finally left bottom. The SCANMAR sensors and GPS recorded the following information at each interval: time, bottom depth, latitude, longitude, warp length, wind speed, wind direction, vessel direction and vessel towing speed. Post-survey transcription of the screen-capture data and the HyperTerm serial data are included as supplemental information in the DFO GFBio data archive for Trip_ID 50220.

Nobeltec navigational software (Visual Navigation Suite) captured tow track information (location, vessel speed and direction, time) that enabled visual presentation of the vessel path during each tow. Normally the vessel skipper would begin logging the vessel position using this software at the time when the winch was locked to begin fishing, and then stop logging the position data when net retrieval began. Each tow track was identified with the set number. Incomplete tracks were occasionally recorded for some tows because the skipper failed to either start or stop tracking the tow at the required time. Post-survey manual editing of track data corrected for incomplete tracks by 1) adding coordinates for the start location based on bridge log records, and 2) removing extraneous data when the software continued logging position after the tow ended. Ideally, GPS sensors should be attached directly to the trawl net, logging true net location with time, but the current proxy is to use the vessel path information.

A bottom contact sensor (BCS) was deployed with each survey tow to measure the effective tow time, defined as the time difference between the points at which the net made first and last contact with bottom during a tow. Acceptable tows within areas A-D needed at least 30 minutes of effective tow time, with 15 minutes or more required in areas E-G. The sensor attached below the trawl footrope using two short chains, and an internal inclinometer recorded tilt angle of this device (0° = vertical, 90° = horizontal). Chains used to attach the BCS were shortened from the 8 links used in 2002 to 6 links for 2003 to reduce the variability in the bottom

contact readings. A rapid change in angle from 0° toward 90° was interpreted to indicate net contact with the bottom as the sensor began dragging horizontally behind the footrope (M. Wilkins, NFMS, pers. comm.). The sensor would hang vertically (reading near 0°) beneath the footrope whenever the net was off the bottom. A data logger installed within the BCS device recorded time and tilt angle every 6 seconds and was synchronized with the GPS clock each morning. Following each tow, BCS data were transferred to an onboard computer and the data logger memory was purged in preparation for the next tow. BCS data exist for all tows except for tow 51 (the BCS device was lost during this tow) and tow 69 (aborted before net reached bottom). These data are archived as supplemental data for GFBio Trip_ID 50220.

A Seabird depth-temperature sensor (Model # SEB 39) was used to gather continuous temperature and depth data throughout the day. It was attached to the headrope within a protective housing and was retrieved every 2-3 tows to download data and clear sensor memory. All Seabird data are archived at the Institute of Ocean Sciences (DFO, Sidney, B.C.) and also as supplemental data for GFBio Trip_ID 50220.

TOW SELECTION

The survey area was divided into 500 m x 500 m square grids which were assigned unique station numbers. Potential tow locations for each area/depth stratum were based on a random pre-selected list of 25 station numbers. Tows were performed in sequential order from the list (1 to 25) until the required number of tows was completed. Survey protocol required investigation of the first four stations on the list for strata in shallower depth ranges (501-800 m and 801-1200 m), while only the first two stations needed investigation in the deep (1201-1600 m) stratum.

The skipper was allowed to fish any tow line in survey areas A through D that passed within 250 m of the designated random station at some point during the tow, as well as maintaining at least 30 minutes of effective tow time within the required depth range. Random locations could be skipped in favour of the next random station on the list if:

- The station did not meet the area/depth stratum definition (e.g., the depth of the random station was not within the specified depth zone or the station was outside the area boundaries); OR
- The station was considered untrawlable due to bottom topography or other obstacles such as known snags. The skipper was encouraged to select another station if there was a significant danger of either losing the net or not achieving adequate bottom contact time.

The tow location selection rules were relaxed for the three northern areas (E, F and G) as the bottom topography in these areas is much less suitable for bottom trawl gear. The skipper was allowed to select any location in the 25 random grids that was deemed trawlable. Bottom contact requirements were also relaxed to a minimum of 15 minutes bottom contact time and the vessel had to pass within 2 km of the random station at some time during the tow.

Depth contours available in the survey grid database are only approximate and the primary determinant of depth occurred as the survey progressed. Deviations from plotted depth contours were not considered a problem, as all valid tows were located within the appropriate depth zones.

Additional random sites were required for areas E (501-800 m zone in Esperanza) and F (1201-1600 m zone in Cape Cook–Winter Harbour) after the initial lists of 25 potential sites were either used or rejected without achieving the target number of tows per stratum.

CATCH AND SAMPLE PROCESSING

Catches were released into the hopper on deck and transferred along a conveyor belt to the sampling area. The sampling crew stationed along the belt sorted species or species groups into separate sampling baskets for bulk weighing. All species had specimens counted, if practical, and a total weight recorded by species. Eleven "target" species required detailed sampling that varied between species (Table 2). All specimens of a target species were measured unless the species catch consisted of more than 150 individuals, in which case subsampling took place. Catches were randomly subsampled in proportion to the estimated number of fish caught, so that a manageable number of fish was processed for required attributes. For example, one in every six fish was sampled if 600 fish were estimated in the species catch, providing a subsample of approximately 100 specimens. The procedure was repeated with a larger proportion if the initial sub-sample was too small.

A large capacity motion-compensating electronic balance (Marel Model M1100) provided weights of species catches within each basket to estimate the total catch by species. A smaller balance was used to measure weight from individual specimens being sampled for otoliths.

Eight target species (Table 2) had maturity stages recorded using established maturity codes for flatfish (Appendix B) and rockfish (Appendix C). A simplified maturity code scheme continued to be used for thornyheads in 2003 (0 = immature, 1 = mature) which was consistent with the maturities taken for these species in the 2001 and 2002 surveys (Appendix A1).

The method for selecting subsamples for ageing structures, weights and maturity information changed in 2003 from a length-stratified scheme (Starr et al. 2004) to direct random sampling by tow. This was accomplished through a series of random number tables (see Appendix A2 for an example) that indicated which fish in the series should be sampled. These tables were constructed based on the numbers of fish in the sample and overall survey targets for the species in question (Table 2).

DATA ANALYSIS

Only tows which were considered to have met the requirements for site suitability and bottom contact time were used to estimate target species biomass. Equations 2, 3, 5 and 6 below have been modified from Appendix D in Starr et al. (2002) to accommodate estimates of wingspread available from Scanmar net sensor data. Actual wingspread values are not available for 2003 since the vessel used the available Scanmar distance sensor to gather doorspread measurements (see pg. 3). Wingspread values for 2003 are estimated from a relationship between wingspread and doorspread derived from 2002 survey data when both measurements were available (Appendix D).

The biomass estimate (B_s) for species *s* from the survey was calculated in kg as follows:

$$B_s = \sum_i C_{s_i} A_i \qquad \textbf{Eq. 1}$$

where C_{s_i} = mean CPUE density (kg/km^2) for species *s* in stratum *i*

A_i = area of stratum *i* (km^2)

The variance of the survey biomass estimate V_{B_s} for species *s* was calculated in kg^2 as follows:

$$V_{B_s} = \sum_i V_{s_i} A_i^2 \Big/ n_i \qquad \textbf{Eq. 2}$$

where V_{s_i} = variance of CPUE (kg^2/km^4) for species *s* in stratum *i*

n_i = number of observations in stratum *i*

Tow distance is estimated by summing the distance traveled within time intervals during each tow. Interval data are obtained from either Scanmar screen captures or live data feeds via serial outputs from the Scanmar system and Nobeltec software linked to the onboard GPS. The distance traveled in km (D_{ij}) by tow *j* in stratum *i* was calculated from intermediate observations within a tow:

$$D_{ij} = \sum_t S_{ijt} T_{ijt} \qquad \textbf{Eq. 3}$$

S_{ijt} = speed (km/h) for tow *j* in stratum *i* over time interval *t*
T_{ijt} = length of time interval *t* (h) for tow *j* in stratum *i*

Note that S_{ijt} is defined as the mean of the vessel speed observation from the start and end of each interval *t*.

C_{s_i} (Catch per unit area (kg/km^2) for species *s*) for the 2003 survey is then calculated as:

$$C_{s_i} = \frac{\sum_j \left(W_{s_{ij}} \Big/ D_{ij} w_{ij} \right)}{J_i} \qquad \textbf{Eq. 4}$$

where $W_{s_{ij}}$ = catch weight (kg) for species *s* in stratum *i* and tow *j*

w_{ij} = wingspread width in km for tow *j* in stratum *i*

J_i = number of tows in stratum *i*

The precision of the survey is often expressed in terms of the relative error (*RE*) which is estimated from the values obtained in Eq. 1 and Eq. 2:

$$RE_{B_s} = \frac{\sqrt{V_{B_s}}}{B_s} \qquad \textbf{Eq. 5}$$

where RE_{B_s} is the relative error for the biomass index for species *s*.

The relationship of weight from length is usually expressed as follows (Quinn & Deriso 1999):

$$Z_{sijk} = a_s L_{sijk}^{b_s} e^{\varepsilon_{sijk}} \qquad \textbf{Eq. 6}$$

where Z_{sijk} is the weight of observation *k* of species *s* with length L_{sijk} from tow *j* in stratum *i*, a_s and b_s are species regression constants and e_{sijk} is a random error term with mean 0 and constant variance s^2.

The sample for any species was scaled up to the catch in the sampled tow as follows:

$$S_{sijk} = \frac{Z_{sijk}}{\sum_k Z_{sijk}} W_{s_{ij}} \qquad \textbf{Eq. 7}$$

where S_{sijk} is the scaled weight (in kg) of observation *k* of species *s* from tow *j* in stratum *i*.

As S_{sijk} is equivalent to the catch weight $\left(W_{s_{ij}}\right)$ in Eq. 4, S_{sijk} can be substituted into these equations instead of $W_{s_{ij}}$ and then the corresponding CPUE estimate can be used in Eq. 1 and Eq. 2 to calculate the mean and standard error of any sub-group of the biomass. Length distributions were calculated by binning the lengths into 1-cm intervals for longspines and into 5-cm intervals for shortspines, the two rattail species and Dover sole.

RESULTS AND DISCUSSION

TOW FREQUENCY AND DISTRIBUTION

The survey was completed in 16 fishing days from September 5-20th. From two to seven acceptable tows were completed each day, averaging 4.2 per day. No fishing days were lost due to weather, but several days were shortened so that serial communication with the Scanmar net sensors could be established.

Seventy-four tows were attempted, of which 66 were accepted for calculating species biomass indices and 8 were rejected (Figure 1; Tables 3 and 4). Tows were aborted for several reasons including gear malfunctions, snagged bottom or communications line, and one tow that dropped below the maximum allowable depth (Table 4).

Table 5 summarizes 110 random tow locations that were not selected and the reasons for rejection. Forty-five percent of the random tow locations were rejected because of steep or irregular bottom topography; most of these came from the three northern areas. On-site depth verification identified actual site depths that were outside stratum limits, therefore rejecting another 36 tow locations. This is a common reason for rejecting sites since the depth contours used for depth stratification are not exact. Areas E-G sites represent 84% of all rejected sites.

NET MENSURATION

Streaming Scanmar net sensor data could not be collected during the first half of the 2003 survey. As explained earlier (pg. 3), technicians established a working system of streaming data capture between the Scanmar system, GPS and survey computers just prior to tow 37. This resulted in continuous Scanmar sensor and GPS position information for all tows beginning with tow 37.

Survey staff noticed a problem with Scanmar depth sensor data partway through the survey but were unable to correct the situation during the survey. Factory settings on the depth sensor prevented measurement of depths beyond 1240 m. Unfortunately, the sensors needed to be returned to Scanmar in Norway to adjust the sensor limit and this was not practical during the survey. This quirk only affected depth measurements in the deepest depth strata (1201-1600 m). Seabird temperature and depth data are available to compensate for missing Scanmar depth data for 11 of the 14 deepest tows. The Seabird sensor also malfunctioned at times due to problems with weak batteries and poor connections.

Total distance traveled by the net was estimated in several ways. The method used for the previous two surveys involved estimating the distance traveled for each time interval based on the interval speed and the elapsed time, with the total distance traveled being the sum of these distances. Interval calculations in 2002 began from winch lockup and ended at winch release while interval distances were calculated in 2003 beyond the point of winch release. This manner of estimation was continued in 2003 so that the methodology used to estimate distance traveled (Eq. 3) was consistent for all three survey years.

Nobeltec navigational software permitted an independent measure of tow track length based on positional coordinates taken at 1-minute intervals. Data points (time and position) were manually added to tow tracks if vessel tracking actually began after winch lockup or ended before the winch release time recorded on bridge logs (Appendix F). Data filtering eliminated extraneous information gathered before the winch lockup time and after the winch release time, allowing estimates of tow length to be made directly from the Nobeltec data. Track length estimates derived using PBSMapping software (Schnute et al. 2003) confirmed Nobeltec distance calculations. Future data collection should ensure that Nobeltec tow tracks capture the entire tow distance by recording position data for the period beginning several minutes before winch lockup and continuing to the time when the net leaves the bottom after winch release.

Regardless of the methodology used to estimate tow distance, two types of tow distance estimates can be made: one spanning the period from winch lockup to winch release ("winch time") and the other spanning the period from the time the net reached the bottom to the time the net left the bottom ("bottom contact time") as specified by the BCS devices attached to the net.

Tow distances based on winch time, using either Scanmar or Nobeltec data, provide slightly longer distance estimates than those based on bottom contact time (Table 6). The preferred distance estimate to use for biomass estimation should be based on the bottom contact time because this time period best represents the actual time that the gear is fishing on bottom even though the net appears to leave bottom for variable periods during many tows (Figure 5). However, bouncing on the bottom will affect all of the available sources for distance measurement.

The frequency distribution of distance traveled for valid tows shows that the majority of tows traveled between 3.5 and 6 km (Table 6; Figure 3) which was similar to the range of distances observed in previous surveys. The range of estimated tow distances based on winch time span (3.3-6.6 km) is slightly wider than the range based on bottom contact (3.1-6.3 km).

Mean tow distance decreases with depth zone regardless of the method used to estimate tow distance (Table 6).

Average tow speed varied from 3.3 to 5.8 km/h (Table 6). The average vessel speed for 2003 (4.6 km/h) was similar to the 2002 survey (4.6 km/h) and higher than the mean for the 2001 survey (4.2 km/h) (Starr et al. 2002, 2004). Mean vessel speed decreased with increasing depth (Table 6).

Wingspread measurements were not available from Scanmar sensors during the 2003 survey while doorspread and headline height data were available. In the absence of 2003 wingspread readings, median doorspread values by tow were converted to the equivalent wingspread value based on a relationship of wingspread-to-doorspread estimated from 2002 survey data (Appendix D). These data indicate that the relationship between these two net dimensions can be quite variable during a tow (Fig. 1 in Appendix D) but that there is stability in the median values. The wingspread-to-doorspread functional relationship is based on 758 paired observations with a high level of correlation ($R^2 = 0.998$) which provides a reasonable level of comfort in making this adjustment. However, the obvious preference would be to have enough Scanmar distance sensors to collect both wingspread and doorspread measurements during future surveys.

Additional information gathered by net sensors included the flow of water through the net opening. An incorrectly installed flow meter in the trawl net gave invalid readings for the first 21 tows. Once the error was noticed, the deck crew correctly mounted the meter to the net for subsequent tows. No analysis of flow data was done for this report but the data are archived in GFBio for future consideration.

BOTTOM CONTACT SENSOR DATA

Bottom contact sensor data permit the calculation of the length of time required for the net to reach the bottom after the winch is locked and the length of time it takes for the net to leave the bottom after the winch is released. These delays increase with depth at the beginning of tows (Table 7, Fig. 4), largely due to the slack present with extended warp lengths. A similar response is expected during retrieval but the average delay for the net leaving bottom does not appear to increase with depth (Fig. 4). BCS profiles from four tows (Fig. 5 - tows 12/26/32/61) show the net leaving bottom just as the winch released. The profile for tow 63 shows net contact with bottom before winch lockup. The times for winch lockup and first bottom contact are the same for tow 72, with only a minor delay upon retrieval. These anomalies between the winch times and the BCS times may be the result of poor synchronization between the GPS and the BCS device, or to imprecision in the recording of the winch lockup and retrieval times as these latter times were recorded manually. Only tow 51 lacks a BCS profile because one of the BCS devices was lost during that tow.

Tow 6 was an unusual case where the net snagged on the bottom 25 minutes after winch lockup and the tow was suspended. The skipper was able to free the gear and lifted it to approximately 730 m below the surface where inspection of the Scanmar sensor data indicated proper gear configuration. The tow was then resumed after reaching bottom a second time and fishing continued for another 41 minutes. This tow was initially accepted as a valid tow after the net was inspected on deck for damage, ensuring that the catch was not compromised by gear failure. Tow 6 was ultimately considered invalid based on the highly irregular manner in which the tow was completed and the consequent difficulty in deciding how long the tow was actually in contact with the bottom. Such tows should normally be repeated under similar circumstances.

Bottom contact profiles for most tows indicated consistent bottom contact during the tow. Numerous tows (e.g. tows 15/32/36/37/38/59/61/73) showed irregular contact based on the BCS trace, probably due to bouncing of the device. These tows were accepted as valid tows because they met the tow duration criteria which are based only on the net arrival and departure time from bottom. A quick review of the profiles in Figure 6 illustrates that bottom contact can be quite variable but the reasons for this variability are not well understood. Possible factors include substrate variation, rough topography, currents and others that influence fishing characteristics of trawl nets. The US National Marine Fisheries Service (NMFS) uses these BCS devices to determine the net arrival and liftoff times but does not use them to determine the precise period of net contact on the bottom (M. Wilkins, NMFS, pers. comm.).

CATCHES AND CATCH RATES

The top six species by weight accounted for over 86% of the total catch weight from 66 valid survey tows (Table 8). The most abundant species by weight were sablefish, roughscale rattail, and longspine thornyheads. These three species represented 55% of the 24.1 tonnes caught during the survey.

Roughscale rattail (*Coryphaenoides acrolepis*) is also known as the Pacific grenadier, while the pectoral rattail (*Albatrossia pectoralis*) is also known as the giant grenadier. We will continue to refer to these two species as rattails rather than as grenadiers for consistency with earlier survey documents (Starr et al. 2002, Starr et al. 2004).

Longspine and shortspine thornyheads were each taken in 63 of 66 valid tows (96%) while sablefish (85%), pectoral rattail (92%) and roughscale rattail (77%) were well represented in most survey tows (Table 8). Pacific flatnose (*Antimora microlepis*), tanner crabs (*Chionoecetes* sp.), threadfin grenadier (*Coryphaenoides filifer*) and deepsea sole (*Embassichthys bathybius*) were often part of the catch but contributed less than 6% of the combined catch weight.

Inspected catches from another 8 tows that were not used for biomass analysis captured 45 species/groups, including three species (barracudinas, blacktail snailfish *Careproctus melanurus*, threadfin slickhead *Talismania bifurcata*) which were absent from the valid biomass tows (Table 9).

BIOLOGICAL DATA

Four hundred thirty two samples were taken from the 66 valid survey tows to obtain biological data for 18 species, including length and sex data (Table 10). Of the 15,797 specimens processed, maturity information was collected from 12 species (11,487 fish). Twelve species had individual weights recorded (3,655 fish) and otoliths were collected from 11 species (3,656 fish). A further 12 samples were collected from rejected tows 6 and 35 (Table 11).

Sablefish tags were recovered from 13 fish (Table 12). Specimen data and tags were forwarded to Malcolm Wyeth (DFO, Pacific Biological Station, Nanaimo, B.C.) to assist with sablefish monitoring and assessment.

Summary unscaled length data for selected species are provided by depth zone in Table 13. Unscaled length frequency distributions for the 18 species (Figure 6) are provided for species which were subsampled for otolith and weight data. The random subsampling method used in 2003 appears to have been successful, given the good correspondence between the two

size distributions. Scaled length and weight frequencies by sex have not been calculated for this report.

Weight-length regressions for six species are shown in Figure 7. These relationships are consistent with equivalent relationships calculated from the previous two surveys (Starr et al. 2002, 2004).

BIOMASS ESTIMATION

This survey is designed to: 1) estimate relative biomass for longspine thornyheads with no more than a 20% RE, and 2) explore the practicality of obtaining estimates from other groundfish species which exhibit sufficiently low RE values such that these biomass estimates could be used in a formal stock assessment. These survey estimates will allow the comparison of relative biomass changes across years. The complete series, spanning 2001 to 2003, will provide the basis for beginning a longer times series of biomass estimates for these species.

Relative biomass estimates from the 2003 survey are well below the 20% RE target set for longspine thornyhead and are also under 20% RE for another nine species (Table 14). Longspine thornyhead biomass is estimated at 4,971 t (11.2% RE) within the survey area off the west coast of Vancouver Island. Shortspine thornyhead biomass is approximately 2,500 t with a 13.2% RE. The two dominant rattail species have a combined biomass of just over 27,500 t and RE values between 15-20%. Biomass estimates for sablefish are similar in scale to those of longspine thornyheads. Figure 8 illustrates species biomass estimates based on bottom contact times and winch times for selected species.

Survey stratification by area and depth provide additional insight into species biomass distributions. Thornyhead and sablefish biomass estimates are summarized for each of the 21 survey strata in Table 15.

COMPARISON WITH PREVIOUS SURVEY BIOMASS ESTIMATES

Two methodologies have been developed to compare the biomass estimates from this survey across years because of changes in the survey design. The following restrictions were used to provide comparability of the estimates for 2001-2003:

- Area G (Quatsino; Figure 1) was dropped as it was not surveyed in 2001.
- A constant wingspread of 20 m was used because wingspread measurements are not available for 2001.
- Tow duration based on the time from winch lockup to net retrieval (winch time) was used to calculate the CPUE density because the behaviour of the BCS device appeared to differ between the 2001 survey and the two subsequent surveys.

There are few differences in biomass by species between survey years after applying these restrictions and considering sampling variability. The thornyhead estimates are consistent and show low variability between years, while the sablefish and two sole estimates appear to be more variable (Table 16). Very few of the species show significant differences between survey years, although this is often due to the high relative errors for some species (e.g. longnose skate, brittle stars). The only significant differences between the three surveys are for Tanner crabs, which have a considerably lower biomass estimate for 2001, and for brittle stars. Squid relative

biomass appears to increase steadily with year but the differences remain non-significant due to estimation error.

A somewhat better comparison is possible for 2002-2003 due to greater similarities between these two surveys because the same vessel and skipper were used, similar net mensuration sensors are available and the same survey areas were covered. Unlike the 2001 survey, the two more recent surveys included area G (Quatsino) and thus cover the entire southern management area for longspine thornyheads.

Relative biomass estimates between the two years are similar for most species once sampling variability is considered (Table 17, Fig. 9). There is a possible decrease in the Pacific flatnose biomass between the two surveys. Deepsea sole biomass is also considerably lower in 2003 but the high RE values for these biomass estimates means that the difference is not significant. The largest biomass difference occurs for brittle stars but the high RE again suggests these two estimates are not statistically different.

RECOMMENDATIONS

Several recommendations arise following the third consecutive year of this survey to assist with implementing future surveys:

- Measure and document detailed net dimensions and materials at the beginning of each survey to capture any possible changes in net configuration between surveys.
- The Scanmar depth sensor range should be adjusted at the factory to record depths beyond 1240 metres.
- Scanmar distance sensors should be available to record both wingspread and doorspread readings.
- Nobeltec tow track logging should cover the entire tow, beginning before winch lockup and continuing until after the net leaves the bottom following winch release.

CONCLUSION

Three consecutive years of survey data have produced a valuable benchmark for future thornyhead assessments off the west coast of Vancouver Island. Schnute et al. (2004) have reviewed the available commercial and survey thornyhead data and have demonstrated the utility of these surveys for assessment of commercial species. Application of the design used in this survey to other areas of the BC coast is recommended by Schnute et al. (2004) on a rotating basis and is considered a high priority for the Rennell thornyhead management region off the west coast of the Queen Charlotte Islands.

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Table 1. Names and labels for seven area strata and three depth zone strata used for the 2003 survey. Trawlable area (km^2) is the estimated area after the removal of untrawlable areas identified by Chris Roberts (skipper of the F/V *Viking Storm*) prior to the 2001 survey. Note that untrawlable areas in area G are not defined.

Area	Name	Depth Zone (m)	Estimated Area (km^2)	
			Total	Trawlable
A	Barkley	501-800	487	384
		801-1200	702	637
		1201-1600	577	577
B	Loudon/Clayoquot	501-800	330	233
		801-1200	373	336
		1201-1600	694	694
C	Clayoquot/Estevan	501-800	265	238
		801-1200	380	380
		1201-1600	462	462
D	Nootka/500	501-800	274	154
		801-1200	386	221
		1201-1600	448	427
E	Esperanza/Kyuquot	501-800	427	324
		801-1200	355	290
		1201-1600	259	252
F	Cape Cook/Winter Harbour	501-800	201	79
		801-1200	540	367
		1201-1600	571	523
G	Quatsino	501-800	130	130
		801-1200	215	215
		1201-1600	307	307
	Total		**8,383**	**7,230**

Table 2. Biological sampling targets for selected fish species. Specimen sampling designations include: LS (length/sex), LWSMO (length/weight/sex/maturity/otoliths), and LSM (length/sex/maturity). Samples are taken from each tow that captures listed species.

Species	Specimen sampling	Type of Otolith sampling	Target number of otoliths for the survey	Otoliths to sample per tow
Longspine thornyhead	LS, LWSMO	Random	1,000	20
Shortspine thornyhead	LS, LWSMO	Random	600	12
Shortraker rockfish	LWSMO	Every fish	200	N/A
Rougheye rockfish	LWSMO	Every fish	200	N/A
Dover sole	LS, LWSMO	Random	500	12
Deepwater sole	LSM	No	N/A	N/A
Arrowtooth flounder	LS, LWSMO	Every fish	200	N/A
Sablefish	LS, LWSMO	Random	500	12
Roughscale rattail	LS	Random*	N/A	6
Pectoral rattail	LS	Random*	N/A	6
Sharks or skates	LS	No	N/A	N/A

* undertaken if time permits

Table 3. Summary of stratum, time, distance, speed, and depth information for completed tows that were used for biomass estimation. The random sequence number (SEQ) refers to the order in which potential trawl sites were selected *within* each area/depth combination. Table contents are sorted by area, depth zone and then tow. Tow distance is estimated from bridge log interval data. Measures of tow duration and estimated distance include: a) the time from winch lockup to release (Winch) and b) the time span from first to last net contact with bottom based on bottom contact sensor (BCS) profiles (see Figure 6). Mean vessel speed is based on interval data from winch lockup to release.

Tow	Area	Depth zone (m)	Date	Tow Duration (minutes)		SEQ	Est. Distance (km)		Vessel speed (km/h)	Start Depth (m)	End Depth (m)
				Winch	BCS		Winch	BCS			
8	A	501-800	Sept. 06, 2003	69	72	3	6.50	6.27	5.65	580	576
9	A	501-800	Sept. 06, 2003	64	71	1	5.26	5.39	4.93	722	741
10	A	501-800	Sept. 06, 2003	66	65	10	5.68	5.49	5.16	536	576
11	A	501-800	Sept. 06, 2003	68	65	9	5.23	4.75	4.62	689	565
1	A	801-1200	Sept. 05, 2003	62	63	2	4.33	4.15	4.19	997	1000
3	A	801-1200	Sept. 05, 2003	63	58	3	4.68	4.25	4.45	951	786
5	A	801-1200	Sept. 05, 2003	67	57	6	4.33	4.05	3.88	986	1035
2	A	1201-1600	Sept. 05, 2003	67	61	2	4.80	4.17	4.30	1253	1242
7	A	1201-1600	Sept. 06, 2003	74	64	5	5.38	4.67	4.33	1234	1383
15	B	501-800	Sept. 07, 2003	73	71	3	5.74	5.56	4.72	587	732
16	B	501-800	Sept. 07, 2003	74	76	2	6.32	6.34	5.13	560	552
17	B	501-800	Sept. 08, 2003	63	61	4	4.76	4.62	4.53	633	640
21	B	501-800	Sept. 08, 2003	63	59	5	5.37	5.02	5.11	732	691
14	B	801-1200	Sept. 07, 2003	67	66	2	5.19	4.82	4.65	850	1006
18	B	801-1200	Sept. 08, 2003	63	59	3	4.83	4.67	4.60	1024	896
19	B	801-1200	Sept. 08, 2003	64	65	6	4.71	4.75	4.41	1072	969
20	B	801-1200	Sept. 08, 2003	67	59	1	5.20	4.48	4.66	1170	1097
12	B	1201-1600	Sept. 07, 2003	78	63	3	4.52	4.02	3.48	1417	1527
13	B	1201-1600	Sept. 07, 2003	78	68	2	5.17	4.70	3.98	1262	1362
22	C	501-800	Sept. 09, 2003	65	66	1	5.66	5.63	5.22	677	668
27	C	501-800	Sept. 10, 2003	68	72	2	5.67	5.84	5.01	567	530
29	C	501-800	Sept. 10, 2003	67	69	3	5.28	5.29	4.73	631	571
30	C	501-800	Sept. 10, 2003	68	67	4	5.52	5.39	4.87	631	668
23	C	801-1200	Sept. 09, 2003	66	71	2	5.30	5.43	4.82	881	860
24	C	801-1200	Sept. 09, 2003	64	63	4	4.56	4.69	4.27	896	978
25	C	801-1200	Sept. 09, 2003	69	65	3	5.16	4.95	4.49	1134	1112
28	C	801-1200	Sept. 10, 2003	68	72	1	5.91	6.12	5.21	860	841
26	C	1201-1600	Sept. 10, 2003	69	56	1	4.42	3.93	3.84	1289	1509
31	C	1201-1600	Sept. 10, 2003	88	71	2	5.12	4.53	3.49	1454	1485
34	D	501-800	Sept. 11, 2003	63	61	2	4.85	4.66	4.62	530	600
61	D	501-800	Sept. 18, 2003	80	73	4	6.33	5.96	4.75	640	640
62	D	501-800	Sept. 18, 2003	61	66	3	4.72	4.70	4.64	589	501
63	D	501-800	Sept. 18, 2003	66	74	5	5.03	5.27	4.57	604	658
32	D	801-1200	Sept. 10, 2003	85	69	4	5.94	5.12	4.20	1134	988
36	D	801-1200	Sept. 11, 2003	68	70	3	5.04	4.90	4.45	812	799
59	D	801-1200	Sept. 17, 2003	74	80	2	5.51	5.77	4.46	896	896
60	D	801-1200	Sept. 17, 2003	62	57	1	4.49	4.15	4.35	988	1024
33	D	1201-1600	Sept. 11, 2003	74	65	1	4.55	4.24	3.69	1298	1390
58	D	1201-1600	Sept. 16, 2003	55	43	2	3.93	3.08	4.29	1298	1262

(Continued)

Table 3 (continued).

Tow	Area	Depth zone (m)	Date	Duration (minutes)		SEQ	Distance (km)		Vessel speed (km/h)	Start Depth (m)	End Depth (m)
				Winch	BCS		Winch	BCS			
53	E	501-800	Sept. 15, 2003	58	54	3	5.14	4.76	5.31	594	604
71	E	501-800	Sept. 19, 2003	68	66	5	6.58	6.10	5.81	613	594
72	E	501-800	Sept. 20, 2003	55	56	9	4.88	4.94	5.32	713	677
74	E	501-800	Sept. 20, 2003	58	56	8	4.58	4.33	4.74	631	783
54	E	801-1200	Sept. 15, 2003	60	60	2	4.71	4.62	4.71	924	841
65	E	801-1200	Sept. 18, 2003	71	74	3	5.50	5.60	4.65	933	924
66	E	801-1200	Sept. 19, 2003	70	746	5	5.20	5.32	4.46	997	988
67	E	801-1200	Sept. 19, 2003	74	76	7	5.62	5.70	4.56	1097	878
68	E	1201-1600	Sept. 19, 2003	66	59	34	4.53	4.07	4.12	1280	1244
70	E	1201-1600	Sept. 19, 2003	82	64	41	5.28	4.23	3.86	1317	1289
51	F	501-800	Sept. 15, 2003	71	71	5	5.60	5.60	4.43	604	786
52	F	501-800	Sept. 15, 2003	60	56	3	4.94	4.41	4.94	549	530
55	F	501-800	Sept. 16, 2003	43	39	15	3.56	3.14	4.97	549	494
56	F	501-800	Sept. 16, 2003	50	50	22	3.71	3.58	4.45	516	521
73	F	501-800	Sept. 20, 2003	43	49	44	3.32	3.91	4.64	594	549
42	F	801-1200	Sept. 13, 2003	59	60	1	4.47	4.38	4.54	860	1006
43	F	801-1200	Sept. 14, 2003	54	57	2	3.61	3.80	4.01	1079	1125
44	F	801-1200	Sept. 14, 2003	51	55	6	3.79	3.92	4.46	1070	1061
49	F	801-1200	Sept. 15, 2003	51	48	4	3.97	3.79	4.66	863	1061
46	F	1201-1600	Sept. 14, 2003	57	51	3	3.40	3.19	3.58	1372	1317
50	F	1201-1600	Sept. 15, 2003	62	49	1	4.49	3.50	4.35	1335	1308
37	G	501-800	Sept. 12, 2003	58	57	2	4.79	4.64	4.95	549	523
38	G	501-800	Sept. 12, 2003	56	52	5	4.73	4.46	5.06	604	604
40	G	801-1200	Sept. 13, 2003	52	58	13	4.09	4.19	4.71	969	1198
41	G	801-1200	Sept. 13, 2003	54	52	10	4.15	3.65	4.61	1097	951
47	G	1201-1600	Sept. 14, 2003	67	60	1	4.38	4.02	3.92	1244	1253
48	G	1201-1600	Sept. 14, 2003	53	53	22	3.33	3.32	3.77	1262	1280

Table 4. Tows that were attempted and excluded from analyses and the reasons why.

Tow	Area	Depth Zone (m)	Date	Reason for exclusion
4	A	801-1200	Sept. 5, 2003	Tow aborted – communications line hooked
6	A	801-1200	Sept. 5, 2003	Tow rejected – snagged on bottom
35	D	801-1200	Sept. 11, 2003	Tow aborted – snagged on bottom
39	G	801-1200	Sept. 12, 2003	Tow rejected – wing was twisted
45	F	1201-1600	Sept. 14, 2003	Tow aborted – twisted wing
57	E	801-1200	Sept. 16, 2003	Tow aborted – twisted wing
64	E	801-1200	Sept. 18, 2003	Tow aborted – twisted wing
69	E	1201-1600	Sept. 19, 2003	Tow aborted – depth dropped below stratum maximum

Table 5. Reasons for rejecting selected tow sites following exploratory sounding by the skipper.

Stratum	Reason						Total
	Wrong depth	Wrong Area	Bottom steep or irregular	Bottom too hard	Tow path too short	Too close to existing tows	
A1	3	2				1	6
A2	2						2
A3	3		2				5
B1	1						1
B2	1		1				2
B3				1			1
D1	1						1
E1	3		2				5
E2	2		1				3
E3	7		16	2	1		26
F1	10		6	4		1	21
F2	1		1				2
F3			1				1
G1		2	1				3
G2	2	4	5				11
G3		7	13				20
Total	**36**	**15**	**49**	**7**	**1**	**2**	**110**

Table 6. Summary statistics of selected gear and tow characteristics by depth strata. Only valid biomass tows are considered. Winch time refers to the time from winch lockup to winch release. Bottom contact time is the time span from first-to-last bottom contact based on bottom contact sensor data. Tow distance from Nobeltec navigational software is automatically calculated from tow track data.

	Mean	Minimum	Maximum	N	Standard Deviation
Estimates based on winch time					
Tow distance (km)					
501-800 m	5.18	3.32	6.58	27	0.82
801-1200 m	4.81	3.61	5.94	25	0.64
1201-1600 m	4.52	3.33	5.34	14	0.63
All tows	**4.90**	**3.32**	**6.58**	**66**	**0.75**
Doorspread (m)					
501-800 m	59.73	52.12	64.31	27	2.59
801-1200 m	58.25	49.56	61.38	25	3.02
1201-1600 m	59.42	52.10	63.13	14	3.47
All tows	**59.10**	**49.56**	**64.31**	**66**	**2.99**
Wingspread (m)					
501-800 m	17.42	16.21	18.08	27	0.40
801-1200 m	17.20	15.76	17.68	25	0.48
1201-1600 m	17.37	16.21	17.92	14	0.54
All tows	**17.33**	**15.76**	**18.08**	**66**	**0.47**
Opening (m)					
501-800 m	3.19	2.76	4.44	27	0.39
801-1200 m	3.39	2.98	4.08	25	0.30
1201-1600 m	3.70	2.62	5.11	14	0.57
All tows	**3.37**	**2.62**	**5.11**	**66**	**0.44**
Vessel speed (km/h)					
501-800 m	4.94	4.45	5.81	27	0.33
801-1200 m	4.50	3.88	5.21	25	0.27
1201-1600 m	3.93	3.48	4.35	14	0.31
All tows	**4.56**	**3.48**	**5.81**	**66**	**0.49**
Estimates based on bottom contact time					
Tow distance (km)					
501-800 m	5.03	3.14	6.34	27	0.79
801-1200 m	4.69	3.65	6.12	25	0.68
1201-1600 m	3.98	3.08	4.70	14	0.53
All tows	**4.68**	**3.08**	**6.34**	**66**	**0.80**
Vessel speed (km/h)					
501-800 m	4.84	4.28	5.59	27	0.33
801-1200 m	4.44	3.96	5.13	25	0.24
1201-1600 m	4.06	3.79	4.42	14	0.22
All tows	**4.52**	**3.79**	**5.59**	**66**	**0.40**
Estimates from Nobeltec					
Tow distance (km)					
501-800 m	5.18	0.81	6.68	27	0.79
801-1200 m	4.82	0.63	5.94	25	0.68
1201-1600 m	4.45	0.61	5.30	14	0.53
All tows	**4.89**	**3.32**	**0.75**	**66**	**0.80**

Table 7. Time delays in minutes for: a) first gear contact with bottom following winch lockup, and b) last gear contact with bottom after winch release for net retrieval. Initial and final gear contact times are determined from bottom contact sensor data for valid tows only.

Depth Zone	Mean	Standard Deviation	Minimum	Maximum	N
Winch lockup to first bottom contact (minutes)					
501-800 m	5.2	2.4	-0.4	10.5	26
801-1200 m	8.5	3.5	2.9	16.1	25
1201-1600 m	15.1	3.2	9.2	22.8	14
All tows	**8.6**	**4.8**	**-0.4**	**22.8**	**65**
Winch release to last bottom contact (minutes)					
501-800 m	4.9	2.7	0.5	10.0	26
801-1200 m	7.6	2.8	0.0	12.2	25
1201-1600 m	4.6	2.6	0.3	8.8	14
All tows	**5.9**	**3.0**	**0.0**	**12.2**	**65**

Table 8. Species or higher taxonomic groups captured in 66 valid tows during the 2003 survey. Species catches are listed in descending order of total catch. Species codes come from the DFO GFBio database. Appendix E lists species and catch weights for each of the 66 valid tows plus eight tows that were either rejected or aborted.

Species	Scientific Name	GFBio Species code	Catch Weight (kg)	Valid tows	% of valid tows	% of total catch	Cumulative % of total catch
Sablefish	*Anoplopoma fimbria*	455	5,506.89	57	85.1	22.7	22.7
Roughscale rattail	*Coryphaenoides acrolepis*	251	4,379.41	51	77.3	18.1	41.0
Longspine thornyhead	*Sebastolobus altivelis*	453	3,401.64	63	95.5	14.1	55.1
Shortspine thornyhead	*Sebastolobus alascanus*	451	2,997.82	63	95.5	12.4	67.5
Pectoral rattail	*Albatrossia pectoralis*	256	2,265.30	61	92.4	9.4	76.9
Dover sole	*Microstomus pacificus*	626	2,255.66	39	59.1	9.3	86.2
Shortraker rockfish	*Sebastes borealis*	403	467.59	19	28.8	1.9	88.2
Schoolmaster gonate squid	*Berryteuthis magister*	95E	382.38	47	71.2	1.6	89.7
Pacific flatnose	*Antimora microlepis*	220	381.11	64	97.0	1.6	91.3
Tanner crabs	*Chionoecetes*	ZAD	345.27	56	84.8	1.4	92.8
Longnose skate	*Raja rhina*	059	234.69	17	25.8	1.0	93.7
Pacific hake	*Merluccius productus*	225	204.67	27	40.9	0.8	94.6
Threadfin grenadier	*Coryphaenoides filifer*	254	142.69	51	77.3	0.6	95.2
Popeye	*Coryphaenoides cinereus*	250	136.00	24	36.4	0.6	95.7
Arrowtooth flounder	*Atheresthes stomias*	602	132.82	11	16.7	0.6	96.3
Deepsea sole	*Embassichthys bathybius*	605	108.79	44	66.7	0.5	96.7
Abyssal skate	*Bathyraja abyssicola*	054	104.66	13	19.7	0.4	97.2
Roughtail skate	*Bathyraja trachura*	057	67.59	14	21.2	0.3	97.4
Slickheads	Alepocephalidae	642	61.58	21	31.8	0.3	97.7
Twoline eelpout	*Bothrocara brunneum*	235	53.60	36	54.5	0.2	97.9
Anemone	Actiniaria	3L0	46.97	30	45.5	0.2	98.1
Inanimate objects		004	40.16	16	24.2	0.2	98.3
Rex sole	*Glyptocephalus zachirus*	610	35.65	9	13.6	0.1	98.4
Pacific sleeper shark	*Somniosus pacificus*	043	34.75	2	3.0	0.1	98.6
Rougheye rockfish	*Sebastes aleutianus*	394	33.24	9	13.6	0.1	98.7
Glass sponges	Hexactinellida	2I0	32.00	16	24.2	0.1	98.8
Black eelpout	*Lycodes diapterus*	243	26.63	24	36.4	0.1	99.0
Giant squid	*Architeuthis martensi*	92R	25.39	1	1.5	0.1	99.1
Vampire squid	Vampyromorpha	96E	24.33	11	16.7	0.1	99.2
Zoantharia	Zoantharia	3J1	22.30	9	13.6	0.1	99.3
Brown cat shark	*Apristurus brunneus*	038	18.90	20	30.3	0.1	99.3
Sandpaper skate	*Bathyraja interrupta*	058	18.84	10	15.2	0.1	99.4
Octopus	*Octopus* sp.	98D	16.10	11	16.7	0.1	99.5
Octopus	Octopoda	97A	11.97	3	4.5	0.0	99.5
Echinasteridae	Echinasteridae	4QA	9.67	8	12.1	0.0	99.6
Giant blobsculpin	*Psychrolutes phrictus*	534	9.52	2	3.0	0.0	99.6
Solasteridae	Solasteridae	4TA	9.06	31	47.0	0.0	99.6
Sponges	Porifera	2A0	8.88	12	18.2	0.0	99.7
Squids	Teuthoidea	92A	8.65	3	4.5	0.0	99.7
Spiny red sea star	*Hippasteria spinosa*	4JF	7.19	19	28.8	0.0	99.7
Bigfin eelpout	*Lycodes cortezianus*	233	6.29	10	15.2	0.0	99.8
Blacktail snailfish	*Careproctus melanurus*	574	4.64	20	30.3	0.0	99.8
Lithodes couesi	*Lithodes couesi*	VMD	4.38	8	12.1	0.0	99.8
Gorgonian corals	Gorgonacea	3S0	3.24	3	4.5	0.0	99.8
Pacific hagfish	*Eptatretus stouti*	018	3.20	8	12.1	0.0	99.8
Brittle stars	Phrynophiurida	5AB	3.18	16	24.2	0.0	99.9

(Continued)

Table 8 (continued).

Species	Scientific Name	GFBio Species code	Catch Weight (kg)	Valid tows	% of valid tows	% of total catch	Cumulative % of total catch
Lumpfishes and Snailfishes	Cyclopteridae	568	2.91	10	15.2	0.0	99.9
Lithodes	*Lithodes* sp.	VMB	2.73	2	3.0	0.0	99.9
Deepsea smelts	Bathylagidae	152	2.65	25	37.9	0.0	99.9
Aurora rockfish	*Sebastes aurora*	400	2.56	4	6.1	0.0	99.9
Lithodinae	Lithodinae	VLA	2.51	1	1.5	0.0	99.9
Jellyfish	Scyphozoa	3G0	1.98	11	16.7	0.0	99.9
Sea cucumber	Holothuroidea	6NA	1.89	9	13.6	0.0	99.9
Paragorgia pacifica	*Paragorgia pacifica*	3S7	1.89	1	1.5	0.0	99.9
Pacific ocean perch	*Sebastes alutus*	396	1.80	1	1.5	0.0	99.9
Basket stars	Euryalae	5QA	1.63	2	3.0	0.0	99.9
Viperfishes	Chauliodontidae	170	1.35	14	21.2	0.0	100.0
Sand star	*Luidia foliolata*	4GD	1.35	10	15.2	0.0	100.0
Eelpouts	Zoarcidae	231	1.26	2	3.0	0.0	100.0
Fish-eating star	*Stylasterias forreri*	4XF	1.15	9	13.6	0.0	100.0
Shrimp	*Nantantia* sp.	SAB	0.92	8	12.1	0.0	100.0
Red king crab	*Paralithodes cammtschatica*	VNH	0.90	3	4.5	0.0	100.0
Redbanded rockfish	*Sebastes babcocki*	401	0.90	1	1.5	0.0	100.0
Northern lampfish	*Stenobrachius leucopsarus*	198	0.81	19	28.8	0.0	100.0
Slender codling	*Halargyreus johnsoni*	223	0.59	1	1.5	0.0	100.0
Splitnose rockfish	*Sebastes diploproa*	412	0.52	2	3.0	0.0	100.0
Henricia asthenactis	*Henricia asthenactis*	4QD	0.51	2	3.0	0.0	100.0
Primnoa	*Primnoa* sp.	3T0	0.42	3	4.5	0.0	100.0
Lanternfishes	Myctophidae	185	0.33	10	15.2	0.0	100.0
Fish Eggs		001	0.28	4	6.1	0.0	100.0
Lampreys	Petromyzontidae	019	0.26	1	1.5	0.0	100.0
Eualus	*Eualus*	SQA	0.26	1	1.5	0.0	100.0
Pinpoint lampfish	*Nannobrachium regale*	191	0.20	2	3.0	0.0	100.0
Heart urchins	Atelostomata	6KA	0.17	2	3.0	0.0	100.0
Gastropods	Gastropoda	10A	0.14	10	15.2	0.0	100.0
Bigeye poacher	*Bathyagonus pentacanthus*	556	0.10	4	6.1	0.0	100.0
Tarsaster alascanus	*Tarsaster alascanus*	4YC	0.10	1	1.5	0.0	100.0
Sea urchins	Echinacea	6AB	0.10	1	1.5	0.0	100.0
Sea whip	*Osteocella septentrionalis*	3U2	0.10	3	4.5	0.0	100.0
Slender blacksmelt	*Bathylagus pacificus*	155	0.10	3	4.5	0.0	100.0
True crabs	Bracyura	WAA	0.06	1	1.5	0.0	100.0
Blackfin poacher	*Bathyagonus nigripinnis*	557	0.05	3	4.5	0.0	100.0
Squat lobster	*Munida quadrispina*	VSA	0.01	2	3.0	0.0	100.0
Crested bigscale	*Poromitra crassiceps*	264	0.01	4	6.1	0.0	100.0
Snailfishes	Liparinae	578	Trace	1	1.5	0.0	100.0
Seaslugs	Nudibranchiata	51A	Trace	4	6.1	0.0	100.0
Cushion star	*Pteraster tesselatus*	4UH	Trace	1	1.5	0.0	100.0
Myxoderma sacculatum	*Myxoderma sacculatum*	4YX	Trace	4	6.1	0.0	100.0
Polychaete worms	Polychaeta	0AB	Trace	1	1.5	0.0	100.0
Pacific lyre crab	*Hyas lyratus*	ZBA	Trace	1	1.5	0.0	100.0
Unidentified organic matter		849	Trace	2	3.0	0.0	100.0
Unknown fish		015	Trace	1	1.5	0.0	100.0
Golden king crab	*Lithodes aequispina*	VMC	Trace	1	1.5	0.0	100.0
Psolidae	Psolidae	6QA	Trace	2	3.0	0.0	100.0
TOTAL			**24,130.79**	**66**			

Table 9. Species and higher taxonomic groups collected from eight rejected tows. Valid tows did not capture three of the 45 groups (shown in bold).

Species	Scientific Name	GFBio Species Code	Total Catch (kg)	Number of Rejected Tows
Sablefish	*Anoplopoma fimbria*	455	248.32	5
Longspine thornyhead	*Sebastolobus altivelis*	453	177.44	5
Dover sole	*Microstomus pacificus*	626	112.74	3
Roughscale rattail	*Coryphaenoides acrolepis*	251	52.40	4
Shortspine thornyhead	*Sebastolobus alascanus*	451	48.63	4
Shortraker rockfish	*Sebastes borealis*	403	36.17	2
Pectoral rattail	*Albatrossia pectoralis*	256	27.67	5
Tanner crabs	*Chionoecetes* sp.	ZAD	18.93	4
Deepsea sole	*Embassichthys bathybius*	605	11.94	4
Schoolmaster gonate squid	*Berryteuthis magister*	95E	9.46	4
Longnose skate	*Raja rhina*	059	8.86	1
Roughtail skate	*Bathyraja trachura*	057	7.16	1
Pacific hake	*Merluccius productus*	225	5.56	2
Abyssal skate	*Bathyraja abyssicola*	054	5.26	1
Sponges	Porifera	2A0	3.43	3
Threadfin grenadier	*Coryphaenoides filifer*	254	2.18	2
Slickheads	Alepocephalidae	642	2.15	3
Twoline eelpout	*Bothrocara brunneum*	235	2.02	4
Solasteridae	Solasteridae	4TA	1.99	2
Octopus	Octopoda	97A	1.48	2
Pacific hagfish	*Eptatretus stouti*	018	1.29	2
Pacific flatnose	*Antimora microlepis*	220	1.13	2
Popeye	*Coryphaenoides cinereus*	250	0.82	2
Lithodes couesi	*Lithodes couesi*	VMD	0.80	1
Bigfin eelpout	*Lycodes cortezianus*	233	0.80	1
Barracudinas	**Paralepididae**	180	0.74	1
Vampire squid	Vampyromorpha	96E	0.73	1
Black eelpout	*Lycodes diapterus*	243	0.72	2
Brown cat shark	*Apristurus brunneus*	038	0.62	1
Blacktail snailfish	***Careproctus melanurus***	574	0.47	1
Spiny red sea star	*Hippasteria spinosa*	4JF	0.36	2
Inanimate objects		004	0.36	1
Brittle stars	Phrynophiurida	5AB	0.34	1
Sandpaper skate	*Bathyraja interrupta*	058	0.24	1
Sea cucumber	Holothuroidea	6NA	0.17	1
Blackfin poacher	*Bathyagonus nigripinnis*	557	Trace	1
Anemone	Actiniaria	3L0	Trace	1
Threadfin slickhead	***Talismania bifurcata***	643	Trace	1
Glass sponges	Hexactinellida	2I0	Trace	1
Zoantharia	Zoantharia	3J1	Trace	1
Jellyfish	Scyphozoa	3G0	Trace	1
Lanternfishes	Myctophidae	185	Trace	1
Lumpfishes and Snailfishes	Cyclopteridae	568	Trace	1
Paragorgia pacifica	*Paragorgia pacifica*	3S7	Trace	1
Gastropods	Gastropoda	10A	Trace	1
TOTAL			**793.40**	**8**

Table 10. Number of samples collected by species from 66 valid tows, plus numbers of specimens sampled for selected biological attributes. Otolith numbers refer to pairs of otoliths.

	Species		Attribute				
Species	**Code**	**Samples**	**Length**	**Weight**	**Sex**	**Maturity**	**Otoliths**
Longspine thornyhead	453	63	5,014	1,233	5,008	3,923	1,233
Shortspine thornyhead	451	63	2,791	688	2,794	2,761	691
Roughscale rattail	251	39	2,361	220	2,362	327	220
Dover sole	626	38	1,977	418	1,980	1,979	419
Sablefish	455	56	1,883	586	1,883	1,868	587
Pectoral rattail	256	48	1,284	265	1,284	272	265
Shortraker rockfish	403	18	126	126	126	126	126
Deepsea sole	605	25	124	0	124	117	0
Arrowtooth flounder	602	11	83	83	83	83	83
Roughtail skate	057	12	34	0	34	0	0
Longnose skate	059	16	33	0	33	0	0
Rougheye rockfish	394	9	26	26	26	26	26
Brown cat shark	038	6	26	0	26	0	0
Abyssal skate	054	12	16	4	16	0	0
Sandpaper skate	058	9	10	0	10	0	0
Aurora rockfish	400	4	4	4	3	3	4
Pacific sleeper shark	043	2	3	0	3	0	0
Redbanded rockfish	401	1	2	2	2	2	2
Total		**432**	**15,797**	**3,655**	**15,797**	**11,487**	**3,656**

Table 11. Additional samples collected from tows 6 and 35 that were rejected after becoming snagged on bottom. These samples are excluded from biomass analyses.

Species	Species Code	Samples	Attribute				
			Length	Weight	Sex	Maturity	Otolith
Longspine thornyhead	453	2	170	40	170	83	40
Roughscale rattail	251	1	58	6	58	6	6
Sablefish	455	2	16	16	16	16	16
Shortspine thornyhead	451	2	14	14	14	14	14
Deepsea sole	605	1	12	0	12	12	0
Dover sole	626	1	11	11	11	11	11
Pectoral rattail	256	1	8	8	8	8	8
Longnose skate	059	1	2	0	2	0	0
Shortraker rockfish	403	1	1	1	1	1	1
Total		12	292	96	292	151	96

Table 12. Sablefish tags recovered during the 2003 survey.

Tow	Position		Date	Tag Number	Length	Weight
	Latitude	Longitude			(mm)	(kg)
8	48° 25.014’	126° 12.291’	Sept. 06/2003	B8320263	543	1.84
10	48° 28.157’	126° 12.887’	Sept. 06/2003	B9723072	422	2.03
11	48° 32.525’	126° 18.015’	Sept. 06/2003	A00785637	669	3.70
28	49° 07.422’	127° 03.927’	Sept. 19/2003	B9937633	609	2.62
29	49° 12.384’	127° 06.873’	Sept. 10/2003	B9651106	566	2.28
30	49° 10.798’	127° 05.891’	Sept. 10/2003	A00043884	519	1.65
30	49° 10.798’	127° 05.891’	Sept. 10/2003	A00043899	543	1.73
40	50° 19.149’	128° 22.361’	Sept. 13/2003	CSA 23520	650	2.56
40	50° 19.149’	128° 22.361’	Sept. 13/2003	B9628560	533	1.42
42	50° 15.782’	128° 21.968’	Sept. 13/2003	B9937874	-	-
44	50° 10.961’	128° 24.668’	Sept. 14/2003	A00550526	606	2.24
62	49° 39.693’	127° 27.266’	Sept. 18/2003	B8365447	799	5.68
63	49° 38.357’	127° 25.965’	Sept. 18/2003	B9643074	735	4.82

Table 13. Unscaled length statistics and sample frequency by depth zone for the 66 valid tows.

Species	Depth Zone (m)	Samples	Specimen length (mm)				
			Mean	SD	Min	Max	N
Longspine thornyhead	501-800	24	204.8	44.1	71	313	1,811
	801-1200	26	207.8	40.6	83	332	2,153
	1201-1600	14	229.7	41.9	77	533	1,050
Shortspine thornyhead	501-800	27	326.1	78.8	133	762	2,050
	801-1200	26	404.9	75.0	216	668	654
	1201-1600	11	405.0	64.9	282	569	87
Sablefish	501-800	27	586.9	80.3	420	935	1,254
	801-1200	26	583.3	66.1	456	866	608
	1201-1600	4	675.5	66.1	516	758	21
Deepsea sole	501-800	5	389.0	54.9	282	456	11
	801-1200	14	333.5	46.8	186	402	82
	1201-1600	6	350.8	46.6	280	552	31
Dover sole	501-800	28	411.3	53.9	107	852	1,782
	801-1200	10	438.1	46.5	322	640	195
Arrowtooth flounder	501-800	11	518.2	79.7	415	762	83
Roughscale rattail	501-800	4	525.5	76.7	321	720	95
	801-1200	22	492.6	96.1	170	822	1,134
	1201-1600	14	515.8	103.8	105	790	1,132
Pectoral rattail	501-800	11	661.8	79.5	410	923	103
	801-1200	24	641.1	100.8	54	962	449
	1201-1600	14	699.9	115.9	111	1,265	732
Rougheye rockfish	501-800	9	424.3	101.0	295	721	26
Aurora rockfish	501-800	4	341.8	26.6	312	368	4
Redbanded rockfish	501-800	1	349.5	54.4	311	388	2
Shortraker rockfish	501-800	17	595.8	83.5	290	802	123
	801-1200	1	603.3	29.1	580	636	3
Brown cat shark	501-800	3	474.5	55.3	386	585	14
	801-1200	3	435.3	36.0	365	495	12
Pacific sleeper shark	501-800	1	1,012.0	1.41	1,011	1,013	2
	1201-1600	1	1,175.0	-	1,175	1,175	1
Abyssal skate	501-800	1	825.0	-	825	825	1
	801-1200	4	849.6	245.4	668	1,282	5
	1201-1600	7	1,063.0	240.4	725	1,370	10
Roughtail skate	501-800	2	672.3	63.3	610	752	4
	801-1200	7	639.3	196.0	322	1,180	20
	1201-1600	3	595.2	152.9	440	842	10
Sandpaper skate	501-800	2	551.0	45.3	519	583	2
	801-1200	5	679.6	373.4	321	1,290	5
	1201-1600	2	319.0	59.9	281	388	3
Longnose skate	501-800	13	998.4	275.7	102	1,805	28
	801-1200	2	103.0	13.9	87	112	3
	1201-1600	1	854.0	82.0	796	912	2

Table 14. Two alternative biomass estimates in tonnes, plus associated standard errors (SE) and relative errors (RE) from the 2003 survey for the selected species. One set of estimates is calculated from CPUE based on total bottom contact time while the other set uses CPUE estimates where the effort component is derived from winch lockup-to-retrieval times. Two species codes for squid (92A and 95E) and brittle stars (5AA and 5AB) are combined for this table.

	CPUE based on bottom contact time			CPUE based on winch lockup to retrieval time		
Species	**Biomass (t)**	**SE (t)**	**RE (%)**	**Biomass (t)**	**SE (t)**	**RE (%)**
Roughscale rattail	11,828	2,354	19.9	10,539	2,128	20.2
Pectoral rattail	5,731	836	14.6	5,061	697	13.8
Longspine thornyhead	4,971	554	11.2	4,720	532	11.3
Sablefish	4,772	555	11.6	4,660	551	11.8
Shortspine thornyhead	2,482	327	13.2	2,390	319	13.4
Dover sole	1,518	214	14.1	1,491	216	14.5
Pacific flatnose	899	93	10.3	799	77	9.6
Tanner crabs	407	68	16.7	392	65	16.7
Squids	292	40	13.9	283	38	13.6
Shortraker rockfish	256	48	18.6	248	46	18.6
Deepsea sole	197	54	27.5	184	50	27.4
Longnose skate	132	36	27.4	128	35	27.1
Brittle stars	5	2	52.3	4	2	51.9

Table 15. Biomass, standard error (SE) and relative error (RE) estimates by depth zone and areal stratum for longspine thornyhead, shortspine thornyhead and sablefish. These estimates are based on bottom contact time and estimated wingspread measurements converted from the mean doorspread per tow.

Area	501-800 m			801-1200 m			1201-1600 m			Total		
	Biomass (t)	SE (t)	RE (%)	Biomass (t)	SE (t)	RE (%)	Biomass (t)	SE (t)	RE (%)	Biomass (t)	SE (t)	RE (%)
Longspine thornyhead												
A	159.0	91.7	57.7	1,515.6	480.4	31.7	360.3	33.3	9.2	2,034.9	490.2	24.1
B	57.4	18.2	31.7	313.8	52.3	16.7	128.7	64.1	49.8	499.8	84.7	16.9
C	13.4	4.4	32.7	220.7	9.4	4.3	67.0	55.3	82.5	301.0	56.3	18.7
D	31.9	22.7	71.2	364.8	52.8	14.5	204.2	19.3	9.5	600.9	60.7	10.1
E	51.9	21.8	42.0	333.7	84.3	25.3	80.4	18.3	22.7	465.9	88.9	19.1
F	24.9	15.3	61.6	524.7	162.3	30.9	85.0	13.4	15.8	634.6	163.5	25.8
G	19.3	2.2	11.4	208.6	62.6	30.0	205.7	120.0	58.3	433.6	135.4	31.2
Total	**357.6**	**99.9**	**27.9**	**3,481.8**	**523.2**	**15.0**	**1,131.3**	**153.5**	**13.6**	**4,970.8**	**554.3**	**11.2**
Shortspine thornyhead												
A	237.1	40.4	17.0	197.4	64.8	32.8	82.0	3.6	4.4	516.5	76.5	14.8
B	104.0	17.1	16.4	89.7	34.6	38.6	46.9	46.9	100.0	240.6	60.8	25.3
C	93.5	25.3	27.1	62.7	16.3	26.0	6.2	6.2	100.0	162.4	30.8	18.9
D	132.6	37.6	28.3	54.4	13.4	24.7	8.4	8.4	100.0	195.5	40.8	20.9
E	379.6	89.3	23.5	139.1	31.1	22.4	26.9	0.5	2.0	545.6	94.5	17.3
F	155.4	18.1	11.7	361.8	291.5	80.6	60.8	2.8	4.6	578.0	292.1	50.5
G	105.7	18.1	17.1	110.6	20.9	18.9	27.4	0.4	1.3	243.7	27.6	11.3
Total	**1,207.9**	**112.3**	**9.3**	**1,015.7**	**303.7**	**29.9**	**258.7**	**48.3**	**18.7**	**2,482.3**	**327.3**	**13.2**
Sablefish												
A	1,001.0	336.9	33.7	307.4	100.4	32.7	168.8	89.6	53.1	1,477.20	362.7	24.6
B	146.8	40.7	27.7	184.0	54.8	29.8	57.5	57.5	100.0	388.3	89.3	23.0
C	424.5	156.8	36.9	105.3	36.0	34.2	0.0	0.0		529.8	160.9	30.4
D	609.1	189.3	31.1	135.6	67.5	49.7	0.0	0.0		744.7	200.9	27.0
E	213.9	45.2	21.1	113.3	39.0	34.4	24.5	24.5	100.0	351.7	64.5	18.3
F	33.6	10.2	30.3	725.0	279.2	38.5	20.2	20.2	100.0	778.8	280.1	36.0
G	183.9	12.2	6.6	317.3	138.1	43.5	0.0	0.0		501.2	138.6	27.7
Total	**2,612.8**	**421.7**	**16.1**	**1,887.8**	**342.7**	**18.2**	**271.0**	**111.1**	**41.0**	**4,771.7**	**554.7**	**11.6**

Table 16. Comparison of biomass estimates for 2001-2003 using winch time span and a fixed wingspread of 20 m. Estimates include biomass (B) and standard error (SE) in metric tonnes and relative error (RE) as a percentage. Only areas A-F are considered for these calculations since the 2001 survey did not cover area G. Two species codes for squid (92A and 95E) and brittle stars (5AA and 5AB) are combined for this table.

Species	2001			2002			2003		
	B (t)	SE (t)	RE (%)	B (t)	SE (t)	RE (%)	B (t)	SE (t)	RE (%)
Roughscale rattail	6,431	747	11.6	5,915	804	13.6	6,790	1,490	21.9
Pectoral rattail	4,167	492	11.8	3,904	594	15.2	3,535	606	17.1
Longspine thornyhead	3,191	302	9.5	3,204	337	10.5	3,151	425	13.5
Sablefish	3,824	505	13.2	2,893	578	20.0	3,302	464	14.1
Shortspine thornyhead	1,531	119	7.8	1,725	126	7.3	1,743	208	11.9
Dover sole	845	112	13.3	1,068	231	21.6	986	144	14.6
Pacific flatnose	824	100	12.2	776	130	16.7	553	70	12.6
Tanner crabs	538	98	18.3	299	40	13.5	282	48	16.9
Squids	112	27	24.0	162	26	16.1	207	33	15.7
Deepsea sole	104	18	17.6	221	76	34.5	104	29	27.8
Longnose skate	504	257	51.1	127	46	35.9	109	30	27.3
Brittle stars	349	313	89.6	734	260	35.4	2	1	47.3

Table 17. Biomass estimates in tonnes, plus associated standard errors (SE) and relative errors (RE) from the 2002 and 2003 surveys for selected species. Data selection includes all valid biomass tows in areas A-G. Tow distances are based on bottom contact time and separate wingspread values are used for each tow. Two species codes for squid (92A and 95E) and brittle stars (5AA and 5AB) are combined for this table.

Species	2002			2003		
	Biomass (t)	SE (t)	RE (%)	Biomass (t)	SE (t)	RE (%)
Roughscale rattail	9,504	1,118	11.8	11,828	2,354	19.9
Pectoral rattail	5,791	804	13.9	5,731	836	14.6
Longspine thornyhead	4,875	463	9.5	4,971	554	11.2
Sablefish	4,347	689	15.8	4,772	555	11.6
Shortspine thornyhead	2,607	184	7.1	2,482	327	13.2
Dover sole	1,815	317	17.5	1,518	214	14.1
Pacific flatnose	1,264	172	13.6	899	93	10.3
Tanner crabs	409	56	13.8	407	68	16.7
Squids	244	38	15.5	292	40	13.9
Shortraker rockfish	380	94	24.7	256	48	18.6
Deepsea sole	339	120	35.3	197	54	27.5
Longnose skate	167	57	34.3	132	36	27.4
Brittle stars	1,694	735	43.4	5	2	52.3

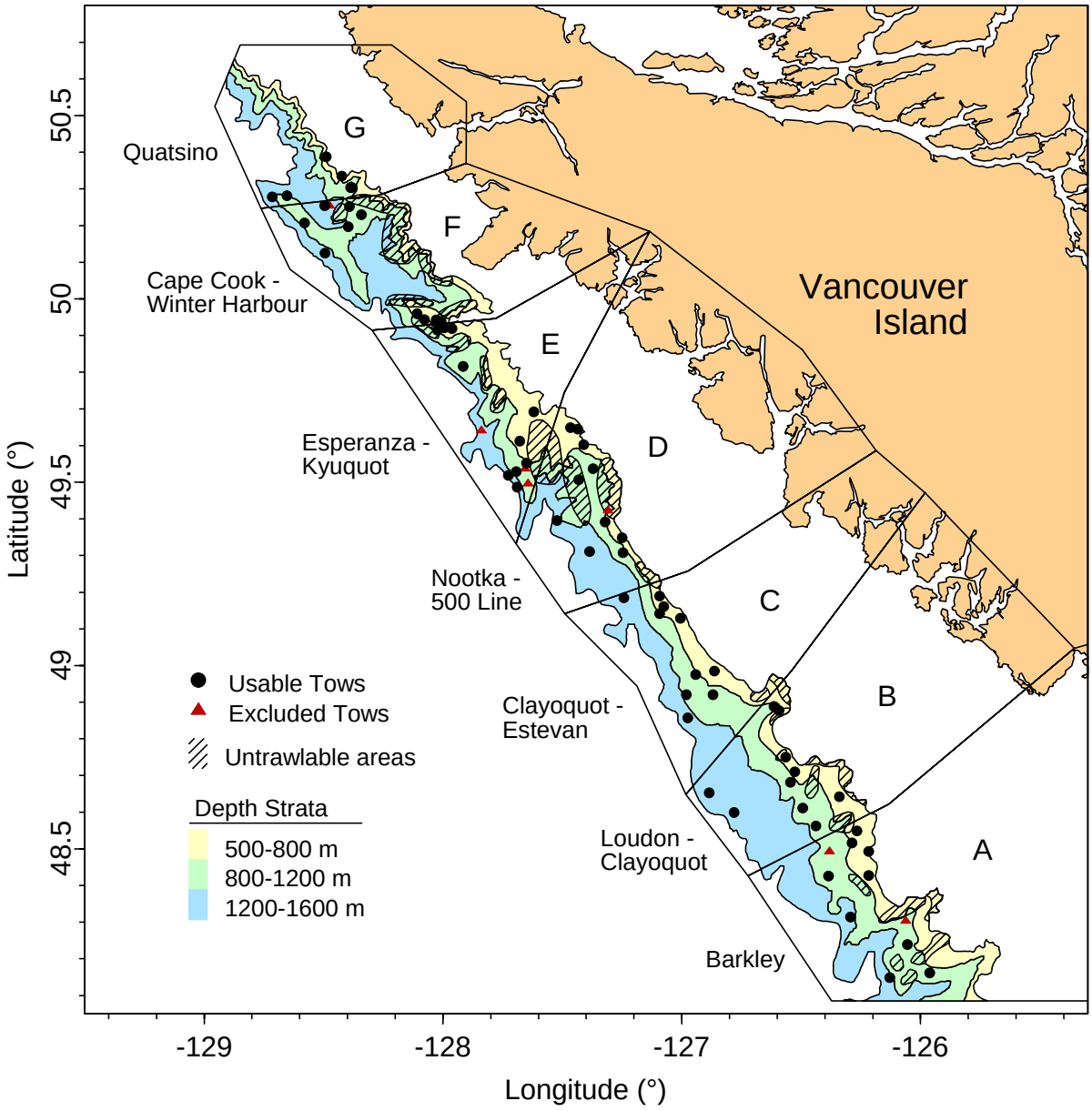

Figure 1. Coastal waters of Vancouver Island illustrating the 7 area strata and 3 depth strata defined for the 2003 survey. Locations of usable and excluded survey tows are shown, along with areas that were considered untrawlable and excluded from site selection. See Table 1 for estimated surface areas within area strata A-G.

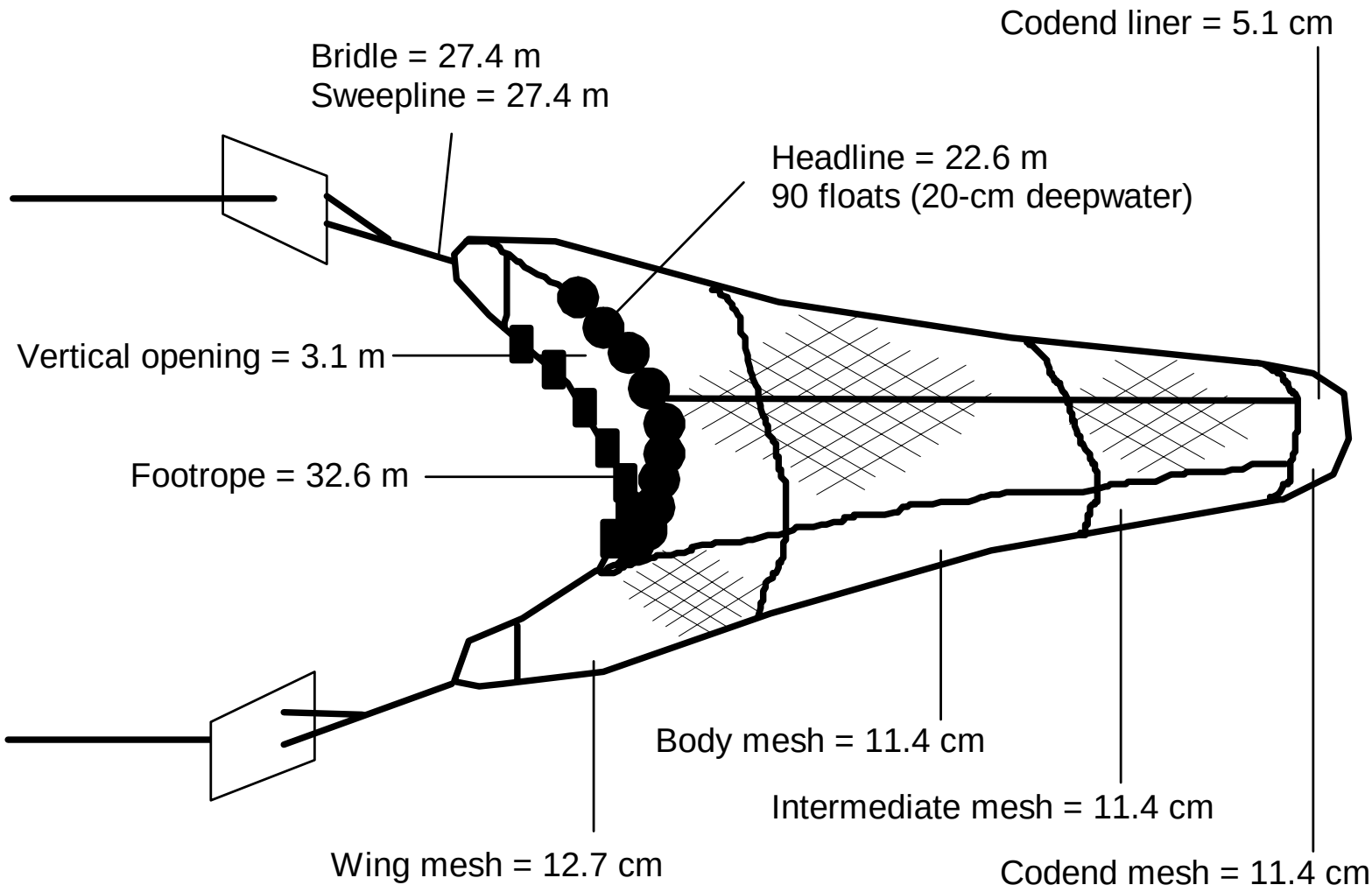

Figure 2. Net specifications for the Atlantic Western II box trawl.

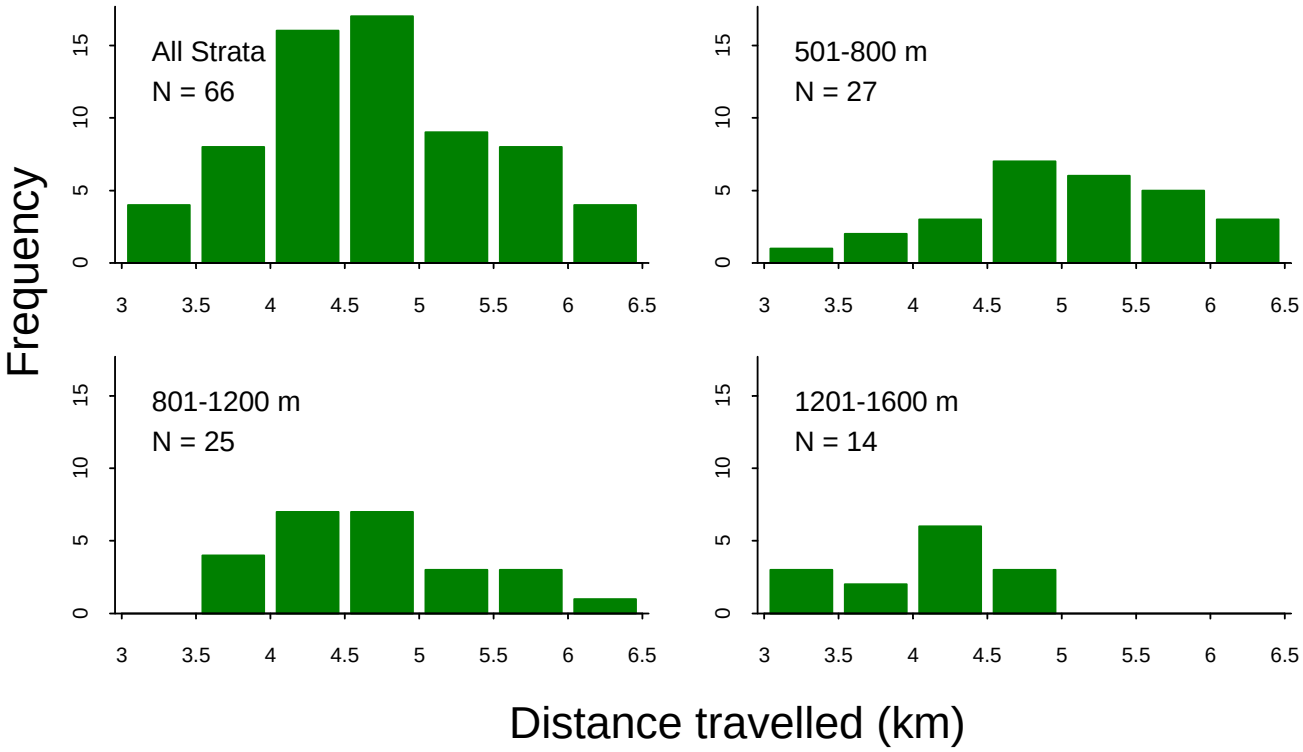

Figure 3. Frequency distributions of tow distances (km) for the entire survey and by depth stratum using data from valid biomass tows. Tow distances are estimated using interval data from first-to-last bottom contact based on bottom contact sensor readings.

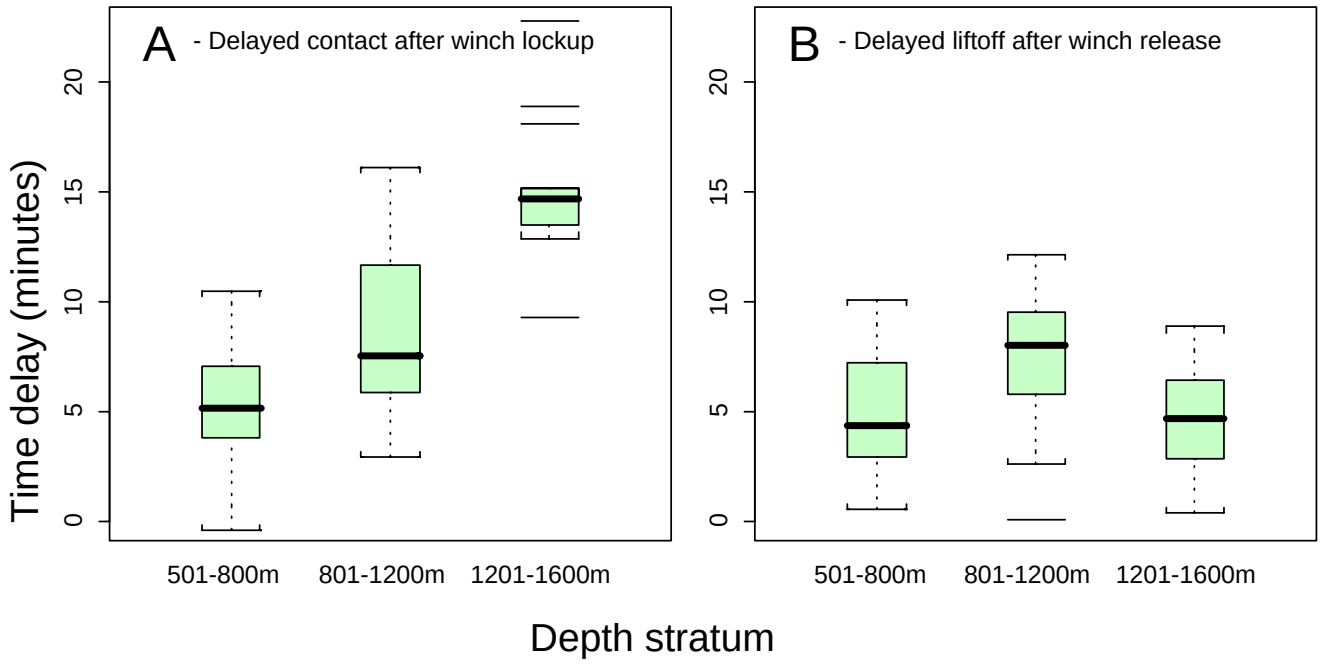

Figure 4. Distribution of time delays for: A) first gear contact with bottom after winch lockup, and B) last gear contact with bottom after winch release for all survey tows.

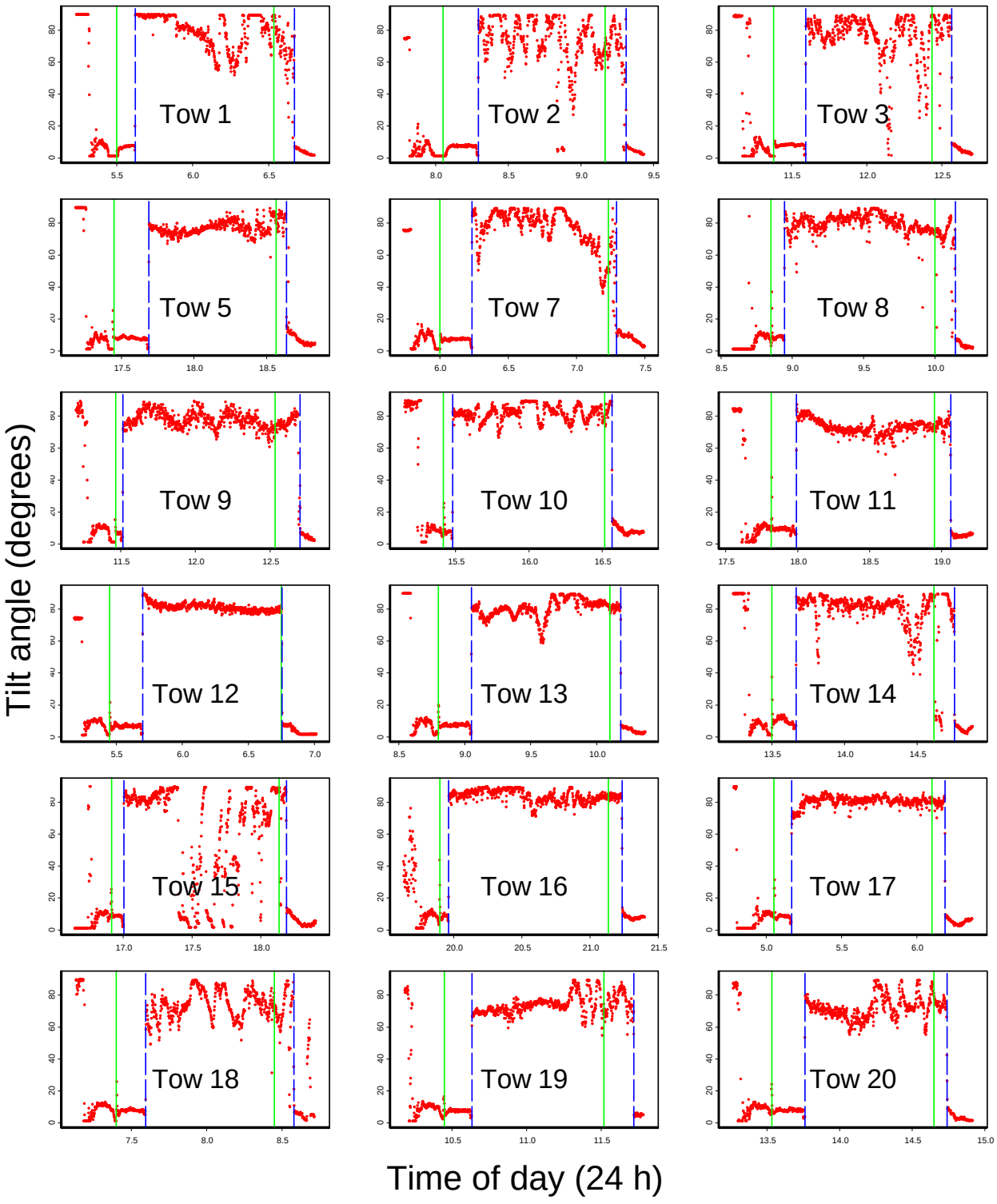

Figure 5. Bottom contact sensor profiles for Tows 1 to 20 from the 2003 WCVI longspine thornyhead survey. Time of day is given as decimal hours for a 24-hour clock. Solid vertical lines are the recorded times of winch lockup and release, and dashed vertical lines are the selected times for first and last gear contact with bottom during the tow based on bottom contact data. Tows 4 and 6 (not shown) are rejected tows.

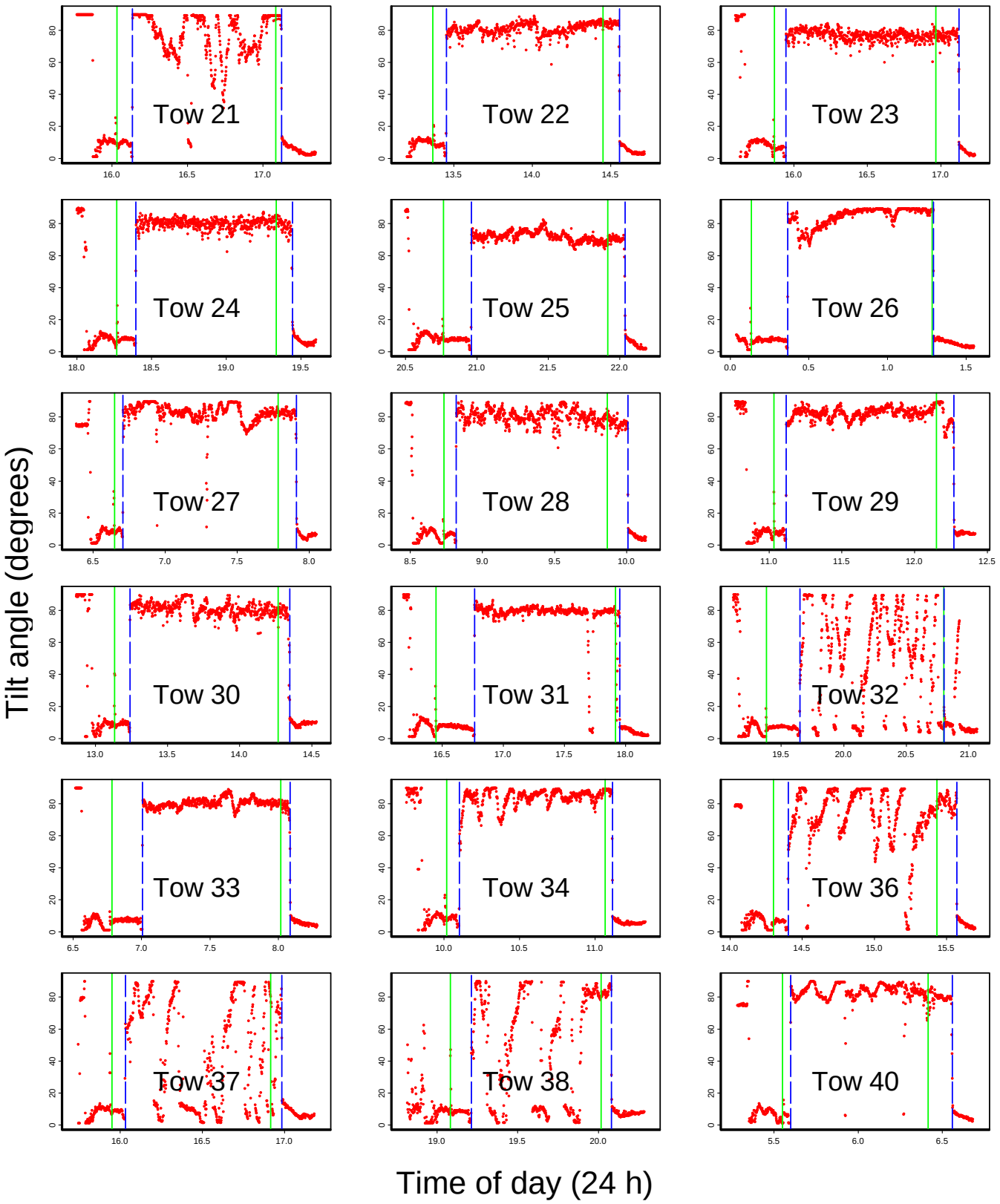

Figure 5 (continued)**.** Bottom contact sensor profiles for tows 21 to 40. Tows 35 and 39 (not shown) are rejected tows.

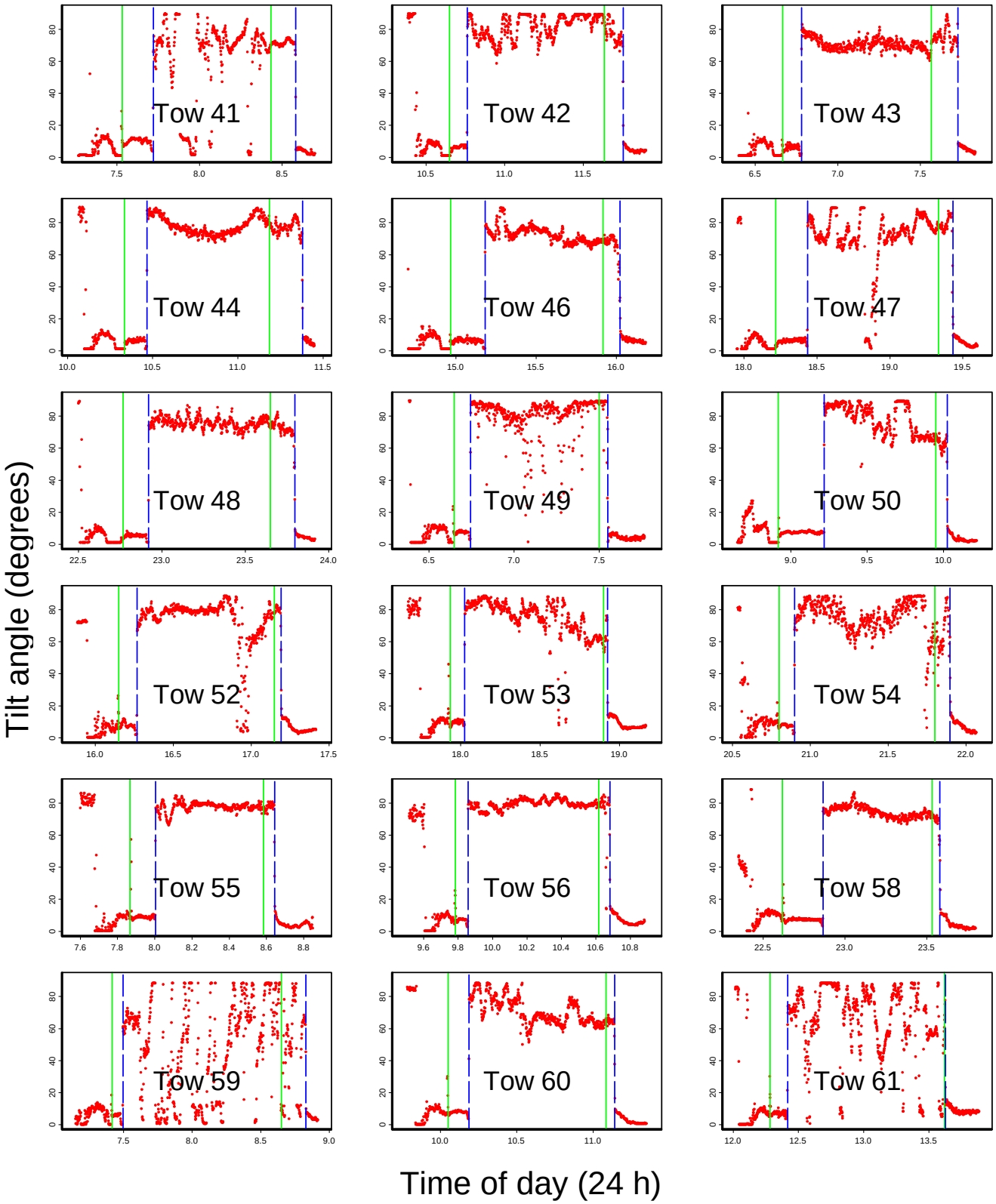

Figure 5 (continued)**.** Bottom contact sensor profiles for tows 41 to 61. The bottom contact sensor was lost during Tow 51. Tows 45 and 57 (not shown) are rejected tows.

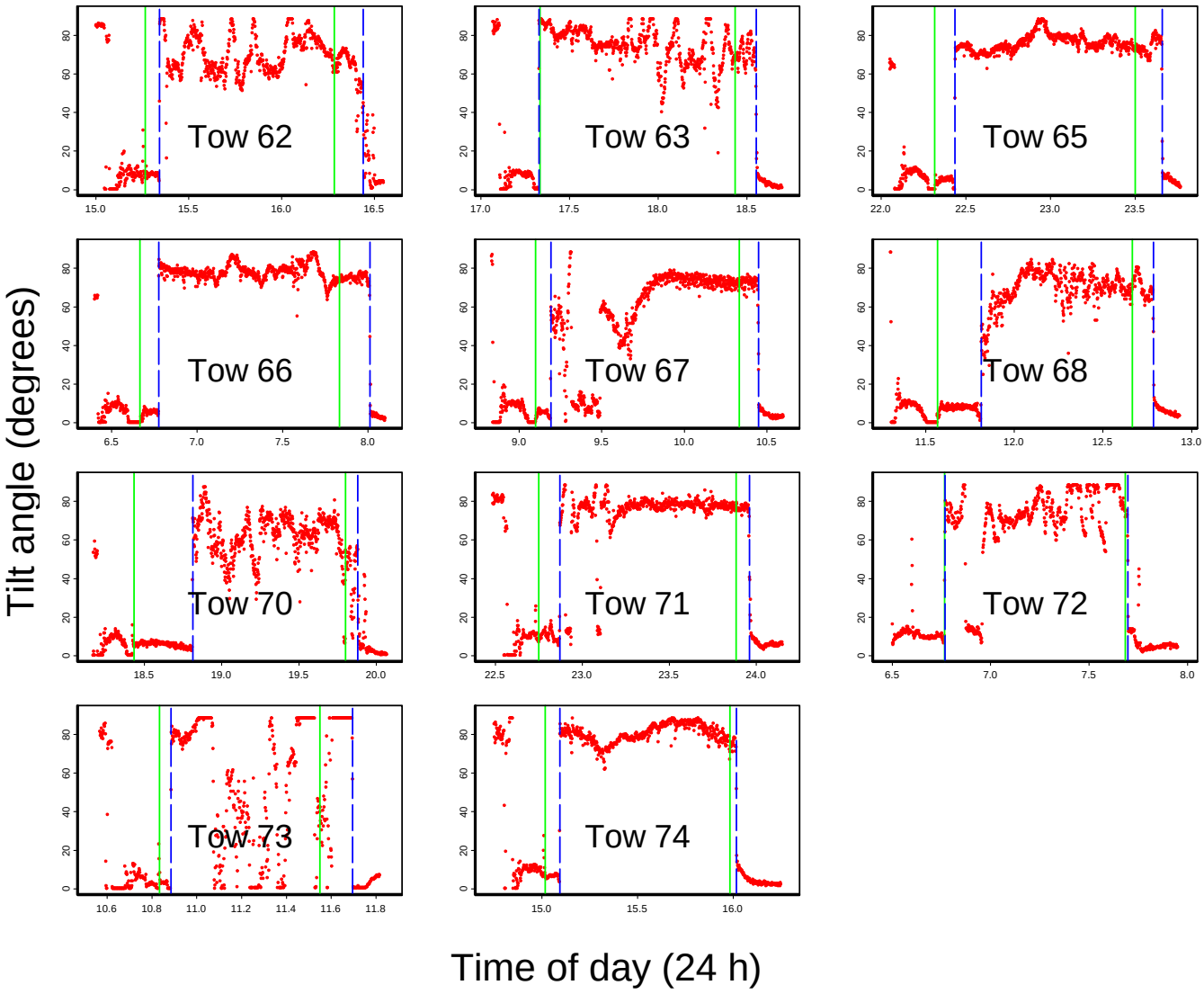

Figure 5 (continued)**.** Bottom contact sensor profiles for tows 62 to 74. Tows 64 and 69 (not shown) are rejected tows.

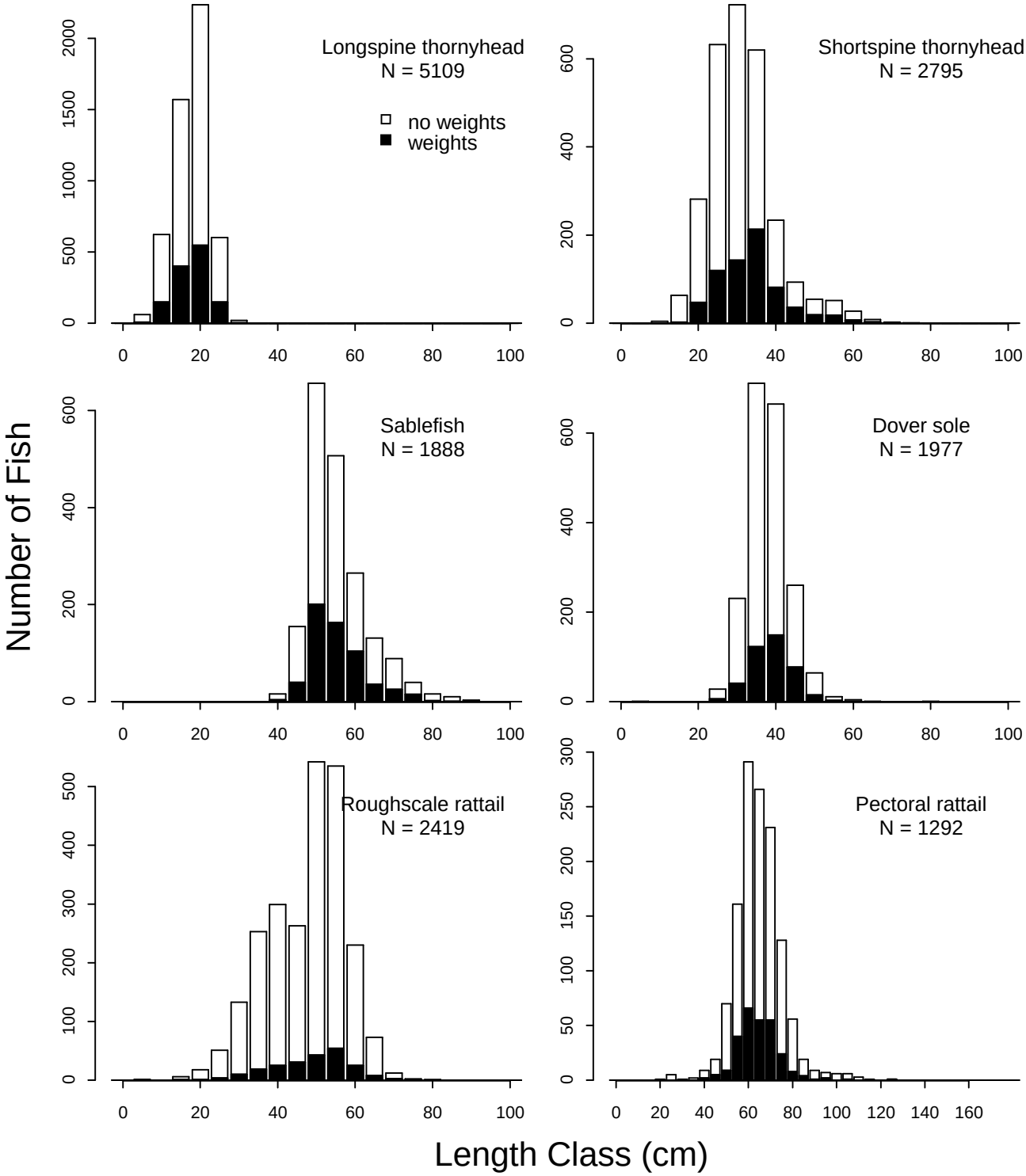

Figure 6. Unscaled size distributions from samples collected by species, giving numbers of specimens with length measurements and the subsample that was weighed individually (black bars). N is the total number of specimens.

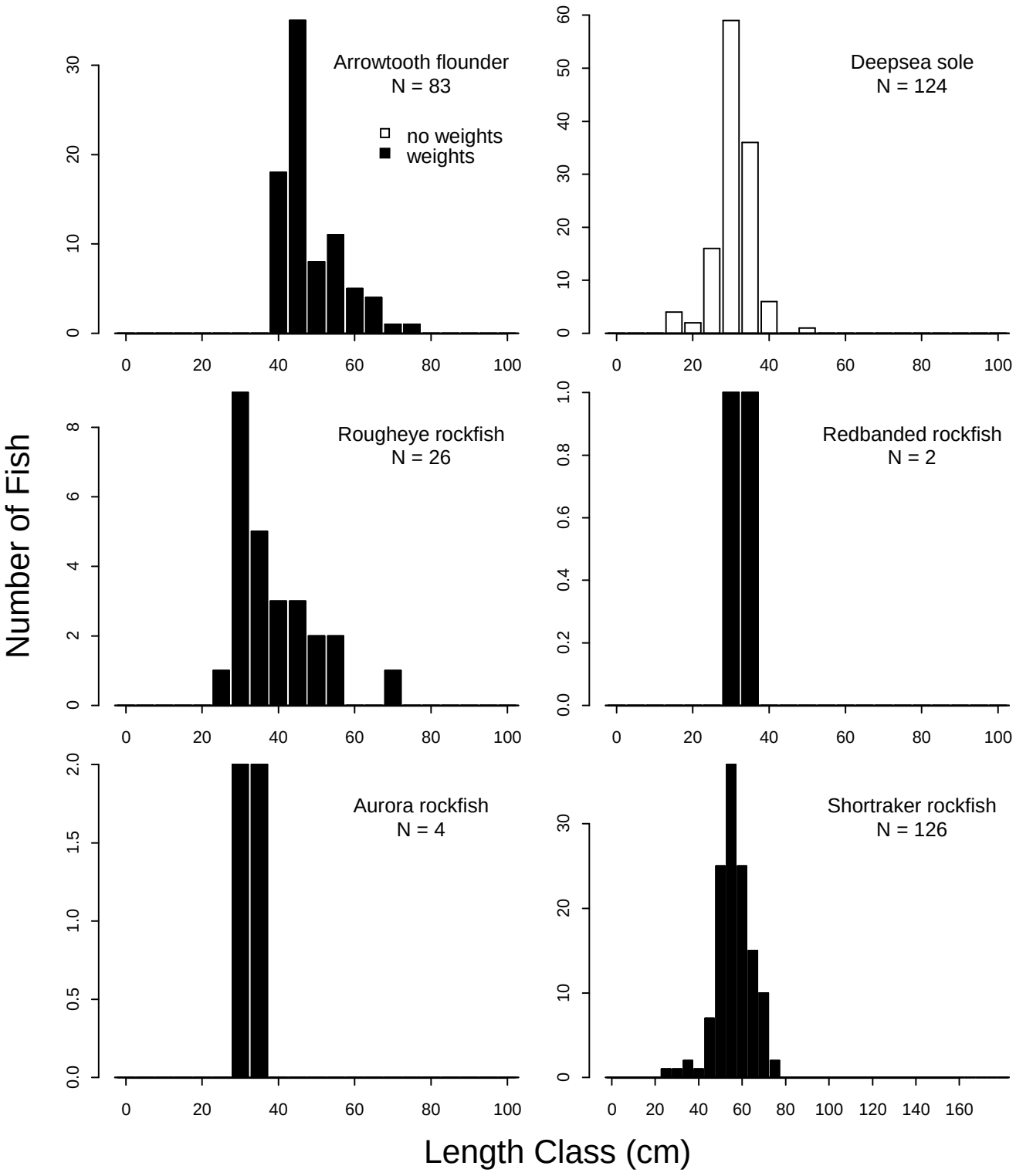

Figure 6 (continued)**.** Unscaled size distributions.

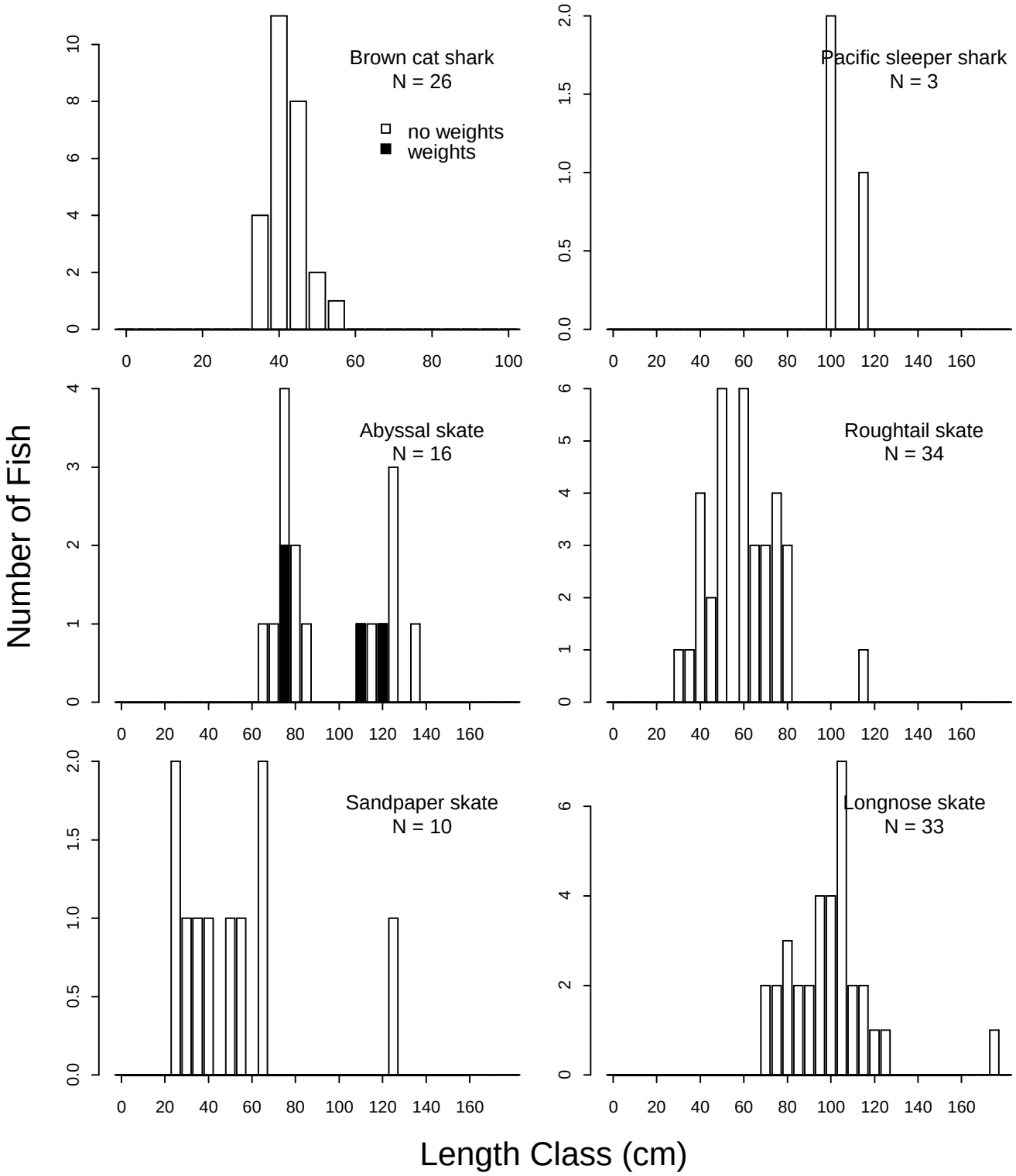

Figure 6 (continued)**.** Unscaled size distributions.

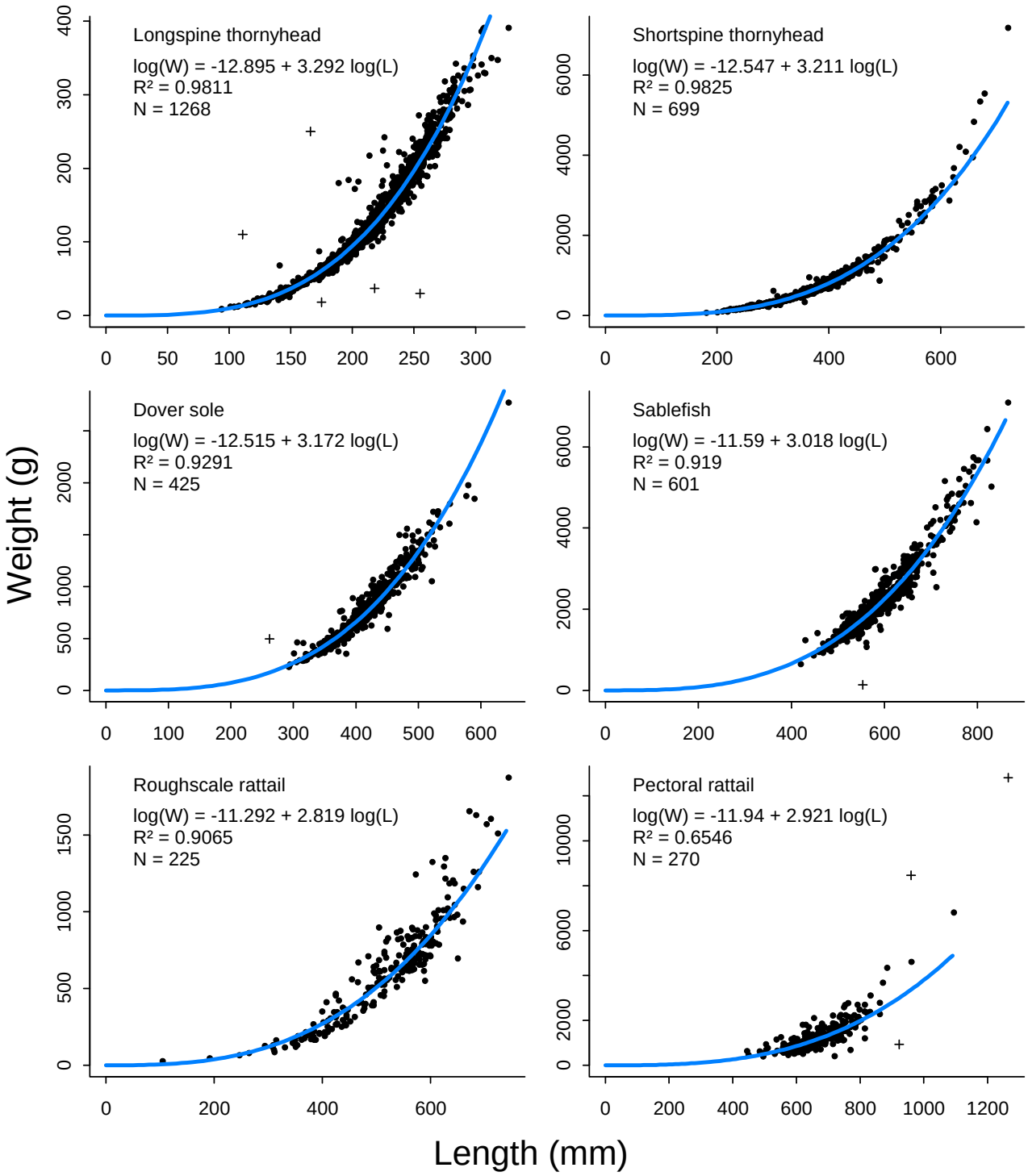

Figure 7. Regression plots of weight (g) versus length (mm) for six species. Data include specimens from excluded tows where biological samples were collected. Outliers (+) were removed from analyses.

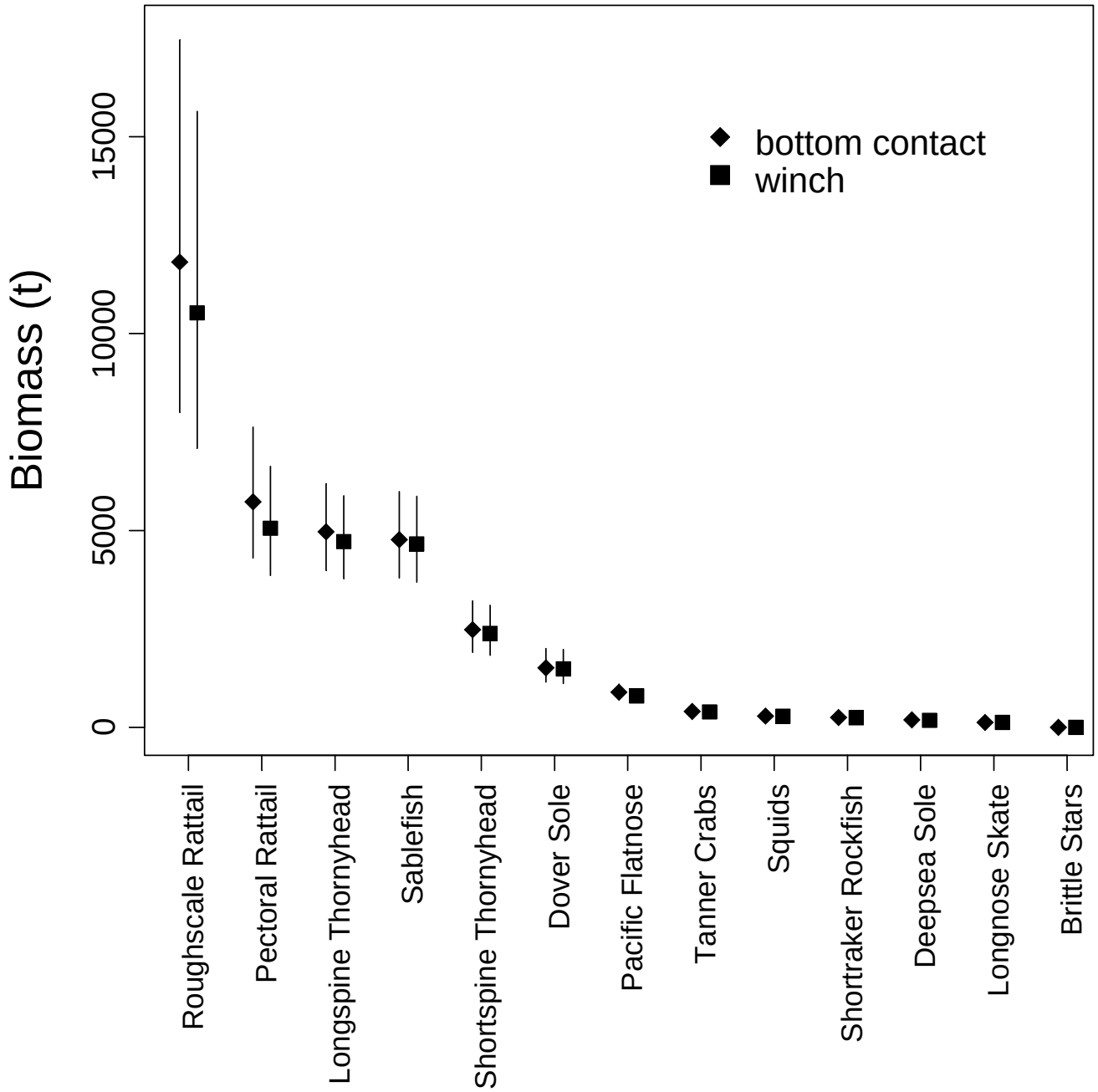

Figure 8. Comparison of biomass estimates for 13 species in the 2003 survey using CPUE estimates based on total bottom contact time and CPUE estimates calculated using winch lockup to retrieval time (Eq. 4). Approximate confidence bounds are indicated based on a log-normal distribution using the analytic CV for plotting only.

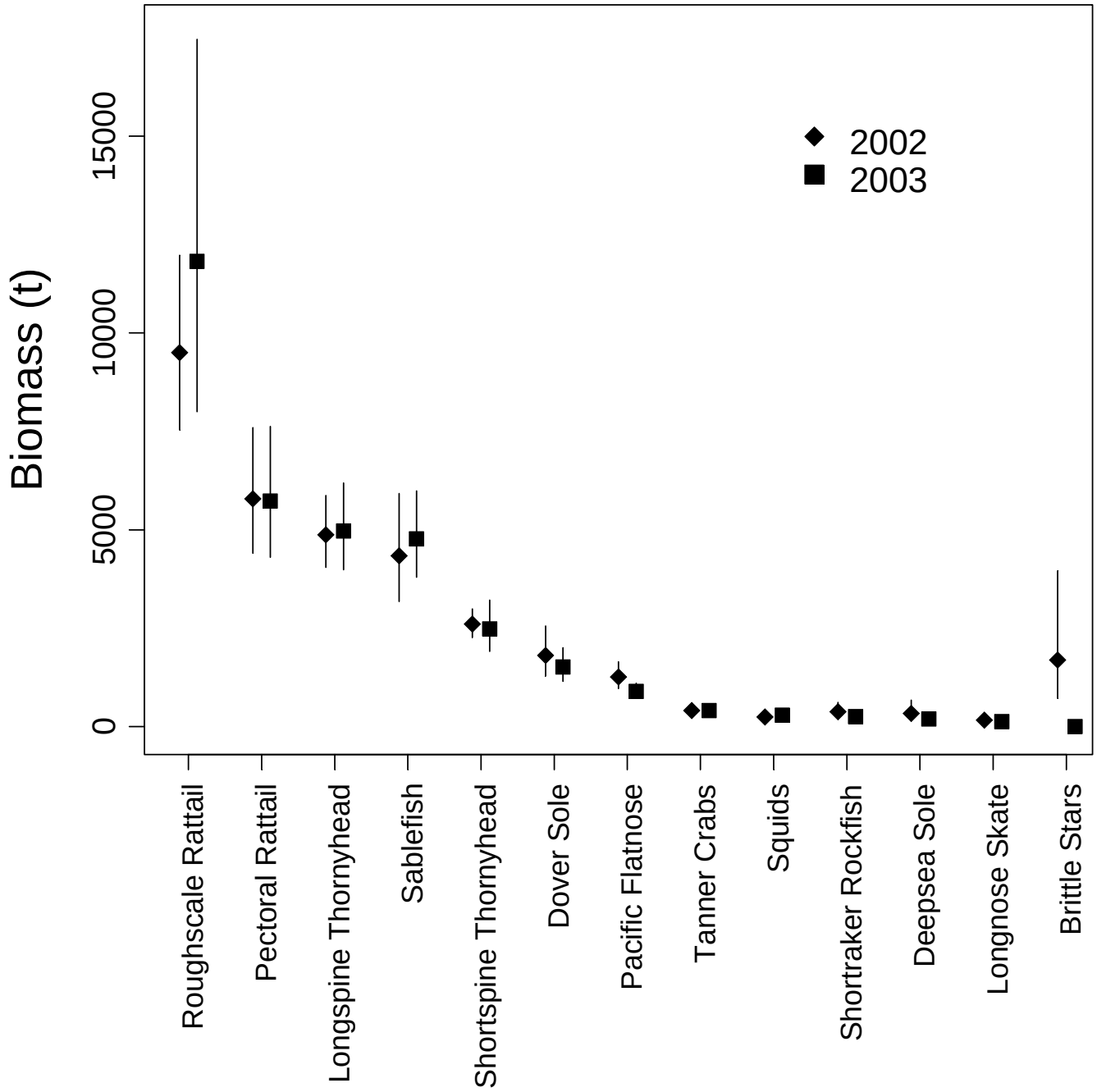

Figure 9. Comparison of biomass estimates for 13 species from the 2002 and 2003 surveys using CPUE estimates based on total bottom contact time (Eq. 4). Approximate confidence bounds are indicated based on a log-normal distribution using the analytic CV for plotting only.

APPENDICES

APPENDIX A. Design for the 2003 west coast Vancouver Island longspine thornyhead survey. (Paul Starr, Canadian Groundfish Research & Conservation Society, 2003)

Introduction

The design for a longspine thornyhead trawl survey presented in this document is a revision of documents drafted for the 2001 and 2002 surveys (Starr et al. 2002; Starr et al. in prep.). The initial design considerations for this survey were presented to the Groundfish Sub-committee of the Pacific Stock Assessment Review Committee in 2000 (Starr & Schwarz 2000). These were subsequently refined and revised based on discussions over a period of nearly eight months between scientists from the Pacific Biological Station, Simon Fraser University, the Canadian Groundfish Research & Conservation Society (CGRCS), and the US National Marine Fisheries Service (NMFS). There was also consultation with Department of Fisheries and Oceans (DFO) management and with representatives of the fishing industry. The 2001 survey was conducted from 15 September to 02 October on the *F/V Viking Storm* (Starr et al. 2002) and was repeated from 06 to 23 September 2002 on the F/V Ocean Selector (Starr et al. in prep.). A preliminary comparison of the results of the two surveys shows excellent comparability (Starr 2003).

The design of these trawl surveys is targeted at the longspine thornyhead resource. This aspect is reflected in the depth range selected for the survey and the survey coverage which is restricted to the west coast of Vancouver Island (WCVI). The reasons for this decision are:

a. all parties recognize that the developing thornyhead fishery requires robust fisheries data which can be incorporated into future stock assessments;

b. thornyheads appear to be distributed relatively uniformly on the bottom (Wakefield 1990) compared to other slope/shelf rockfish species which translated into a low relative error (RE) in the initial survey;

c. this survey represents the third year of a three-year commitment on the part of the CGRCS to support new research on longspine thornyheads.

Objectives of the survey

1. To estimate the relative abundance of longspine thornyhead lying between a southern boundary defined by the Canada-US border and a northern boundary defined approximately by 50° 30’ N between the depths 500 m and 1 600 m. The target RE of the biomass estimate is 20% $\left(RE = \mu/SE\right)$ (where μ is the mean biomass for the survey and *SE* is the standard error of the biomass estimate).
2. To estimate the distribution by size class and sex category of the longspine thornyhead population within the extent of the survey area, given the uncertainty that results from sampling with non-representative fishing gear.
3. To obtain quantitative biological information pertaining to selected finfish and invertebrate species.

Survey Charter and Personnel

4. As in 2002, the charter for the 2003 WCVI longspine survey will be performed by the *F/V Ocean Selector* with Dave Clattenberg as skipper.

5. The survey leader will be Paul Starr of the Canadian Groundfish Society. He will be on board the Ocean Selector for the first four to five days of the survey. Brian Krishka and Ed Choromanski of DFO will be on board the Ocean Selector for the full duration of the survey and Nev Venables (formerly of DFO) is scheduled come on board when Paul Starr disembarks. Archipelago Marine Research will provide Dean Gaidica (who participated in the 2001 survey) and Mike Orcutt (who participated in the 2002 survey) to assist with the sampling and the data recording for the entire period of the survey

Elements of this design

6. The survey will be targeted at the vulnerable slope and shelf rockfish species between the depths of 500 and 1600 m. It will be conducted off WCVI and will use the seven areal strata used in the 2002 survey (Figure A1; Table A1). The initial survey design in 2001 was based on six strata, but a seventh areal stratum was added in 2002 to accommodate the revised northern limit (at 50° 30') of the southern longspine thornyhead management area (Figure A1). The boundaries between these seven areal strata were selected to reflect the natural boundaries of the existing longspine thornyhead fishery. Although the analysis of both the 2001 and 2002 survey data indicated that the areal stratification did not substantially improve the statistical performance of the survey, the use of these strata ensures good geographical coverage by the survey.

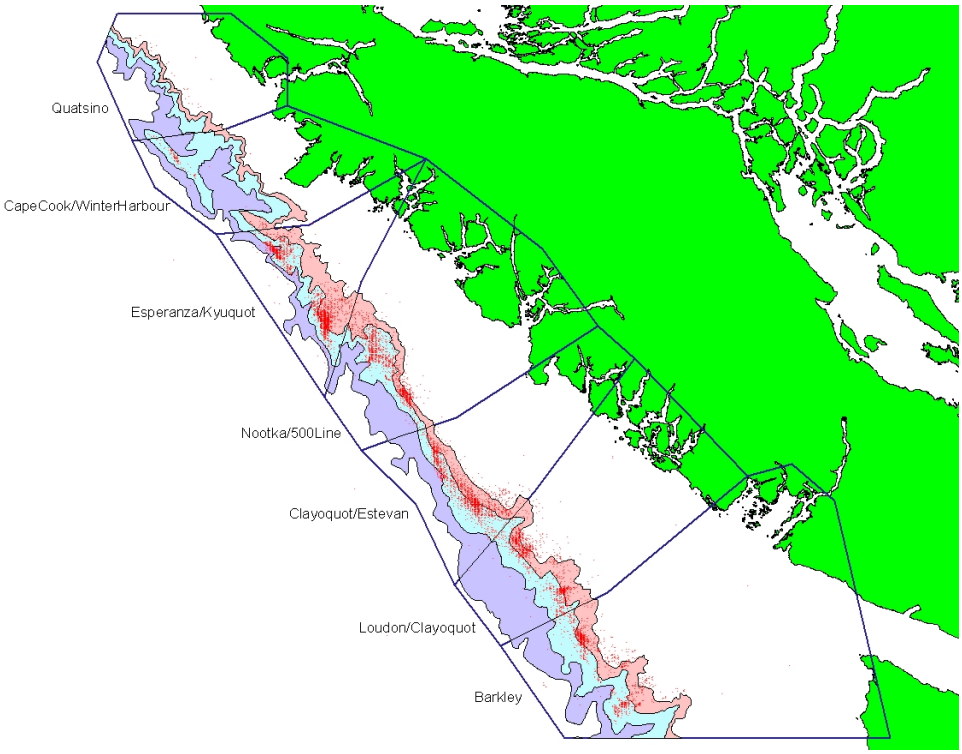

Figure A1. Map of the seven areal survey strata with most of the relevant tows in the PacHarvest database (over period 15 February 1996 to 01 April 2002).

7. Each areal stratum is divided into three depth strata: 501–800 m; 801–1200 m; 1201–1600 m (Table A1). The use of these depth strata reduced the calculated RE for longspine thornyheads from about 15% for a completely random survey to around 10% when only using the depth strata. The inclusion of these depth strata therefore significantly improved the performance of the survey design.

Table A1. Names and approximate size of each areal stratum by depth stratum. Trawlable area estimated from the number of $(500\ m)^2$ cells used to select the random tows.

		Estimated size of trawlable area (km^2)			
Areal stratum name		**501-800 m**	**801-1200 m**	**1201-1600 m**	**Total**
A.	Barkley	491	689	588	1,768
B.	Loudon/Clayoquot	331	370	698	1,398
C.	Clayoquot/Estevan	265	379	462	1,106
D.	Nootka/500 Line	265	388	452	1,105
E.	Esperanza/Kyuquot	425	361	260	1,046
F.	Cape Cook/Winter Harbour	191	540	574	1,305
G.	Quatsino	131	215	304	650
	Total	2,099	2,941	3,337	8,377

8. The number of tows allocated to each areal stratum is designed to ensure that a reasonably high level of precision for longspine thornyheads is achieved over the entire survey area, based on an analysis of the existing catch and effort data for longspine thornyheads (Starr & Schwarz 2000). The design requires 10 tows per areal stratum, 4 tows in each of the two shallower strata and 2 tows in the deepest stratum (with the exception of the northernmost areal stratum). This number of tows per stratum resulted in acceptable REs for all the main species caught in the 2001 survey except for longnose skate, brittle stars and shortraker rockfish and reasonable estimates of RE for all the major species in 2002 (Table A2)). The number of tows required in the most northerly stratum (Quatsino; Figure A1) has been set to a lower number than the more southerly areal strata as the terrain is likely to be very difficult to tow and there have been very few commercial sets in this area.

Table A2. Biomass estimates (t) and the associated relative errors (RE [%]) for the top 13 species by total weight caught in the 2001 and 2002 west coast Vancouver Island longspine thornyhead surveys (Starr 2003). The 2002 survey estimates have been made for the areal strata A to F (Table A1) only and are based on tow durations from winch lockup to winch release for comparability with the 2001 survey estimates.

Species	**2001 biomass (t)**	**2002 biomass (t)**	**Difference (%)**	**2001 survey RE**	**2002 survey RE**
Sablefish	3,824	2,899	-24%	13.2%	19.9%
Roughscale rattail	6,431	5,906	-8%	11.6%	13.6%
Longspine thornyhead	3,191	3,210	1%	9.5%	10.5%
Shortspine thornyhead	1,531	1,721	12%	7.8%	7.3%
Pectoral rattail	4,167	3,900	-6%	11.8%	15.4%
Dover sole	845	1,071	27%	13.3%	21.5%
Pacific flatnose	824	776	-6%	12.2%	16.8%
Tanner crabs	538	299	-45%	18.3%	13.5%
Shortraker rockfish	15	219	1,352%	71.4%	24.4%
Brittle stars	414	731	76%	76.4%	35.3%
Longnose skate	504	127	-75%	51.1%	35.8%
Squids	115	162	41%	23.3%	16.0%
Deepsea sole	104	220	112%	17.6%	34.3%

9. Table A3 defines the depth strata selected for this design and the target and minimum times to be towed in each depth stratum, based on the time from winch lockup to winch release. The target tow time has been set between ¾ and 1 hour to minimize large catches and to reduce sub-sampling as well as ensuring comparability with the 2001 and 2002 surveys. The actual tow times may be shorter or longer than the target, depending on bottom conditions or other considerations but should not be less than the specified minimum times. The target and minimum tow time have been adjusted downward for the three northern strata (Esperanza/Kyuquot; Cape Cook/Winter Harbour and Quatsino) because towing conditions in these strata are more difficult.

Table A3. Specifications for target and minimum times between winch lockup and winch release by depth stratum. Strata are labelled A to G as shown in Table A1.

		Strata A-D		Strata E-G	
Depth Stratum	**Number of assigned tows**	**Target length of tow in stratum[1]**	**Minimum length of tow in stratum[1]**	**Target length of tow in stratum[1]**	**Minimum length of tow in stratum[1]**
501 – 800 m	4[2]	1.0 h	0.75 h	0.75 h	0.50 h
801 – 1200 m	4[2]	1.0 h	0.75 h	0.75 h	0.50 h
1201 – 1600 m	2	1.0 h	0.75 h	0.75 h	0.50 h

[1] Defined as the time between winch lockup and the beginning of winch release.
[2] Reduced to two tows in Stratum G.

10. The design provided in Table A4 is based on the assumption that tows will be chosen randomly from a prescribed list of locations. If a tow location is not feasible, then another tow will be selected from a list of alternative random tow locations in a specified sequence.

Table A4. Survey design based on equal allocation of tows to each of the 7 areas defined in Figure A1 and Table A1.

		Depth stratum (m)			Total
Areal stratum		**501-800**	**801-1200**	**1201-1600**	**all depths**
A.	Barkley	4	4	2	10
B.	Loudon/Clayoquot	4	4	2	10
C.	Clayoquot/Estevan	4	4	2	10
D.	Nootka/500 Line	4	4	2	10
E.	Esperanza/Kyuquot	4	4	2	10
F.	Cape Cook/Winter Harbour	4	4	2	10
G.	Quatsino	2	2	2	6
	Total	26	26	14	66

11. The minimum tow period in this survey has become more difficult to specify due to changes in the way that the bottom contact sensor behaved between the 2001 and 2002 surveys. Table A5 shows the average by stratum for five (for 2002) and three (for 2001) estimates in the length of time that tow was on the bottom, ranging from the period between the winch lockup to winch release to a high standard of acceptance based on the bottom contact sensor tilt angle while the net was on bottom. Table A6 shows the minimum bottom contact time in hours for the same estimates of bottom contact time. The performance of the bottom contact sensor appeared to be more variable in 2002 and bottom contact times may have been lower in 2002 than 2001 when assessed based on the bottom contact sensor data. The information presented in Table A5 is important because it demonstrates that it is difficult to specify minimum tow periods based on the performance of the bottom contact sensor

data. However, there is better comparability when comparing the tow periods based on the more conventional tow duration estimate based on winch lockup to winch release (Table A5).

Table A5. Mean bottom contact time for the 2001 and 2002 surveys using three and five estimation methods respectively. Standard: [winch release time]-[winch lockup time]; BCS: [time leave bottom]-[time hit bottom] based on bottom contact sensor; B50, B70 & B80: estimates of total time at tilt angles of 50°, 70° and 80° using the bottom contact sensor for each depth and areal stratum. NA: Not Applicable.

Depth and	2002 Survey					2001 Survey		
areal stratum	Standard	BCS	B50	B70	B80	Standard	B50	B80
501-800 m								
A	1.13	1.10	1.09	1.06	0.79	1.03	0.96	0.81
B	1.38	1.30	1.21	1.13	0.90	1.00	0.91	0.72
C	1.42	1.25	1.24	1.16	0.89	1.07	1.05	0.92
D	1.35	1.29	1.18	0.98	0.70	1.20	1.08	0.93
E	1.12	1.03	0.92	0.77	0.59	1.08	1.03	0.97
F	0.91	0.84	0.74	0.67	0.56	1.07	0.96	0.56
G	0.90	0.86	0.71	0.56	0.46	NA	NA	NA
Average for stratum	1.19	1.12	1.04	0.93	0.72	1.07	1.00	0.82
801–1200 m								
A	1.23	1.14	1.07	0.93	0.61	1.08	0.87	0.78
B	1.21	1.05	1.01	0.87	0.56	1.16	0.99	0.74
C	1.44	1.16	1.15	1.03	0.62	1.17	1.05	0.90
D	1.68	1.61	1.32	0.96	0.64	1.24	1.03	0.81
E	1.29	1.23	1.03	0.92	0.53	1.14	0.94	0.81
F	1.11	1.01	1.01	0.94	0.73	1.09	0.80	0.71
G	1.08	0.92	0.89	0.86	0.67	NA	NA	NA
Average for stratum	1.33	1.21	1.10	0.94	0.62	1.15	0.95	0.79
1201–1600 m								
A	1.11	0.85	0.83	0.79	0.52	1.23	0.63	0.58
B	1.35	1.17	1.16	1.15	0.73	1.33	1.46	1.45
C	1.33	1.10	1.10	1.08	0.62	1.27	0.98	0.85
D	1.43	1.25	1.25	1.22	0.75	1.26	1.22	1.22
E	1.15	0.71	0.59	0.37	0.09	0.97	0.84	0.82
F	0.90	0.89	0.87	0.83	0.30	NA	NA	NA
G	1.05	0.93	0.89	0.49	0.22	NA	NA	NA
Average for stratum	1.19	1.01	0.98	0.88	0.49	1.21	1.07	1.03

12. Table A6 shows the minimum times that were achieved in the two surveys by depth and areal stratum which were used to base the minimum times specified in Table A3. The minima shown in Table A6 should be consulted when deciding whether to accept or reject tows during the 2003 survey.

Table A6. Minimum bottom contact time for the 2001 and 2002 surveys using three and five estimation methods respectively. Standard: [winch release time]-[winch lockup time]; BCS: [time leave bottom]-[time hit bottom] based on bottom contact sensor; B50, B70 & B80: estimates of total time at tilt angles of 50°, 70° and 80° using the bottom contact sensor for each depth and areal stratum. NA: Not Applicable.

Depth and	2002 Survey					2001 Survey		
areal stratum	Standard	BCS	B50	B70	B80	Standard	B50	B80
501-800 m								
A	0.98	0.78	0.75	0.65	0.31	0.97	0.89	0.65
B	1.13	0.94	0.89	0.78	0.52	1.00	0.57	0.48
C	1.20	1.05	1.05	1.04	0.70	1.00	0.91	0.65
D	1.20	1.09	0.99	0.93	0.57	1.10	0.95	0.79
E	0.73	0.70	0.70	0.64	0.56	0.93	0.81	0.71
F	0.88	0.77	0.50	0.41	0.32	1.00	0.85	0.43
G	0.72	0.70	0.69	0.55	0.44	NA	NA	NA
Minimum for stratum	0.72	0.70	0.50	0.41	0.31	0.93	0.57	0.43
801–1200 m								
A	1.12	0.93	0.93	0.61	0.31	1.00	0.79	0.69
B	1.03	0.86	0.85	0.83	0.46	1.00	0.56	0.38
C	1.37	1.10	1.10	0.96	0.15	1.17	0.95	0.76
D	1.37	1.38	1.01	0.64	0.41	1.17	0.80	0.50
E	0.93	0.97	0.80	0.67	0.18	0.93	0.80	0.46
F	1.00	0.98	0.97	0.87	0.69	1.00	0.67	0.52
G	1.07	0.77	0.71	0.68	0.49	NA	NA	NA
Minimum for stratum	0.93	0.77	0.71	0.61	0.15	0.93	0.56	0.38
1201–1600 m								
A	1.00	0.84	0.79	0.79	0.43	1.10	0.63	0.58
B	1.17	1.09	1.09	1.08	0.39	1.33	1.43	1.41
C	1.20	0.91	0.91	0.89	0.46	1.10	0.82	0.72
D	1.40	1.23	1.22	1.21	0.38	1.17	1.07	1.07
E	1.15	0.71	0.59	0.37	0.09	0.95	0.79	0.78
F	0.55	0.55	0.55	0.53	0.15	NA	NA	NA
G	1.02	0.91	0.83	0.48	0.19	NA	NA	NA
Minimum for stratum	0.55	0.55	0.55	0.37	0.09	0.95	0.63	0.58

13. The issue of tow duration is important because it is possible that there is a relationship between the length of time spent on the bottom and the CPUE used to estimate the biomass. This relationship is plotted (Figure A2) for the top 12 species in the combined 2001/2002 longspine surveys. Unfortunately, it appears that the species where such a relationship is potentially present is longspine thornyhead, the primary target species of the survey. Because of this plot, it has been decided to maintain the overall tow period (as determined from winch lockup to winch release) in 2003 to the same standards as specified in 2001 and 2002.

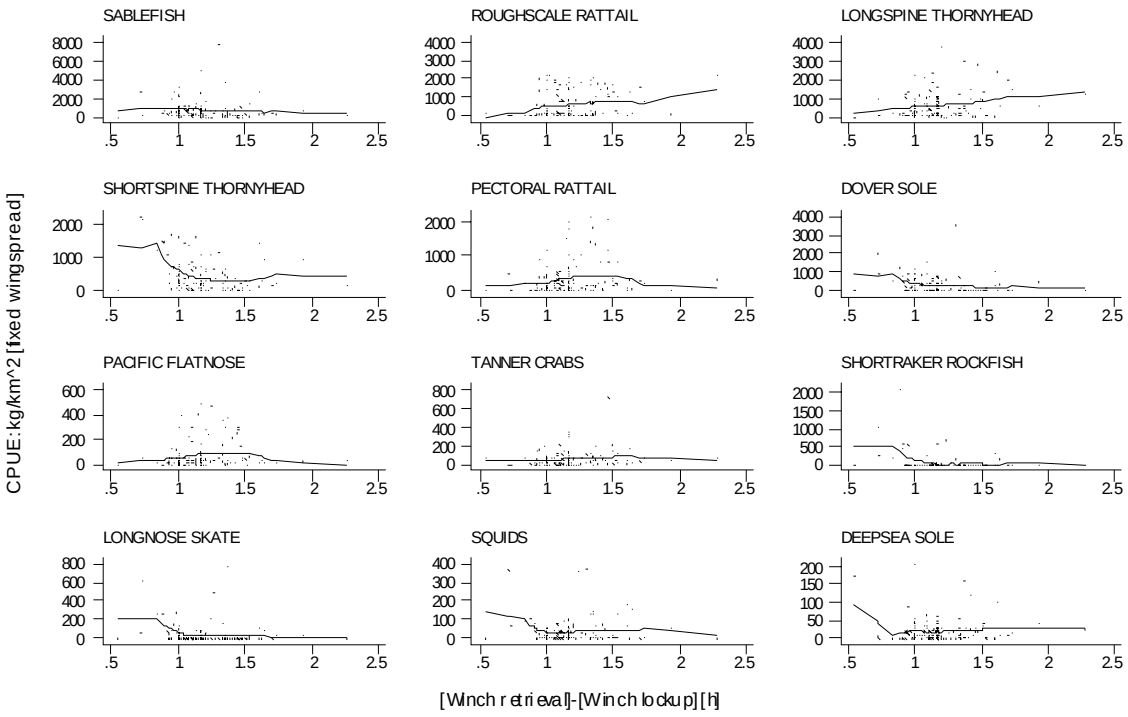

Figure A2. CPUE (kg/km^2) from the longspine survey (2001 and 2002 surveys combined) plotted against tow duration calculated as the time from winch lockup to winch release for the top 12 species in the survey catch. CPUE={catch_weight/[tow_distance*0.04]} Tow distance is {[winch_release]-[winch_lockup]}*[average_speed]. A lowess line is fitted for each species.

Protocol for survey and survey gear

14. This survey is the last of a planned series of three surveys to be conducted in the late summer/early autumn of 2001, 2002 and 2003. It is a requirement of the survey contract that the vessel master is a specialist in the Canadian longspine fishery. The contract is held by the Ocean Selector with skipper Dave Clattenberg.

15. Two nets (#2 box trawl each built to the same agreed specifications) are to be used for the survey and will be retained by the CGRCS for continuity. These nets will have a 50 mm (2 inch) cod end liner made from braided knotless web, Thyboron 107 doors will be used and bridles for the net and a pair of suitable main warp cables will be provided by the vessel. The length of the warp and the weight of the doors are to be measured accurately prior to the beginning of the survey.

16. The survey contract specifies that the net must be restored to its original condition whenever it is mended and that the condition of the net be externally audited at the beginning of each subsequent survey based on a set of written specifications that will be drawn from the original net design.

17. The following net monitoring equipment have been made a condition of the survey contract: a) doorspread monitor; b) pressure depth monitor; c) codend sensor; d) temperature sensor; e) headline height sensor. Two “bottom contact sensors” (one available as a backup) have been manufactured and will be available for use in 2003 which are comparable to those designed by the NMFS and which were loaned for use in the 2001 and 2002 surveys. These devices will give a complete monitoring of the period of contact with the bottom during each tow.

18. The survey is presently scheduled to begin on 03 September and will continue until the 66 tows described in Table A4 are completed. This should take approximately 15-18 days to complete, depending on weather conditions.

Protocol for selecting and conducting survey tows

19. Tows will be allocated to 7 areal strata using three depth strata described in Table A4, for a total of 21 separate sub-strata. The depth boundaries will be determined by the mean interpolated depth lines (500 m, 800 m, 1200 m, and 1600 m) based on available bathymetric data (Figure A1). This is to ensure that the strata definitions are continuous. The definitions of these 21 sub-strata are maintained by Rowan Haigh (DFO).

20. Each sub-stratum will be characterized by a set of 500 m X 500 m grids (e.g., Figure A3). There are approximately 33,500 of these grids (or about 8,400 $km^{2;}$ Table A1; Table A7) within the survey area. A list containing a sequence of randomly selected grid co-ordinates from each of the 21 area/depth sub-strata has been provided to the Ocean Selector from which each tow is to be executed until the required number of tows for that sub-stratum is completed. The vessel master is to select a starting location for the tow so that he can pass through the selected grid while maintaining the bottom contact specifications and staying within the boundaries of the sub-stratum. If the location is not suitable (e.g., rough bottom terrain or inappropriate depths for the sub-stratum), then the next randomly selected grid on the list will be sampled.

21. Tows in each sub-stratum will be conducted for about one hour from winch lockup to winch release at a speed of 2.2 nm/h with no more than ±10% variation. The average time period between winch lockup to winch release will be 1.0 hours for the 4 southern strata (Barkley, Loudon/Clayoquot, Clayoquot/Estevan, Nootka/500 Line), with a minimum period of 0.75 hours between winch lockup and winch release. It is assumed that adequate bottom contact will be achieved if these standards are met, but onboard analysis of the bottom contact sensors should be made to confirm that bottom contact time is adequate. The average period between winch lockup to winch release will be relaxed to 0.75 hours and the minimum time to 0.50 hours for the 3 more northerly strata (Esperanza/Kyuquot to Quatsino) because of the more difficult bottom topography in these strata. However, longer bottom contact times in these strata are preferred, if possible.

22. Once a tow location is selected in the 4 southern strata (Barkley, Loudon/Clayoquot, Clayoquot/Estevan, Nootka/500 Line), the skipper is required to tow so that the net passes within 250 m of the designated survey point while maintaining the required minimum bottom contact time (as described in Paragraph 20) and staying within the stratum definition of area and depth range. The requirement to pass within 250 m of the selected random location is relaxed to 2000 m in the three northern strata (Esperanza/Kyuquot; Cape Cook/Winter Harbour and Quatsino), again in acknowledgement of the more difficult bottom topography.

23. An ordered list of 25 randomly selected grid locations will be provided for each of the 21 sub-strata described in Table A4 (7 areal strata X 3 depth strata). The skipper of the *Ocean Selector* will be asked to tow, in any order, the first four locations on the list. However, the skipper is allowed to reject a randomly selected tow location for any of the three reasons listed in Paragraph 24. Additional reasons for discarding random tows can be added if the survey leader (Paul Starr) agrees. However, the list provided in Paragraph 24 are the reasons used in both the 2001 and 2002 surveys and should not be changed substantially in future surveys to ensure comparability with past surveys.

24. Acceptable reasons for discarding a randomly selected tow location and taking the next location:

1.	The bottom topography is not suitable for completing the tow requirements (too rough).
2.	The random grid location does not conform to the sub-stratum definitions (i.e. wrong depth[1] or outside the defined sub-stratum boundaries).
3.	Towing the random grid location means a substantial overlap with a previously selected tow line. The definition of "substantial" is not exact but should be at least 50% same coverage as determined jointly by the skipper and the lead scientist on board.

[1] Do not accept tows which have more than 5–10% of the total track distance at the wrong depth due to undulating bottom topography, based on a decision jointly made by the skipper and the lead scientist on board the vessel. If the tow track enters a different depth stratum at the end of a tow, it is better to simply end the tow as soon as the depth stratum changes as long as the minimum required tow duration is achieved.

25. The number of tows presented in **Table A4 must all be completed successfully** for each of the 21 sub-strata. The skipper is required to select random grid locations in the order presented in the list described in Paragraph 23 until all tows are completed. Random grid locations can only be skipped if they conform to one of the reasons listed in Paragraph24. If a tow fails the minimum requirements (speed, distance from the grid location, or bottom contact time) described in Paragraphs 21 and 22, then that tow must be discarded and replaced with a tow made through the next random grid location on the list. This procedure is continued until all the required tows for that sub-stratum have been completed.

26. Due to the failure to obtain adequate data streaming software from Scanmar, we will use the screen capture facility provided on the Scanbas system.

    a. The protocol will be to take a screen capture approximately every one minute, resulting in 45 to 70 files for each tow. Screen captures should begin at the time that the winch is locked to ensure that the moment of bottom contact is recorded and should continue until it is clear that the net has left the bottom. This information is saved as a compressed `.bmp` file by the Scanmar software with file sizes of single screen shots on the order of 8-12 kb, and it is probably reasonable to expect that all the screen capture shots for a single tow will fit on a single 1.44 mb floppy. Therefore, the procedure will be to use a fresh floppy for each tow and to transfer all the files to one of the laptops, saving the dump files in a unique subdirectory associated with the tow number. The subdirectories are to be backed up on a CD-R.

    b. We will evaluate whether it is necessary to maintain paper copies of the net monitoring data using the supplemental bridge log. At this point, it is probably not necessary to use the paper forms, given the likely reliability (and timing consuming nature) of the screen dump software. Also, if it appears that the screen dumping procedure is failing at any given moment, then recording on the supplemental bridge logs can be taken up right away to cover for the problem. Therefore, the supplemental bridge logs should be readily available on the bridge so that they can be used in case of failure in the screen dumping procedure.

    c. If it is necessary to use the supplemental bridge logs due to failure of the Scanmar screen dumping procedure, the following protocol is to be used: beginning at the time the net reaches the bottom, at approximately 5 minute intervals, record the vessel direction, speed, depth, position and distance traveled. From the Scanmar system at the same interval, record the headline height, net depth, water velocity at the entrance of the net, doorspread, codend sensor reading, and water temperature at the net. Additionally record the length of warp out, the wind speed and wind direction. Any comments pertaining to the preceding interval can also be

recorded on the form. This procedure should continue until it is clear that the net has left the bottom.

d. The supplemental bridge log form can be used during any tow to record comments by the skipper or any of the voyage scientists, by simply noting the time during the tow. Other information that are not captured in one of the other data streams can also be recorded on these forms.

e. The bottom contact sensor is to be attached to the net footrope and the data are to be downloaded after every tow.

Table A7. Approximate number of 500 m X 500 m grids and percentage distribution in each of the 21 depth/area sub-strata presented in Table A4.

	501-800		801-1200		1201-1600		Total all depths	
Longspine Area	**# Grids**	**% Total**	**# Grids**	**% Total**	**# Grids**	**% Total**	**# Grids**	**% Total**
Barkley	1 965	5.9%	2 756	8.2%	2 351	7.0%	7 072	21.1%
Loudon/Clayoquot	1 323	3.9%	1 478	4.4%	2 790	8.3%	5 591	16.7%
Clayoquot/Estevan	1 060	3.2%	1 517	4.5%	1 846	5.5%	4 423	13.2%
Nootka/500 Line	1 059	3.2%	1 552	4.6%	1 807	5.4%	4 418	13.2%
Esperanza/Kyuquot	1 701	5.1%	1 442	4.3%	1 041	3.1%	4 184	12.5%
Cape Cook/Winter Harbour	764	2.3%	2 160	6.4%	2 297	6.9%	5 221	15.6%
Quatsino	525	1.6%	860	2.6%	1 214	3.6%	2 599	7.8%
Total	8 397	25.1%	11 765	35.1%	13 346	39.8%	33 508	100.0%

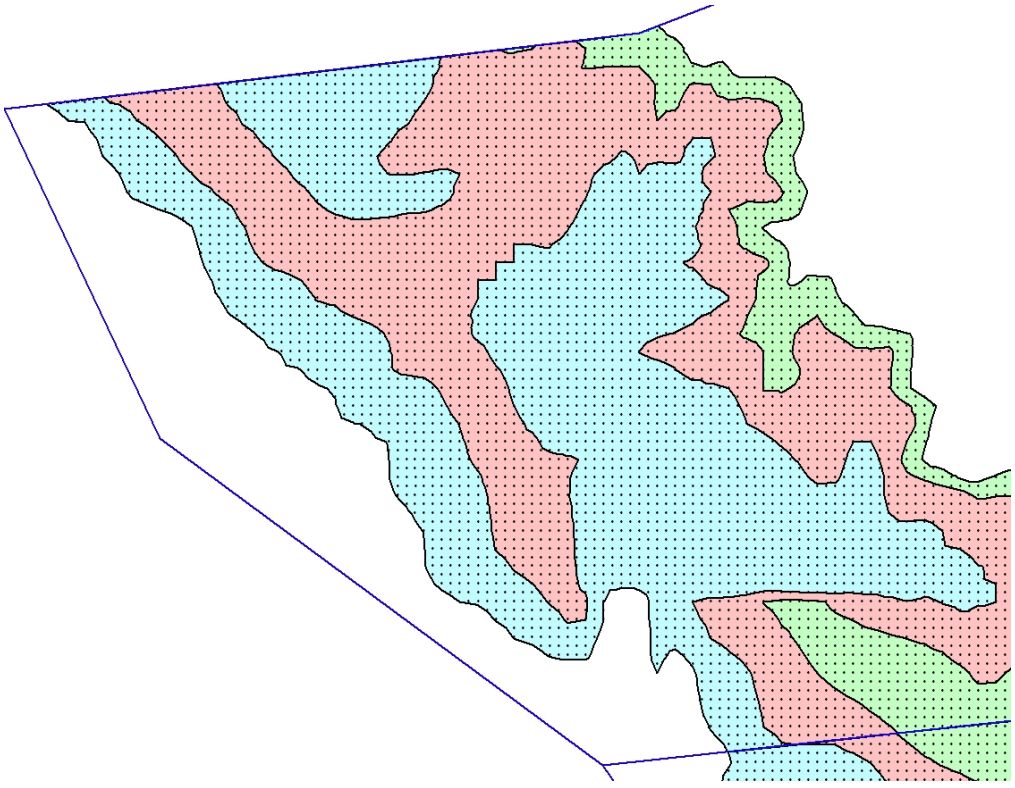

Figure A3. Diagram for areal stratum 6 (Cape Cook/Winter Harbour) showing proposed 500 m X 500 m grid locations from which random locations will be selected (each location is represented by a single dot which may not be readily visible in a printed version of this document).

Provision for untrawlable areas

27. The set of 500 X 500 m grids was shown in 2001 to Chris Roberts, one of the skippers of the *F/V Viking Storm*, with the request that he indicate areas of known untrawlable bottom. In the end, 26 areas were identified covering about 15% of the available area (about 1,300 km^2 – Figure A4). These grids were distributed unevenly among the 6 areal strata fished in 2001, with Nootka/500 Line and Cape Cook/Winter Harbour accounting for over 50% of the excluded grids and Clayoquot/Estevan accounting for less than 3% (Table A8). The percentage of excluded grids was approximately equal among the two shallower depth strata and the deepest stratum accounted for less than 10% of the exclusions, which is probably indicative of the lack of exploration in these depths.

28. The definition of the survey area was not changed in 2002 and will not be changed in 2003 by adding additional excluded grids. This decision has been made to maintain comparability among years.

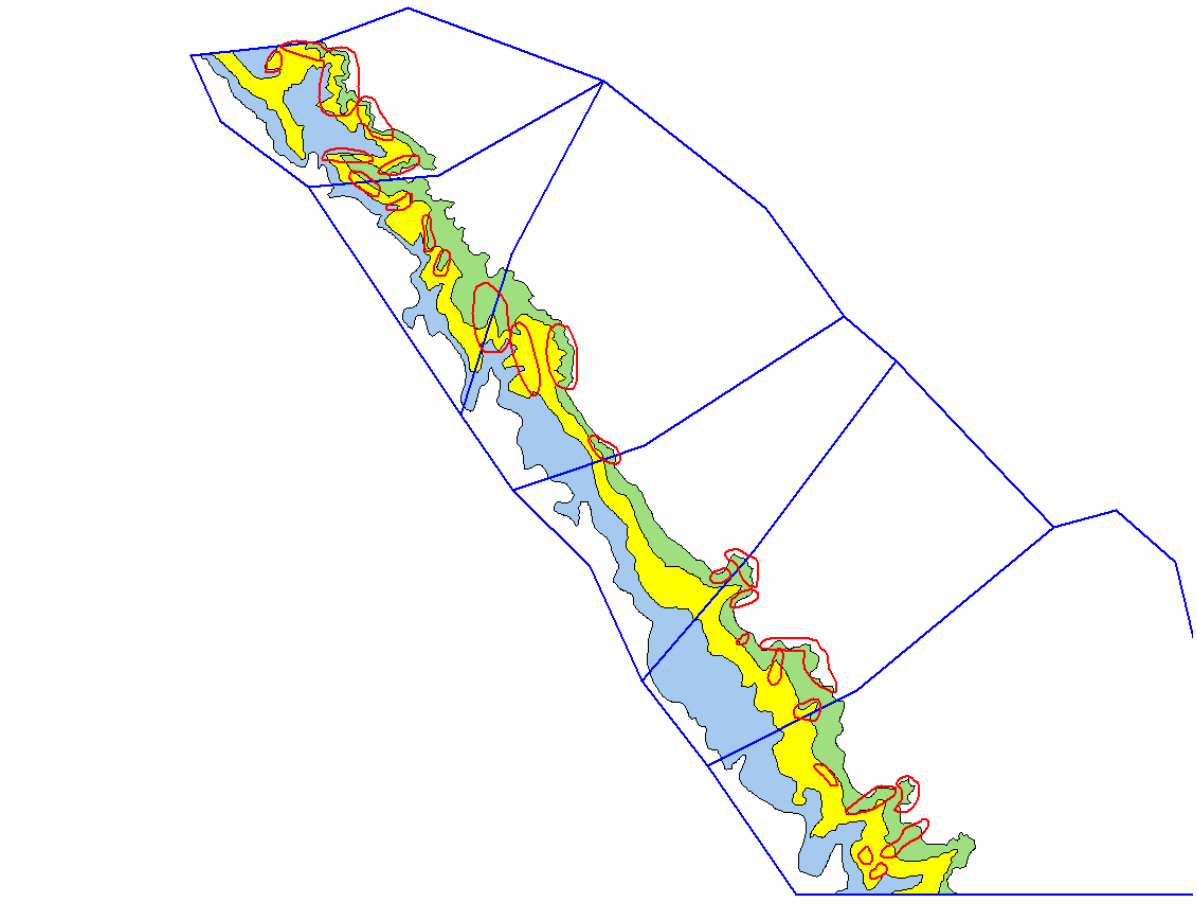

Figure A4. Outlines of the excluded areas (red polygons) in the six areal strata as provided by Chris Roberts from the Viking Storm.

Table A8. Distribution of grids excluded in 2001 by depth and area strata expressed as a percentage. Note that the total number of excluded grids is about 15% of the total area of the combined area from Barkley to Cape Cook/Winter Harbour.

Longspine Area	501-800	801-1200	1201-1600	Total all depths
Barkley	8.5%	5.7%	0.0%	14.1%
Loudon/Clayoquot	8.5%	3.2%	0.0%	11.6%
Clayoquot/Estevan	2.5%	0.0%	0.0%	2.5%
Nootka/500 Line	9.8%	14.9%	1.8%	26.5%
Esperanza/Kyuquot	8.7%	5.8%	0.5%	15.0%
Cape Cook/Winter Harbour	9.9%	16.0%	4.4%	30.3%
Total	47.9%	45.5%	6.7%	100.0%

Protocol for sampling survey tows

29. For each tow, the following data will be collected:

a. Total catch **in numbers** and **weight** for all commercially important or potentially commercially important species of fish (including elasmobranchs). This category will be separated out to the species level. Generally, the total weight in the catch will be determined by successively weighing individual fish bins after sorting.

b. Total catch in numbers and weight for invertebrate species separated to the Family or Order level will be collected as appropriate. Crabs (queen and tanner) can be separated into species categories.

c. The following list of species will be sampled for biological characteristics (length, sex and maturity stage). If the catch of that species is too large to sample every fish, then a random sub-sample will be taken for that species. The sub-sample will be weighed to determine the proportion by weight that is sampled of that species.

Species	Length/sex/maturity sample (every tow)	Otolith sampling	Target number otoliths	Number otoliths to sample per tow
Longspine thornyheads	YES	RANDOM AGE	1000	20
Shortspine thornyheads	YES	RANDOM AGE	600	12
Shortraker rockfish	YES	EVERY FISH	200	NA
Rougheye rockfish	YES	EVERY FISH	200	NA
Dover sole	YES	RANDOM AGE	500	12
Deepsea sole	YES	NO	N/A	NA
Turbot	YES	EVERY FISH	200	NA
Sablefish	YES	RANDOM AGE	500	12
Roughscale grenadier	YES[1]	RANDOM AGE[2]	N/A	6
Pectoral grenadier	YES[1]	RANDOM AGE[2]	N/A	6
Any sharks or skates	YES[1]	NO	N/A	NA

[1] maturity not required

[2] this sampling will only be undertaken if time permits

d. Maturity protocols for the appropriate species groupings (flatfish, slope rockfish) will be provided by DFO. There is still no maturity protocol yet developed for the thornyhead species, but the provisional schedule based on information collected during the 2001 and 2002 surveys will be applied again in 2003. The maturity schedule used for longspine and shortspine

thornyheads in these previous surveys was based on a two-stage categorization derived from an email from Bob Lauth of NMFS (Appendix A1).

e. Otoliths will be taken for the indicated finfish species using a random age sampling procedure OR every landed fish, depending on the species. The sampling strategy to be used is described in Paragraph 31. Random otoliths by species will be collected using a random number table that will be supplied by Paul Starr. The number of otoliths taken in any single tow has been determined so that the sampling is spread throughout the entire survey and with the expectation that sampling will not be complete for every tow. Otolith sampling for the grenadier species will have a lower priority and will only be undertaken if it does not take away from the primary survey objectives.

f. The fish selected for otolith sampling in Paragraph 29.c will also be individually weighed to generate a length-weight key.

30. Sampling the catch:

a. The entire catch will be initially sorted by species or invertebrate group. Each category will be then counted and weighed. **Under no circumstances is the total catch to be estimated without being weighed.**

b. If the total catch is large (generally greater than 1000 to 1200 kg), then one of two procedures can be followed to subdivide the catch:

i. One procedure is to place all the fish in bins without sorting. After weighing <u>all</u> the unsorted fish bins, a sufficient number of complete fish bins, totaling approximately 600 to 800 kg in aggregate, will be selected systematically as there may be structure in the way the fish came off the conveyor belt. An example of systematic selection would be to take every second bin (or 2 of every 3 bins). Processing of the selected bins would be done in the usual manner from that point and the sample must be clearly recorded as being a sub-sample of the total catch. It is likely that such a large subsample of the total catch will capture all the species categories in the total catch.

ii. A second procedure is available if it appears that the large catch is comprised of only one or two species. If this is the case, the catch can be sorted in the usual way, with the large species catch set aside (this is most likely to be sablefish or Dover sole). Again, the total catch must be weighed, but the one or two species which dominate the catch can be subsampled while the remainder of the catch is sampled in totality.

iii. In any case, Paul Starr **<u>must</u>** be contacted if this situation occurs and decisions need to be made about how to handle the tow.

c. The conveyer belt of the Ocean Selector should be carefully examined once the catch is sorted and weighed to ensure that fish, particularly smaller size classes, have not been lost in the machinery during the sorting process. If this occurs, a note should be made in the bridge log form or some other suitably location.

d. The entire catch for the species listed in Paragraph 29.c will be measured for length and the sex and maturity state for each fish will be determined. If there are more than 100 to 150 fish

in any category, then that category can be sub-sampled by estimating the total number of fish in the sample and then determining the frequency of selection that would be required to get a sample of approximately 100 fish (e.g. if there are 600 fish, then a sample of 1 in every 6 fish is required). Once this fraction has been determined, then the **entire** catch of that category must be selected using the determined fraction, even if this results in a larger than expected sample size. If the sample size is too small, then the procedure must be repeated using a larger fraction of the catch category.

e. If the catch is bimodal for a particular species (e.g., a large number of small, non-commercial fish and only a few larger commercial-sized fish), then the catch of that species can be sub-divided, with complete enumeration of the less numerous category (usually the large fish category) and sub-sampling of the more numerous category (usually the smaller size classes), as described in Paragraph 30.d. If this occurs, then the total weight of each size category needs to be recorded before sub-sampling (specifying clearly where each sample was obtained) and following this procedure essentially means that two new categories have been created from a single category.

f. The total weight of the sample should be recorded in every instance that a species category is subsampled as described in Paragraph 30.d.

g. If there is time, two or three tows should be subsampled and then fully enumerated for longspine thornyheads to ascertain if the sub-sampling procedures are obtaining reasonable samples of the length distribution. This work will involve measuring every fish in the catch after the catch has been sub-sampled using the procedure outlined in Paragraph 30.d.

31. A random age sampling procedure will be attempted for four species (longspine and shortspine thornyheads, sablefish and Dover sole) in the 2003 survey.

a. The procedure to be followed should be relatively simple and will be based on a set of random numbers generated for each tow. Each list will contain the appropriate number of random numbers (12 or 20), sorted in ascending order and drawn from the appropriate sample size. There will be no duplicate random numbers. See Appendix A2 for an example set of random numbers for four tows across 8 different sample sizes.

b. This procedure will require two individuals, one to sort and one to monitor the random number table. Given that two forms are used for recording biological information and that the preferred form for length frequencies is a tally form that does not lend itself easily to a counting procedure, it will probably be better if the species subsample is counted manually by the sorter, with recorder indicating which fish will put aside for otolith sampling based on the random number table. This will separate the subsample into two bins, one for otolith sampling and the other for simple length frequency measurements. While this procedure will add to the processing time, the additional time should not be onerous. [Alternatively, the counting could be done while sampling for length, if that is easier].

i. This procedure will require the recorder to indicate verbally to the sorter which fish has been selected during the counting process. For instance, if the first number in the random number sequence is “5”, then when the fifth fish is counted, it will also become an otolith sample.

ii. It is important for the recorder to not give the sampler prior notice that a fish is due for an otolith sample so that there is no opportunity for bias.

c. As indicated in Paragraph 31.a, there will be two types of random number sheets, one for 20 otolith samples and the other for 12 (which are the two numbers of otolith samples indicated in Paragraph 29.c).

i. Each sheet will have the correct number of random numbers (12 or 20) drawn from different sample sizes. While a sample size of 100 fish will be common, the number of fish in the sample will vary, depending on the catch. Unless the variation in the sample size in taken into account, the otolith sample will not be complete for the tow if there are fewer fish in the sample than are assumed in the random number list.

ii. The random numbers for each type will be drawn from decadal samples (e.g. 30, 40, 50, etc. fish) and the decade below the actual sample size can be used to select the otolith samples. For, instance if the sample size is 83 fish, then the random number table appropriate to 80 fish can be used to select the otoliths.

iii. One sheet for each type (12 or 20 otoliths) will be supplied for each valid survey tow (for a total of 66 tows). Each sheet will have a set of random numbers drawn from a sample of 20 to 100 fish. These sheets of random numbers will be provided by Paul Starr.

DNA sampling

32. Sampling for DNA will not be undertaken in the 2003 survey.

Data logging

33. All data will be placed in the existing DFO GFBio database. Current versions of the event, catch and biological sampling forms will be used.

34. All data will be recorded in hard copy. Data checking will be performed after every tow or in the evening as time permits.

References

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APPENDIX A1

TEXT OF EMAIL FROM BOB LAUTH OF THE ALASKA FISHERIES SCIENCE CENTER ON MATURITY STAGES FOR LONGSPINE THORNYHEADS

Maturity for LST's and SST's is a tough one. They do not fit the descriptions of rockfish maturities. So tough in fact that we gave up on it on our slope survey. I believe the only reliable way is using histological means. To begin with, one must be skilled to determine the sex of these fish. I do not believe the NW center even bothers sexing thornyheads on their slope survey. I generally reserve the duty of sexing to a select few who I know have the experience.

The maturity table we have used in the past is a very simple and general one, as follows:

MALES
1 IMMATURE - Gonads small, stringlike, and clear or transparent.

2 DEVELOPING OR INACTIVE - Testes swollen, opaque or translucent, colored tan or white. No milt present in ducts or expressible when testis is sectioned.

3 MATURE (ACTIVE) - Testes swollen and opaque. Milt present in ducts posterior to testes.

FEMALES
1 IMMATURE - Gonads small, stringlike, and clear or transparent.

2 DEVELOPING OR INACTIVE - Ovary swollen and translucent. No tiny eggs present. (Note: often the outer membrane of ovary must be removed to detect eggs.)

3 MATURE (ACTIVE) - Ovary swollen and translucent or opaque. Tiny eggs present in ovarian tissues.

As you can imagine, this table can be very subjective. Most thornyheads (during the fall) get placed in category 1, regardless that they may have spawned previously. There are a lot of bigger LSTs with small stringlike gonads and a majority of the SSTs under 25 cm are that way. I do not think it is always possible to detect a sexually mature fish during an inactive phase. We rarely see stage 3 males during the fall. Stage 3 females are seen, but different biologists interpret "tiny eggs" differently so the distinction between female stage 2 and 3 is blurred. And, I think there are sexually mature females that have stringlike ovaries in the post-spawning phase that are placed in stage 1 but should actually be place in stage 2.

Perhaps the most useful maturity table would be a 2 scale maturity table: 1) immature – never spawned before 2) sexually mature - spawned before and will spawn again. Trouble is, as stated before, 1) can you reliably sex the fish? and 2) can you reliably use gross examination for determining if these buggers are "sexually mature"? I have concluded that we can do #1 with practice and #2 is a waste of time for your average field biologist.

APPENDIX A2

EXAMPLE SHEET OF RANDOM NUMBERS FOR OTOLITH SAMPLING
(6 FISH PER TOW FOR 7 TOWS/ NO DUPLICATE NUMBERS)

Last number	order	set1	set2	Set3	set4	set5	set6	set7
10	1	1	1	1	3	3	1	1
10	2	2	3	2	4	4	3	5
10	3	4	4	3	5	5	6	6
10	4	5	5	4	6	6	7	7
10	5	6	8	5	9	9	8	9
10	6	8	10	6	10	10	10	10
20	1	2	2	2	7	1	1	10
20	2	5	5	4	8	6	6	13
20	3	10	7	7	10	12	7	15
20	4	13	11	9	11	17	10	16
20	5	19	12	12	13	18	16	18
20	6	20	19	15	14	20	19	20
30	1	3	3	2	3	11	5	1
30	2	5	7	7	5	12	18	8
30	3	8	15	10	11	15	19	10
30	4	13	19	16	13	16	25	15
30	5	14	28	18	18	19	26	23
30	6	24	30	29	22	21	27	28
40	1	3	4	3	4	14	13	1
40	2	6	9	9	7	15	16	12
40	3	11	20	13	14	20	24	23
40	4	17	26	21	17	21	29	34
40	5	18	38	24	24	26	30	35
40	6	32	40	38	29	28	33	39
50	1	4	5	3	5	18	17	9
50	2	8	12	11	8	19	20	29
50	3	13	25	17	17	24	30	32
50	4	22	32	26	21	27	36	42
50	5	23	47	29	30	32	37	43
50	6	40	50	47	37	34	42	45
60	1	5	6	4	6	21	20	10
60	2	9	14	13	10	23	24	35
60	3	16	30	20	21	29	36	38
60	4	26	38	32	25	32	43	50
60	5	27	56	35	36	38	44	51
60	6	48	59	57	44	41	50	54
70	1	5	30	7	4	7	25	23
70	2	11	41	16	15	11	26	28
70	3	18	46	35	23	24	34	41
70	4	30	50	44	37	29	37	50
70	5	31	51	66	41	41	45	52
70	6	55	65	69	66	51	48	58
80	1	6	35	7	5	8	28	26
80	2	12	47	18	17	13	30	32
80	3	21	52	40	26	28	39	47
80	4	34	57	51	42	33	42	57
80	5	36	58	75	47	47	51	59
80	6	63	74	79	75	58	55	66

APPENDIX A2 (CONTINUED)

Last number	order	set1	set2	Set3	set4	set5	set6	set7
90	1	7	8	27	5	9	32	29
90	2	14	21	53	19	15	34	36
90	3	23	45	62	30	31	43	53
90	4	39	57	63	47	37	47	64
90	5	40	84	67	53	53	57	66
90	6	71	89	88	85	65	61	75
100	1	7	9	30	6	10	35	33
100	2	15	23	59	21	16	37	40
100	3	26	50	69	33	34	48	59
100	4	43	63	70	52	41	53	71
100	5	45	94	74	58	59	63	73
100	6	79	99	98	94	73	68	83
110	1	8	10	18	33	6	11	39
110	2	17	25	19	65	24	18	41
110	3	28	55	36	76	36	38	53
110	4	47	69	62	77	57	45	58
110	5	49	103	63	82	64	65	70
110	6	87	108	70	108	103	80	75
120	1	9	11	36	7	11	42	39
120	2	18	27	71	26	19	45	48
120	3	31	60	83	39	41	58	71
120	4	51	76	84	63	49	63	85
120	5	53	112	89	70	71	76	88
120	6	95	118	118	113	87	82	99

APPENDIX B. Flatfish gonad condition and maturity stages.

Maturity Stage	Code	Male (testes)	Female (ovaries)
Immature	1	very small, string-like and somewhat translucent or pinkish in colour.	very small, translucent or pinkish in colour and somewhat gelatinous in texture.
Maturing	2	enlarged, a distinct bulge evident but still translucent or pinkish in colour.	relatively small, pinkish-yellow or cream in colour, granular in texture. No distinct eggs visible.
Developing	3	enlarged, brown-white or white in colour, firm in texture.	large, cream or yellow in colour, containing opaque eggs that can be distinguished by direct observation. Sex may be determined externally.
Ripe	4	large, white and easily broken. No sperm evident.	containing partly or wholly translucent eggs. Sex easily determined externally.
Spawning	5	large, white and sperm evident.	containing entirely translucent, mature ova. Eggs loose and will run from oviducts under slight pressure.
Spent	6	flaccid, shrunken and yellow-brown in colour. Sperm ducts enlarged and a small amount of sperm may be present.	large, flaccid and purple in colour. A few translucent eggs may be left. Ovarian membrane very bloodshot and sac-like.
Resting	7	firm, small and yellow-brown in colour. Sperm ducts small.	contracted and firm, pinkish-grey to cream-yellow in colour and may appear granular in texture but no distinct eggs are visible.

APPENDIX C. Rockfish (*Sebastes* spp.) gonad condition and maturity stages.

Maturity Code	Male (testes)	Female (ovaries)
0	**Unknown**	**Unknown**
1	**Immature** - thread-like and translucent pink in colour.	**Immature** - small, translucent pink in colour.
2	**Maturing** - string-like, with slight swelling evident but still translucent.	**Maturing** - small, yellow eggs visible. Translucent or opaque.
3	**Developing** - swelling, brown-white in colour.	**Mature** - large, yellow or orange eggs. Opaque.
4	**Developed** - large, white and easily broken.	**Fertilized** – large orange-yellow eggs. Translucent.
5	**Running** – running sperm.	**Embryos or larvae** – include eyed eggs. Translucent.
6	**Spent** – white-brown in colour. Sperm still present in duct.	**Spent** - large, flaccid, red in colour. A few larvae may be present.
7	**Resting** - triangular in cross-section. Small and brown in colour.	**Resting** – moderate size, firm, orange-grey in colour. Some with dark blotches.

APPENDIX D. Estimating wingspread from wingspread/doorspread paired observations from the 2002 FV *Ocean Selector* longspine survey (Paul Starr, Canadian Groundfish Research & Conservation Society, 2004)

Introduction

The 2003 *M.V. Ocean Selector* longspine survey had no wingspread observations because only one Scanmar sensor was available at the time of sailing and this sensor was placed on the doors instead of the wings. Therefore it was necessary to derive a functional relationship which would allow the estimation of wingspread values using the 2003 doorspread observations. Fortunately there were a reasonable number of paired wingspread/doorspread observations from the same vessel when conducting the 2002 longspine survey (Starr et al. 2004).

Methods

There are 944 records available from the "supplementary bridge logs" which consist of readings of the Scanmar output made from the vessel bridge during each research tow. One hundred eighty-two of these records are missing either a wingspread or a doorspread observation or both. As well, all records from Tow 67 (4 records) were dropped because of suspected transcription errors, leaving a total of 758 valid paired observations (Table D1). A plot of the wingspread/doorspread ratio by set (Figure D1) shows relatively few outliers so it was decided that the data did not require further grooming. A histogram of these ratios (Figure D2) shows that the distribution is underdispersed. It was decided that a normal distribution would be adequate to use for estimating the parameters of the proposed functional relationship.

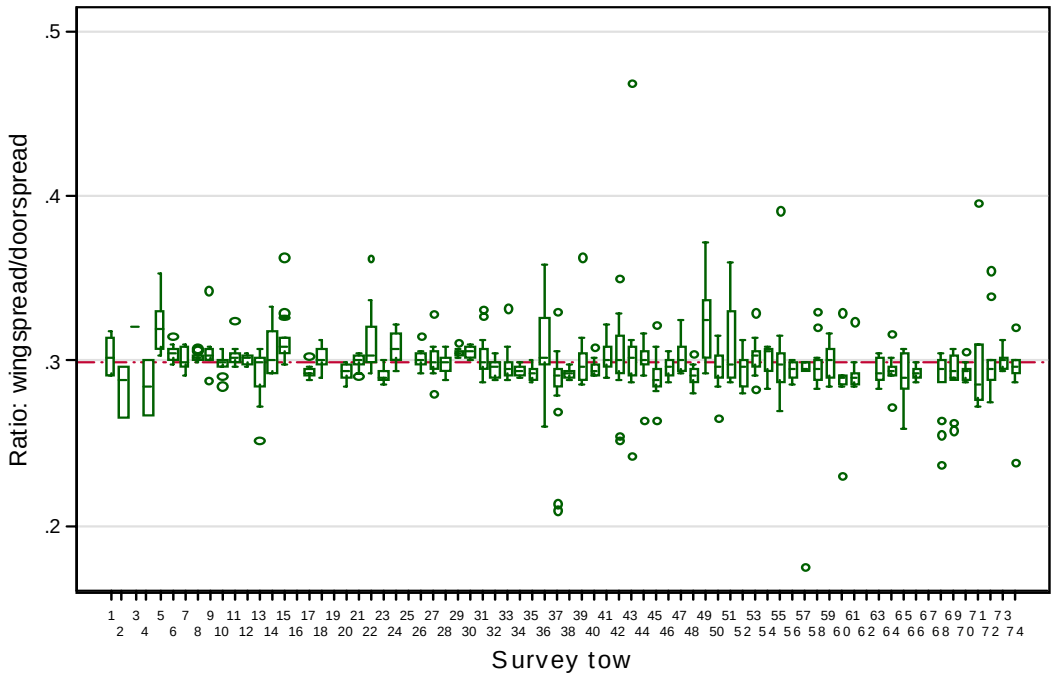

Figure D1. Box plots for each 2002 survey set of the ratio of wingspread to doorspread, showing all outlier points. Heavy horizontal line is the mean of all the ratios for the survey (mean=0.2994).

Table D1. Number of observations, mean, median and other statistics associated with the valid paired observations of wingspread and doorspread from the 2002 longspine survey.

Variable	N	Mean (m)	Standard Deviation (m)	Median (m)	Minimum (m)	Maximum (m)
Wingspread	758	16.95	0.98	17.01	11.16	21.40
Doorspread	758	56.80	4.50	57.42	32.37	109.55

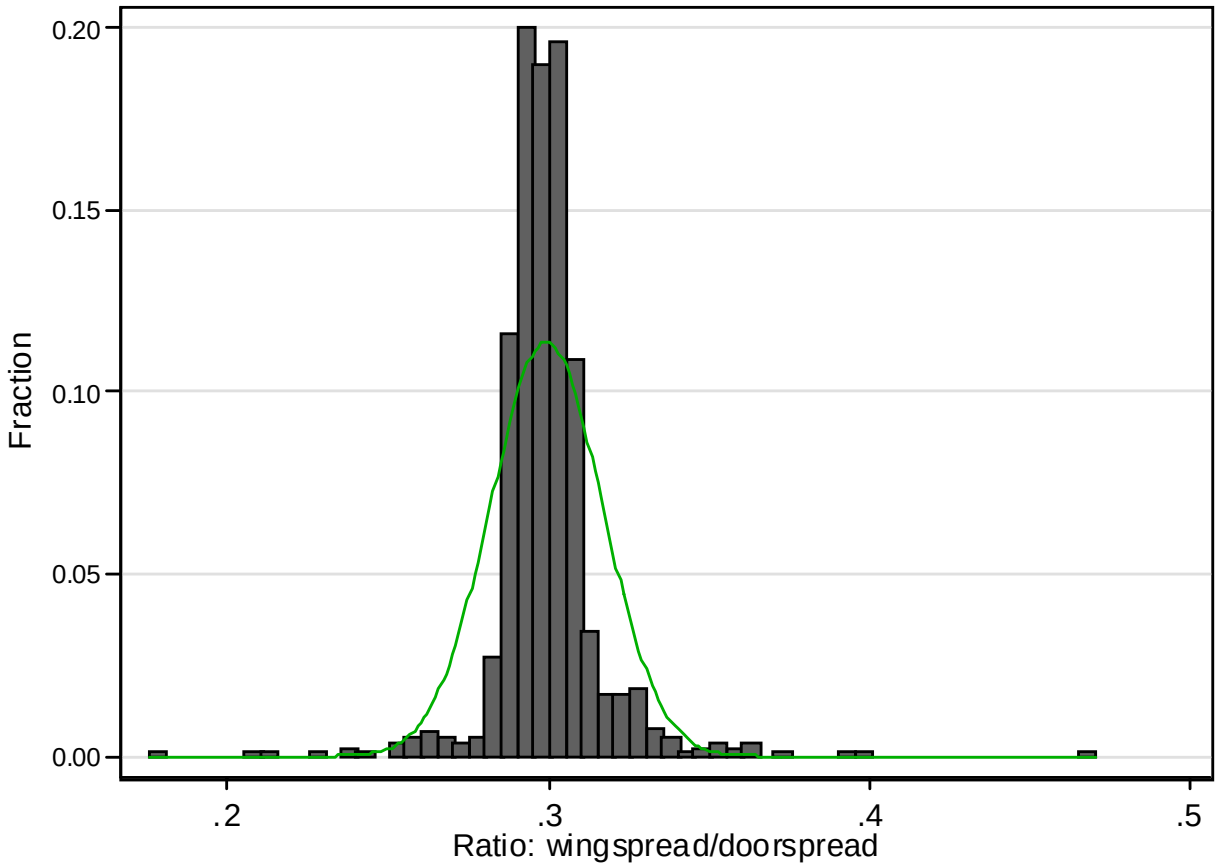

Figure D2. Distribution of the wingspread:doorspread ratio. Also shown is a normal approximation to the distribution.

An asymptotic two parameter exponential model was fitted to these data by minimizing the sum of squares of the deviations from the model in Eq. D1:

$$W_i = \alpha\left(1 - e^{-\upsilon D_i}\right) \qquad \text{Eq. D1}$$

where α and υ are parameters of the model and W_i and D_i are the paired wingspread and doorspread observations in metres. For comparison, two linear regression models were also fitted to the data: a one-parameter model forced through the origin (equivalent to a simple ratio estimator) and a two parameter linear model for comparison with the non-linear model described in Eq. D1.

Results

Both of the two-parameter models fit the data well (Figure D3 and Figure D4) but there is a clear preference for the non-linear model given the much better R^2 value obtained for that fit (Table D2). This improvement in the fit is probably the result of better residuals for the extreme values in the data set but it is likely that there would little practical difference in the 2003 survey wingspread estimates if either model were used. The simple one-parameter linear model forced through the origin shows a biased pattern in the residuals (Figure D4) and can be rejected on these grounds in spite of its high R^2 value (Table D2).

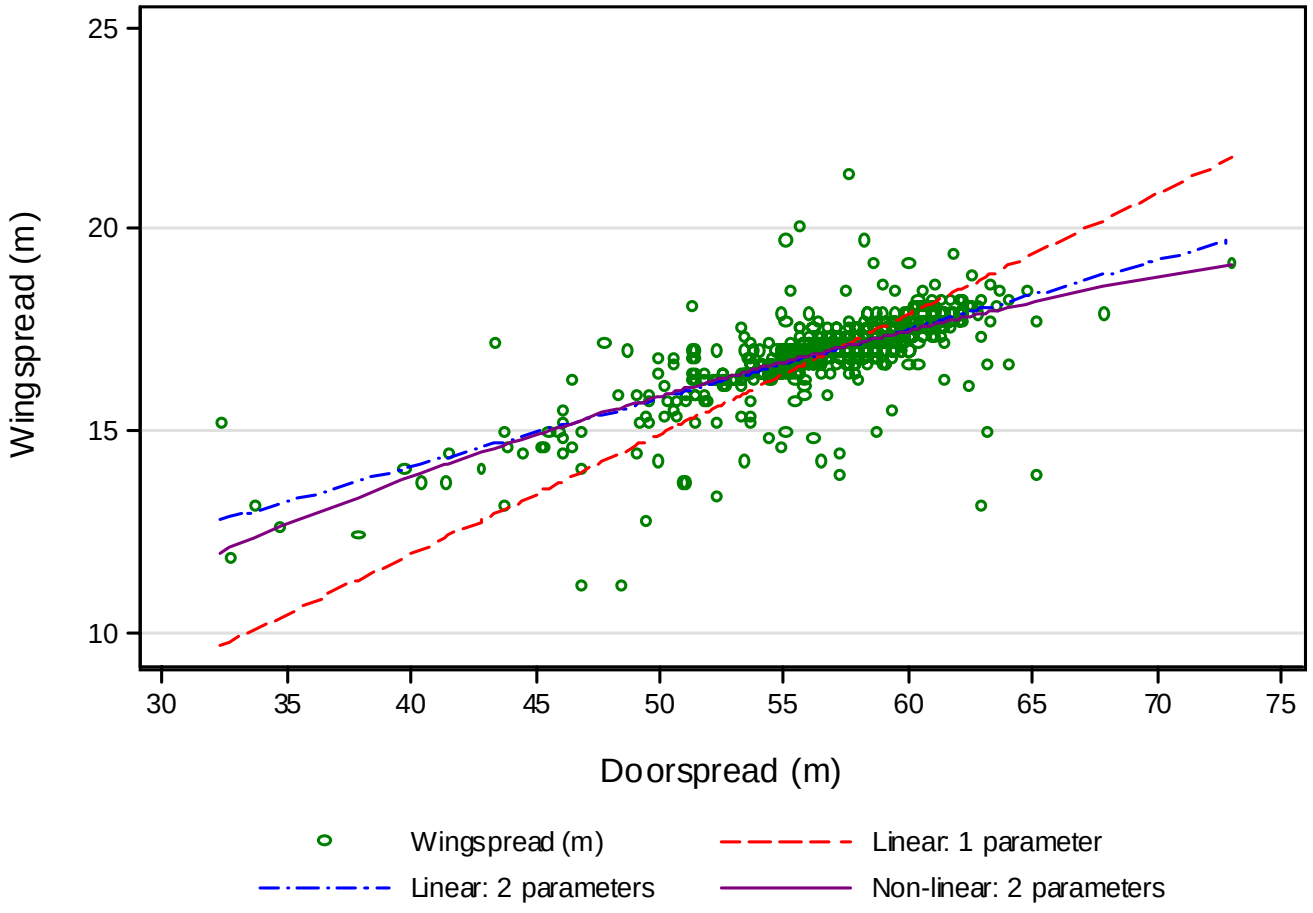

Figure D3. Fit of the three models fitted to the wingspread/doorspread data pairs from the 2002 survey.

Table D2. Estimated parameter values and approximate R^2 values for the three fitted models.

Model	**Intercept** α	**slope** υ	**Model R^2**
Linear: 1 parameter	0	0.298	0.9975
Linear: 2 parameters	7.238	0.171	0.5168
Nonlinear: 2 parameters	24.617	0.021	0.9984

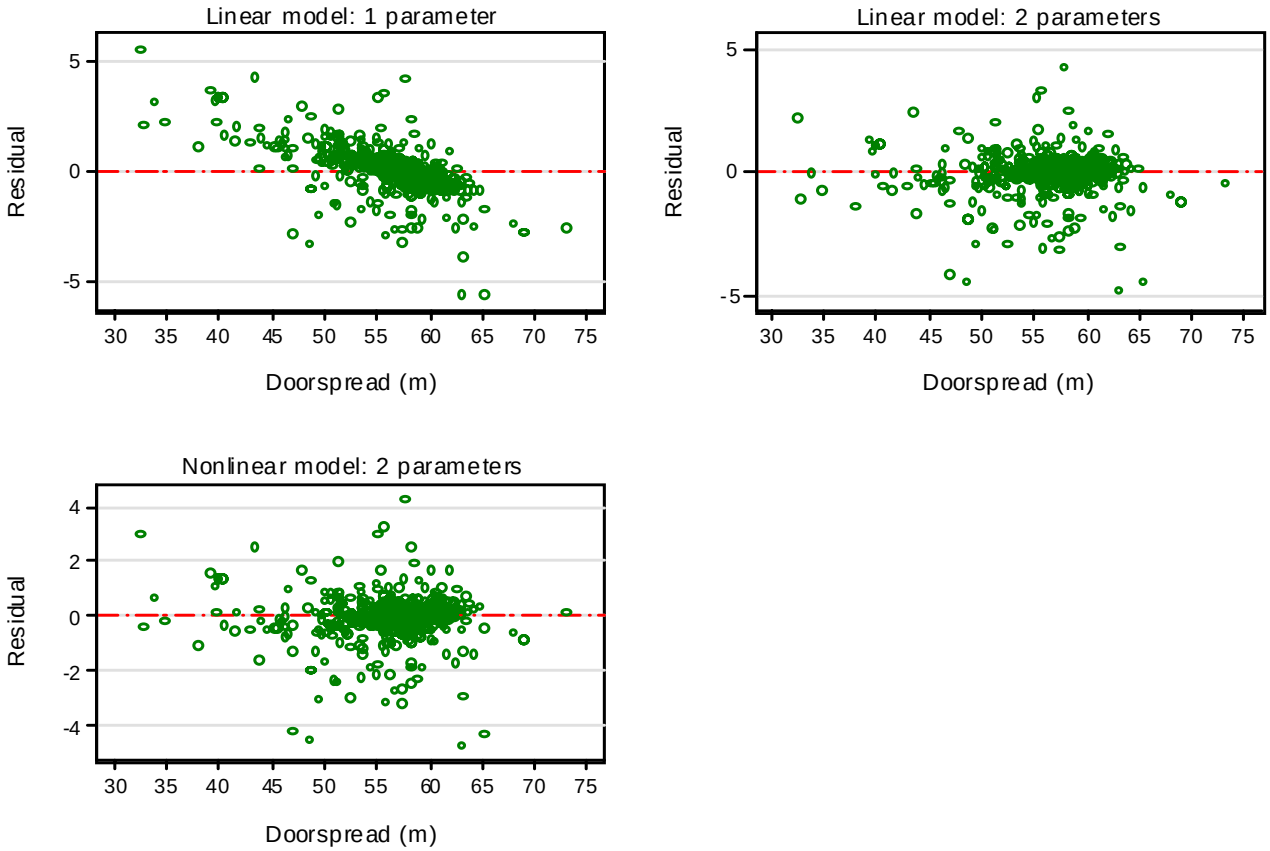

Figure D4. Residuals from the model fit for the three models fitted to the wingspread/doorspread data pairs from the 2002 survey.

References

Starr, P.J., Krishka, B.A., and Choromanski, E.M. 2004. Longspine thornyhead random stratified trawl survey off the west coast of Vancouver Island, September 6-23, 2002. Can. Tech. Rep. Fish. Aquat. Sci. 2558: 81 p.

APPENDIX E. Bridge log and haul information by tow for the 2003 Thornyhead Biomass Survey aboard the F/V *Ocean Selector*, September 4-21, 2003. Refer to notes at the end of this appendix to explain data fields. Species catches are sorted in decreasing order within each species group and the total weight of the entire catch is given at the bottom. Trace amounts have no weight shown.

Set :	**1**	**Date: 05/09/2003**	
Region :	A	Dep Zone:	801-1200
Usable :	**yes**	Major/Minor :	03 23
Contact (min) :	63	Duration (min) :	62
Hdline Hgt (m):	3.6	Distance (km) :	4.33
Door sprd (m):	55.0	Speed (km/h) :	4.19

	Start	Finish
Time :	5:30	6:32
Depth (m) :	997	1000
Latitude :	48° 09.54'	48° 09.79'
Longitude :	125° 55.46'	125° 59.89'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	208.4
Shortspine thornyhead	15.7
Flatfish	
Dover sole	2.7
Deepsea sole	0.9
Roundfish	
Sablefish	35.0
Elasmobranchs	
Roughtail skate	3.3
Miscellaneous fish	
Pectoral rattail	10.3
Roughscale rattail	6.1
Slickheads	4.1
Twoline eelpout	2.0
Black eelpout	0.6
Pacific flatnose	0.6
Lumpfishes and snailfishes	
Filamented rattail	
Northern lampfish	
Lanternfishes	
Invertebrates	
Tanner crabs	0.9
Solasteridae	0.5
Anemone	0.5
Tarsaster alascanus	0.1
Sea urchins	0.1
TOTAL	**291.6 kg**

Set :	**2**	**Date: 05/09/2003**	
Region :	A	Dep Zone:	1201-1600
Usable :	**yes**	Major/Minor :	03 23
Contact (min) :	61	Duration (min) :	67
Hdline Hgt (m):	2.6	Distance (km) :	4.80
Door sprd (m):	52.3	Speed (km/h) :	4.30

	Start	Finish
Time :	8:03	9:10
Depth (m) :	1253	1242
Latitude :	48° 07.86'	48° 10.00'
Longitude :	126° 07.04'	126° 08.38'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	38.4
Shortspine thornyhead	9.2
Flatfish	
Deepsea sole	8.9
Roundfish	
Sablefish	9.3
Elasmobranchs	
Roughtail skate	3.5
Brown cat shark	0.5
Miscellaneous fish	
Pectoral rattail	210.1
Roughscale rattail	200.2
Pacific flatnose	14.4
Twoline eelpout	3.8
Lumpfishes and snailfishes	0.7
Deepsea smelts	
Lanternfishes	
Invertebrates	
Anemone	6.3
Octopus	6.0
Lithodes	2.2
Tanner crabs	0.8
Sponges	0.7
Henricia asthenactis	0.5
Solasteridae	0.5
Shrimp	0.3
Spiny red sea star	
Gastropods	
Sea cucumber	
Schoolmaster gonate squid	
Other items	
Inanimate object(s)	1.3
TOTAL	**517.3 kg**

Set :	**3**	**Date: 05/09/2003**	
Region :	A	Dep Zone:	801-1200
Usable :	**yes**	Major/Minor :	03 23
Contact (min) :	58	Duration (min) :	63
Hdline Hgt (m):	4.0	Distance (km) :	4.68
Door sprd (m):	49.6	Speed (km/h) :	4.45

	Start	Finish
Time :	11:23	12:26
Depth (m) :	951	786
Latitude :	48° 14.37'	48° 14.31'
Longitude :	126° 01.63'	126° 04.98'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	218.0
Shortspine thornyhead	12.8
Flatfish	
Deepsea sole	2.4
Dover sole	1.1
Roundfish	
Sablefish	49.8
Elasmobranchs	
Roughtail skate	12.6
Miscellaneous fish	
Roughscale rattail	17.1
Pacific flatnose	2.7
Slickheads	2.4
Pectoral rattail	1.7
Twoline eelpout	0.6
Slender blacksmelt	
Lumpfishes and snailfishes	
Invertebrates	
Tanner crabs	3.0
Sea cucumber	0.8
Red king crab	0.8
Jellyfish	0.7
Heart urchins	0.2
Henricia asthenactis	0.0
Spiny red sea star	
Glass sponges	
Sponges	
Lithodes couesi	
Solasteridae	
Cushion star	
Anemone	
TOTAL	**326.5 kg**

Appendix E (continued)

Set :	4	Date: 05/09/2003
Region :	A	Dep Zone: 801-1200
Usable :	**NO**	Major/Minor : 03 23
Contact (min) :		Duration (min) :
Hdline Hgt (m):		Distance (km) :
Door sprd (m):		Speed (km/h) :

	Start	Finish
Time :	13:52	14:13
Depth (m) :	907	984
Latitude :	48° 18.18'	48° 18.12'
Longitude :	126° 03.57'	126° 03.89'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	11.1
Shortspine thornyhead	1.0
Flatfish	
Dover sole	1.1
Roundfish	
Sablefish	3.8
Miscellaneous fish	
Slickheads	1.6
Pectoral rattail	1.2
Twoline eelpout	0.8
Invertebrates	
Tanner crabs	0.8
Lithodes couesi	0.8
Octopus	0.5
Sponges	0.4
Schoolmaster gonate squid	
Paragorgia pacifica	
TOTAL	**23.0 kg**

Set :	5	Date: 05/09/2003
Region :	A	Dep Zone: 801-1200
Usable :	**yes**	Major/Minor : 03 23
Contact (min) :	57	Duration (min) : 67
Hdline Hgt (m):	3.5	Distance (km) : 4.33
Door sprd (m):	59.4	Speed (km/h) : 3.88

	Start	Finish
Time :	17:27	18:34
Depth (m) :	986	1035
Latitude :	48° 24.92'	48° 26.14'
Longitude :	126° 21.53'	126° 24.74'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	61.9
Shortspine thornyhead	36.1
Flatfish	
Deepsea sole	1.1
Roundfish	
Sablefish	14.0
Miscellaneous fish	
Roughscale rattail	42.9
Pectoral rattail	20.0
Slickheads	1.6
Pacific flatnose	0.8
Lampreys	0.3
Deepsea smelts	0.1
Pinpoint lampfish	0.1
Unknown fish	
Slender blacksmelt	
Crested bigscale	
Popeye	
Northern lampfish	
Invertebrates	
Tanner crabs	6.9
Anemone	1.9
Spiny red sea star	
Schoolmaster gonate squid	
Solasteridae	
Other items	
Inanimate object(s)	0.8
TOTAL	**188.3 kg**

Set :	6	Date: 05/09/2003
Region :	A	Dep Zone: 801-1200
Usable :	**NO**	Major/Minor : 03 23
Contact (min) :	83	Duration (min) : 96
Hdline Hgt (m):		Distance (km) :
Door sprd (m):	59.9	Speed (km/h) : 3.51

	Start	Finish
Time :	21:44	23:20
Depth (m) :	1134	924
Latitude :	48° 32.90'	48° 29.94'
Longitude :	126° 21.03'	126° 20.49'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	80.0
Shortspine thornyhead	4.5
Flatfish	
Deepsea sole	1.6
Roundfish	
Sablefish	12.2
Miscellaneous fish	
Roughscale rattail	38.1
Pectoral rattail	8.5
Twoline eelpout	0.5
Popeye	0.3
Threadfin slickhead	
Slickheads	
Lumpfishes and snailfishes	
Invertebrates	
Tanner crabs	2.2
Octopus	1.0
Sponges	
Jellyfish	
Schoolmaster gonate squid	
Spiny red sea star	
Other items	
Inanimate object(s)	0.4
TOTAL	**149.3 kg**

Appendix E (continued)

Set : 7 **Date: 06/09/2003**
Region : A Dep Zone: 1201-1600
Usable : yes Major/Minor : 03 23
Contact (min) : 64 Duration (min) : 74
Hdline Hgt (m): 3.5 Distance (km) : 5.38
Door sprd (m): 59.8 Speed (km/h) : 4.33

	Start	Finish
Time :	6:00	7:14
Depth (m) :	1234	1383
Latitude :	48° 17.68'	48° 19.97'
Longitude :	126° 16.63'	126° 18.55'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	55.6
Shortspine thornyhead	12.1
Flatfish	
Deepsea sole	1.2
Roundfish	
Sablefish	36.5
Elasmobranchs	
Abyssal skate	9.7
Roughtail skate	9.2
Miscellaneous fish	
Roughscale rattail	351.8
Pectoral rattail	82.3
Pacific flatnose	28.4
Deepsea smelts	0.1
Blacktail snailfish	0.1
Slender blacksmelt	0.1
Invertebrates	
Zoantharia	14.9
Glass sponges	6.5
Tanner crabs	5.0
Lithodinae	2.5
Anemone	2.0
Lithodes couesi	0.9
Jellyfish	
Solasteridae	
Seaslugs	
Sea cucumber	
Other items	
Inanimate object(s)	0.3
TOTAL	**619.0 kg**

Set : 8 **Date: 06/09/2003**
Region : A Dep Zone: 501-800
Usable : yes Major/Minor : 03 23
Contact (min) : 72 Duration (min) : 69
Hdline Hgt (m): 3.1 Distance (km) : 6.50
Door sprd (m): 58.9 Speed (km/h) : 5.65

	Start	Finish
Time :	8:51	10:00
Depth (m) :	580	576
Latitude :	48° 25.01'	48° 26.26'
Longitude :	126° 12.29'	126° 13.65'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	39.3
Longspine thornyhead	12.2
Flatfish	
Dover sole	46.7
Roundfish	
Sablefish	522.0
Pacific hake	9.4
Elasmobranchs	
Brown cat shark	0.5
Sandpaper skate	0.3
Miscellaneous fish	
Pectoral rattail	13.2
Roughscale rattail	9.2
Pacific flatnose	4.6
Twoline eelpout	1.3
Eelpouts	1.1
Filamented rattail	0.4
Bigeye poacher	
Invertebrates	
Squids	2.1
Anemone	1.8
Tanner crabs	1.7
Solasteridae	
TOTAL	**665.8 kg**

Set : 9 **Date: 06/09/2003**
Region : A Dep Zone: 501-800
Usable : yes Major/Minor : 03 23
Contact (min) : 71 Duration (min) : 64
Hdline Hgt (m): 2.9 Distance (km) : 5.26
Door sprd (m): 52.1 Speed (km/h) : 4.93

	Start	Finish
Time :	11:28	12:32
Depth (m) :	722	741
Latitude :	48° 32.29'	48° 29.60'
Longitude :	126° 17.70'	126° 16.73'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	97.6
Shortspine thornyhead	47.3
Shortraker rockfish	3.3
Flatfish	
Dover sole	14.0
Deepsea sole	2.0
Roundfish	
Sablefish	136.9
Pacific hake	2.6
Elasmobranchs	
Longnose skate	11.8
Brown cat shark	0.8
Miscellaneous fish	
Filamented rattail	2.6
Pectoral rattail	2.5
Pacific flatnose	2.4
Twoline eelpout	1.7
Roughscale rattail	1.7
Black eelpout	0.5
Lumpfishes and snailfishes	0.3
Blacktail snailfish	0.1
Lanternfishes	
Deepsea smelts	
Invertebrates	
Tanner crabs	25.5
Squids	3.0
Vampire squid	1.0
Octopus	0.9
Anemone	0.6
Sponges	0.3
Spiny red sea star	0.3
Solasteridae	0.3
Sand star	
Myxoderma sacculatum	
TOTAL	**360.0 kg**

Appendix E (continued)

Set :	10	Date: 06/09/2003
Region :	A	Dep Zone: 501-800
Usable :	**yes**	Major/Minor : 03 23
Contact (min) :	65	Duration (min) : 66
Hdline Hgt (m):	2.9	Distance (km) : 5.68
Door sprd (m):	60.7	Speed (km/h) : 5.16

	Start	Finish
Time :	15:25	16:31
Depth (m) :	536	576
Latitude :	48° 28.16'	48° 30.96'
Longitude :	126° 12.89'	126° 13.14'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	70.0
Longspine thornyhead	11.2
Shortraker rockfish	7.7
Flatfish	
Dover sole	60.9
Deepsea sole	1.8
Roundfish	
Sablefish	306.1
Pacific hake	4.1
Elasmobranchs	
Longnose skate	3.8
Sandpaper skate	1.3
Brown cat shark	0.5
Miscellaneous fish	
Pectoral rattail	3.4
Pacific flatnose	2.2
Filamented rattail	2.1
Twoline eelpout	1.2
Black eelpout	0.8
Invertebrates	
Tanner crabs	15.3
Schoolmaster gonate squid	8.2
Anemone	0.5
Fish-eating star	0.4
Spiny red sea star	0.2
Solasteridae	0.2
TOTAL	**501.7 kg**

Set :	11	Date: 06/09/2003
Region :	A	Dep Zone: 501-800
Usable :	**yes**	Major/Minor : 03 23
Contact (min) :	64	Duration (min) : 68
Hdline Hgt (m):	3.3	Distance (km) : 5.23
Door sprd (m):	60.4	Speed (km/h) : 4.62

	Start	Finish
Time :	17:49	18:57
Depth (m) :	689	565
Latitude :	48° 32.53'	48° 33.30'
Longitude :	126° 18.02'	126° 13.85'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	70.1
Longspine thornyhead	25.9
Shortraker rockfish	8.8
Rougheye rockfish	2.6
Flatfish	
Dover sole	23.3
Arrowtooth flounder	2.6
Deepsea sole	0.2
Roundfish	
Sablefish	73.2
Pacific hake	6.1
Elasmobranchs	
Longnose skate	5.0
Brown cat shark	0.9
Miscellaneous fish	
Pectoral rattail	6.3
Twoline eelpout	1.1
Pacific flatnose	1.0
Filamented rattail	0.5
Black eelpout	0.5
Roughscale rattail	0.4
Viperfishes	0.1
Invertebrates	
Schoolmaster gonate squid	4.1
Tanner crabs	2.7
Anemone	0.8
Sponges	0.1
TOTAL	**236.1 kg**

Set :	12	Date: 07/09/2003
Region :	B	Dep Zone: 1201-1600
Usable :	**yes**	Major/Minor : 03 24
Contact (min) :	63	Duration (min) : 78
Hdline Hgt (m):	3.8	Distance (km) : 4.52
Door sprd (m):	60.7	Speed (km/h) : 3.48

	Start	Finish
Time :	5:27	6:45
Depth (m) :	1417	1527
Latitude :	48° 37.00'	48° 34.91'
Longitude :	126° 47.63'	126° 46.09'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	9.6
Longspine thornyhead	6.6
Miscellaneous fish	
Roughscale rattail	106.9
Pectoral rattail	78.5
Pacific flatnose	12.9
Filamented rattail	1.0
Black eelpout	0.2
Deepsea smelts	
Popeye	
Crested bigscale	
Blacktail snailfish	
Invertebrates	
Tanner crabs	7.7
Schoolmaster gonate squid	4.1
Basket stars	1.6
Fish-eating star	0.3
Sea whip	0.1
Sea cucumber	
Other items	
Inanimate object(s)	0.1
TOTAL	**229.4 kg**

Appendix E (continued)

Set : 13 **Date: 07/09/2003**

Region :	B	Dep Zone:	1201-1600
Usable :	**yes**	Major/Minor :	03 24
Contact (min) :	68	Duration (min) :	78
Hdline Hgt (m):	3.4	Distance (km) :	5.17
Door sprd (m):	60.4	Speed (km/h) :	3.98

	Start	Finish
Time :	8:48	10:06
Depth (m) :	1262	1362
Latitude :	48° 40.45'	48° 37.89'
Longitude :	126° 53.60'	126° 52.57'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	22.9
Roundfish	
Sablefish	13.7
Elasmobranchs	
Roughtail skate	7.8
Miscellaneous fish	
Roughscale rattail	645.5
Pectoral rattail	100.3
Pacific flatnose	26.5
Filamented rattail	0.8
Deepsea smelts	0.1
Crested bigscale	0.0
Invertebrates	
Lithodes	0.6
Eualus	0.3
TOTAL	**818.4 kg**

Set : 14 **Date: 07/09/2003**

Region :	B	Dep Zone:	801-1200
Usable :	**yes**	Major/Minor :	03 24
Contact (min) :	66	Duration (min) :	67
Hdline Hgt (m):	3.3	Distance (km) :	5.19
Door sprd (m):	58.7	Speed (km/h) :	4.65

	Start	Finish
Time :	13:30	14:37
Depth (m) :	850	1006
Latitude :	48° 54.23'	48° 52.39'
Longitude :	126° 35.27'	126° 38.37'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	51.0
Shortspine thornyhead	22.7
Flatfish	
Dover sole	16.7
Deepsea sole	1.1
Roundfish	
Sablefish	84.3
Miscellaneous fish	
Roughscale rattail	12.4
Pectoral rattail	0.7
Filamented rattail	0.4
Twoline eelpout	0.2
Viperfishes	0.1
Slickheads	0.1
Bigeye poacher	0.1
Popeye	0.1
Northern lampfish	
Blacktail snailfish	
Invertebrates	
Schoolmaster gonate squid	4.1
Tanner crabs	1.7
Sponges	
Psolidae	
Basket stars	
Jellyfish	
TOTAL	**195.6 kg**

Set : 15 **Date: 07/09/2003**

Region :	B	Dep Zone:	501-800
Usable :	**yes**	Major/Minor :	03 24
Contact (min) :	71	Duration (min) :	73
Hdline Hgt (m):	3.8	Distance (km) :	5.74
Door sprd (m):	57.4	Speed (km/h) :	4.72

	Start	Finish
Time :	16:55	18:08
Depth (m) :	587	732
Latitude :	48° 51.57'	48° 53.70'
Longitude :	126° 37.06'	126° 34.07'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	41.6
Longspine thornyhead	39.9
Flatfish	
Dover sole	44.8
Deepsea sole	0.8
Roundfish	
Sablefish	92.9
Pacific hake	20.6
Miscellaneous fish	
Pectoral rattail	16.0
Pacific flatnose	3.3
Twoline eelpout	3.1
Black eelpout	1.1
Blacktail snailfish	0.7
Northern lampfish	0.2
Bigeye poacher	
Invertebrates	
Schoolmaster gonate squid	3.5
Sponges	3.3
Tanner crabs	2.2
Solasteridae	
Myxoderma sacculatum	
TOTAL	**274.0 kg**

Appendix E (continued)

Set : 16	Date: 07/09/2003		
Region :	B	Dep Zone:	501-800
Usable :	**yes**	Major/Minor :	03 24
Contact (min) :	76	Duration (min) :	74
Hdline Hgt (m):	2.9	Distance (km) :	6.32
Door sprd (m):	60.5	Speed (km/h) :	5.13

	Start	Finish
Time :	19:54	21:08
Depth (m) :	560	552
Latitude :	48° 46.14'	48° 43.86'
Longitude :	126° 35.44'	126° 32.29'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	43.8
Longspine thornyhead	11.8
Shortraker rockfish	5.7
Flatfish	
Dover sole	75.1
Roundfish	
Sablefish	28.0
Pacific hake	15.7
Elasmobranchs	
Brown cat shark	1.0
Miscellaneous fish	
Pacific flatnose	5.2
Black eelpout	3.5
Pectoral rattail	0.7
Blacktail snailfish	
Invertebrates	
Schoolmaster gonate squid	13.5
Tanner crabs	2.1
Anemone	0.8
Solasteridae	0.1
Fish-eating star	
Other items	
Inanimate object(s)	14.2
TOTAL	**221.1 kg**

Set : 17	Date: 08/09/2003		
Region :	B	Dep Zone:	501-800
Usable :	**yes**	Major/Minor :	03 24
Contact (min) :	61	Duration (min) :	63
Hdline Hgt (m):	3.1	Distance (km) :	4.76
Door sprd (m):	61.3	Speed (km/h) :	4.53

	Start	Finish
Time :	5:03	6:06
Depth (m) :	633	640
Latitude :	48° 41.93'	48° 43.27'
Longitude :	126° 29.88'	126° 33.22'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	24.8
Longspine thornyhead	10.1
Flatfish	
Dover sole	34.0
Deepsea sole	1.0
Roundfish	
Sablefish	34.3
Pacific hake	9.7
Miscellaneous fish	
Pectoral rattail	9.2
Pacific flatnose	7.2
Black eelpout	0.6
Filamented rattail	0.4
Pinpoint lampfish	0.1
Viperfishes	0.1
Invertebrates	
Schoolmaster gonate squid	5.5
TOTAL	**136.9 kg**

Set : 18	Date: 08/09/2003		
Region :	B	Dep Zone:	801-1200
Usable :	**yes**	Major/Minor :	03 24
Contact (min) :	59	Duration (min) :	63
Hdline Hgt (m):	3.3	Distance (km) :	4.83
Door sprd (m):	59.8	Speed (km/h) :	4.60

	Start	Finish
Time :	7:24	8:27
Depth (m) :	1024	896
Latitude :	48° 39.76'	48° 41.99'
Longitude :	126° 31.64'	126° 33.69'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	99.8
Shortspine thornyhead	43.4
Roundfish	
Sablefish	36.4
Pacific hake	1.7
Elasmobranchs	
Sandpaper skate	1.3
Miscellaneous fish	
Pectoral rattail	38.4
Roughscale rattail	13.4
Popeye	5.1
Pacific flatnose	5.1
Slickheads	0.6
Pacific hagfish	0.4
Twoline eelpout	0.1
Northern lampfish	0.1
Viperfishes	0.1
Deepsea smelts	0.1
Invertebrates	
Tanner crabs	5.1
Schoolmaster gonate squid	2.1
Anemone	0.5
TOTAL	**253.8 kg**

Appendix E (continued)

Set :	19	Date: 08/09/2003
Region :	B	Dep Zone: 801-1200
Usable :	**yes**	Major/Minor : 03 24
Contact (min) :	65	Duration (min) : 64
Hdline Hgt (m):	3.3	Distance (km) : 4.71
Door sprd (m):	57.1	Speed (km/h) : 4.41

	Start	Finish
Time :	10:27	11:31
Depth (m) :	1072	969
Latitude :	48° 35.45'	48° 37.88'
Longitude :	126° 30.27'	126° 28.90'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	95.2
Shortspine thornyhead	18.7
Flatfish	
Deepsea sole	4.4
Roundfish	
Sablefish	38.5
Miscellaneous fish	
Roughscale rattail	129.8
Pectoral rattail	29.4
Filamented rattail	4.9
Twoline eelpout	1.8
Slickheads	1.1
Black eelpout	0.5
Pacific hagfish	0.4
Pacific flatnose	
Invertebrates	
Tanner crabs	10.0
Anemone	3.5
Schoolmaster gonate squid	1.0
Sponges	0.6
Fish-eating star	
TOTAL	**339.8 kg**

Set :	20	Date: 08/09/2003
Region :	B	Dep Zone: 801-1200
Usable :	**yes**	Major/Minor : 03 23
Contact (min) :	59	Duration (min) : 67
Hdline Hgt (m):	3.4	Distance (km) : 5.20
Door sprd (m):	59.8	Speed (km/h) : 4.66

	Start	Finish
Time :	13:32	14:39
Depth (m) :	1170	1097
Latitude :	48° 32.39'	48° 35.04'
Longitude :	126° 26.36'	126° 26.15'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	56.4
Shortspine thornyhead	2.4
Flatfish	
Deepsea sole	0.6
Roundfish	
Sablefish	19.8
Elasmobranchs	
Sandpaper skate	0.2
Miscellaneous fish	
Roughscale rattail	111.3
Pectoral rattail	20.3
Slickheads	16.0
Filamented rattail	6.3
Twoline eelpout	1.9
Pacific flatnose	0.6
Pacific hagfish	0.5
Northern lampfish	
Invertebrates	
Tanner crabs	12.8
Anemone	1.3
Vampire squid	0.9
Spiny red sea star	0.2
Solasteridae	0.2
Fish-eating star	0.2
Other items	
Inanimate object(s)	0.5
TOTAL	**252.6 kg**

Set :	21	Date: 08/09/2003
Region :	B	Dep Zone: 501-800
Usable :	**yes**	Major/Minor : 03 23
Contact (min) :	59	Duration (min) : 63
Hdline Hgt (m):	3.3	Distance (km) : 5.37
Door sprd (m):	59.1	Speed (km/h) : 5.11

	Start	Finish
Time :	16:02	17:05
Depth (m) :	732	691
Latitude :	48° 37.78'	48° 39.26'
Longitude :	126° 18.68'	126° 22.10'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	56.5
Longspine thornyhead	29.1
Flatfish	
Dover sole	52.2
Roundfish	
Sablefish	75.7
Elasmobranchs	
Longnose skate	7.3
Roughtail skate	2.3
Miscellaneous fish	
Roughscale rattail	26.5
Pectoral rattail	9.2
Slickheads	4.9
Filamented rattail	2.4
Pacific flatnose	1.8
Twoline eelpout	1.7
Black eelpout	0.6
Invertebrates	
Tanner crabs	2.2
Schoolmaster gonate squid	1.2
Octopus	0.9
Sponges	0.3
Brittle stars	
Sea cucumber	
TOTAL	**274.6 kg**

Appendix E (continued)

Set :	22	Date: 09/09/2003
Region :	C	Dep Zone: 501-800
Usable :	**yes**	Major/Minor : 03 24
Contact (min) :	66	Duration (min) : 65
Hdline Hgt (m):	3.0	Distance (km) : 5.66
Door sprd (m):	60.4	Speed (km/h) : 5.22

	Start	Finish
Time :	13:22	14:27
Depth (m) :	677	668
Latitude :	48° 58.25'	48° 59.91'
Longitude :	126° 49.83'	126° 53.63'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	13.3
Longspine thornyhead	10.7
Flatfish	
Dover sole	13.8
Roundfish	
Sablefish	75.5
Miscellaneous fish	
Pectoral rattail	18.1
Black eelpout	2.6
Pacific flatnose	1.0
Roughscale rattail	0.7
Filamented rattail	0.3
Deepsea smelts	0.2
Viperfishes	0.1
Lanternfishes	
Invertebrates	
Schoolmaster gonate squid	8.4
Tanner crabs	1.8
Sponges	1.6
Zoantharia	
Other items	
Inanimate object(s)	0.4
TOTAL	**148.5 kg**

Set :	23	Date: 09/09/2003
Region :	C	Dep Zone: 801-1200
Usable :	**yes**	Major/Minor : 03 24
Contact (min) :	71	Duration (min) : 66
Hdline Hgt (m):	3.1	Distance (km) : 5.30
Door sprd (m):	52.5	Speed (km/h) : 4.82

	Start	Finish
Time :	15:52	16:58
Depth (m) :	881	860
Latitude :	48° 57.27'	48° 59.78'
Longitude :	126° 55.36'	126° 57.67'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	52.6
Shortspine thornyhead	11.7
Flatfish	
Dover sole	3.5
Deepsea sole	0.7
Roundfish	
Sablefish	33.1
Elasmobranchs	
Brown cat shark	2.2
Miscellaneous fish	
Pectoral rattail	16.6
Pacific flatnose	2.2
Roughscale rattail	1.1
Black eelpout	0.7
Filamented rattail	0.5
Blacktail snailfish	0.2
Lanternfishes	
Invertebrates	
Tanner crabs	36.3
Schoolmaster gonate squid	3.0
Sponges	1.8
Glass sponges	
Other items	
Inanimate object(s)	0.7
TOTAL	**167.1 kg**

Set :	24	Date: 09/09/2003
Region :	C	Dep Zone: 801-1200
Usable :	**yes**	Major/Minor : 03 24
Contact (min) :	63	Duration (min) : 64
Hdline Hgt (m):	3.2	Distance (km) : 4.56
Door sprd (m):	60.5	Speed (km/h) : 4.27

	Start	Finish
Time :	18:16	19:20
Depth (m) :	896	978
Latitude :	48° 55.88'	48° 54.48'
Longitude :	126° 53.78'	126° 50.47'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	52.9
Shortspine thornyhead	8.1
Roundfish	
Sablefish	7.3
Elasmobranchs	
Brown cat shark	0.5
Miscellaneous fish	
Pectoral rattail	16.1
Roughscale rattail	1.5
Filamented rattail	1.1
Black eelpout	0.6
Pacific flatnose	0.3
Slickheads	0.2
Viperfishes	0.1
Deepsea smelts	0.0
Invertebrates	
Tanner crabs	32.2
Schoolmaster gonate squid	0.2
TOTAL	**121.0 kg**

Appendix E (continued)

Set :	25	Date: 09/09/2003
Region :	C	Dep Zone: 801-1200
Usable :	**yes**	Major/Minor : 03 24
Contact (min) :	65	Duration (min) : 69
Hdline Hgt (m):	3.4	Distance (km) : 5.16
Door sprd (m):	60.7	Speed (km/h) : 4.49

	Start	Finish
Time :	20:46	21:55
Depth (m) :	1134	1112
Latitude :	48° 53.83'	48° 56.57'
Longitude :	126° 58.43'	126° 59.29'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	45.6
Shortspine thornyhead	12.0
Flatfish	
Deepsea sole	0.7
Roundfish	
Sablefish	13.2
Elasmobranchs	
Roughtail skate	2.3
Miscellaneous fish	
Roughscale rattail	130.3
Pectoral rattail	32.2
Filamented rattail	12.8
Slickheads	9.5
Pacific flatnose	1.2
Deepsea smelts	0.1
Viperfishes	0.1
Twoline eelpout	0.0
Invertebrates	
Tanner crabs	14.9
Anemone	4.9
Glass sponges	3.0
Lithodes couesi	1.4
Schoolmaster gonate squid	0.5
Sponges	
TOTAL	**284.6 kg**

Set :	26	Date: 10/09/2003
Region :	C	Dep Zone: 1201-1600
Usable :	**yes**	Major/Minor : 03 24
Contact (min) :	56	Duration (min) : 69
Hdline Hgt (m):	3.6	Distance (km) : 4.42
Door sprd (m):	62.4	Speed (km/h) : 3.84

	Start	Finish
Time :	0:08	1:17
Depth (m) :	1289	1509
Latitude :	48° 50.98'	48° 51.86'
Longitude :	126° 56.79'	127° .12.00'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	18.5
Shortspine thornyhead	1.9
Elasmobranchs	
Sandpaper skate	0.1
Miscellaneous fish	
Roughscale rattail	161.3
Pectoral rattail	70.8
Pacific flatnose	13.6
Filamented rattail	5.6
Popeye	0.2
Twoline eelpout	0.2
Deepsea smelts	0.1
Invertebrates	
Octopus	3.2
Anemone	2.4
Fish-eating star	0.2
Brittle stars	0.1
Other items	
Fish eggs	0.1
TOTAL	**278.2 kg**

Set :	27	Date: 10/09/2003
Region :	C	Dep Zone: 501-800
Usable :	**yes**	Major/Minor : 04 25
Contact (min) :	72	Duration (min) : 68
Hdline Hgt (m):	3.0	Distance (km) : 5.67
Door sprd (m):	60.2	Speed (km/h) : 5.01

	Start	Finish
Time :	6:39	7:47
Depth (m) :	567	530
Latitude :	49° 08.96'	49° 06.45'
Longitude :	127° 01.58'	126° 59.05'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	64.1
Longspine thornyhead	3.4
Shortraker rockfish	2.8
Aurora rockfish	0.7
Flatfish	
Dover sole	215.3
Rex sole	1.4
Roundfish	
Sablefish	142.7
Pacific hake	10.7
Elasmobranchs	
Longnose skate	6.3
Miscellaneous fish	
Roughscale rattail	14.5
Pectoral rattail	12.3
Pacific flatnose	7.2
Bigfin eelpout	3.8
Twoline eelpout	1.7
Filamented rattail	1.3
Viperfishes	0.1
Invertebrates	
Schoolmaster gonate squid	37.6
Glass sponges	0.4
Brittle stars	0.1
TOTAL	**526.5 kg**

Appendix E (continued)

Set :	28	Date: 10/09/2003
Region :	C	Dep Zone: 801-1200
Usable :	**yes**	Major/Minor : 04 25
Contact (min) :	72	Duration (min) : 68
Hdline Hgt (m):	3.1	Distance (km) : 5.91
Door sprd (m):	58.7	Speed (km/h) : 5.21

	Start	Finish
Time :	8:44	9:52
Depth (m) :	860	841
Latitude :	49° 07.42'	49° 09.55'
Longitude :	127° 03.93'	127° 07.21'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	59.3
Shortspine thornyhead	30.8
Flatfish	
Dover sole	9.6
Deepsea sole	1.4
Roundfish	
Sablefish	52.2
Elasmobranchs	
Longnose skate	3.7
Brown cat shark	2.4
Miscellaneous fish	
Pectoral rattail	6.5
Twoline eelpout	1.3
Roughscale rattail	1.0
Pacific flatnose	0.5
Filamented rattail	0.5
Black eelpout	
Invertebrates	
Schoolmaster gonate squid	4.3
Tanner crabs	2.9
Jellyfish	0.6
TOTAL	**176.8 kg**

Set :	29	Date: 10/09/2003
Region :	C	Dep Zone: 501-800
Usable :	**yes**	Major/Minor : 04 25
Contact (min) :	69	Duration (min) : 67
Hdline Hgt (m):	2.9	Distance (km) : 5.28
Door sprd (m):	61.4	Speed (km/h) : 4.73

	Start	Finish
Time :	11:02	12:09
Depth (m) :	631	571
Latitude :	49° 12.38'	49° 10.32'
Longitude :	127° 06.87'	127° 04.13'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	45.8
Longspine thornyhead	5.0
Flatfish	
Dover sole	109.3
Deepsea sole	1.3
Roundfish	
Sablefish	348.0
Pacific hake	14.9
Elasmobranchs	
Longnose skate	3.0
Brown cat shark	0.6
Miscellaneous fish	
Pectoral rattail	13.8
Pacific flatnose	11.0
Black eelpout	1.3
Roughscale rattail	1.0
Invertebrates	
Schoolmaster gonate squid	27.1
Giant squid	25.4
Tanner crabs	7.1
Spiny red sea star	0.4
Solasteridae	
TOTAL	**614.9 kg**

Set :	30	Date: 10/09/2003
Region :	C	Dep Zone: 501-800
Usable :	**yes**	Major/Minor : 04 25
Contact (min) :	66	Duration (min) : 68
Hdline Hgt (m):	2.9	Distance (km) : 5.52
Door sprd (m):	61.5	Speed (km/h) : 4.87

	Start	Finish
Time :	13:08	14:16
Depth (m) :	631	668
Latitude :	49° 10.80'	49° 08.51'
Longitude :	127° 05.89'	127° 03.09'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	30.5
Longspine thornyhead	2.7
Flatfish	
Dover sole	46.7
Roundfish	
Sablefish	119.7
Pacific hake	4.1
Elasmobranchs	
Longnose skate	2.1
Brown cat shark	0.2
Miscellaneous fish	
Pectoral rattail	7.3
Pacific flatnose	4.8
Black eelpout	3.2
Twoline eelpout	0.9
Invertebrates	
Schoolmaster gonate squid	38.1
Tanner crabs	5.1
TOTAL	**265.4 kg**

Appendix E (continued)

Set :	31	Date: 10/09/2003
Region :	C	Dep Zone: 1201-1600
Usable :	**yes**	Major/Minor : 04 25
Contact (min) :	71	Duration (min) : 88
Hdline Hgt (m):	4.1	Distance (km) : 5.12
Door sprd (m):	58.7	Speed (km/h) : 3.49

	Start	Finish
Time :	16:27	17:55
Depth (m) :	1454	1485
Latitude :	49° 11.03'	49° 11.06'
Longitude :	127° 16.62'	127° 12.47'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	2.0
Elasmobranchs	
Longnose skate	6.5
Brown cat shark	0.1
Miscellaneous fish	
Pectoral rattail	205.6
Roughscale rattail	154.9
Pacific flatnose	24.8
Filamented rattail	10.8
Twoline eelpout	2.5
Popeye	1.8
Lumpfishes and snailfishes	1.1
Deepsea smelts	0.4
Northern lampfish	0.1
Invertebrates	
Schoolmaster gonate squid	6.6
Tanner crabs	3.9
Octopus	3.6
Vampire squid	1.7
Shrimp	0.1
Brittle stars	
Sea cucumber	
Sea whip	
TOTAL	**426.4 kg**

Set :	32	Date: 10/09/2003
Region :	D	Dep Zone: 801-1200
Usable :	**yes**	Major/Minor : 04 25
Contact (min) :	69	Duration (min) : 85
Hdline Hgt (m):	4.1	Distance (km) : 5.94
Door sprd (m):	57.1	Speed (km/h) : 4.20

	Start	Finish
Time :	19:23	20:48
Depth (m) :	1134	988
Latitude :	49° 17.05'	49° 19.85'
Longitude :	127° 13.04'	127° 16.52'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	137.2
Shortspine thornyhead	11.8
Flatfish	
Deepsea sole	3.4
Roundfish	
Sablefish	6.8
Elasmobranchs	
Abyssal skate	15.3
Miscellaneous fish	
Roughscale rattail	146.3
Pectoral rattail	33.0
Pacific flatnose	3.8
Filamented rattail	1.8
Slickheads	1.2
Popeye	0.5
Deepsea smelts	0.1
Invertebrates	
Schoolmaster gonate squid	1.7
Tanner crabs	0.6
Brittle stars	0.1
TOTAL	**363.4 kg**

Set :	33	Date: 11/09/2003
Region :	D	Dep Zone: 1201-1600
Usable :	**yes**	Major/Minor : 04 25
Contact (min) :	65	Duration (min) : 74
Hdline Hgt (m):	3.8	Distance (km) : 4.55
Door sprd (m):	60.9	Speed (km/h) : 3.69

	Start	Finish
Time :	6:47	8:01
Depth (m) :	1298	1390
Latitude :	49° 19.74'	49° 17.50'
Longitude :	127° 23.79'	127° 22.44'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	32.3
Flatfish	
Deepsea sole	0.5
Elasmobranchs	
Pacific sleeper shark	14.5
Miscellaneous fish	
Roughscale rattail	183.4
Pectoral rattail	60.1
Pacific flatnose	8.2
Filamented rattail	4.4
Deepsea smelts	0.3
Blacktail snailfish	
Viperfishes	
Invertebrates	
Schoolmaster gonate squid	1.4
Anemone	1.2
Brittle stars	0.6
Tanner crabs	0.3
Myxoderma sacculatum	
Solasteridae	
TOTAL	**307.1 kg**

Appendix E (continued)

Set : 34 **Date: 11/09/2003**

Region :	D	Dep Zone:	501-800
Usable :	**yes**	Major/Minor :	04 25
Contact (min) :	61	Duration (min) :	63
Hdline Hgt (m):	3.0	Distance (km) :	4.85
Door sprd (m):	61.8	Speed (km/h) :	4.62

	Start	Finish
Time :	10:01	11:04
Depth (m) :	530	600
Latitude :	49° 19.94'	49° 21.86'
Longitude :	127° 13.56'	127° 16.34'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	28.7
Shortraker rockfish	3.9
Longspine thornyhead	0.5
Flatfish	
Dover sole	246.7
Arrowtooth flounder	15.0
Rex sole	1.7
Roundfish	
Sablefish	207.1
Pacific hake	8.5
Elasmobranchs	
Longnose skate	8.6
Roughtail skate	5.3
Miscellaneous fish	
Pectoral rattail	16.9
Roughscale rattail	13.6
Black eelpout	3.0
Pacific flatnose	2.6
Filamented rattail	1.4
Blacktail snailfish	0.4
Invertebrates	
Schoolmaster gonate squid	19.8
Tanner crabs	0.6
Brittle stars	0.5
Myxoderma sacculatum	
TOTAL	**584.6 kg**

Set : 35 **Date: 11/09/2003**

Region :	D	Dep Zone:	801-1200
Usable :	**NO**	Major/Minor :	04 25
Contact (min) :		Duration (min) :	
Hdline Hgt (m):		Distance (km) :	
Door sprd (m):		Speed (km/h) :	

	Start	Finish
Time :	12:31	12:49
Depth (m) :	860	903
Latitude :	49° 25.42'	49° 25.14'
Longitude :	127° 17.98'	127° 19.02'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	39.9
Shortspine thornyhead	8.0
Shortraker rockfish	4.5
Flatfish	
Dover sole	9.5
Deepsea sole	7.6
Roundfish	
Sablefish	32.8
Pacific hake	1.5
Elasmobranchs	
Longnose skate	8.9
Miscellaneous fish	
Pectoral rattail	1.5
Bigfin eelpout	0.8
Roughscale rattail	0.8
Barracudinas	0.7
Slickheads	0.6
Blacktail snailfish	0.5
Pacific flatnose	0.4
Pacific hagfish	0.4
Filamented rattail	0.2
Twoline eelpout	0.1
Black eelpout	0.1
Lanternfishes	
Invertebrates	
Tanner crabs	11.6
Schoolmaster gonate squid	6.0
Solasteridae	0.6
Brittle stars	0.3
Glass sponges	
TOTAL	**137.3 kg**

Set : 36 **Date: 11/09/2003**

Region :	D	Dep Zone:	801-1200
Usable :	**yes**	Major/Minor :	04 25
Contact (min) :	70	Duration (min) :	68
Hdline Hgt (m):	3.4	Distance (km) :	5.04
Door sprd (m):	54.7	Speed (km/h) :	4.45

	Start	Finish
Time :	14:18	15:26
Depth (m) :	812	799
Latitude :	49° 22.23'	49° 24.70'
Longitude :	127° 18.70'	127° 19.79'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	84.5
Shortspine thornyhead	33.9
Flatfish	
Dover sole	2.8
Deepsea sole	1.9
Roundfish	
Sablefish	113.1
Elasmobranchs	
Brown cat shark	0.8
Miscellaneous fish	
Pectoral rattail	23.2
Filamented rattail	1.1
Bigfin eelpout	0.4
Slickheads	0.3
Blacktail snailfish	0.1
Popeye	0.1
Twoline eelpout	0.1
Deepsea smelts	0.1
Invertebrates	
Tanner crabs	18.0
Vampire squid	4.4
Brittle stars	0.3
Fish-eating star	0.1
Solasteridae	0.1
Jellyfish	
Gastropods	
Polychaete worms	
TOTAL	**285.4 kg**

Appendix E (continued)

Set :	37	Date: 12/09/2003
Region :	G	Dep Zone: 501-800
Usable :	**yes**	Major/Minor : 04 27
Contact (min) :	57	Duration (min) : 58
Hdline Hgt (m):	3.6	Distance (km) : 4.79
Door sprd (m):	59.2	Speed (km/h) : 4.95

	Start	Finish
Time :	15:57	16:55
Depth (m) :	549	523
Latitude :	50° 21.99'	50° 24.53'
Longitude :	128° 29.22'	128° 29.37'

Species	Wgt (kg)
Rockfish	
Shortraker rockfish	56.5
Shortspine thornyhead	54.2
Longspine thornyhead	10.6
Rougheye rockfish	8.2
Redbanded rockfish	0.9
Aurora rockfish	0.5
Flatfish	
Dover sole	87.3
Deepsea sole	2.0
Rex sole	1.5
Roundfish	
Sablefish	121.4
Pacific hake	3.4
Miscellaneous fish	
Filamented rattail	2.5
Pacific flatnose	2.2
Black eelpout	0.9
Popeye	0.2
Invertebrates	
Schoolmaster gonate squid	11.7
Tanner crabs	3.3
Octopus	0.9
Jellyfish	
Fish-eating star	
Gastropods	
TOTAL	**368.1 kg**

Set :	38	Date: 12/09/2003
Region :	G	Dep Zone: 501-800
Usable :	**yes**	Major/Minor : 04 27
Contact (min) :	52	Duration (min) : 56
Hdline Hgt (m):	3.9	Distance (km) : 4.73
Door sprd (m):	59.1	Speed (km/h) : 5.06

	Start	Finish
Time :	19:05	20:01
Depth (m) :	604	604
Latitude :	50° 19.81'	50° 20.35'
Longitude :	128° 23.58'	128° 27.26'

Species	Wgt (kg)
Rockfish	
Shortraker rockfish	75.2
Shortspine thornyhead	73.6
Longspine thornyhead	12.8
Rougheye rockfish	5.5
Flatfish	
Dover sole	66.7
Deepsea sole	3.3
Arrowtooth flounder	1.7
Rex sole	0.4
Roundfish	
Sablefish	102.0
Pacific hake	13.4
Elasmobranchs	
Brown cat shark	0.5
Miscellaneous fish	
Pectoral rattail	5.2
Pacific flatnose	2.2
Popeye	0.1
Lumpfishes and snailfishes	
Black eelpout	
Invertebrates	
Schoolmaster gonate squid	19.3
Fish-eating star	
Other items	
Fish eggs	
TOTAL	**382.0 kg**

Set :	39	Date: 12/09/2003
Region :	G	Dep Zone: 801-1200
Usable :	**NO**	Major/Minor : 04 27
Contact (min) :		Duration (min) :
Hdline Hgt (m):		Distance (km) :
Door sprd (m):		Speed (km/h) :

	Start	Finish
Time :	21:28	22:20
Depth (m) :	794	1174
Latitude :	50° 19.28'	50° 17.51'
Longitude :	128° 22.17'	128° 23.85'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	45.7
Shortspine thornyhead	35.2
Shortraker rockfish	31.7
Flatfish	
Dover sole	102.1
Deepsea sole	1.4
Roundfish	
Sablefish	197.6
Pacific hake	4.0
Elasmobranchs	
Roughtail skate	7.2
Brown cat shark	0.6
Miscellaneous fish	
Pectoral rattail	15.6
Roughscale rattail	2.1
Filamented rattail	2.0
Pacific hagfish	0.9
Pacific flatnose	0.7
Black eelpout	0.6
Twoline eelpout	0.6
Blackfin poacher	
Invertebrates	
Tanner crabs	4.2
Schoolmaster gonate squid	3.5
Solasteridae	1.4
Spiny red sea star	0.4
Gastropods	
Anemone	
TOTAL	**457.4 kg**

Appendix E (continued)

Set :	40	Date: 13/09/2003
Region :	G	Dep Zone: 801-1200
Usable :	**yes**	Major/Minor : 04 27
Contact (min) :	58	Duration (min) : 52
Hdline Hgt (m):	3.0	Distance (km) : 4.09
Door sprd (m):	59.9	Speed (km/h) : 4.71

	Start	Finish
Time :	5:33	6:25
Depth (m) :	969	1198
Latitude :	50° 19.15'	50° 17.25'
Longitude :	128° 22.36'	128° 24.04'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	92.4
Shortspine thornyhead	44.8
Flatfish	
Dover sole	88.3
Deepsea sole	4.6
Roundfish	
Sablefish	155.1
Elasmobranchs	
Roughtail skate	5.1
Miscellaneous fish	
Pectoral rattail	42.4
Popeye	32.8
Roughscale rattail	17.8
Filamented rattail	12.8
Twoline eelpout	1.9
Pacific flatnose	1.6
Pacific hagfish	0.6
Invertebrates	
Schoolmaster gonate squid	5.9
Tanner crabs	3.5
Solasteridae	1.7
Anemone	0.7
Octopus	0.4
Sea cucumber	0.2
TOTAL	**512.6 kg**

Set :	41	Date: 13/09/2003
Region :	G	Dep Zone: 801-1200
Usable :	**yes**	Major/Minor : 04 27
Contact (min) :	52	Duration (min) : 54
Hdline Hgt (m):	3.6	Distance (km) : 4.15
Door sprd (m):	60.9	Speed (km/h) : 4.61

	Start	Finish
Time :	7:32	8:26
Depth (m) :	1097	951
Latitude :	50° 17.17'	50° 19.24'
Longitude :	128° 23.57'	128° 22.29'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	43.6
Shortspine thornyhead	26.8
Flatfish	
Dover sole	26.6
Deepsea sole	3.8
Roundfish	
Sablefish	53.5
Elasmobranchs	
Roughtail skate	10.5
Miscellaneous fish	
Roughscale rattail	319.0
Pectoral rattail	29.1
Popeye	28.8
Pacific flatnose	3.2
Filamented rattail	1.4
Twoline eelpout	0.6
Blacktail snailfish	0.3
Invertebrates	
Solasteridae	1.3
Tanner crabs	1.2
Sea cucumber	0.5
Anemone	0.4
Spiny red sea star	0.2
Gastropods	
Zoantharia	
Other items	
Inanimate object(s)	3.0
TOTAL	**553.7 kg**

Set :	42	Date: 13/09/2003
Region :	F	Dep Zone: 801-1200
Usable :	**yes**	Major/Minor : 04 27
Contact (min) :	60	Duration (min) : 59
Hdline Hgt (m):	3.4	Distance (km) : 4.47
Door sprd (m):	60.8	Speed (km/h) : 4.54

	Start	Finish
Time :	10:39	11:38
Depth (m) :	860	1006
Latitude :	50° 15.78'	50° 14.43'
Longitude :	128° 21.97'	128° 25.00'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	259.6
Longspine thornyhead	66.9
Flatfish	
Dover sole	106.3
Deepsea sole	1.3
Roundfish	
Sablefish	267.8
Elasmobranchs	
Roughtail skate	2.6
Miscellaneous fish	
Roughscale rattail	45.2
Pectoral rattail	33.5
Popeye	9.1
Pacific flatnose	1.2
Viperfishes	0.5
Slickheads	0.5
Filamented rattail	0.5
Northern lampfish	
Invertebrates	
Tanner crabs	6.3
Schoolmaster gonate squid	4.0
Spiny red sea star	1.5
Octopus	1.3
Glass sponges	0.6
Lithodes couesi	0.5
Sponges	0.2
Solasteridae	
Psolidae	
TOTAL	**809.3 kg**

Appendix E (continued)

Set :	43	Date: 14/09/2003
Region :	F	Dep Zone: 801-1200
Usable :	**yes**	Major/Minor : 04 27
Contact (min) :	57	Duration (min) : 54
Hdline Hgt (m):	3.7	Distance (km) : 3.61
Door sprd (m):	58.8	Speed (km/h) : 4.01

	Start	Finish
Time :	6:40	7:34
Depth (m) :	1079	1125
Latitude :	50° 14.32'	50° 13.18'
Longitude :	128° 19.24'	128° 21.65'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	177.1
Shortspine thornyhead	14.7
Flatfish	
Dover sole	17.1
Deepsea sole	9.6
Roundfish	
Sablefish	195.1
Elasmobranchs	
Abyssal skate	1.9
Miscellaneous fish	
Pectoral rattail	51.9
Roughscale rattail	31.7
Popeye	10.8
Filamented rattail	8.2
Twoline eelpout	4.8
Pacific flatnose	3.2
Pacific hagfish	0.5
Slickheads	0.3
Deepsea smelts	
Invertebrates	
Anemone	6.1
Spiny red sea star	1.7
Tanner crabs	0.7
Brittle stars	0.1
Jellyfish	
TOTAL	**535.5 kg**

Set :	44	Date: 14/09/2003
Region :	F	Dep Zone: 801-1200
Usable :	**yes**	Major/Minor : 04 27
Contact (min) :	55	Duration (min) : 51
Hdline Hgt (m):	3.6	Distance (km) : 3.79
Door sprd (m):	56.1	Speed (km/h) : 4.46

	Start	Finish
Time :	10:20	11:11
Depth (m) :	1070	1061
Latitude :	50° 10.96'	50° 12.66'
Longitude :	128° 24.67'	128° 22.87'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	90.3
Shortspine thornyhead	11.1
Roundfish	
Sablefish	83.7
Elasmobranchs	
Abyssal skate	2.6
Sandpaper skate	0.7
Miscellaneous fish	
Roughscale rattail	133.6
Pectoral rattail	22.4
Popeye	6.1
Filamented rattail	4.0
Pacific flatnose	3.1
Bigfin eelpout	
Invertebrates	
Tanner crabs	13.0
Anemone	4.0
Glass sponges	2.7
Solasteridae	0.8
Spiny red sea star	0.5
Brittle stars	0.1
Gastropods	
Lithodes couesi	
Zoantharia	
TOTAL	**378.8 kg**

Set :	45	Date: 14/09/2003
Region :	F	Dep Zone: 1201-1600
Usable :	**NO**	Major/Minor : 04 27
Contact (min) :		Duration (min) :
Hdline Hgt (m):		Distance (km) :
Door sprd (m):		Speed (km/h) :

	Start	Finish
Time :	13:13	
Depth (m) :	1372	
Latitude :	50° 15.24'	50° 15.16'
Longitude :	128° 28.11'	128° 28.93'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	0.7
Flatfish	
Deepsea sole	1.4
Roundfish	
Sablefish	2.0
Elasmobranchs	
Abyssal skate	5.3
Sandpaper skate	0.2
Miscellaneous fish	
Roughscale rattail	11.5
Pectoral rattail	0.9
Popeye	0.5
Invertebrates	
Sponges	3.1
Vampire squid	0.7
Sea cucumber	0.2
Zoantharia	
TOTAL	**26.5 kg**

Appendix E (continued)

Set :	46	Date: 14/09/2003
Region :	F	Dep Zone: 1201-1600
Usable :	**yes**	Major/Minor : 04 27
Contact (min) :	51	Duration (min) : 57
Hdline Hgt (m):	3.9	Distance (km) : 3.40
Door sprd (m):	62.4	Speed (km/h) : 3.58

	Start	Finish
Time :	14:58	15:55
Depth (m) :	1372	1317
Latitude :	50° 15.41'	50° 15.05'
Longitude :	128° 28.35'	128° 31.07'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	7.8
Shortspine thornyhead	6.3
Flatfish	
Deepsea sole	9.2
Roundfish	
Sablefish	4.4
Elasmobranchs	
Abyssal skate	3.1
Miscellaneous fish	
Roughscale rattail	101.6
Pectoral rattail	21.6
Popeye	20.3
Pacific flatnose	9.4
Filamented rattail	2.5
Blacktail snailfish	0.1
Invertebrates	
Echinasteridae	5.9
Paragorgia pacifica	1.9
Jellyfish	0.6
Sand star	
Brittle stars	
TOTAL	**194.6 kg**

Set :	47	Date: 14/09/2003
Region :	G	Dep Zone: 1201-1600
Usable :	**yes**	Major/Minor : 04 27
Contact (min) :	60	Duration (min) : 67
Hdline Hgt (m):	5.1	Distance (km) : 4.38
Door sprd (m):	62.1	Speed (km/h) : 3.92

	Start	Finish
Time :	18:13	19:20
Depth (m) :	1244	1253
Latitude :	50° 16.57'	50° 17.15'
Longitude :	128° 37.42'	128° 40.90'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	19.9
Shortspine thornyhead	6.3
Flatfish	
Deepsea sole	0.7
Elasmobranchs	
Abyssal skate	19.2
Miscellaneous fish	
Roughscale rattail	183.8
Pectoral rattail	104.4
Pacific flatnose	18.2
Popeye	3.8
Filamented rattail	2.0
Deepsea smelts	0.2
Invertebrates	
Echinasteridae	2.1
Vampire squid	1.7
Schoolmaster gonate squid	0.2
Solasteridae	0.2
Brittle stars	
TOTAL	**362.9 kg**

Set :	48	Date: 14/09/2003
Region :	G	Dep Zone: 1201-1600
Usable :	**yes**	Major/Minor : 04 27
Contact (min) :	53	Duration (min) : 53
Hdline Hgt (m):	3.8	Distance (km) : 3.33
Door sprd (m):	52.1	Speed (km/h) : 3.77

	Start	Finish
Time :	22:46	23:39
Depth (m) :	1262	1280
Latitude :	50° 15.95'	50° 17.42'
Longitude :	128° 42.09'	128° 43.63'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	57.2
Shortspine thornyhead	4.9
Flatfish	
Deepsea sole	3.3
Elasmobranchs	
Abyssal skate	11.1
Roughtail skate	0.6
Miscellaneous fish	
Roughscale rattail	149.1
Pectoral rattail	68.5
Pacific flatnose	14.4
Giant blobsculpin	4.4
Filamented rattail	1.9
Deepsea smelts	0.1
Northern lampfish	
Invertebrates	
Vampire squid	4.1
Anemone	2.0
Tanner crabs	0.6
Schoolmaster gonate squid	0.3
Sand star	
Gastropods	
Brittle stars	
Zoantharia	
Other items	
Inanimate object(s)	3.3
TOTAL	**325.8 kg**

Appendix E (continued)

Set :	49	Date: 15/09/2003
Region :	F	Dep Zone: 801-1200
Usable :	**yes**	Major/Minor : 04 27
Contact (min) :	48	Duration (min) : 51
Hdline Hgt (m):	3.0	Distance (km) : 3.97
Door sprd (m):	61.1	Speed (km/h) : 4.66

	Start	Finish
Time :	6:39	7:30
Depth (m) :	863	1061
Latitude :	50° 13.17'	50° 11.70'
Longitude :	128° 35.99'	128° 33.56'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	52.6
Shortspine thornyhead	12.3
Flatfish	
Deepsea sole	0.7
Roundfish	
Sablefish	12.6
Elasmobranchs	
Roughtail skate	2.4
Sandpaper skate	2.2
Miscellaneous fish	
Roughscale rattail	6.9
Pectoral rattail	5.0
Filamented rattail	0.9
Pacific flatnose	0.7
Eelpouts	0.1
Northern lampfish	0.1
Deepsea smelts	0.1
Invertebrates	
Glass sponges	12.8
Brittle stars	1.3
Lithodes couesi	1.1
Octopus	0.9
Solasteridae	0.2
Anemone	0.2
Other items	
Inanimate object(s)	2.3
TOTAL	**115.4 kg**

Set :	50	Date: 15/09/2003
Region :	F	Dep Zone: 1201-1600
Usable :	**yes**	Major/Minor : 04 27
Contact (min) :	48	Duration (min) : 62
Hdline Hgt (m):	4.0	Distance (km) : 4.49
Door sprd (m):	60.4	Speed (km/h) : 4.35

	Start	Finish
Time :	8:55	9:57
Depth (m) :	1335	1308
Latitude :	50° 08.29'	50° 06.68'
Longitude :	128° 30.73'	128° 28.52'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	11.6
Shortspine thornyhead	7.5
Flatfish	
Deepsea sole	0.8
Miscellaneous fish	
Roughscale rattail	101.0
Pectoral rattail	86.9
Pacific flatnose	18.1
Popeye	3.7
Filamented rattail	1.4
Deepsea smelts	
Viperfishes	
Lumpfishes and snailfishes	
Crested bigscale	
Invertebrates	
Glass sponges	1.9
Shrimp	0.5
Echinasteridae	0.5
Schoolmaster gonate squid	0.2
Golden king crab	
Sand star	
Solasteridae	
Brittle stars	
Zoantharia	
Other items	
Inanimate object(s)	0.7
TOTAL	**234.7 kg**

Set :	51	Date: 15/09/2003
Region :	F	Dep Zone: 501-800
Usable :	**yes**	Major/Minor : 04 26
Contact (min) :	71	Duration (min) : 71
Hdline Hgt (m):	4.4	Distance (km) : 5.60
Door sprd (m):	52.8	Speed (km/h) :

	Start	Finish
Time :	12:51	14:02
Depth (m) :	604	786
Latitude :	49° 56.42'	49° 58.71'
Longitude :	128° 05.00'	128° 07.96'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	166.9
Longspine thornyhead	98.4
Shortraker rockfish	33.1
Rougheye rockfish	4.3
Flatfish	
Dover sole	26.3
Deepsea sole	1.2
Roundfish	
Sablefish	24.4
Pacific hake	7.3
Elasmobranchs	
Pacific sleeper shark	20.3
Miscellaneous fish	
Roughscale rattail	13.3
Pacific flatnose	3.2
Blacktail snailfish	0.3
Northern lampfish	
Invertebrates	
Zoantharia	7.0
Gorgonian corals	3.2
Schoolmaster gonate squid	2.6
Tanner crabs	2.2
Octopus	0.3
Anemone	
Sand star	
Echinasteridae	
Other items	
Inanimate object(s)	5.0
TOTAL	**419.2 kg**

Appendix E (continued)

Set :	52	Date: 15/09/2003
Region :	F	Dep Zone: 501-800
Usable :	**yes**	Major/Minor : 04 26
Contact (min) :	56	Duration (min) : 60
Hdline Hgt (m):	2.8	Distance (km) : 4.94
Door sprd (m):	58.9	Speed (km/h) : 4.94

	Start	Finish
Time :	16:09	17:09
Depth (m) :	549	530
Latitude :	49° 56.50'	49° 57.23'
Longitude :	127° 59.60'	128° 03.17'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	139.6
Shortraker rockfish	18.4
Longspine thornyhead	11.2
Rougheye rockfish	3.9
Aurora rockfish	0.6
Flatfish	
Dover sole	78.2
Arrowtooth flounder	3.7
Rex sole	2.5
Roundfish	
Sablefish	43.4
Pacific hake	8.5
Elasmobranchs	
Longnose skate	20.4
Miscellaneous fish	
Pacific flatnose	2.2
Pectoral rattail	0.9
Black eelpout	0.7
Blacktail snailfish	
Viperfishes	
Invertebrates	
Schoolmaster gonate squid	2.6
Tanner crabs	1.9
Other items	
Inanimate object(s)	1.0
TOTAL	**339.7 kg**

Set :	53	Date: 15/09/2003
Region :	E	Dep Zone: 501-800
Usable :	**yes**	Major/Minor : 04 26
Contact (min) :	54	Duration (min) : 58
Hdline Hgt (m):	3.1	Distance (km) : 5.14
Door sprd (m):	58.5	Speed (km/h) : 5.31

	Start	Finish
Time :	17:56	18:54
Depth (m) :	594	604
Latitude :	49° 55.25'	49° 55.24'
Longitude :	128° 01.77'	127° 57.54'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	150.6
Longspine thornyhead	13.5
Rougheye rockfish	0.5
Flatfish	
Dover sole	83.0
Arrowtooth flounder	9.2
Deepsea sole	1.1
Rex sole	0.7
Roundfish	
Sablefish	36.0
Pacific hake	9.9
Elasmobranchs	
Longnose skate	5.5
Miscellaneous fish	
Pacific flatnose	3.2
Pectoral rattail	2.7
Lanternfishes	0.1
Deepsea smelts	0.1
Blacktail snailfish	
Invertebrates	
Schoolmaster gonate squid	11.0
Tanner crabs	5.0
Shrimp	
TOTAL	**332.2 kg**

Set :	54	Date: 15/09/2003
Region :	E	Dep Zone: 801-1200
Usable :	**yes**	Major/Minor : 04 26
Contact (min) :	60	Duration (min) : 60
Hdline Hgt (m):	3.0	Distance (km) : 4.71
Door sprd (m):	59.8	Speed (km/h) : 4.71

	Start	Finish
Time :	20:48	21:48
Depth (m) :	924	841
Latitude :	49° 49.62'	49° 48.25'
Longitude :	127° 56.52'	127° 53.31'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	80.3
Shortspine thornyhead	61.7
Shortraker rockfish	3.3
Flatfish	
Dover sole	7.2
Deepsea sole	2.7
Roundfish	
Sablefish	33.8
Pacific hake	3.4
Elasmobranchs	
Longnose skate	17.0
Miscellaneous fish	
Pectoral rattail	13.5
Pacific flatnose	2.2
Filamented rattail	2.2
Slickheads	0.5
Roughscale rattail	0.3
Blacktail snailfish	0.3
Twoline eelpout	0.2
Bigfin eelpout	0.2
Deepsea smelts	0.2
Lanternfishes	0.1
Invertebrates	
Tanner crabs	5.7
Schoolmaster gonate squid	2.0
Zoantharia	0.4
Solasteridae	0.2
Other items	
Fish eggs	
TOTAL	**237.5 kg**

Appendix E (continued)

Set :	55	Date: 16/09/2003
Region :	F	Dep Zone: 501-800
Usable :	**yes**	Major/Minor : 04 26
Contact (min) :	39	Duration (min) : 43
Hdline Hgt (m):	3.3	Distance (km) : 3.56
Door sprd (m):	62.3	Speed (km/h) : 4.97

	Start	Finish
Time :	7:52	8:35
Depth (m) :	549	494
Latitude :	49° 56.59'	49° 55.89'
Longitude :	127° 59.22'	128° 01.69'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	85.8
Shortraker rockfish	38.9
Longspine thornyhead	6.2
Aurora rockfish	0.8
Flatfish	
Dover sole	53.9
Arrowtooth flounder	23.8
Rex sole	5.7
Roundfish	
Sablefish	48.7
Pacific hake	2.8
Miscellaneous fish	
Filamented rattail	1.9
Pacific flatnose	0.7
Roughscale rattail	0.5
Viperfishes	0.0
Invertebrates	
Schoolmaster gonate squid	7.0
Tanner crabs	4.0
Primnoa	0.3
Gorgonian corals	0.0
Solasteridae	0.0
Seaslugs	
TOTAL	**281.1 kg**

Set :	56	Date: 16/09/2003
Region :	F	Dep Zone: 501-800
Usable :	**yes**	Major/Minor : 04 26
Contact (min) :	50	Duration (min) : 50
Hdline Hgt (m):	3.2	Distance (km) : 3.71
Door sprd (m):	59.8	Speed (km/h) : 4.45

	Start	Finish
Time :	9:47	10:37
Depth (m) :	516	521
Latitude :	49° 56.02'	49° 57.08'
Longitude :	128° 00.38'	128° 03.02'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	111.7
Shortraker rockfish	40.9
Rougheye rockfish	4.4
Flatfish	
Dover sole	75.4
Arrowtooth flounder	24.8
Rex sole	19.9
Roundfish	
Sablefish	13.4
Pacific hake	6.5
Elasmobranchs	
Longnose skate	82.9
Miscellaneous fish	
Pacific flatnose	2.0
Lumpfishes and snailfishes	
Bigfin eelpout	
Invertebrates	
Tanner crabs	2.8
Schoolmaster gonate squid	2.4
TOTAL	**387.3 kg**

Set :	57	Date: 16/09/2003
Region :	E	Dep Zone: 801-1200
Usable :	**NO**	Major/Minor : 04 26
Contact (min) :		Duration (min) :
Hdline Hgt (m):		Distance (km) :
Door sprd (m):		Speed (km/h) :

	Start	Finish
Time :	17:45	17:50
Depth (m) :	604	
Latitude :	49° 31.13'	
Longitude :	128° 39.35'	

** Catch was not sampled **

Appendix E (continued)

Set :	58	Date: 16/09/2003
Region :	D	Dep Zone: 1201-1600
Usable :	**yes**	Major/Minor : 04 25
Contact (min) :	43	Duration (min) : 55
Hdline Hgt (m):	3.6	Distance (km) : 3.93
Door sprd (m):	63.1	Speed (km/h) : 4.29

	Start	Finish
Time :	22:37	23:32
Depth (m) :	1298	1262
Latitude :	49° 24.73'	49° 22.72'
Longitude :	127° 31.48'	127° 31.18'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	28.9
Shortspine thornyhead	2.2
Flatfish	
Deepsea sole	0.5
Elasmobranchs	
Abyssal skate	2.8
Miscellaneous fish	
Roughscale rattail	207.9
Pectoral rattail	104.7
Giant blobsculpin	5.1
Pacific flatnose	5.1
Filamented rattail	1.3
Deepsea smelts	0.1
Northern lampfish	
Bigfin eelpout	
Invertebrates	
Tanner crabs	3.2
Schoolmaster gonate squid	1.0
Anemone	1.0
Echinasteridae	0.5
Shrimp	0.1
Gorgonian corals	0.0
Brittle stars	
Gastropods	
Sea whip	
TOTAL	**364.3 kg**

Set :	59	Date: 17/09/2003
Region :	D	Dep Zone: 801-1200
Usable :	**yes**	Major/Minor : 04 25
Contact (min) :	80	Duration (min) : 74
Hdline Hgt (m):	3.2	Distance (km) : 5.51
Door sprd (m):	54.3	Speed (km/h) : 4.46

	Start	Finish
Time :	7:25	8:39
Depth (m) :	896	896
Latitude :	49° 30.13'	49° 30.65'
Longitude :	127° 28.16'	127° 23.57'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	173.9
Shortspine thornyhead	18.1
Flatfish	
Deepsea sole	4.5
Roundfish	
Sablefish	16.7
Elasmobranchs	
Sandpaper skate	11.2
Abyssal skate	2.3
Roughtail skate	0.1
Miscellaneous fish	
Roughscale rattail	53.6
Pectoral rattail	10.1
Slickheads	3.4
Twoline eelpout	1.7
Bigfin eelpout	1.3
Filamented rattail	0.7
Pacific flatnose	0.4
Lumpfishes and snailfishes	0.3
Popeye	0.2
Northern lampfish	0.1
Invertebrates	
Tanner crabs	22.5
Vampire squid	3.7
Spiny red sea star	1.5
Solasteridae	1.0
Glass sponges	1.0
Echinasteridae	0.6
Sand star	0.5
Sea cucumber	0.4
Gastropods	0.1
Primnoa	0.1
True crabs	0.1
Anemone	
Pacific lyre crab	
Seaslugs	
Shrimp	
Other items	
Fish eggs	0.2
TOTAL	**330.3 kg**

Set :	60	Date: 17/09/2003
Region :	D	Dep Zone: 801-1200
Usable :	**yes**	Major/Minor : 04 25
Contact (min) :	57	Duration (min) : 62
Hdline Hgt (m):	3.3	Distance (km) : 4.49
Door sprd (m):	59.3	Speed (km/h) : 4.35

	Start	Finish
Time :	10:03	11:05
Depth (m) :	988	1024
Latitude :	49° 33.19'	49° 31.19'
Longitude :	127° 21.32'	127° 23.24'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	156.9
Shortspine thornyhead	17.6
Flatfish	
Deepsea sole	4.8
Dover sole	3.8
Roundfish	
Sablefish	58.7
Elasmobranchs	
Brown cat shark	0.7
Miscellaneous fish	
Roughscale rattail	10.1
Pectoral rattail	7.4
Twoline eelpout	4.6
Filamented rattail	4.3
Popeye	3.1
Pacific flatnose	0.8
Pacific hagfish	0.6
Slickheads	0.6
Northern lampfish	
Invertebrates	
Tanner crabs	5.1
Schoolmaster gonate squid	1.5
Glass sponges	0.7
Solasteridae	0.5
Spiny red sea star	0.2
TOTAL	**281.9 kg**

Appendix E (continued)

Set : 61	Date: 18/09/2003	Set : 62	Date: 18/09/2003	Set : 63	Date: 18/09/2003
Region : D	Dep Zone: 501-800	Region : D	Dep Zone: 501-800	Region : D	Dep Zone: 501-800
Usable : yes	Major/Minor : 04 25	**Usable : yes**	Major/Minor : 04 26	**Usable : yes**	Major/Minor : 04 26
Contact (min) : 73	Duration (min) : 80	Contact (min) : 66	Duration (min) : 61	Contact (min) : 74	Duration (min) : 66
Hdline Hgt (m): 3.7	Distance (km) : 6.33	Hdline Hgt (m): 3.3	Distance (km) : 4.72	Hdline Hgt (m): 3.1	Distance (km) : 5.03
Door sprd (m): 60.1	Speed (km/h) : 4.75	Door sprd (m): 58.6	Speed (km/h) : 4.64	Door sprd (m): 58.3	Speed (km/h) : 4.57

	Start	Finish	Start	Finish	Start	Finish
Time :	12:17	13:37	15:16	16:17	17:20	18:26
Depth (m) :	640	640	589	501	604	658
Latitude :	49° 36.74'	49° 35.52'	49° 39.69'	49° 37.70'	49° 38.36'	49° 39.43'
Longitude :	127° 26.97'	127° 22.26'	127° 27.27'	127° 24.99'	127° 25.97'	127° 29.91'

Species	Wgt (kg)	Species	Wgt (kg)	Species	Wgt (kg)
Rockfish		**Rockfish**		**Rockfish**	
Shortspine thornyhead	70.6	Shortspine thornyhead	122.0	Shortspine thornyhead	83.0
Longspine thornyhead	65.5	Shortraker rockfish	82.3	Shortraker rockfish	18.9
Shortraker rockfish	3.3	Splitnose rockfish	0.1	Longspine thornyhead	17.6
Flatfish		**Flatfish**		Pacific ocean perch	1.8
Dover sole	29.3	Dover sole	124.7	Splitnose rockfish	0.4
Deepsea sole	1.8	Arrowtooth flounder	27.9	**Flatfish**	
Roundfish		**Roundfish**		Dover sole	88.2
Sablefish	132.1	Sablefish	517.7	Arrowtooth flounder	18.4
Pacific hake	5.0	Pacific hake	10.5	**Roundfish**	
Elasmobranchs		**Elasmobranchs**		Sablefish	513.6
Brown cat shark	1.0	Longnose skate	17.4	Pacific hake	3.4
Miscellaneous fish		Brown cat shark	1.7	**Elasmobranchs**	
Filamented rattail	3.9	Sandpaper skate	0.9	Longnose skate	26.6
Pacific flatnose	3.2	**Miscellaneous fish**		Abyssal skate	3.2
Popeye	2.8	Pacific flatnose	4.7	Brown cat shark	3.0
Roughscale rattail	1.5	Black eelpout	2.2	**Miscellaneous fish**	
Pectoral rattail	1.0	Pectoral rattail	1.5	Pacific flatnose	6.0
Bigfin eelpout	0.4	Blacktail snailfish	0.1	Pectoral rattail	4.4
Blacktail snailfish	0.2	Blackfin poacher	0.1	Blacktail snailfish	1.7
Twoline eelpout	0.1	**Invertebrates**		Black eelpout	1.3
Northern lampfish	0.1	Schoolmaster gonate squid	39.0	Twoline eelpout	0.9
Bigeye poacher		Anemone	1.5	Filamented rattail	0.4
Invertebrates		Glass sponges	1.0	Blackfin poacher	
Tanner crabs	11.5	Octopus	0.8	**Invertebrates**	
Schoolmaster gonate squid	10.4	Tanner crabs	0.7	Schoolmaster gonate squid	46.1
Solasteridae	0.6	Solasteridae	0.5	Octopus	2.7
Spiny red sea star	0.2	Sand star	0.2	Vampire squid	1.2
Squat lobster	0.0	Spiny red sea star	0.1	Anemone	0.6
Jellyfish		Gastropods		Tanner crabs	0.5
				Sand star	0.4
				Solasteridae	0.2
				Heart urchins	
TOTAL	**344.5 kg**	**TOTAL**	**957.6 kg**	**TOTAL**	**844.6 kg**

Appendix E (continued)

Set : 64 **Date: 18/09/2003**
Region : E
Dep Zone: 801-1200
Usable : NO
Major/Minor : 04 26
Contact (min) :
Duration (min) :
Hdline Hgt (m):
Distance (km) :
Door sprd (m):
Speed (km/h) :

	Start	Finish
Time :	20:57	21:05
Depth (m) :	933	942
Latitude :	49° 29.63'	49° 29.82'
Longitude :	127° 38.52'	127° 38.69'

** Catch was not sampled **

Set : 65 **Date: 18/09/2003**
Region : E
Dep Zone: 801-1200
Usable : yes
Major/Minor : 04 26
Contact (min) : 74
Duration (min) : 71
Hdline Hgt (m): 3.2
Distance (km) : 5.50
Door sprd (m): 61.4
Speed (km/h) : 4.65

	Start	Finish
Time :	22:19	23:30
Depth (m) :	933	924
Latitude :	49° 29.26'	49° 31.88'
Longitude :	127° 38.03'	127° 40.12'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	66.3
Shortspine thornyhead	38.7
Shortraker rockfish	10.6
Flatfish	
Deepsea sole	4.5
Roundfish	
Sablefish	14.4
Elasmobranchs	
Brown cat shark	0.3
Miscellaneous fish	
Pectoral rattail	24.8
Roughscale rattail	16.4
Slickheads	5.2
Twoline eelpout	4.5
Filamented rattail	2.7
Pacific flatnose	1.3
Black eelpout	0.3
Northern lampfish	0.1
Pacific hagfish	0.1
Snailfishes	
Bigfin eelpout	
Viperfishes	
Invertebrates	
Schoolmaster gonate squid	5.3
Tanner crabs	4.0
Octopus	1.2
Vampire squid	0.7
Anemone	0.5
Red king crab	0.1
Sand star	0.1
TOTAL	**202.0 kg**

Set : 66 **Date: 19/09/2003**
Region : E
Dep Zone: 801-1200
Usable : yes
Major/Minor : 04 26
Contact (min) : 74
Duration (min) : 70
Hdline Hgt (m): 4.0
Distance (km) : 5.20
Door sprd (m): 59.1
Speed (km/h) : 4.46

	Start	Finish
Time :	6:40	7:50
Depth (m) :	997	988
Latitude :	49° 30.59'	49° 32.87'
Longitude :	127° 40.46'	127° 42.68'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	184.0
Shortspine thornyhead	24.0
Flatfish	
Deepsea sole	1.8
Roundfish	
Sablefish	22.3
Miscellaneous fish	
Roughscale rattail	61.9
Pectoral rattail	20.8
Slickheads	8.4
Filamented rattail	4.5
Pacific flatnose	0.5
Invertebrates	
Tanner crabs	5.2
Anemone	1.2
Red king crab	
Lithodes couesi	
Jellyfish	
Gastropods	
TOTAL	**334.7 kg**

Appendix E (continued)

Set :	67	Date: 19/09/2003
Region :	E	Dep Zone: 801-1200
Usable :	**yes**	Major/Minor : 04 26
Contact (min) :	75	Duration (min) : 74
Hdline Hgt (m):	3.3	Distance (km) : 5.62
Door sprd (m):	61.1	Speed (km/h) : 4.56

	Start	Finish
Time :	9:06	10:20
Depth (m) :	1097	878
Latitude :	49° 32.23'	49° 33.98'
Longitude :	127° 37.05'	127° 40.89'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	94.7
Shortspine thornyhead	50.5
Flatfish	
Deepsea sole	2.0
Roundfish	
Sablefish	76.1
Elasmobranchs	
Brown cat shark	0.8
Miscellaneous fish	
Roughscale rattail	38.8
Pectoral rattail	11.0
Filamented rattail	6.6
Pacific flatnose	1.2
Twoline eelpout	1.1
Popeye	1.0
Bigfin eelpout	0.3
Slickheads	0.2
Deepsea smelts	0.2
Pacific hagfish	0.2
Northern lampfish	0.1
Lanternfishes	0.1
Invertebrates	
Tanner crabs	6.0
Glass sponges	1.2
Sand star	0.1
Squat lobster	
TOTAL	**292.1 kg**

Set :	68	Date: 19/09/2003
Region :	E	Dep Zone: 1201-1600
Usable :	**yes**	Major/Minor : 04 26
Contact (min) :	59	Duration (min) : 66
Hdline Hgt (m):	2.9	Distance (km) : 4.53
Door sprd (m):	59.8	Speed (km/h) : 4.12

	Start	Finish
Time :	11:34	12:40
Depth (m) :	1280	1244
Latitude :	49° 30.38'	49° 31.80'
Longitude :	127° 42.22'	127° 44.93'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	27.8
Shortspine thornyhead	7.8
Flatfish	
Deepsea sole	2.9
Elasmobranchs	
Abyssal skate	2.4
Miscellaneous fish	
Pectoral rattail	126.2
Roughscale rattail	87.9
Pacific flatnose	10.9
Filamented rattail	2.9
Popeye	1.1
Twoline eelpout	0.9
Invertebrates	
Vampire squid	1.5
Tanner crabs	1.3
Jellyfish	0.1
Shrimp	0.0
Solasteridae	0.0
TOTAL	**273.4 kg**

Set :	69	Date: 19/09/2003
Region :	E	Dep Zone: 1201-1600
Usable :	**NO**	Major/Minor : 04 26
Contact (min) :		Duration (min) :
Hdline Hgt (m):		Distance (km) :
Door sprd (m):		Speed (km/h) :

	Start	Finish
Time :	15:43	15:56
Depth (m) :	1372	1737
Latitude :	49° 38.17'	49° 38.61'
Longitude :	127° 50.51'	127° 50.09'

** Catch was not sampled **

Appendix E (continued)

Set :	70	Date: 19/09/2003
Region :	E	Dep Zone: 1201-1600
Usable :	**yes**	Major/Minor : 04 26
Contact (min) :	64	Duration (min) : 82
Hdline Hgt (m):	3.7	Distance (km) : 5.28
Door sprd (m):	56.8	Speed (km/h) : 3.86

	Start	Finish
Time :	18:26	19:48
Depth (m) :	1317	1289
Latitude :	49° 27.92'	49° 30.48'
Longitude :	127° 40.44'	127° 42.28'

Species	Wgt (kg)
Rockfish	
Longspine thornyhead	17.7
Shortspine thornyhead	7.5
Flatfish	
Deepsea sole	4.0
Roundfish	
Sablefish	14.0
Elasmobranchs	
Abyssal skate	26.3
Sandpaper skate	0.5
Miscellaneous fish	
Roughscale rattail	310.1
Pectoral rattail	266.4
Pacific flatnose	40.0
Filamented rattail	6.2
Popeye	4.2
Twoline eelpout	2.4
Lumpfishes and snailfishes	0.5
Slickheads	0.5
Northern lampfish	
Invertebrates	
Octopus	5.1
Vampire squid	3.4
Tanner crabs	0.7
Schoolmaster gonate squid	0.5
Glass sponges	0.2
Spiny red sea star	0.1
Primnoa	
Anemone	
Echinasteridae	
Solasteridae	
Seaslugs	
Other items	
Inanimate object(s)	0.9
Unidentified organic matter	
TOTAL	**711.3 kg**

Set :	71	Date: 19/09/2003
Region :	E	Dep Zone: 501-800
Usable :	**yes**	Major/Minor : 04 26
Contact (min) :	66	Duration (min) : 68
Hdline Hgt (m):	3.0	Distance (km) : 6.58
Door sprd (m):	62.3	Speed (km/h) : 5.81

	Start	Finish
Time :	22:45	23:53
Depth (m) :	613	594
Latitude :	49° 43.26'	49° 39.73'
Longitude :	127° 36.99'	127° 37.31'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	57.0
Rougheye rockfish	1.4
Flatfish	
Dover sole	45.2
Arrowtooth flounder	1.9
Roundfish	
Sablefish	92.3
Pacific hake	7.4
Miscellaneous fish	
Pectoral rattail	7.6
Pacific flatnose	5.6
Roughscale rattail	2.9
Twoline eelpout	1.2
Filamented rattail	0.3
Lanternfishes	0.0
Invertebrates	
Squids	3.5
Tanner crabs	1.6
Shrimp	
TOTAL	**227.8 kg**

Set :	72	Date: 20/09/2003
Region :	E	Dep Zone: 501-800
Usable :	**yes**	Major/Minor : 04 26
Contact (min) :	56	Duration (min) : 55
Hdline Hgt (m):	2.8	Distance (km) : 4.88
Door sprd (m):	60.8	Speed (km/h) : 5.32

	Start	Finish
Time :	6:46	7:41
Depth (m) :	713	677
Latitude :	49° 54.77'	49° 55.42'
Longitude :	127° 59.78'	127° 55.58'

Species	Wgt (kg)
Rockfish	
Shortspine thornyhead	115.8
Longspine thornyhead	28.6
Flatfish	
Dover sole	67.6
Roundfish	
Sablefish	82.3
Pacific hake	2.8
Elasmobranchs	
Longnose skate	6.8
Miscellaneous fish	
Pectoral rattail	4.1
Pacific flatnose	1.8
Black eelpout	1.1
Slender codling	0.6
Filamented rattail	0.3
Blackfin poacher	
Blacktail snailfish	
Deepsea smelts	
Invertebrates	
Schoolmaster gonate squid	9.2
Spiny red sea star	0.1
Echinasteridae	0.1
Other items	
Unidentified organic matter	
TOTAL	**321.1 kg**

Appendix E (continued)

Set :	**73**	**Date: 20/09/2003**	
Region :	F	Dep Zone:	501-800
Usable :	**yes**	Major/Minor :	04 26
Contact (min) :	49	Duration (min) :	43
Hdline Hgt (m):	3.0	Distance (km) :	3.32
Door sprd (m):	61.9	Speed (km/h) :	4.64

	Start	**Finish**
Time :	10:50	11:33
Depth (m) :	594	549
Latitude :	49° 56.04'	49° 57.18'
Longitude :	128° 3.510'	128° 5.710'

Species	**Wgt (kg)**
Rockfish	
Shortspine thornyhead	198.2
Shortraker rockfish	32.8
Longspine thornyhead	16.8
Rougheye rockfish	2.4
Flatfish	
Dover sole	137.0
Arrowtooth flounder	3.7
Rex sole	1.8
Deepsea sole	1.5
Roundfish	
Sablefish	14.5
Pacific hake	8.4
Miscellaneous fish	
Pacific flatnose	3.9
Filamented rattail	1.7
Twoline eelpout	
Invertebrates	
Schoolmaster gonate squid	2.6
Tanner crabs	1.3
Solasteridae	
Spiny red sea star	
Other items	
Inanimate object(s)	5.7
TOTAL	**432.5 kg**

Set :	**74**	**Date: 20/09/2003**	
Region :	E	Dep Zone:	501-800
Usable :	**yes**	Major/Minor :	04 26
Contact (min) :	56	Duration (min) :	58
Hdline Hgt (m):	2.9	Distance (km) :	4.58
Door sprd (m):	64.3	Speed (km/h) :	4.74

	Start	**Finish**
Time :	15:01	15:59
Depth (m) :	631	783
Latitude :	49° 36.03'	49° 37.43'
Longitude :	127° 39.10'	127° 42.21'

Species	**Wgt (kg)**
Rockfish	
Shortspine thornyhead	78.0
Shortraker rockfish	21.2
Longspine thornyhead	11.5
Flatfish	
Dover sole	24.2
Roundfish	
Sablefish	31.7
Pacific hake	4.0
Elasmobranchs	
Abyssal skate	4.8
Miscellaneous fish	
Pacific flatnose	4.2
Pectoral rattail	2.9
Twoline eelpout	1.5
Filamented rattail	1.3
Roughscale rattail	0.2
Lanternfishes	
Invertebrates	
Tanner crabs	2.5
Schoolmaster gonate squid	1.2
Lithodes couesi	0.5
TOTAL	**189.7 kg**

APPENDIX E (continued).

Notes pertaining to haul information:

Dep Zone: depth stratum limits (metres).

Usable: indicates whether the tow was considered usable for biomass estimation.

Major/Minor: Major and Minor Statistical Area codes used for DFO groundfish management purposes.

Contact: bottom contact time (minutes) is the elapsed time between first net contact with bottom after winch lockup to last contact with bottom following winch release as the net was retrieved. These start/end times were based on tilt angle changes using 45° as the cutoff angle between vertical and horizontal sensor orientation.

Duration: elapsed time (minutes) between winch lockup as the fishing event begins until the time that the winch is released to start retrieving the gear.

Hdline Hgt: mean height (metres) of the headline above the footrope, based on interval data from winch lockup to winch release during each tow.

Distance: estimated distance (kilometres) that the gear was towed along bottom, calculated using interval distances estimated from winch lockup to winch release during each tow (see Eq. 3).

Door sprd: median distance (metres) between the trawl doors, measured by Scanmar distance sensor readings from live-feed and screen-capture data.

Speed: average vessel speed (km/h) during the tow based on interval data from winch lockup to winch release, using Scanmar screen captures (tows 1-36, 51, 72) and live data feeds (tows 37-74 except 51 and 72).

APPENDIX F. Date, time and position information added to existing Nobeltec track data to correspond with time and location recorded on bridge logs for winch lockup and/or winch release. Original Nobeltec track start/end points for these tows differed from bridge logs when the skipper failed to activate track recording at the required time.

Tow	Date	Local Time	Latitude (decimal degrees)	Longitude (decimal degrees)
4	September 5, 2003	14:13:00	48.302	126.065
5	September 5, 2003	17:27:20	48.415	126.359
6	September 5, 2003	23:20:00	48.499	126.342
8	September 6, 2003	08:51:00	48.417	126.205
9	September 6, 2003	11:28:00	48.538	126.295
10	September 6, 2003	15:25:00	48.469	126.215
11	September 6, 2003	17:49:00	48.542	126.300
13	September 7, 2003	08:48:00	48.674	126.893
14	September 7, 2003	13:30:00	48.904	126.588
15	September 7, 2003	16:55:00	48.859	126.618
15	September 7, 2003	18:08:00	48.895	126.568
16	September 7, 2003	21:08:00	48.731	126.538
19	September 8, 2003	10:27:00	48.591	126.505
23	September 9, 2003	16:58:00	48.996	126.961
27	September 10, 2003	06:39:00	49.149	127.026
29	September 10, 2003	11:02:00	49.206	127.115
31	September 10, 2003	16:27:00	49.184	127.277
35	September 11, 2003	12:31:00	49.424	127.300
35	September 11, 2003	12:49:00	49.419	127.317
37	September 12, 2003	15:57:00	50.367	128.487
38	September 12, 2003	19:05:00	50.330	128.393
43	September 14, 2003	06:40:00	50.239	128.321
44	September 14, 2003	10:20:00	50.183	128.411
45	September 14, 2003	13:13:00	50.254	128.468
45	September 14, 2003	13:35:16	50.253	128.482
48	September 14, 2003	22:46:00	50.266	128.701
51	September 15, 2003	12:51:00	49.940	128.083
52	September 15, 2003	16:09:00	49.942	127.993
55	September 16, 2003	08:35:00	49.932	128.028
59	September 17, 2003	07:25:00	49.502	127.469
64	September 18, 2003	20:57:00	49.494	127.642
64	September 18, 2003	21:05:00	49.497	127.645
66	September 19, 2003	07:50:00	49.548	127.711
69	September 19, 2003	15:43:00	49.636	127.842
69	September 19, 2003	15:56:00	49.643	127.835
70	September 19, 2003	19:48:00	49.508	127.705
71	September 19, 2003	22:45:00	49.721	127.616