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Retrospective Analysis of Suspiciously Small Catches in the National Marine Fisheries Service West Coast Triennial Bottom Trawl Survey

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Abstract

A review of the National Marine Fisheries Service U.S. West Coast triennial bottom trawl survey time series (1977-98) revealed a large number of hauls with unusually small catches, particularly during the first three triennial surveys (1977, 1980, and 1983). Beginning in 1986, technological advances in the equipment that we use to monitor trawl performance have progressively improved our understanding of how our sampling trawl operates. This knowledge has led to a subtle evolution of trawling procedures and probably increased the rate at which we catch benthic fish and invertebrates, making year-to-year comparisons of our survey data more challenging.

A minimum catch per unit effort value of a benthic species group ($CPUE_B$), derived from the most recent and most technologically advanced survey in 1998, was used as a criterion to eliminate trawl hauls with poor bottom contact from earlier surveys. The truncated data sets produce significantly larger biomass estimates, especially in 1980 where 156 of 505 hauls (30.9%) were removed, with increases of 40% for Dover sole (*Microstomus pacificus*), 42% for petrale sole (*Eopsetta jordani*), and 55% for Pacific sanddab (*Citharichthys sordidus*). These new estimates are not corrections to standard survey results. Rather, they are most likely under-estimates of the magnitude of how this new interpretation could change the original biomass estimates and abundance trends. Additionally, the $CPUE_B$ across each earlier survey was significantly less than in the 1998 survey, indicating that the impact was not just limited to a specific group of hauls with unusually low catches. Total catch of flatfish has also changed substantially during the time series, with the highest catches of flatfish occurring in the recent surveys, and the lowest catches occurring in the earlier surveys. While a switch from a nylon net to one constructed of polyethylene in 1986, and an unusual occurrence of jellyfish schools in

1980 did not significantly affect the $CPUE_B$, there were significant differences associated with different vessel-years. This is further evidence that changes in the $CPUE_B$ over the time series is not related to a natural change in the environment or caused by gear differences, but may be linked to changing fishing methods.

Contents

Introduction

Survey scientists for the National Marine Fisheries Service (NMFS) have been conducting bottom trawl shelf surveys of U.S. West Coast groundfish resources on a triennial basis since 1977 as part of a long-term monitoring program (Gunderson and Sample 1980, Weinberg et al. 1984, Coleman 1986, Coleman 1988, Weinberg et al. 1994, Zimmermann et al. 1994, Wilkins et al. 1998, Shaw et al. 2000). The Northwest and Alaska Fisheries Science Center conducted the surveys from 1977-86 and, following the split into separate Northwest and Alaska Centers, the Alaska Fisheries Science Center (AFSC) has conducted the surveys from 1989-1998. Eight surveys have now provided stock assessment scientists with a time series of fishery independent estimates of relative biomass, size and age information for many commercially important species. Comparison of survey results among years yield best results when there are no changes in methods over time. However, it is unrealistic to assume that a survey would remain unchanged over a 21-year period. Indeed, the U.S. West Coast shelf survey has utilized the latest technology in efforts to increase the precision of our catch per unit effort (CPUE) estimates, which in turn has increased our understanding of sampling efficiency and led to changes in survey protocol, both at-sea and during post cruise analyses. The impact of these changes on biomass estimates were difficult to define, warranting careful consideration of the estimates by stock assessment scientists.

A review of West Coast triennial bottom trawl data (1977-98) suggests several hauls from early survey years (1977, 1980, and 1983), originally considered successful and included in the computation of biomass estimates, would likely be considered unsuccessful because of poor gear sampling efficiency under today's methodology and excluded from further analyses. The

efficiency of a bottom trawl is in part dependent upon the maintenance of footrope contact with the bottom. Loss of footrope contact creates a passage through which fish and invertebrates can escape under the trawl (Engås and Godø 1989, Somerton and Weinberg In press). Examination of notes made by vessel captains and scientific staff on original data sheets, in conjunction with a review of the total catch of benthic fish and invertebrates, suggest that the trawl footrope lost contact with the bottom, or in some cases, likely failed to establish contact with the bottom, resulting in zero or trace catches of benthic biota, termed "Water hauls." The likelihood of a survey bottom trawl dragged along the seafloor for a distance of 3 km and yet catching nothing is contrary to the lead author's experiences during recent surveys in which all tows contained some benthic catch. The inclusion of unsatisfactory tows for estimation of relative abundance could bias the stock assessments for some species. In this paper, we summarize the history of changes to our survey, identify the methods used to determine off-bottom tows in earlier surveys, and explore the consequences of the removal of off-bottom tows in the abundance estimation process.

An important assumption with our tow data is that the catchability of any particular species will remain constant from tow to tow and from survey to survey, even though the true catchability is unknown. This assumption is very important because the data are standardized by dividing the mass of each species in a haul by the area swept (effort) by that haul and converted into catch per unit effort values (CPUEs):

$$CPUE = \frac{mass\ (kg)}{area\ swept\ (ha)} \quad .$$

The average of all CPUE values from a stratum is multiplied by the area of that stratum in order to estimate biomass:

$$Stratum\ biomass = \overline{CPUE}\ (kg / ha) \times Stratum\ area\ (ha)\ .$$

Total estimated biomass for the whole survey area is calculated by summing the biomass estimates of individual strata.

Many of the more obvious differences between surveys resulted from changing survey objectives. These changes include shifts in the areas of survey coverage, sampling stratification schemes, and station allocations, as well as changes in vessel-related characteristics such as who, when, where, and how many and which vessels were involved, what role the vessel captain and field biologist in charge played in fishing procedural decisions, what gear was used, and what navigational aids were available. The implications of these survey design changes (Table 1) on abundance trends are beyond the scope of this paper.

Less obvious changes imposed on the trawling process and treatment of data both during and after a survey may have also affected catch rates. Changes have come about through our increasing use of various technological innovations and scientific instruments placed on the trawl to enhance understanding of the fishing process and gear performance. New knowledge related to trawl performance has led to both conscious and unconscious adjustments to our fishing procedures (Table 2), and hence probable changes to the meaning of our CPUE. There were significant, unintended changes in our surveys from the supposedly "benign" introduction of

modern equipment. Before we can offer a measurement of the impact of these changes made between surveys on biomass estimates, we need to clarify the changes that have occurred. A detailed review and chronology of changes in the design, sampling methodology (instrumentation and procedures), data editing and other aspects of conducting the triennial bottom trawl survey which may have impacted trawl efficiency are reported in Appendix A.

To determine possible impacts of changes in bottom trawling methods described in Appendix A, we developed a list of benthic species to be used as a proxy for measuring bottom contact. Comparisons were made between the total CPUE of these benthic species in individual trawl hauls in each earlier survey (1977-95), and CPUE of the same species in the 1998 survey. These comparisons were made to determine whether the problem with off-bottom hauls was limited to a few hauls, or whether catches were significantly different across entire surveys. Then we developed an approximate, minimum catch level of benthic species from the 1998 survey, eliminated hauls from earlier surveys which fell below this minimum, recalculated biomass estimates with the truncated data sets, and determined percent differences from original estimates (Appendices B to H).

While there are myriad potential differences in bottom trawling methods between different vessels and different vessel captains over the years of the survey, many of these are qualitative and are difficult to measure. Instead of attempting to test different specific factors, we simply tested the number of observed and expected off-bottom hauls between vessel-years.

The original biomass estimates of several flatfish species are plotted over the survey time series, along with the original estimated biomass of all flatfish species combined, to demonstrate that there has been a large increase in all flatfish species from the early to the more recent surveys.

Early examination of the data suggested that there were a great number of possible off-bottom hauls from 1980. Since it was always suspected that an unusual occurrence of jellyfish schools may have negatively affected the catch rates of important commercial species (Dark et al. 1983), and several of these potentially impacted stations were resampled after the jellyfish schools left, we examined the possible difference in the catch rate of benthic species to determine if jellyfish may have been responsible for these low catch rates.

Materials and Methods

Minimal Catch Level

There is no definitive method of determining which hauls may have been off-bottom in the surveys prior to 1998 because of limited net performance measurements. Instead, we calculated the combined CPUE of an extremely conservative list of the most benthic fish and invertebrates, denoted as $CPUE_B$, as a proxy for bottom contact. This species list was based on our personal experience with bottom trawling, scuba-diving, mini-submersibles, and underwater video (Table 3). Data from the 1998 survey was set as our standard for comparing possible changes in $CPUE_B$ during the survey history, since we have the best understanding and greatest control of trawl hauls conducted in this year. We used the $CPUE_B$ values from 1998 as standards in two ways; the first method examined if $CPUE_B$ values in general were deficient in the earlier surveys,

and the second method examined if biomass estimates changed substantially by removing hauls which fell below a survey minimum.

We first used the 1998 $CPUE_B$ values as benchmarks to compare potential differences in $CPUE_B$ between individual trawl hauls in all earlier surveys and 1998 to determine if $CPUE_B$, in general, has changed over time. Since the surveys have varied in their latitudinal and depth coverage (Table 1), and the station locations have changed significantly, a direct comparison of the $CPUE_B$ at each geographic location could not be done. Instead the $CPUE_B$ from the appropriate latitudinal and depth distribution of each earlier survey (1977-95) was compared to the 1998 survey results. Both data sets were truncated according to latitude and depth, if necessary, to make an appropriate comparison between $CPUE_B$ in each earlier survey and 1998. For example, the 1977 survey fished farther south than the 1998 survey, and the 1998 survey fished farther north than the 1977 survey, so in order to make the 1977 to 1998 comparison, both were truncated according to latitude. In this manner only $CPUE_B$ values from comparable depths and latitudes were used for each of the seven comparisons.

The $CPUE_B$ values for each of the seven comparisons were sorted from lowest to highest so that we could determine if $CPUE_B$ were higher in 1998 compared to each earlier survey. Since there were a different number of trawl hauls conducted in each survey, direct, tow-to-tow comparisons could not be made. We assume that if any two surveys were sampling the same distribution of abundance of benthic organisms, the survey with the greater number of samples would have more small catches, more medium-sized catches, and more large catches. Thus the appropriate

way to compare $CPUE_B$ between each earlier survey and the 1998 survey was to make comparisons between the same percentile of hauls. Thus, instead of comparing the 50th largest $CPUE_B$ between two surveys with different numbers of trawl hauls, the $CPUE_B$ values from the 50th percentile of total trawl hauls of each survey were compared. To avoid a bias which might create an artificially large difference, the $CPUE_B$ values from 1998 (e.g., the 50.1 percentile) were subtracted from the next highest $CPUE_B$ from the earlier survey (e.g., the 50.2 percentile). The differences in $CPUE_B$ between each earlier trawl survey and those of 1998 were then analyzed in two-tailed t tests to determine if they were significantly different than zero.

The second method of using the 1998 $CPUE_B$ values as benchmarks was to eliminate all trawl hauls from previous surveys with $CPUE_B$ that fell below an approximate minimum from 1998 (Table 4). While the exact depth and latitudinal range of 1998 was different than each of the earlier survey years, the 1998 survey covered most of the ranges of all previous surveys and was used as a test of determining the minimal possible $CPUE_B$ within our survey area. Biomass estimates for individual species were then recalculated for the earlier surveys and percent changes were calculated (Table 5). These changes in biomass estimates were not calculated as corrections, but as indicators of the magnitude of the change, to determine whether or not this different interpretation of trawl survey history might have an impact on abundance trends.

Test for Effects of Different Factors

Differences in the actual and expected number of on-bottom and off-bottom hauls between different vessel-years were examined using a Chi square test. The test examined if off-bottom

hauls were unevenly divided among different vessel-years, which would indicate that trawling methodology unique to particular vessel-years may have impacted the catch of benthic species.

Flatfish Biomass

Trends in flatfish biomass, as estimated from the original survey data, were examined by plotting the percent maximal biomass of each flatfish species (calculated by dividing the estimated biomass in each year by the highest biomass estimated for that species in any year) over time. Percentage of maximal biomass for each flatfish species was used because the species have significantly different abundances. While the seven proxy flatfish species comprised most of the flatfish biomass in each survey, the total flatfish biomass of all flatfish species was also plotted.

Results

Deviation From the 1998 Survey

The differences between appropriate subsets of each survey year and 1998 were plotted on the same graph to illustrate comparable differences in $CPUE_B$ from 1977 to 1995 (Fig. 1). For example, by the 50^{th} percentile of hauls completed in each survey, there was a group of three surveys (1995, 1989, and 1986) whose $CPUE_B$ values were approximately 5 to 7.5 kg/ha less than the 1998 survey. It is interesting to note that the differences for these three years remained relatively constant, suggesting that if the smallest 10% were removed, the differences would be close to zero. At the same point, the 1992 survey was about 12.5 kg/ha less, both the 1977 (17.3 kg/ha) and 1983 (14.8 kg/ha) surveys had greater differences, and the 1980 survey was about 22.3 kg/ha less. These four surveys all had increasing deficiencies. All surveys had consistently

negative differences until reaching the upper end of their distributions, when there were some very large positive differences (above the 90th percentile). These large positive differences are due to extremely large catches of benthic species which were not matched by similar catches in the 1998 survey. The mean differences of all older surveys were significantly less than zero (two-tailed t tests, $\alpha = 0.05$, $P < 0.001$) with the exception of 1989, which was not significantly less than zero due to several extremely large, positive differences at the upper end of its distribution (not shown). All differences in 1989 were negative until the 96th percentile (422 out of 437).

Minimal Benthic $CPUE_B$ Level in 1998

An examination of the lowest 100 $CPUE_B$ values of the 1998 triennial survey showed that there were 4 values less than 1.0 kg/ha (Fig. 2). All of these came from stations off California which historically has accounted for some of our smallest catches. The smallest $CPUE_B$ (0.53 kg/ha) came from a haul in which the cod end of the net was partially open, but was not felt to have had a significant impact on the catch. None of the other $CPUE_B$ values less than 1.0 (range 0.67 - 0.94 kg/ha) had any recorded problems; the bottom contact sensor recorded normal values from two of the hauls, but failed on the third haul. We did not want to declare that a specific $CPUE_B$ from one haul was the authoritative minimum for the entire survey area. Thus we rounded the smallest $CPUE_B$ up to 1.0 kg/ha as an arbitrary, conservative threshold for determining if a trawl caught a sufficient amount of benthic fish and invertebrates to indicate that it fished on the ocean floor. This catch rate is roughly equivalent to a total catch of about 4 kg of benthic fish and invertebrates in a standard haul covering a distance of 2.95 km and width of 13.7 m (area equal to 4.04 hectares, or 0.04 km^2). In terms of actual fish, this threshold is equal to a single

arrowtooth flounder (*Atheresthes stomias*) 70 cm long, or ten 35 cm Dover sole (*Microstomus pacificus*), or five 40 cm shortspine thornyhead (*Sebastolobus alascanus*); about enough biomass to cover the bottom of one of our sampling baskets. Therefore the original data set for each triennial survey was truncated at the 1.0 kg/ha level of benthic species, and biomass estimates were recalculated for several species to determine if there was a significant impact by removing these suspiciously low catches.

Changes in Biomass Estimates

Percent changes in the estimated biomass varied widely by species, year, and depth strata (Table 5). Results are shown for five flatfish species and for shortspine thornyhead which were included in the $CPUE_B$, for Pacific halibut (*Hippoglossus stenolepis*) and sablefish (*Anoplopoma fimbria*) which were not included in the benthic group, and for total flatfish. Changes in individual strata are shown in Appendices B to H.

For the 1977 survey (Table 5, Appendix B), changes were generally highest in the shallow stratum. Changes in total estimated biomass ranged from as little as an 8.3% increase for shortspine thornyhead to as high as an 76.6% increase for Pacific halibut. The estimated biomass of Pacific halibut was unusually and unaccountably low in 1977 (281.3 metric tons (t)) and it increased to 7,716 t in U.S. waters in 1998, an increase of over 27-fold. With a few exceptions, changes in estimated biomass were uniformly high and positive (in value) across all species and all strata in 1980 and generally were largest in the shallow stratum (Table 5, Appendix C). Increases of biomass estimates were much less in 1983 among all species and areas, and changes

were again greatest in the shallow stratum (Table 5, Appendix D). Biomass increases were even lower in 1986, with the largest increases divided between the shallow and deep strata (Table 5, Appendix E). In 1989, estimated biomass increases were much higher and were greatest in the deep stratum (Table 5, Appendix F). In 1992 and 1995 (Table 5, Appendices G and H), changes in total estimated biomass were low, and there were a few decreases, indicating that trawl hauls which contained the species in question, but not enough total benthic biomass to qualify as being on-bottom, were deleted in the analysis.

Test for Effects of Different Factors

The Chi-square test showed that the ratio of on-bottom to off-bottom trawl hauls was significantly different between vessel-years ($\chi^2 > 481$, $P < 0.001$, $DF = 15$). The NOAA ship David Starr Jordan cruise of 1977 (45% off-bottom), and the MV Mary Lou and MV Pat San Marie cruises in 1980 (35% and 27% off-bottom, respectively) had the greatest percentages of off-bottom hauls (Table 6). The MV Tordenskjold cruise in 1977, the FV Alaska cruises in 1986, 1992, and 1995, and the FV Vesteraalen cruise in 1995, had the lowest percentages of off-bottom hauls ($\leq$3%).

Flatfish Biomass

The percent maximal biomass of the seven most abundant flatfish species in the triennial survey was variable from survey to survey (Fig. 3), but generally was higher in the more recent survey years. In 1977, the estimated biomass of Pacific halibut, Pacific sanddab (*Citharichthys sordidus*), English sole (*Parophrys vetulus*), and rex sole (*Glyptocephalus zachirus*) were all less

than 20% of their maximal biomass. The estimated biomass of all species remained roughly the same or declined in 1980, the year with the greatest number of water hauls. In general, the abundance of all individual species, as well as total flatfish, increased from 1980 through 1989, with arrowtooth flounder and petrale sole (*Eopsetta jordani*) having their peak in 1989. There was a sharp decline in 1992 for most species, which may be related to the problem with off-bottom tows which the post-cruise analysis found for one of the two vessels used (Appendix A), and the greater number of water hauls remaining in the data set for the same vessel (Table 6). All species increased in abundance in 1995, which had the fewest number of water hauls among all earlier years (n = 9, Table 4, Table 6). All species, except for Pacific sanddab and Pacific halibut which reached their maximum in 1995, continued their increase in 1998, which had a total of four $CPUE_B$ below the minimal threshold. Dover sole, rex sole, English sole, and all flatfish species combined had their peak in 1998, and petrale sole was at 99.7% of its maximum in 1998.

1980 Jellyfish Tows

The 1980 survey had the greatest number of tows below the minimum $CPUE_B$ from 1998 (Table 4), the largest increases in biomass estimates with the truncated data sets (Table 5), and the greatest differences in comparison to 1998 $CPUE_B$ values (Fig. 1). During that survey, a small part of the survey area off Grays Harbor, Washington (Fig. 4), was nearly untrawlable because of large schools of jellyfish (Class Scyphozoa). The field party chiefs (FPCs) in charge during that portion of the survey were concerned that the jellyfish may have affected the survey in two ways; the mechanical plugging of the mesh of the net which reduced its fishing power, and also that rockfish may have left the area if jellyfish are abundant (Dark et al. 1983). Catches of fish were

felt to be unusually low in this area (Dark et al. 1983) even though high catches (range 116.0 to 747.0 kg/ha) of jellyfish occurred in just four stations in the area (Fig. 4A). After the regular survey was completed, several of these stations were retowed in an effort to obtain a good sample of the groundfish (Fig. 4B); however, these newer samples are coded differently in the database so that they were never used for stock assessments. Catches of jellyfish were extremely low on the second round of tows, while catches of canary (*Sebastes pinniger*) and yellowtail rockfish (*S. flavidus*) increased substantially (Dark et al. 1983). We used a two-tailed, paired sample t-test to determine if the catch of benthic fish and invertebrates increased significantly during the second round of sampling. Forty-two of these stations were successfully sampled twice, and there was no significant difference ($df = 41$, $\alpha = 0.05$, $P > 0.05$) in the mean catch of benthic fish and invertebrates during the regular survey (4.4 kg/ha) and afterwards (4.9 kg/ha). This indicates that there was no 'jellyfish effect' for benthic fish and invertebrates. Low catches of benthic species in the 1980 survey were most likely due to other factors, such as trawling methods.

Discussion

All previous U.S. West Coast surveys (1977-95) caught smaller amounts of benthic fish and invertebrates than the most recent survey in 1998. By removing hauls from the earlier surveys which fell below a minimal CPUE threshold of benthic species, biomass estimates for all species examined increased substantially, especially for the first three triennial surveys and the deep strata of the 1989 survey. While there is no definitive proof, it seems likely that the apparent increase in the abundance of benthic fish and invertebrates through time is due to changing bottom trawl methods. These methodology changes are primarily results of technological

advances added to the survey which afforded us a greater understanding of our bottom trawling methods and, in turn, changed the manner in which we trawl.

We speculate that few of the suspicious hauls were entirely off-bottom during the tow and that few of the remaining hauls were entirely on-bottom throughout the tow. It seems likely that most of the trawls hit bottom at some point and that there was a continuum, ranging from poor to excellent, of how well they tended bottom. The possibility that our net could be off-bottom during a trawl haul was recognized during the early West Coast surveys, but there was no effective way to monitor this possibility or to determine if this significantly affected catch rates. Early research towards developing trawl monitoring equipment produced surprising results (Wathne 1977), but the equipment was impractical to use during bottom trawl surveys.

Wathne's Net Mensuration System

Prior to the beginning of the triennial time series, Wathne (1977) determined that a nylon 400-mesh Eastern bottom trawl was off-bottom a significant amount of time during 29% of the tows monitored during a 1975 Pacific hake (*Merluccius productus*) survey on the West Coast. This 400 mesh Eastern trawl (a two bridle, 2 seam, low rise net) is smaller than the nylon Nor'eastern trawl (3 bridle, 4 seam, high rise net) used for the early triennial surveys, is constructed out of 4 inch mesh instead of 5 inch mesh, and is fished with doors of similar size and weight. Wathne (1977) determined that the net was off-bottom using a device that rode on the footrope and determined footrope height off the bottom; vertical opening of the net was estimated by subtracting the footrope height from the height estimated by another device that rode on the

headrope. Wathne (1977) demonstrated that the gear could take as long as 15 minutes to reach bottom, that it could lift off bottom before the end of the tow, that bottom contact could be poor during an entire tow, that there was a clear relationship between horizontal and vertical openings of the gear, and that the horizontal opening increased with greater depth (more wire out). Surprisingly, these 'off-bottom' hauls from the 1975 Pacific hake survey were given good performance codes, and they still reside in the database today as 'good' hauls for estimating species abundance. Apparently this Pacific hake cruise was seen as a test of Wathne's equipment and not as a test of the fishing gear.

While Wathne's experimental gear provided us with a good description of net behavior, the equipment was difficult to use, the units were subject to flooding, and data was not relayed back to the vessel in real time. Thus the equipment was never widely used and these early lessons in net behavior were quickly forgotten. The SCANMAR units that we began using in 1986 provided us with near real-time data, but the focus was on net width measurements for calculating area swept, the headrope unit produced infrequent data, and no footrope monitor was used. No post-cruise analysis of the net mensuration data, such as Wathne (1977) published, was done until after the 1992 survey, when the newly introduced microbathythermograph (MBT) data were combined with net width and height measurements. It was not until the addition of the bottom contact sensor to the 1998 survey that we began to collect the full range of data that Wathne had pioneered in 1975.

1986: Nylon Versus Polyethylene Gear

While the survey experimented with a polyethylene net as a possible replacement for the nylon net in 1986, the switch to the polyethylene net in 1989 was not based on a formal comparison of possible changes in fishing power of these West Coast data. A second experiment was conducted using both nets off Kodiak Island, Alaska, in April 1986, with larger (1.83 by 2.74 m), heavier (800 kg) doors (Wilderbuer 1988) than used on the West Coast surveys. Using four different methods for comparing the catch rate of different groundfish species, which included species of flatfish also found on the West Coast, such as arrowtooth flounder, Pacific halibut, flathead sole, rex sole, and Dover sole, Wilderbuer et al. (1998) found that the polyethylene net always had an equal or greater mean fishing power than the nylon net, although the 95% confidence intervals generally included "no difference." It is possible that the increased catch rates of $CPUE_B$ noted in this current study may be attributable, in part, to use of the polyethylene net after 1986. It is important to note that using the smaller "West Coast" doors probably affects the performance of the gear, although a two-sample t test demonstrated that there was not a significant difference ($df = 194$, $\alpha = 0.05$, $P > 0.05$) in the mean $CPUE_B$ values between the nylon and polyethylene nets used in the 1986 West Coast shelf survey.

Natural and Man-made Changes in Abundance

While we assert that the increases in $CPUE_B$ found in this study are most likely caused by changes in bottom trawling methods, it is important to consider that the increase could also be due to regime shifts, natural fluctuations in abundance, or changes in commercial fishing effort and location. Beamish (1993) linked a change in climate that occurred in 1976 to 1978 in the

North Pacific Ocean to increased production of several groundfish species occurring off the West Coast of the United States and Canada. This increased production of fish came from ocean conditions which increased the survivorship of year classes in or near 1977, including such abundant and valuable groundfish species as yellowtail rockfish, widow rockfish (*Sebastes entomelas*), Pacific ocean perch (*S. alutus*), Pacific halibut, Pacific cod (*Gadus macrocephalus*), sablefish, and lingcod (*Ophiodon elongatus*) (Beamish 1993). Anderson et al. (1997) described an epibenthic regime shift in the Gulf of Alaska from a community dominated by shrimp in the mid- to late-1970s to a community dominated by gadid and pleuronectid fish more recently. The Center's Gulf of Alaska bottom trawl surveys have shown a 13-fold increase in the estimated biomass of arrowtooth flounder, ranging from approximately 146,000 t in 1973-76, to a peak of 1,922,000 t in 1990 (Turnock et al. 2000). Clark et al. (1999) attributed an unusually high recruitment of Pacific halibut in the Gulf of Alaska and British Columbia areas from 1985 to 1996, as determined from the International Pacific Halibut Commission fishery-independent survey, to the regime shift in the late 1970s. A large increase in the estimated biomass of northern rock sole (15-fold from 1975 to 1994, Walters and Wilderbuer 2000) in the eastern Bering Sea, as estimated by another AFSC bottom trawl survey, has been attributed to changes in water temperature and climate. Fogarty and Murawski (1998) linked a change in the groundfish populations on Georges Bank, off the U.S. East Coast, from gadid and flounder species to elasmobranchs due to intense fishing exploitation levels.

Consequences

If the changes in the catch of benthic species described in this manuscript are due to changes in fishing methods as we conclude, and not due to other causes, then the results of numerous studies using West Coast bottom trawl survey data may be compromised. For example, if increasing catches of flatfish in this survey are not due to increasing populations, then stock assessments which have been tracking large increases since the 1977 survey (and especially since the 1980 survey) may need to reconsider the direction of population trends. It is important to note that the percent changes in biomass estimates shown in this manuscript are most likely underestimates of real differences. We simply recalculated biomass estimates after removing the hauls with CPUE values which fell below a very low minimum; we did not attempt to revise biomass estimates by correcting the CPUE of individual hauls. It is also important to note that these revised estimates are not intended to take the place of the original time series (indeed, these "Water hauls" still remain in the database as good performance hauls). These alternative biomass estimates are presented as examples of what the change in biomass might be, and can be used by stock assessment scientists when comparing alternative model outputs. The best stock assessment models would be those that correctly predict the biomass of benthic species in the 1998 survey (the most accurate) and also overestimate biomass from the 1980 survey (the least accurate). We are uncertain if, or how, corrections could be applied to pelagic or semi-pelagic species. An examination of the West Coast bottom trawl survey catchabilities for several rockfish species is in progress, and preliminary results indicate low catchabilities for 1977 and 1980 (pers. comm., Russell B. Millar, Dept. of Statistics, Private Bag 92019, Univ. of Auckland, Auckland, NZ).

Implications for Future Bottom Trawl Surveys on the U.S. West Coast

As this manuscript was in preparation, final steps were being taken to transfer the responsibility for the U.S. West Coast surveys from the AFSC to the Northwest Fisheries Science Center (NWFSC). While the details of the transfer are not yet final, there is a strong chance that the new West Coast surveys will be conducted by different people and different vessels using different gear and different station patterns, which could increase the likelihood for a break in West Coast bottom trawl research continuity. The detailed accounting of the methods used for conducting our surveys (Appendix A) will hopefully prove useful for the NWFSC and others to understand the AFSC trawl survey history. It is critical to realize that data produced from a survey are inextricably tied to the methods used, and that changes in methods are inevitable.

This project was the result of an accidental discovery which occurred when comparing the comments on original, handwritten data sheets from earlier surveys to experiences in the field during modern surveys. Our analysis showed that significant differences in catches between surveys are most likely due to differences in bottom trawling methods and may not accurately represent true trends in abundance. These observed trends, however, were accepted as true trends in abundance, and most likely would have persisted, especially with the impending transfer of the survey from the AFSC to the NWFSC. The reason this problem remained undiscovered is that we did not formally ask questions of our own survey; we concentrated on dragging the bottom trawl on the ocean floor and accurately recording the area swept, without recognizing that our increasing success in accomplishing these goals changed what we were catching. We provided our methods and data summaries to stock assessment scientists without analyses of the changes

in methods, and assumed that any critical analysis of our data would be performed by the stock assessment scientists. On the other hand, it appears that most stock assessment scientists relied on the field biologists to perform any critical analysis of methods which might affect abundance trends, and did not understand the implications for the changes in methods that we reported.

A formal analysis of field data can only be as good as the understanding of the data collection methods. Data, data collection, data analysis, and proper interpretation of the analysis should necessarily be tied closely together. Of course, it is impossible for any one person to do all the work (for example, being on two survey vessels which are fishing simultaneously); however, the current division of labor between field biologists and stock assessment scientists makes it more difficult to identify and resolve problems. Undoubtedly more unforeseen problems will arise from time to time as other retrospective analyses are completed and as the survey continues to change. The only way a complete understanding will develop is for researchers to be heavily involved in all aspects of the data collection and analysis.

Although this survey began as an exemplary cooperative arrangement between university, state and federal (both U.S. and Canadian) participants in 1976 and 1977 (Gunderson 1976, Gunderson and Lenarz 1980), over time a large and profound gap in knowledge and experience has developed between the two groups involved with the survey; those who plan and conduct the survey, and those who analyze the data. Currently there is little overlap between these two groups; field biologists are only marginally involved in the stock assessment process as data providers, and stock assessment scientists generally do not participate in the West Coast shelf

survey. Certainly this is a joint problem, which can only be solved by both groups working together. We hope that the results of this manuscript will not simply be used as a quick fix for interpreting our bottom trawl data, but instead that this manuscript will prompt a closer working relationship between the field biologists and the stock assessment scientists.

Acknowledgments

This project benefitted greatly from discussions with several stock assessment scientists involved with West Coast fisheries, including Gary Stauffer from the AFSC, Tom Helser, Rick Methot and others from the NWFSC, and from discussions with field biologists too numerous to mention. The lead author is greatly indebted to the moral support from the few colleagues who also feel that our current system of collecting field data without appropriate analysis and providing it to stock assessment scientists who have little experience with the survey is fundamentally flawed.

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Table 1.--Changes in trawling gear and electronic monitoring equipment used during the National Marine Fisheries Service U.S. West Coast triennial bottom trawl survey from 1977 to 1998. The symbol 'Y' is used to indicate which gear or method was used in each survey. Species or species groups with higher survey priorities are indicated by the values of 1 and 2, and those with lower priorities are indicated by 3 and 4. Distance between transect lines are in kilometers for the different high density areas. Minimum and maximum depth boundaries for the survey are in meters. Minimum and maximum latitudes are in degrees and minutes, with the exception of the U.S. - Canada border, which is indicated by 'boundary.'

	Survey year							
	1977	1980	1983	1986	1989	1992	1995	1998
Nor-eastern trawl								
Nylon	Y	Y	Y	Y				
Polyethylene				Y	Y	Y	Y	Y
Dandylines								
3/8 and 1/2 inch	Y	Y						
5/8 inch			Y	Y	Y	Y	Y	Y
Standardized doors		Y	Y	Y	Y	Y	Y	Y
Wire out determined by;								
Captain	Y	Y	Y	Y	Y	Y		
Table							Y	
Experiment							Y	Y
Survey priority								
general rockfish	1				4	4		
hake	2	2	1	2	2	2	2	2
multispecies	3	3	3	3	1	1	1	1
juvenile sablefish					3	3		
canary and yellowtail		1	2	1				

Table 1.--Continued.

	Survey year							
	1977	1980	1983	1986	1989	1992	1995	1998
High density areas for								
general rockfish	9.3							
hake	18.5	11.1	11.1		9.25	9.25	18.5	18.5
multispecies		22.2	22.2	7.4	18.5	18.5	18.5	18.5
juvenile sablefish								
canary and yellowtail		5.6	5.6	3.7				
Minimum depth (m)	91	55	55	55	55	55	55	55
Maximum depth (m)	457	366	366	366	366	366	500	500
Southern latitude boundary	34 00	36 48	36 48	36 48	34 30	34 30	34 30	34 30
Northern latitude boundary	border	50 00	49 15	border	49 40	49 40	49 40	49 40

Table 2.--Methods used for determining subjective events are indicated by a 'Y' during the National Marine Fisheries Service U.S. West Coast triennial bottom trawl survey from 1977 to 1998. If multiple methods were used during the survey, the most significant method in terms of decision-making are indicated by a bold 'Y.'

	Survey year							
	1977	1980	1983	1986	1989	1992	1995	1998
Order of events								
Tow start								
Doors dropped								
On-Bottom determination								
Wait 3-8 minutes	**Y**	**Y**	**Y**	**Y**	**Y**	Y	Y	Y
Real time SCANMAR							**Y**	Y
Post-haul MBT						**Y**	Y	Y
Post-haul BCS								**Y**
Equilibrium determination								
Equals On-Bottom	**Y**	**Y**	**Y**	**Y**	**Y**	Y	Y	Y
Real time SCANMAR							**Y**	**Y**
Post-haul MBT						**Y**	Y	Y
Post-haul BCS								Y
Haul-Back								
Start reel in wire								
Off-Bottom determination								
Equals Haul-Back	**Y**	**Y**	**Y**	**Y**	**Y**	Y	Y	Y
Real time SCANMAR							**Y**	Y
Post-haul MBT						**Y**	Y	Y
Post-haul BCS								**Y**
End of tow								
Doors up								
Net width estimation								
Unmeasured, single value	Y	Y	Y					
Measured mean per vessel/net				Y				
Per tow and by equation				(Y)	Y	Y	Y	Y

Table 3.--Species and taxa included in the group of most benthic fish and invertebrates ($CPUE_B$) for purposes of estimating which hauls caught insufficient benthic species and were assumed to be off-bottom in the National Marine Fisheries Service U.S. West Coast triennial bottom trawl survey.

Fish

Myxinidae (Hagfish)
Rajidae (Skates)
Torpedinidae (*Torpedo californica*)
Pleuronectiformes (Flatfish)
(except *Hippoglossus elassodon*)
Agonidae (Poachers)
Anarhichadidae (Wolf-eel)
Bathymasteridae (Ronquils)
Batrachoididae (Midshipman)
Ophidiidae (Cusk-eels)
Cottidae (Sculpins)
Liparidinae (Snailfish)
Cryptacanthodidae (Wrymouths)
Stichaeidae (Pricklebacks)
Zoarcidae (Eelpouts)
Sebastolobus spp. (Thornyheads)

Invertebrates

Alyconacea (Soft coral)
Gorgonacea (Coral unident.)
Pennatulacea (Sea pens)
Actiniaria (Sea anemones)
Madreporaria (Stony corals)
Polychaeta (Polychaete worms)
Aphroditidae (Sea mice)
Arthropoda except
Euphausiacea,
Mysidacea,
Cirrepedia,
Pasiphaeidae
Nudibranchia
Mollusca except
Cephalopoda
Echinodermata (Seastars, Urchins, Cucumbers)
Porifera (Sponge)
Platyhelminthes (Flatworm)
Sipuncula (Sipunculid worm)
Echiura (Echiuroid worm)
Bryozoa
Brachiopoda
Ascidiacea (Tunicates)
Unidentified invertebrates and eggs
Empty shells

Table 4.--Total number of hauls, hauls removed due to the minimal $CPUE_B$ level, and the percent of hauls removed for each year of the National Marine Fisheries Service U.S. West Coast triennial bottom trawl survey.

Year	Total Hauls	Number Removed	Percent Removed
1977	664	89	13.4
1980	505	156	30.9
1983	561	40	7.1
1986	507	23	4.5
1989	540	34	6.3
1992	502	19	3.8
1995	521	9	1.7

Table 5.--Percent change in biomass caused by removing those hauls with small catches of benthic fish and invertebrates. Changes are calculated only for U.S. portion of each the National Marine Fisheries Service U.S. West Coast triennial bottom trawl surveys.

Year	Depth	Pacific sanddab	Petrale sole	English sole	Rex sole	Dover sole	Pacific halibut	Total Flatfish	Sable-fish	Short-spine
1977										
	91-183	31.2	21.7	33.6	14.9	20.1	117.0	18.8	22.3	7.8
	184-366	11.7	4.2	9.2	8.7	10.0	2.5	6.7	5.3	8.5
	367-475	0.0	4.3	6.1	10.3	11.2	0.0	10.9	11.9	8.3
	Total	31.1	18.3	29.9	11.5	13.7	76.6	12.6	12.7	8.3
1980										
	55-183	56.4	48.1	45.2	55.2	49.1	69.6	44.3	59.0	49.6
	184-366	26.9	18.1	18.1	27.4	36.1	60.0	33.2	67.1	44.4
	Total	56.1	45.1	44.1	46.6	43.1	65.5	40.9	60.1	45.8
1983										
	55-183	7.3	9.6	7.0	7.8	7.8	10.0	7.6	8.6	10.1
	184-366	2.1	1.0	3.4	1.9	2.2	0.0	1.8	1.8	1.8
	Total	7.3	9.1	6.8	6.1	4.8	9.2	5.8	6.2	2.6
1986										
	55-183	3.5	3.0	2.6	1.8	0.7	2.2	2.3	1.0	0.6
	184-366	0.0	2.9	4.0	2.5	1.7	0.9	2.9	4.5	8.0
	Total	3.5	3.0	2.7	1.9	1.0	2.0	2.4	1.8	6.8
1989										
	55-183	5.8	4.8	4.3	4.6	5.5	5.3	5.0	3.3	4.8
	184-366	7.1	41.6	16.4	28.5	27.9	12.2	19.7	20.3	19.1
	Total	5.8	6.0	4.7	9.3	13.2	6.7	7.1	7.6	16.9
1992										
	55-183	2.5	2.1	2.1	1.1	0.8	3.1	2.0	5.0	-2.0
	184-366	0.0	1.2	0.5	1.1	1.6	0.2	1.1	0.2	0.5
	Total	2.5	2.0	2.0	1.1	1.3	1.9	1.8	1.7	0.4
1995										
	55-183	1.6	2.0	0.8	0.9	1.0	1.8	1.3	0.8	0.6
	184-366	0.0	1.6	0.0	4.0	2.5	0.0	2.1	-1.5	0.2
	367-500	----	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	1.6	2.0	0.7	1.6	1.1	1.5	1.3	-0.5	0.1

Table 6.--On-bottom and off-bottom hauls for each cruise in the National Marine Fisheries Service U.S. West Coast triennial bottom trawl survey.

		On-bottom hauls		Off-bottom hauls		
Year	Vessel	Count	Percent	Count	Percent	Total
1977	RV Commando	248	0.90	28	0.10	276
1977	MV Pacific Raider	207	0.90	23	0.10	230
1977	MV Tordenskjold	75	0.99	1	0.01	76
1977	David Starr Jordan	45	0.55	37	0.45	82
1980	MV Mary Lou	159	0.65	85	0.35	244
1980	MV Pat San Marie	190	0.73	71	0.27	261
1983	Warrior II	246	0.94	17	0.06	263
1983	Nordfjord	275	0.92	23	0.08	298
1986	MV Pat San Marie	292	0.94	19	0.06	311
1986	RV Alaska	192	0.98	4	0.02	196
1989	MV Pat San Marie	274	0.93	21	0.07	295
1989	Golden Fleece	232	0.95	13	0.05	245
1992	Green Hope	289	0.94	18	0.06	307
1992	RV Alaska	194	0.99	1	0.01	195
1995	RV Alaska	293	0.99	2	0.01	295
1995	FV Vesteraalen	219	0.97	7	0.03	226

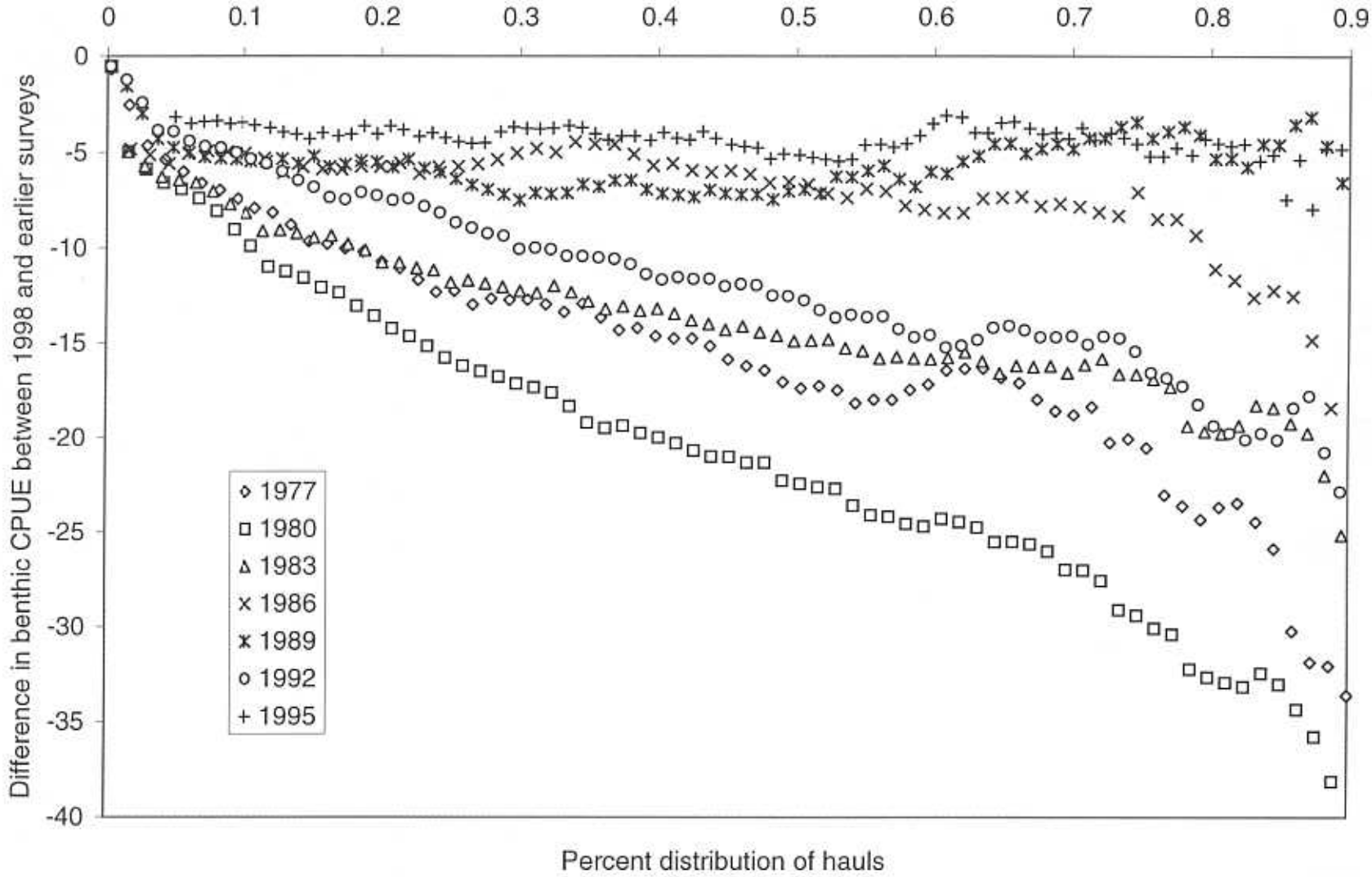

Figure 1. --Differences in benthic CPUE (in kg/ha) between 1998 and each of the earlier surveys (1977-1995). Each comparison is made between latitude and depth truncated data sets for similar coverages. Each difference is calculated by subtracting the benthic CPUE from the value at the same accumulated percent from 1998.

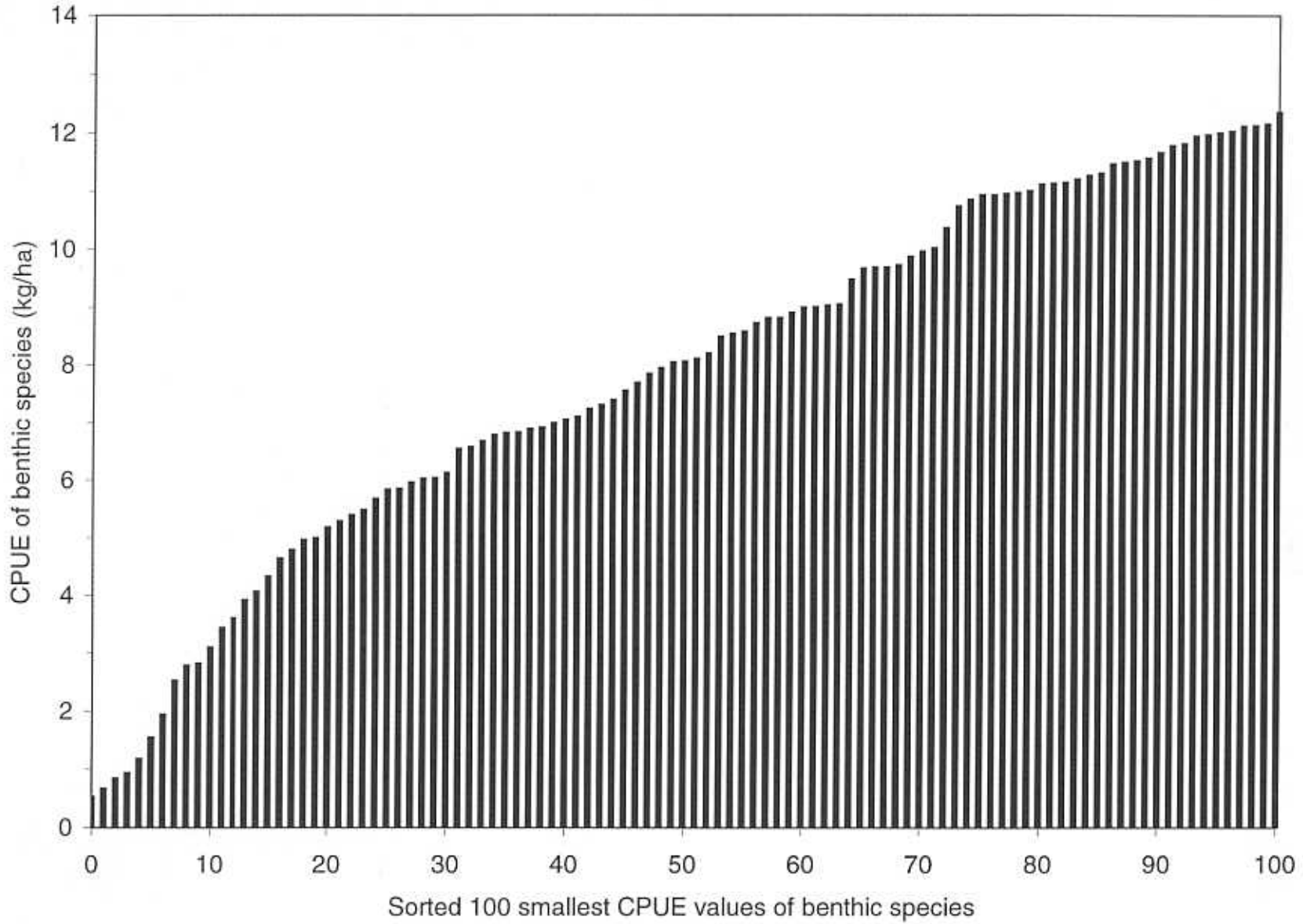

Figure 2. Sorted 100 smallest CPUE values of benthic species in the 1998 West Coast triennial survey.

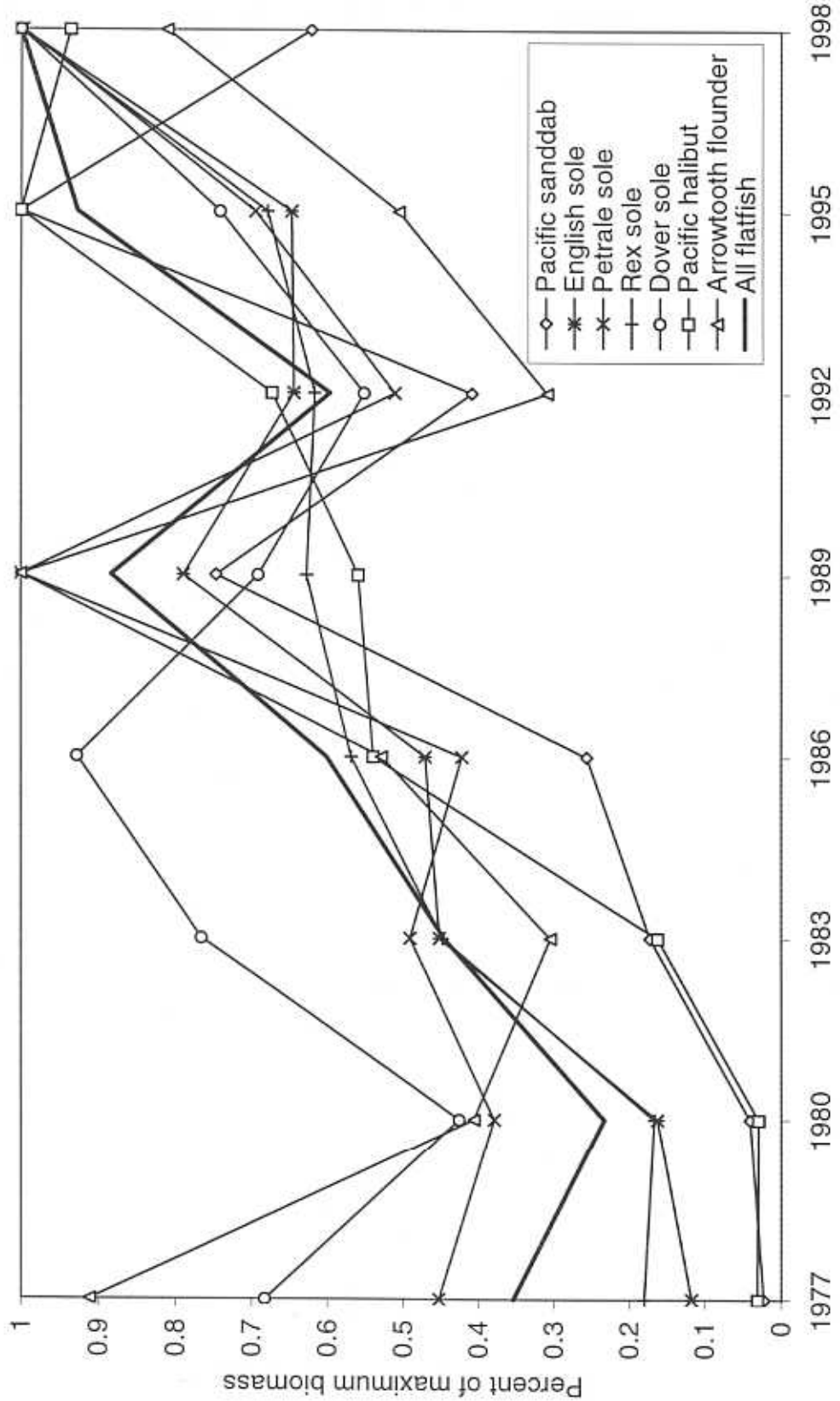

Figure 3. --Percent of maximal biomass of the seven most abundant flatfish species, and all flatfish species combined, during the West Coast triennial surveys. Percent of maximal biomas was calculated by dividing the estimated biomass for each year by the maximal biomass estimated over all survey years for each species.

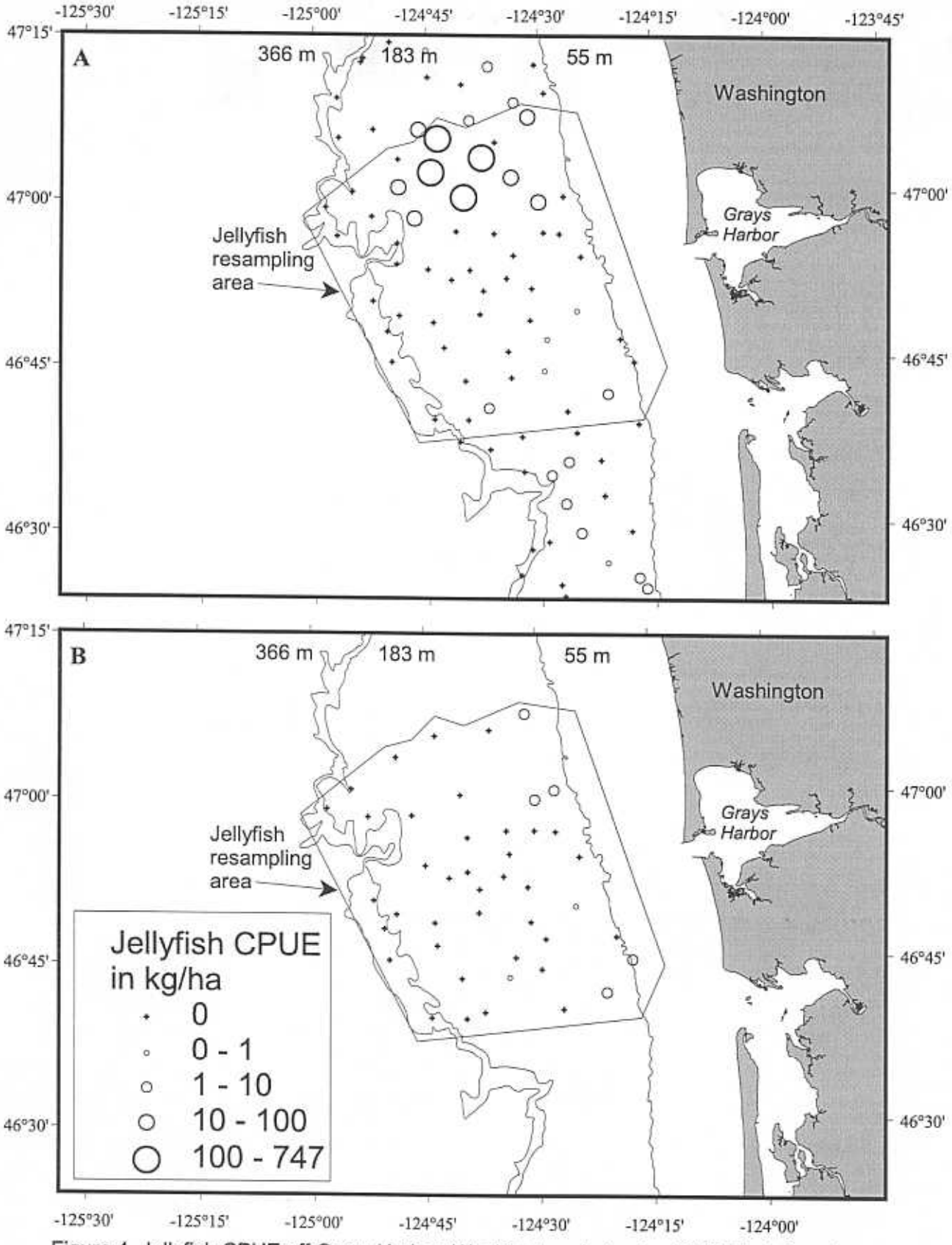

Figure 4. Jellyfish CPUE off Grays Harbor, Washington, during the 1980 West Coast triennial survey (A) and after the regular survey was completed (B).

APPENDIX A

Trawl Survey History

Appendix A contains a detailed history of some of the more significant changes made in the bottom trawling methods of the National Marine Fisheries Service U.S. West Coast triennial bottom trawl survey.

Figure A-1. This is a duplicate of a figure from the original program for plotting net spread (top panel), net height (middle panel), and depth recorded by the microbathythermograph (bottom panel) for Haul 37 conducted by the Green Hope during the 1992 National Marine Fisheries Service U.S. West Coast triennial bottom trawl survey. Each plot is graphed against time (the X-axis) and on the original scale for each Y-axis. This is approximately how the data would have been originally viewed at sea. The plots show that there is some variation in horizontal net opening but there was no apparent relationship to the increasing net height data. There are only small apparent changes in depth.

Figure A-2. The same data are plotted for Haul 37, from the Green Hope in 1992, but with the lower portion of the Y-axis expanded on the bottom panel, as the data would have been seen using the updated plotting program. The scales on the Y-axes of the middle and top panels have also been changed to emphasize trends in the data. From this it is clear that there is a relationship between the vertical net opening and depth, with the net descending in the water column and reaching a minimum around 11:45, then gradually rising off-bottom until about 12:00, when it

climbed to its maximum height off-bottom just prior to 12:15, then descended before being pulled back to the surface. This haul was originally judged to have been a good performance haul, but by replotting the net mensuration and trawl depth data, it was reclassified as being 'off-bottom' and, in fact, may never have reached the bottom.

Figure A-3A. This is the board used for attaching the SCANMAR headrope unit to the net. The board is constructed from ultra high molecular weight (UHMW) plastic. It is hard and heavy yet flexible. The board is gored to the mesh of the net through the four small holes near the corners labeled with 'A.' Vertical signals are sent from the unit to the seafloor through the hole indicated by 'B.' The notches at the far end of the board are where the rubber band of the headrope unit attaches are indicated by 'C.' A-3B. The SCANMAR headrope unit attached to the board with two shackles 'A' at the forward end and a large rubber band at the rear end 'B.' Height signals are sent from the unit towards the ship through the circle indicated by 'C.'

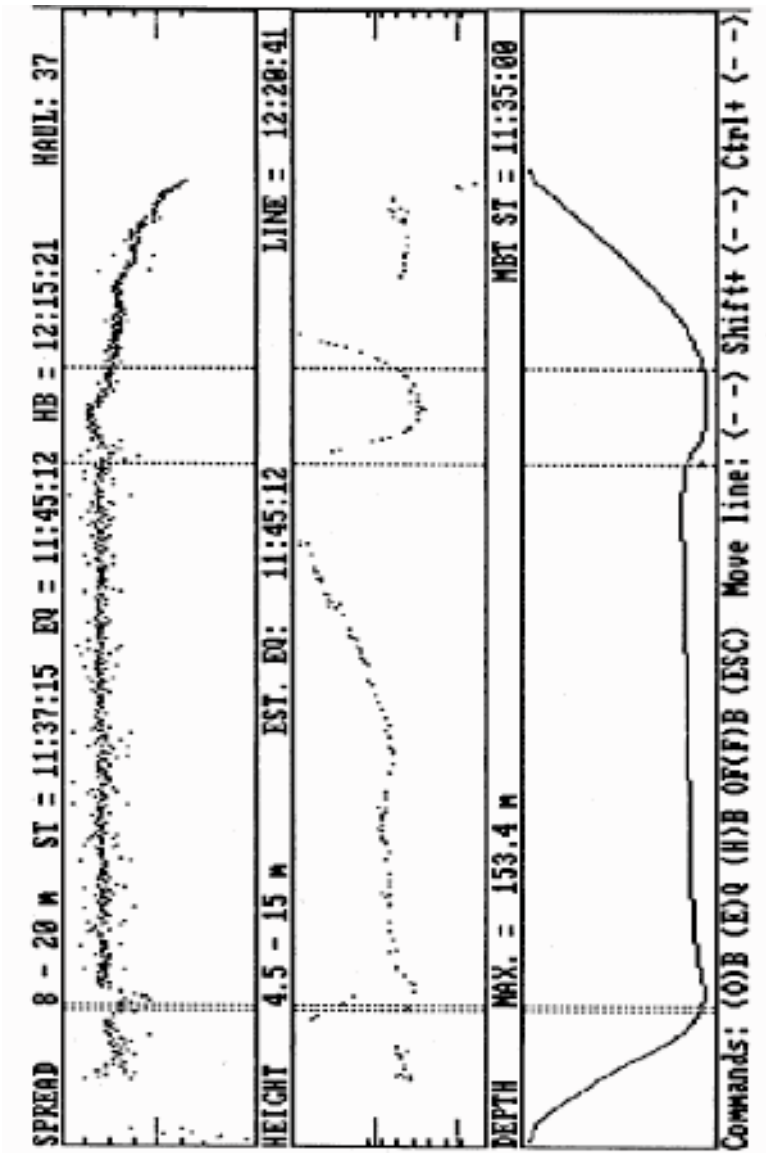
SPREAD 8 - 20 m ST = 11:37:15 EQ = 11:45:12 HB = 12:15:21 HAUL: 37
HEIGHT 4.5 - 15 m EST. EQ: 11:45:12 LINE = 12:20:41
DEPTH MAX. = 153.4 m MBT ST = 11:35:00
Commands: (O)B (E)Q (H)B OK(F)B (ESC) Move line: <- -> Shift+ <- -> Ctrl+ <- ->)

Figure A-1

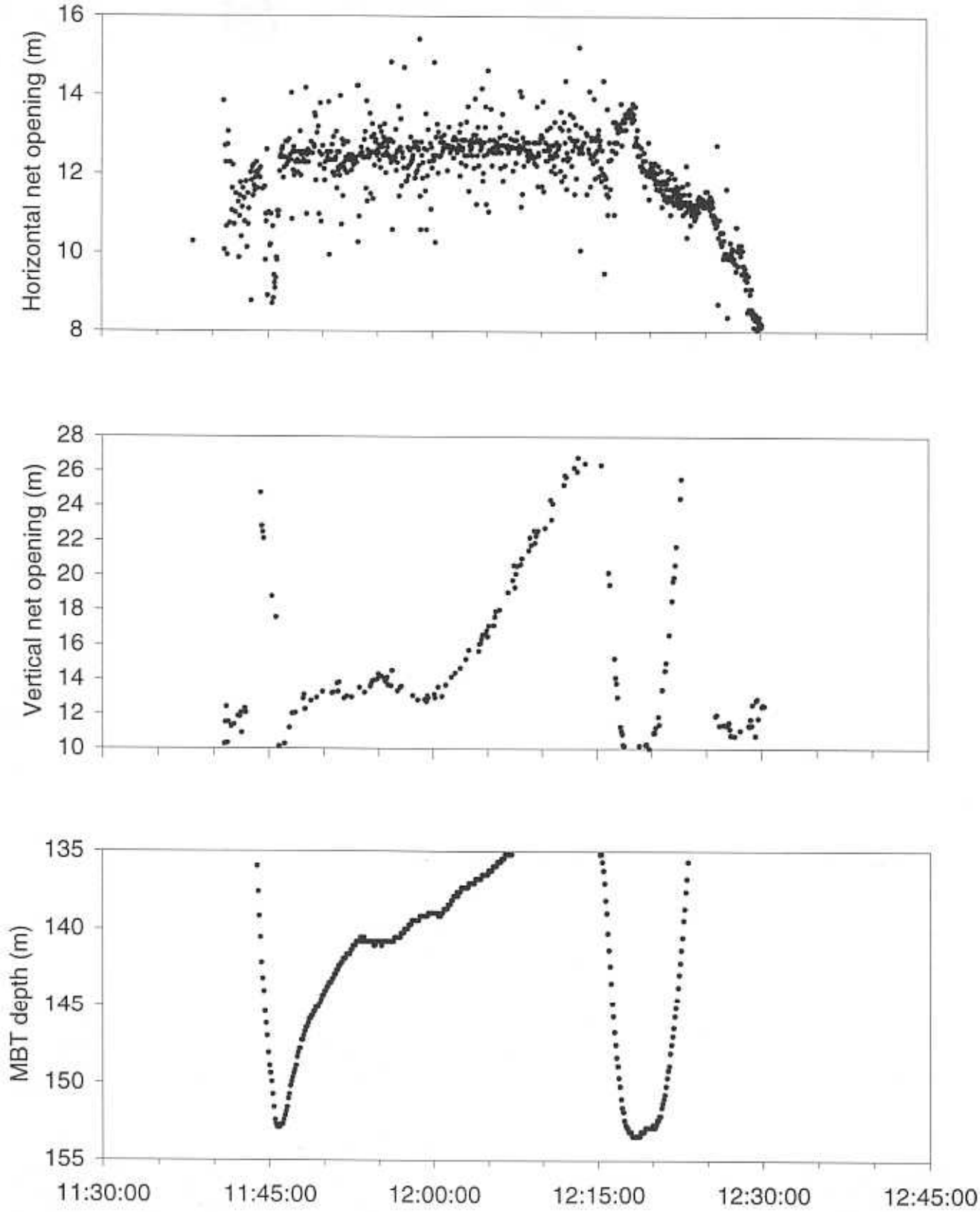
Horizontal net opening (m)
16
14
12
10
8
Vertical net opening (m)
28
26
24
22
20
18
16
14
12
10
MBT depth (m)
135
140
145
150
155
11:30:00
11:45:00
12:00:00
12:15:00
12:30:00
12:45:00

Figure A-2

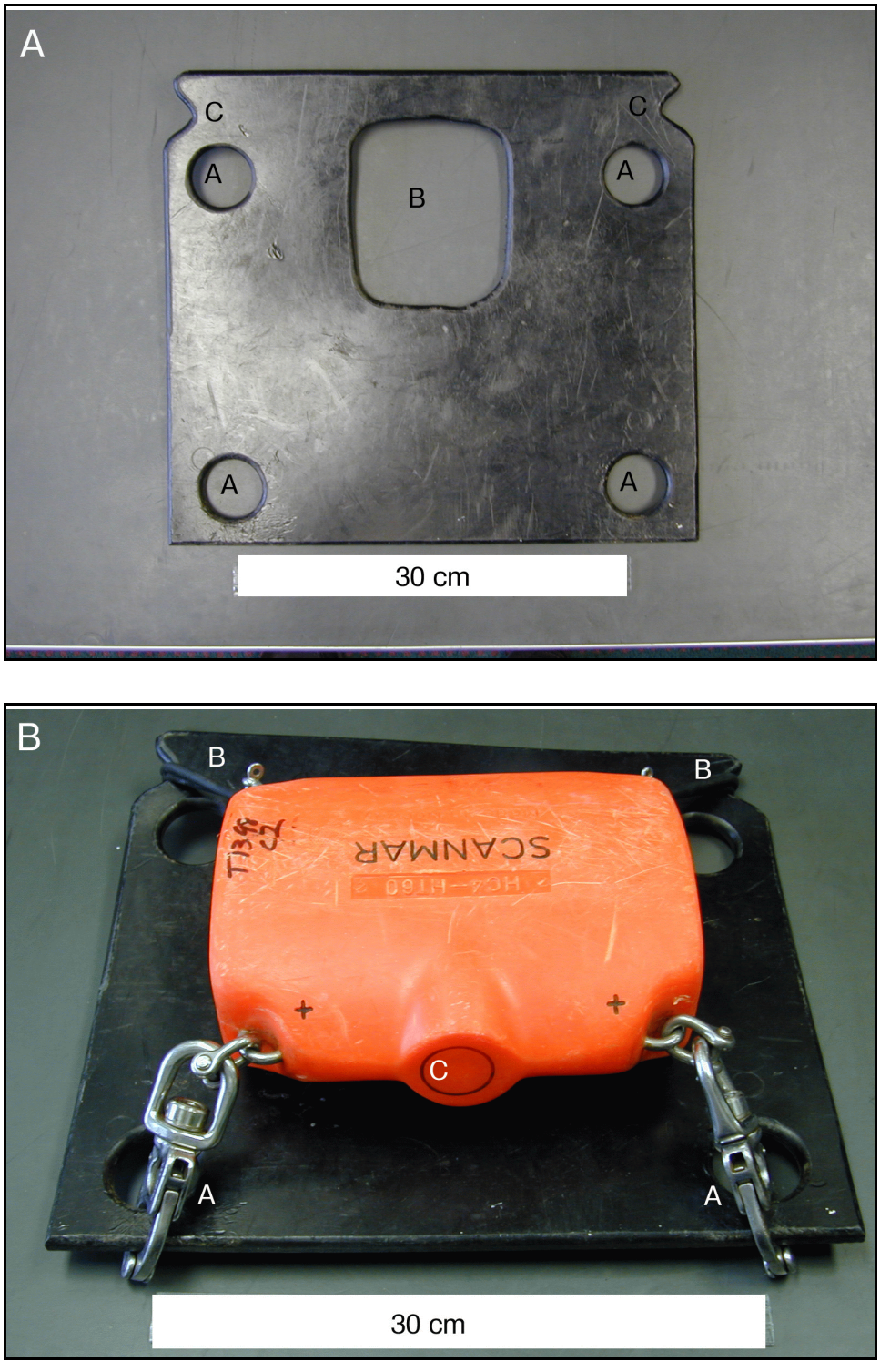

Figure A-3

Early Surveys of 1977 to 1983

Understanding the evolution to the 1998 trawling methodology and post-cruise data treatment requires a detailed look at the original procedures in effect during the 1977, 1980, and 1983 surveys. Although some elements of survey design differed between these surveys (see Table 1), the general at-sea methodology for locating trawl sites, setting, towing, and retrieving the bottom trawl, for determining the path width of the trawl, the distance fished at each tow, and post-cruise editing remained the same. Charts were prepared delineating the survey bounds and showing pre-determined stations marked by an "x" on evenly spaced tracklines. Chartered fishing vessels usually sampled stations on alternate tracklines. Vessel captains were instructed by the fisheries biologist in charge (the field party chief or FPC) to proceed to a station and make a tow. The actual tow site was determined by the vessel's captain. Ideally, the tow path would pass through the "x"; however, any tow was labeled successful if a portion of it passed within one nautical mile (nmi). Based on the vessel captain's interpretation of echo sounder information at the site, the tow was attempted or the captain searched for an alternate tow location within 1 nmi of the "x" and within the same stratum. One-half hour was allotted for finding an alternate tow location (Gunderson and Sample 1980), although search time varied widely, and if no suitable ground could be found then the station was abandoned. A standardized nylon Nor'eastern bottom trawl equipped with rubber bobbin roller gear was used by all vessels during the 1977, 1980, and 1983 surveys. Trawl doors varied slightly in weight in the 1977 survey (454 to 567 kg, Gunderson and Sample 1980) and were standardized in 1980 when 1.5 x 2.1 m, 567 kg steel V-doors were employed (Weinberg et al., 1984). The three sets of 55 m (30 fm) long dandylines (or sweeps) connecting the door to the trawl were standardized at 5/8 inch diameter in 1983 (Weinberg et al.,

1984). Tail chains, which connect the doors to the dandylines, were tailored to an appropriate length for the beam and deck configuration of each vessel. This practice continued for all triennial surveys through 1998. For the 2001 triennial, tail chains were standardized at 15.2 m (50 ft).

A basic trawl haul consisted of setting the gear, dragging the net on the bottom for one-half hour (a minimum of 15 minutes was acceptable in rough areas), then retrieving the gear. The vessel captain determined the amount of wire to use, the tow direction, and the speed required to land the net at the desired location, presumably based on previous fishing experience. Once the wire was paid out, the winch brakes were set and the vessel slowed to allow the net to settle to the ocean floor for 3 to 8 minutes, depending on the depth. When it was felt that the gear had had sufficient time to settle to the bottom (On Bottom or OB), the vessel captain increased the vessel's speed over ground to 1.54 m/s (3.0 knots) as determined by Loran C, bringing the net into equilibrium (EQ) fishing configuration and indicating the official start of a haul. Thus OB and EQ were considered to be a single event at the starting position. After 30 minutes of trawling, the vessel's engine power was reduced and the winches were engaged to haul back the net (HB), at which point the ending time and position were recorded. Haul-back was also assumed to be the moment the net lifted off bottom (FB) and fishing ceased. The Loran C-based positions at the time of OB/EQ and HB/FB were used as the start and end positions for the computation of tow effort. Adjustments to distance fished due to significantly curved tows were approximated. Effort was computed as the distance fished between EQ and HB multiplied by the width of the trawl from wingtip to wingtip. No net mensuration gear was used during these first

surveys, instead a standard net width (13.4 m) (Gunderson and Sample 1980) determined by an electronic net mensuration system (Wathne 1977) from an earlier cruise was used for all tows. Water column temperatures were collected by dropping expendable bathythermographs (XBTs) over the side of the ship. Tows in which the gear sustained damage were determined to be satisfactory or unsatisfactory by the discretion of the FPC, based on the extent to which the damage allowed spillage of the catch. If the gear came up with severe damage the station was typically abandoned rather than retowed.

Transition Surveys of 1986 and 1989

The 1986 triennial survey was a transition year between the "old" and the "modern" way of conducting the survey. The most significant changes were experimental trawling with a polyethylene Nor'eastern and the first use of acoustical net mensuration equipment (SCANMAR) during the trawl survey (Coleman 1988). The switch to a polyethylene net was proposed for several reasons; the new material was supposed to be more durable, rip straighter, and hold its shape better to facilitate repair, and was less susceptible to snags in the belly because it is more buoyant than nylon (Wilderbuer 1988). The polyethylene net design is similar to the nylon net, except that the mesh in the lower of three wings were eliminated ("flying wings") to reduce the occurrence of damage caused by snags in rough areas. One vessel fished alternate stations with both types of net, while the other vessel used the nylon net for the entire survey, and measurements of the gear dimensions were made for both vessels The SCANMAR trawl mensuration system, which has been used in all subsequent surveys, was intended to provide horizontal net measurements between the upper wing tips for effort calculations, but also came

with a headrope unit which measured the distance from the headrope to the ocean floor. These units communicated acoustically with a hydrophone deployed from the vessel, delivering near real time measurements to the bridge. Height and width measurements could thus be observed as they were made, and net conditions could be monitored continuously. While the advent of this new tool was significant to the West Coast triennial survey, its impact on trawling operations was limited because it was used on few trawl hauls and probably did not greatly influence our manner of fishing. On occasion it permitted an FPC to terminate a tow based on readings indicative of poor net performance, such as unusually low net spread or vertical openings. The ability to label a tow unsatisfactory based on spread or height, then retow the station was not an option in earlier surveys. More importantly, the mensuration data were used to compute a new average path width for each vessel and each net type (nylon path width = 12.78 m, and polyethylene path width = 13.82 m, Coleman 1988) in 1986, thus changing the effort calculations from that used in earlier surveys (Weinberg 1994, Dark and Wilkins 1994). (More recently, the path widths were estimated for tows made in 1986 without measurements, based on relationships between trawling depth and net width, and are currently used for calculating CPUE values).

The polyethylene Nor'eastern did seem to be more durable than the nylon net, and since no apparent differences were noticed in its ability to catch fish, we converted over completely to its use in the 1989 triennial. During 1989 both of the chartered vessels were equipped with net mensuration equipment; however, it was still not consistently yielding quality data on every tow. Our increasing familiarity with SCANMAR equipment began influencing our fishing methods more often than in 1986. While we still allowed a settling time of 3-8 minutes, we were more

likely to pay attention to the spread and height readings to help determine when the net was in fishing configuration. For the first time, net width was estimated for all tows following the survey, either by mensuration data collected during a tow, or by an equation relating net width to scope for tows without adequate mensuration data (Weinberg et al. 1994).

Modern surveys of 1992 to 1998

In the 1992 triennial, we replaced the XBTs with micro-bathythermographs (MBTs) which recorded water column temperature and trawling depth at the trawl headrope; positions were recorded continuously with standard GPS (global positioning system) instead of Loran C; real-time SCANMAR data supplemented known sinking rates to help estimate OB; and tow quality was re-examined after the survey utilizing the SCANMAR, MBT and GPS data (Zimmermann et al. 1994). For the first time, differences between OB and EQ, and between HB and FB, could be distinguished in terms of time and distance by plotting the SCANMAR, MBT, and GPS data simultaneously, thus affecting effort computations (Fig. A-1). This innovation was available in a data editing program during the survey. The post-cruise analysis utilized a revised version of the data editing program which permitted changing the scale of the MBT plot such that the bottom 20 m could be expanded (Fig. A-2). With this expansion, we began to interpret the data in a new way. One could review tow data and better estimate when the net came into contact and left the bottom. The haul plotted in Figure A-2 might never have actually touched bottom, but it clearly came closest to the bottom near the tow start at 11:45 and tow end at 12:20, and was far off-bottom between those times. This conclusion can be made because the vertical net opening increases from 10 m to 26 m off bottom (middle panel, Fig. A-2), well above the normal values

for this vessel (average = 12.52 m, range 9.5-16.1 m, Zimmermann et al. 1994), and the change in vertical net opening coincides with a similar increase in the net height off bottom (bottom panel, Fig. A-2). By reinterpreting these trawl data, the post-cruise analysis concluded that 24 hauls from one vessel were probably off-bottom and removed from the data set, while six other hauls from the same vessel may have been off-bottom but the data were too ambiguous to justify their deletion. None of the hauls from the other vessel were reclassified as being off-bottom during the post-cruise analysis. While the survey was underway, a total of eight hauls between the two vessels were determined to be off-bottom and some were retowed. Retowing stations based on analysis of net mensuration readings had not occurred in previous surveys.

In 1995, four important changes took place. First, with increased experience in using all of our instruments, the FPC took a larger role in fishing decisions, while the vessel captain's influence was reduced. Second, we provided the vessel captain with the amount of wire to use at each station based on modified values taken from an empirical experiment (Wilkins et al. 1998). The third major change in 1995 involved the manner in which the trawl was set. While in earlier surveys the trawl was allowed to settle to the bottom by slowing the vessel down, in 1995, we began attempting to "land" the net on the bottom at the towing speed of 1.54 m/s (3.0 knots), so that it would be near its equilibrium configuration at OB (Wilkins et al. 1998). Flying the net into the tow at trawling speed probably served to increase the distance fished because the net began trawling earlier in the towing period. The fourth difference was the consistent collection of high quality net height data, probably the result of fixing the SCANMAR headrope units to hard, plastic boards, gored to the headrope as semi-permanent platforms (Fig. A-3).

When SCANMAR is working well, the headrope unit readings reflect off the ocean floor from as high as 50 m, and an FPC can watch these decrease while the net sinks to the bottom and reaches stable net configuration - a significant advancement over estimated settling times of earlier surveys. The middle panel in Figure A-2 illustrates the different net height measurements which are observed during a tow with consistent, high quality signals. Initially, there are low height values (10 to 13 m, prior to 11:45) made while the net is sinking through the water column, still high above the seafloor, which are actually false readings - the headrope sensor is receiving reflections from the bottom of the net instead of the seafloor. Then, around 11:45, there are a group of six signals showing the net height decreasing from about 25 to 17 m, which are reflections off the seafloor as the net nears the bottom. After 11:45 there are low height signals of 10 to 13 m, indicating the headrope is close to the seafloor. The net in this figure then behaves abnormally between 11:45 and 12:20 by being far off-bottom. Vertical net openings clearly increase from about 10 to 26 m after 12:20, indicating the net is being retrieved off the sea floor, and then there are a series of false readings off the footrope while the net is well off the bottom between 12:25 and 12:30. These different types of signals at the beginning and end of a tow illustrate how these SCANMAR readings can be used to monitor the tow performance.

The 1998 survey was the most technologically advanced, incorporating all of the previous advancements and adding a new one - a bottom contact sensor (BCS) (Shaw et al. 2000). This device is a tilt-meter housed in a heavy, steel case which dangled from the fishing line; it is vertical when the net is off the bottom, and more horizontal when the net is in contact with the bottom (Somerton and Weinberg In Press). After the tow the BCS data were downloaded,

synchronized, and plotted along with the MBT, net spread, and net height, providing the FPC with the most comprehensive picture of trawl performance yet possible. The addition of the BCS data eliminated much of the subjective interpretation of using SCANMAR and MBT plots in earlier years and, for the first time, the moment the net contacted (OB) and left the bottom (FB) was determined by events occurring at the footrope. Decisions on tow success and the timing of events were made immediately after each trawl haul, then reviewed during post-cruise analysis. During the 1998 survey, several stations were retowed based on evidence that the net had come off bottom for a significant part of the tow. Additional changes incorporated into the 1998 survey included using different scope ratios based on results of empirical scope experiments conducted by each vessel at the beginning of the survey, extending the search area around a station from a 1 to 2.5 nmi radius (Shaw et al. 2000), and the instructions to skip several stations that had been untrawlable in previous surveys. Because the BCS was a device which was allowed to dangle, it sometimes rotated out of the appropriate plane for which measurement was desired. A new type of BCS, which is on a sled that moves in a fixed plane, was tested during the 1998 survey, and will be used in the 2001 triennial survey.

APPENDIX B

Original and Revised Biomass Estimates for 1977

Appendix B contains original estimates of biomass and variance, revised estimates of biomass and variance when hauls with small catches of benthic fish and invertebrates are removed, and percent change in biomass and variance estimates. Change is indicated per individual strata for Pacific sanddab (*Citharichthys sordidus*), petrale sole (*Eopsetta jordani*), English sole (*Parophrys vetulus*), rex sole (*Glyptocephalus zachirus*), Dover sole (*Microstomus pacificus*), Pacific halibut (*Hippoglossus stenolepis*), sablefish (*Anoplopoma fimbria*), shortspine thornyhead (*Sebastolobus alascanus*), and all flatfish species combined.

Table B-1.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Pacific sanddab in 1977.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
US Vancouver							
	91-183 m	21.0	107.7	22.8	125.0	8.4	16.1
	184-366 m	0.0	-	0.0	-		
	367-475 m	0.0	-	0.0	-		
	91-475 m	21.0	107.7	22.8	125.0	8.4	16.1
Columbia							
	91-183 m	235.8	5,594.2	287.7	8,246.0	22.0	47.4
	184-366 m	0.0	-	0.0	-		
	367-475 m	0.0	-	0.0	-		
	91-475 m	235.8	5,594.2	287.7	8,246.0	22.0	47.4
Eureka							
	91-183 m	8.1	54.9	19.3	304.6	137.5	454.5
	184-366 m	0.0	-	0.0	-		
	367-475 m	0.0	-	0.0	-		
	91-475 m	8.1	54.9	19.3	304.6	137.5	454.5
Monterey							
	91-183 m	669.6	23,397.9	872.4	34,289.5	30.3	46.5
	184-366 m	1.7	1.1	2.0	1.7	20.8	49.8
	367-475 m	0.1	0.0	0.1	0.0	0.0	0.0
	91-475 m	671.4	23,399.0	874.5	34,291.2	30.3	46.5
Conception							
	91-183 m	107.7	1,353.8	165.6	2,907.3	53.8	114.8
	184-366 m	3.1	5.5	3.4	5.9	6.9	6.1
	367-475 m	0.0	-	0.0	-	0.0	
	91-475 m	110.8	1,359.3	168.9	2,913.1	52.5	114.3
Total US Survey Area							
	91-183 m	1,042.2	30,508.5	1,367.8	45,872.3	31.2	50.4
	184-366 m	4.8	6.7	5.4	7.6	11.7	13.5
	367-475 m	0.1	0.0	0.1	0.0	0.0	0.0
	91-475 m	1,047.2	30,515.1	1,373.3	45,879.9	31.1	50.4

Table B-2.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for petrale sole in 1977.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
US Vancouver							
	91-183 m	399.4	31,440.0	456.9	43,062.7	14.4	37.0
	184-366 m	14.2	47.9	14.2	47.9	0.0	0.0
	367-475 m	0.0	-	0.0	-		
	91-475 m	413.6	31,488.0	471.1	43,110.6	13.9	36.9
Columbia							
	91-183 m	525.3	13,599.3	614.5	19,075.7	17.0	40.3
	184-366 m	223.6	18,165.1	227.3	18,219.1	1.6	0.3
	367-475 m	33.8	774.1	35.2	842.1	4.1	8.8
	91-475 m	782.8	32,538.5	877.0	38,136.9	12.0	17.2
Eureka							
	91-183 m	14.1	73.8	21.8	292.5	54.4	296.6
	184-366 m	2.2	2.5	3.3	5.3	45.8	111.2
	367-475 m	0.0	-	0.0	-		
	91-475 m	16.4	76.3	25.1	297.9	53.2	290.4
Monterey							
	91-183 m	261.7	2,269.3	357.6	2,613.6	36.6	15.2
	184-366 m	7.1	11.2	8.0	14.7	13.0	31.5
	367-475 m	0.5	0.1	0.6	0.2	21.0	42.8
	91-475 m	269.3	2,280.6	366.2	2,628.4	36.0	15.3
Conception							
	91-183 m	73.3	629.8	99.9	988.9	36.2	57.0
	184-366 m	25.1	236.0	30.9	348.3	22.8	47.6
	367-475 m	0.0	-	0.0	-		
	91-475 m	98.5	865.8	130.8	1,337.3	32.8	54.5
Total US Survey Area							
	91-183 m	1,273.9	48,012.2	1,550.6	66,033.5	21.7	37.5
	184-366 m	272.3	18,462.7	283.7	18,635.4	4.2	0.9
	367-475 m	34.3	774.2	35.8	842.2	4.3	8.8
	91-475 m	1,580.5	67,249.1	1,870.1	85,511.2	18.3	27.2

Table B-3.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for English sole in 1977.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
US Vancouver							
	91-183 m	62.8	455.9	74.2	601.1	18.2	31.8
	184-366 m	7.8	13.2	7.8	13.2	0.0	0.0
	367-475 m	0.0	-	0.0	-		
	91-475 m	70.6	469.2	82.0	614.3	16.2	30.9
Columbia							
	91-183 m	612.0	34,109.5	755.6	50,309.3	23.5	47.5
	184-366 m	237.5	8,911.7	260.3	10,523.4	9.6	18.1
	367-475 m	0.0	-	0.0	-		
	91-475 m	849.5	43,021.2	1,015.9	60,832.7	19.6	41.4
Eureka							
	91-183 m	2.9	8.3	6.9	46.9	137.5	464.1
	184-366 m	0.0	-	0.0	-		
	367-475 m	0.2	0.0	0.4	0.1	83.3	236.1
	91-475 m	3.1	8.4	7.2	47.1	134.0	463.0
Monterey							
	91-183 m	853.7	53,319.2	1,215.1	30,386.8	42.3	-43.0
	184-366 m	36.2	300.0	38.6	319.1	6.5	6.4
	367-475 m	2.5	1.9	2.5	1.9	0.0	0.0
	91-475 m	892.4	53,621.1	1,256.2	30,707.8	40.8	-42.7
Conception							
	91-183 m	53.1	196.1	65.8	305.9	24.0	56.0
	184-366 m	6.6	16.5	8.0	24.4	20.2	47.7
	367-475 m	0.0	-	0.0	-		
	91-475 m	59.7	212.6	73.8	330.3	23.5	55.3
Total US Survey Area							
	91-183 m	1,584.4	88,089.0	2,117.5	81,650.0	33.6	-7.3
	184-366 m	288.1	9,241.5	314.7	10,880.1	9.2	17.7
	367-475 m	2.7	1.9	2.9	2.0	6.1	4.9
	91-475 m	1,875.3	97,332.5	2,435.1	92,532.2	29.9	-4.9

Table B-4.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for rex sole in 1977.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
US Vancouver							
	91-183 m	185.2	4,901.7	212.6	6,584.2	14.8	34.3
	184-366 m	323.1	6,110.0	323.1	6,110.0	0.0	0.0
	367-475 m	25.2	79.3	25.2	79.3	0.0	0.0
	91-475 m	533.5	11,091.0	560.8	12,773.5	5.1	15.2
Columbia							
	91-183 m	1,152.6	30,184.0	1,237.3	32,779.8	7.3	8.6
	184-366 m	573.4	8,166.2	614.1	9,166.9	7.1	12.3
	367-475 m	208.8	2,684.8	232.3	3,117.0	11.3	16.1
	91-475 m	1,934.8	41,035.0	2,083.8	45,063.7	7.7	9.8
Eureka							
	91-183 m	20.9	77.2	40.6	349.8	94.5	353.2
	184-366 m	153.3	4,301.3	226.4	8,837.6	47.6	105.5
	367-475 m	50.2	901.8	88.7	2,651.7	76.7	194.1
	91-475 m	224.4	5,280.2	355.7	11,839.1	58.5	124.2
Monterey							
	91-183 m	418.7	13,181.4	531.4	20,136.4	26.9	52.8
	184-366 m	492.0	4,222.8	526.5	4,952.2	7.0	17.3
	367-475 m	286.0	3,536.1	286.1	3,536.2	0.0	0.0
	91-475 m	1,196.7	20,940.3	1,343.9	28,624.7	12.3	36.7
Conception							
	91-183 m	45.4	208.0	72.0	387.1	58.5	86.1
	184-366 m	362.4	5,003.7	379.9	5,581.6	4.8	11.5
	367-475 m	185.2	6,597.9	200.7	7,540.8	0.0	14.3
	91-475 m	593.1	11,809.7	652.6	13,509.5	10.0	14.4
Total US Survey Area							
	91-183 m	1,822.8	48,552.3	2,093.8	60,237.3	14.9	24.1
	184-366 m	1,904.1	27,804.0	2,069.9	34,648.3	8.7	24.6
	367-475 m	755.5	13,799.9	833.1	16,924.9	10.3	22.6
	91-475 m	4,482.4	90,156.2	4,996.8	111,810.6	11.5	24.0

Table B-5.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Dover sole in 1977.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
US Vancouver							
	91-183 m	576.5	43,701.4	666.9	58,298.6	15.7	33.4
	184-366 m	1,330.1	40,566.2	1,330.1	40,566.2	0.0	0.0
	367-475 m	231.5	2,308.0	231.5	2,308.0	0.0	0.0
	91-475 m	2,138.1	86,575.6	2,228.5	101,172.8	4.2	16.9
Columbia							
	91-183 m	4,894.4	373,888.3	5,442.7	422,188.7	11.2	12.9
	184-366 m	3,591.8	208,712.9	3,830.0	232,262.4	6.6	11.3
	367-475 m	1,860.3	167,323.3	2,058.5	217,559.6	10.7	30.0
	91-475 m	10,346.5	749,924.5	11,331.1	872,010.7	9.5	16.3
Eureka							
	91-183 m	336.0	21,949.2	756.1	89,646.1	125.0	308.4
	184-366 m	874.6	127,961.5	1,294.2	254,210.7	48.0	98.7
	367-475 m	297.7	64,010.0	537.3	209,419.4	80.5	227.2
	91-475 m	1,508.3	213,920.7	2,587.6	553,276.2	71.6	158.6
Monterey							
	91-183 m	1,369.6	38,580.4	1,703.1	50,965.5	24.4	32.1
	184-366 m	2,680.2	161,606.6	2,960.7	208,004.8	10.5	28.7
	367-475 m	1,625.1	42,500.9	1,636.7	42,382.6	0.7	-0.3
	91-475 m	5,674.9	242,687.9	6,300.6	301,352.9	11.0	24.2
Conception							
	91-183 m	140.4	1,552.8	219.5	2,577.9	56.4	66.0
	184-366 m	1,376.2	27,795.5	1,427.8	32,052.7	3.7	15.3
	367-475 m	719.2	28,593.6	799.7	31,438.0	0.0	9.9
	91-475 m	2,235.8	57,941.8	2,447.0	66,068.6	9.4	14.0
Total US Survey Area							
	91-183 m	7,317.0	479,672.1	8,788.3	623,676.7	20.1	30.0
	184-366 m	9,852.8	566,642.8	10,842.8	767,096.8	10.0	35.4
	367-475 m	4,733.8	304,735.6	5,263.7	503,107.6	11.2	65.1
	91-475 m	21,903.6	1,351,050.5	24,894.8	1,893,881.1	13.7	40.2

Table B-6.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Pacific halibut in 1977.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
US Vancouver							
	91-183 m	0.0	-	0.0	-		
	184-366 m	31.5	562.7	31.5	562.7	0.0	0.0
	367-475 m	26.4	697.0	26.4	697.0	0.0	0.0
	91-475 m	57.9	1,259.8	57.9	1,259.8	0.0	0.0
Columbia							
	91-183 m	28.4	804.7	29.8	890.1	5.2	10.6
	184-366 m	40.7	700.5	42.4	759.7	4.4	8.5
	367-475 m	0.0	-	0.0	-		
	91-475 m	69.0	1,505.2	72.3	1,649.8	4.7	9.6
Eureka							
	91-183 m	154.4	23,849.4	366.8	134,525.8	137.5	464.1
	184-366 m	0.0	-	0.0	-		
	367-475 m	0.0	-	0.0	-		
	91-475 m	154.4	23,849.4	366.8	134,525.8	137.5	464.1
Monterey							
	91-183 m	0.0	-	0.0	-		
	184-366 m	0.0	-	0.0	-		
	367-475 m	0.0	-	0.0	-		
	91-475 m	0.0	-	0.0	-		
Conception							
	91-183 m	0.0	-	0.0	-		
	184-366 m	0.0	-	0.0	-		
	367-475 m	0.0	-	0.0	-		
	91-475 m	0.0	-	0.0	-		
Total US Survey Area							
	91-183 m	182.8	24,654.2	396.6	135,415.9	117.0	449.3
	184-366 m	72.1	1,263.2	73.9	1,322.4	2.5	4.7
	367-475 m	26.4	697.0	26.4	697.0	0.0	0.0
	91-475 m	281.3	26,614.4	496.9	137,435.3	76.6	416.4

Table B-7.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for sablefish in 1977.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
US Vancouver							
	91-183 m	847.9	101,835.3	935.1	116,825.0	10.3	14.7
	184-366 m	1,666.4	1,188,675.8	1,666.4	1,188,675.8	0.0	0.0
	367-475 m	120.8	1,958.4	120.8	1,958.4	0.0	0.0
	91-475 m	2,635.2	1,292,469.5	2,722.3	1,307,459.3	3.3	1.2
Columbia							
	91-183 m	3,513.3	820,432.4	3,777.0	875,096.4	7.5	6.7
	184-366 m	3,605.0	217,959.0	3,818.1	234,494.6	5.9	7.6
	367-475 m	1,626.7	341,833.1	1,866.9	465,144.8	14.8	36.1
	91-475 m	8,745.0	1,380,224.5	9,462.0	1,574,735.7	8.2	14.1
Eureka							
	91-183 m	547.7	93,291.0	1,261.5	442,556.2	130.3	374.4
	184-366 m	117.3	1,632.6	161.7	3,309.8	37.8	102.7
	367-475 m	82.5	3,345.1	151.2	10,186.5	83.3	204.5
	91-475 m	747.4	98,268.6	1,574.3	456,052.4	110.6	364.1
Monterey							
	91-183 m	583.1	43,890.5	753.0	90,678.4	29.1	106.6
	184-366 m	722.2	15,633.3	775.9	16,506.7	7.4	5.6
	367-475 m	677.1	103,663.8	679.5	103,692.8	0.4	0.0
	91-475 m	1,982.4	163,187.6	2,208.4	210,877.9	11.4	29.2
Conception							
	91-183 m	45.6	219.7	45.4	267.2	-0.6	21.6
	184-366 m	626.4	20,155.8	670.2	26,998.0	7.0	33.9
	367-475 m	641.7	13,438.1	704.2	15,829.8	0.0	17.8
	91-475 m	1,313.7	33,813.6	1,419.7	43,095.0	8.1	27.4
Total US Survey Area							
	91-183 m	5,537.6	1,059,668.9	6,772.0	1,525,423.2	22.3	44.0
	184-366 m	6,737.3	1,444,056.5	7,092.3	1,469,984.9	5.3	1.8
	367-475 m	3,148.8	464,238.5	3,522.5	596,812.3	11.9	28.6
	91-475 m	15,423.7	2,967,963.9	17,386.8	3,592,220.4	12.7	21.0

Table B-8.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for shortspine thornyhead in 1977.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
US Vancouver							
	91-183 m	6.7	41.7	7.6	58.3	14.6	39.9
	184-366 m	219.7	1,299.9	219.7	1,299.9	0.0	0.0
	367-475 m	61.5	638.9	61.5	638.9	0.0	0.0
	91-475 m	287.9	1,980.5	288.8	1,997.1	0.3	0.8
Columbia							
	91-183 m	510.7	23,630.3	544.5	26,424.4	6.6	11.8
	184-366 m	1,098.8	21,615.4	1,165.2	23,409.8	6.0	8.3
	367-475 m	419.9	4,418.9	459.3	5,146.4	9.4	16.5
	91-475 m	2,029.3	49,664.6	2,169.0	54,980.6	6.9	10.7
Eureka							
	91-183 m	3.5	12.6	8.4	71.1	137.5	464.1
	184-366 m	77.5	1,570.6	117.6	3,492.6	51.8	122.4
	367-475 m	11.7	57.0	19.2	182.4	65.0	219.9
	91-475 m	92.7	1,640.2	145.3	3,746.1	56.7	128.4
Monterey							
	91-183 m	1.0	0.2	0.6	0.1	-41.3	-38.2
	184-366 m	155.7	2,248.2	181.9	3,457.5	16.8	53.8
	367-475 m	83.9	726.5	83.9	726.5	0.0	0.0
	91-475 m	240.6	2,974.9	266.4	4,184.1	10.7	40.6
Conception							
	91-183 m	2.3	5.2	3.8	14.4	66.7	177.8
	184-366 m	33.5	71.0	34.8	73.1	3.9	2.9
	367-475 m	49.9	200.6	55.1	247.3	0.0	23.3
	91-475 m	85.8	276.8	93.8	334.7	9.4	20.9
Total US Survey Area							
	91-183 m	524.2	23,690.0	564.9	26,568.3	7.8	12.1
	184-366 m	1,585.2	26,805.1	1,719.3	31,732.8	8.5	18.4
	367-475 m	626.9	6,041.8	679.1	6,941.5	8.3	14.9
	91-475 m	2,736.3	56,537.0	2,963.3	65,242.6	8.3	15.4

Table B-9.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for total flatfish in 1977.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
US Vancouver							
	91-183 m	3,858.4	1,486,851.4	4,435.0	1,960,754.6	14.9	31.9
	184-366 m	7,051.7	13,099,959.2	7,051.7	13,099,959.2	0.0	0.0
	367-475 m	369.3	6,091.1	369.3	6,091.1	0.0	0.0
	91-475 m	11,279.5	14,592,901.8	11,856.0	15,066,804.9	5.1	3.2
Columbia							
	91-183 m	12,604.3	3,290,858.7	13,785.1	3,386,337.2	9.4	2.9
	184-366 m	7,481.5	1,138,844.2	7,938.0	1,251,995.7	6.1	9.9
	367-475 m	2,302.4	216,448.5	2,541.1	270,091.4	10.4	24.8
	91-475 m	22,388.2	4,646,151.4	24,264.2	4,908,424.3	8.4	5.6
Eureka							
	91-183 m	689.3	96,209.1	1,572.0	394,195.3	128.1	309.7
	184-366 m	1,076.7	185,435.7	1,586.1	368,745.5	47.3	98.9
	367-475 m	367.6	79,745.2	661.9	254,240.6	80.1	218.8
	91-475 m	2,133.6	361,389.9	3,820.0	1,017,181.3	79.0	181.5
Monterey							
	91-183 m	3,676.1	249,795.5	4,811.8	186,526.3	30.9	-25.3
	184-366 m	3,278.9	214,675.6	3,609.8	280,448.7	10.1	30.6
	367-475 m	1,926.9	61,541.6	1,938.7	61,419.4	0.6	-0.2
	91-475 m	8,881.8	526,012.7	10,360.3	528,394.4	16.6	0.5
Conception							
	91-183 m	441.1	8,226.9	654.4	10,163.7	48.3	23.5
	184-366 m	1,785.4	49,872.0	1,863.6	56,768.0	4.4	13.8
	367-475 m	904.4	57,584.1	1,000.4	63,750.2	0.0	10.7
	91-475 m	3,131.0	115,683.0	3,518.4	130,681.9	12.4	13.0
Total US Survey Area							
	91-183 m	21,269.1	5,131,941.7	25,258.2	5,937,977.2	18.8	15.7
	184-366 m	20,674.2	14,688,786.7	22,049.1	15,057,917.0	6.7	2.5
	367-475 m	5,870.6	421,410.5	6,511.5	655,592.6	10.9	55.6
	91-475 m	47,814.0	20,242,138.8	53,818.8	21,651,486.8	12.6	7.0

APPENDIX C

Original and Revised Biomass Estimates for 1980

Appendix C contains original estimates of biomass and variance, revised estimates of biomass and variance when hauls with small catches of benthic fish and invertebrates are removed, and percent change in biomass and variance estimates. Change is indicated per individual strata for Pacific sanddab (*Citharichthys sordidus*), petrale sole (*Eopsetta jordani*), English sole (*Parophrys vetulus*), rex sole (*Glyptocephalus zachirus*), Dover sole (*Microstomus pacificus*), Pacific halibut (*Hippoglossus stenolepis*), sablefish (*Anoplopoma fimbria*), shortspine thornyhead (*Sebastolobus alascanus*), and all flatfish species combined.

Table C-1.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Pacific sanddab in 1980.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	49.6	580.7	62.7	909.6	26.3	56.6
	184-366 m	0.0	-	0.0	-		
	55-366 m	49.6	580.7	62.7	909.6	26.3	56.6
US Vancouver							
	55-183 m	147.0	10,759.9	166.6	13,703.5	13.3	27.4
	184-366 m	0.0	-	0.0	-		
	55-366 m	147.0	10,759.9	166.6	13,703.5	13.3	27.4
Columbia							
	55-183 m	900.3	34,310.7	1,476.3	88,264.7	64.0	157.3
	184-366 m	0.6	0.4	1.3	1.5	96.3	299.4
	55-366 m	900.9	34,311.1	1,477.6	88,266.2	64.0	157.3
Eureka							
	55-183 m	30.3	179.0	35.4	379.0	16.8	111.8
	184-366 m	0.0	-	0.0	-		
	55-366 m	30.3	179.0	35.4	379.0	16.8	111.8
Monterey							
	55-183 m	762.7	30,110.1	1,199.9	62,731.3	57.3	108.3
	184-366 m	15.4	78.4	19.1	118.7	24.0	51.3
	55-366 m	778.1	30,188.6	1,219.0	62,850.0	56.7	108.2
US Total							
	55-183 m	1,840.3	75,359.7	2,878.2	165,078.6	56.4	119.1
	184-366 m	16.0	78.8	20.3	120.2	26.9	52.5
	55-366 m	1,856.3	75,438.5	2,898.6	165,198.8	56.1	119.0
Entire Survey Area							
	55-183 m	1,889.9	75,940.4	2,940.9	165,988.2	55.6	118.6
	184-366 m	16.0	78.8	20.3	120.2	26.9	52.5
	55-366 m	1,905.9	76,019.2	2,961.3	166,108.3	55.4	118.5

Table C-2.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for petrale sole in 1980.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	218.0	6,267.6	274.4	9,643.3	25.9	53.9
	184-366 m	34.0	206.6	41.4	273.3	21.6	32.3
	55-366 m	252.0	6,474.2	315.8	9,916.7	25.3	53.2
US Vancouver							
	55-183 m	221.3	14,668.5	250.9	18,470.3	13.3	25.9
	184-366 m	55.3	2,063.5	58.1	2,135.3	5.1	3.5
	55-366 m	276.6	16,732.0	309.0	20,605.7	11.7	23.2
Columbia							
	55-183 m	696.7	35,012.4	1,110.5	84,717.2	59.4	142.0
	184-366 m	46.5	421.1	62.1	832.0	33.4	97.6
	55-366 m	743.2	35,433.5	1,172.6	85,549.2	57.8	141.4
Eureka							
	55-183 m	108.2	2,871.3	145.6	4,565.9	34.6	59.0
	184-366 m	5.1	13.2	6.5	23.0	27.4	74.3
	55-366 m	113.3	2,884.5	152.1	4,589.0	34.3	59.1
Monterey							
	55-183 m	134.1	2,752.2	211.5	6,649.1	57.7	141.6
	184-366 m	21.9	180.3	25.5	256.9	16.5	42.5
	55-366 m	156.0	2,932.5	237.0	6,905.9	51.9	135.5
US Total							
	55-183 m	1,160.2	55,304.4	1,718.4	114,402.5	48.1	106.9
	184-366 m	128.9	2,678.1	152.2	3,247.2	18.1	21.3
	55-366 m	1,289.1	57,982.5	1,870.6	117,649.7	45.1	102.9
Entire Survey Area							
	55-183 m	1,378.3	61,572.0	1,992.8	124,045.9	44.6	101.5
	184-366 m	162.9	2,884.7	193.6	3,520.6	18.9	22.0
	55-366 m	1,541.1	64,456.7	2,186.4	127,566.4	41.9	97.9

Table C-3.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for English sole in 1980.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	519.8	44,870.2	655.6	69,603.5	26.1	55.1
	184-366 m	1.6	1.1	1.6	1.1	0.0	0.0
	55-366 m	521.4	44,871.3	657.2	69,604.7	26.0	55.1
US Vancouver							
	55-183 m	555.8	114,444.2	629.9	144,898.0	13.3	26.6
	184-366 m	19.9	155.2	20.9	158.2	5.2	1.9
	55-366 m	575.7	114,599.4	650.9	145,056.2	13.1	26.6
Columbia							
	55-183 m	1,262.1	68,018.8	1,945.6	120,935.8	54.2	77.8
	184-366 m	37.5	411.8	44.7	529.4	19.2	28.6
	55-366 m	1,299.6	68,430.7	1,990.3	121,465.3	53.1	77.5
Eureka							
	55-183 m	97.7	1,455.0	131.7	2,375.8	34.8	63.3
	184-366 m	4.6	6.0	6.8	11.2	50.0	86.4
	55-366 m	102.3	1,461.0	138.5	2,387.0	35.5	63.4
Monterey							
	55-183 m	558.0	20,184.2	885.6	43,809.9	58.7	117.1
	184-366 m	50.1	751.3	59.8	1,057.4	19.5	40.7
	55-366 m	608.1	20,935.4	945.5	44,867.3	55.5	114.3
US Total							
	55-183 m	2,473.7	204,102.2	3,592.9	312,019.6	45.2	52.9
	184-366 m	112.0	1,324.3	132.3	1,756.2	18.1	32.6
	55-366 m	2,585.6	205,426.5	3,725.1	313,775.8	44.1	52.7
Entire Survey Area							
	55-183 m	2,993.4	248,972.4	4,248.4	381,623.1	41.9	53.3
	184-366 m	113.6	1,325.4	133.9	1,757.3	17.8	32.6
	55-366 m	3,107.0	250,297.8	4,382.3	383,380.4	41.0	53.2

Table C-4.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for rex sole in 1980.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	643.0	54,415.2	811.2	83,643.4	26.1	53.7
	184-366 m	271.5	6,483.6	302.7	7,554.5	11.5	16.5
	55-366 m	914.5	60,898.8	1,113.9	91,198.0	21.8	49.8
US Vancouver							
	55-183 m	449.2	72,496.3	509.0	91,722.4	13.3	26.5
	184-366 m	272.7	11,474.8	297.5	11,867.9	9.1	3.4
	55-366 m	721.9	83,971.1	806.6	103,590.4	11.7	23.4
Columbia							
	55-183 m	1,346.5	43,834.4	2,297.3	151,003.9	70.6	244.5
	184-366 m	350.9	16,259.7	510.1	24,760.1	45.4	52.3
	55-366 m	1,697.4	60,094.1	2,807.4	175,764.0	65.4	192.5
Eureka							
	55-183 m	72.7	498.4	98.4	991.7	35.3	99.0
	184-366 m	93.0	1,758.3	130.0	3,178.3	39.8	80.8
	55-366 m	165.7	2,256.7	228.4	4,170.0	37.8	84.8
Monterey							
	55-183 m	526.5	13,268.8	811.2	27,770.4	54.1	109.3
	184-366 m	340.3	14,472.2	408.4	18,561.7	20.0	28.3
	55-366 m	866.8	27,741.0	1,219.6	46,332.1	40.7	67.0
US Total							
	55-183 m	2,394.9	130,097.9	3,715.9	271,488.5	55.2	108.7
	184-366 m	1,056.9	43,965.1	1,346.1	58,368.0	27.4	32.8
	55-366 m	3,451.9	174,062.9	5,062.0	329,856.5	46.6	89.5
Entire Survey Area							
	55-183 m	3,038.0	184,513.1	4,527.0	355,131.9	49.0	92.5
	184-366 m	1,328.4	50,448.6	1,648.8	65,922.5	24.1	30.7
	55-366 m	4,366.4	234,961.8	6,175.9	421,054.4	41.4	79.2

Table C-5.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Dover sole in 1980.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	1,519.5	154,752.8	1,895.5	229,775.7	24.7	48.5
	184-366 m	369.6	23,227.6	420.7	36,598.1	13.8	57.6
	55-366 m	1,889.1	177,980.4	2,316.2	266,373.8	22.6	49.7
US Vancouver							
	55-183 m	595.3	77,240.7	674.7	96,220.2	13.3	24.6
	184-366 m	1,561.8	234,052.4	1,798.9	232,870.4	15.2	-0.5
	55-366 m	2,157.0	311,293.1	2,473.6	329,090.6	14.7	5.7
Columbia							
	55-183 m	3,325.5	184,442.8	5,077.0	404,268.6	52.7	119.2
	184-366 m	1,577.9	201,585.7	2,676.5	532,317.4	69.6	164.1
	55-366 m	4,903.5	386,028.5	7,753.4	936,586.0	58.1	142.6
Eureka							
	55-183 m	430.0	22,438.9	620.5	40,974.3	44.3	82.6
	184-366 m	436.1	18,608.4	588.6	28,886.1	35.0	55.2
	55-366 m	866.1	41,047.2	1,209.1	69,860.4	39.6	70.2
Monterey							
	55-183 m	1,374.5	119,159.6	2,162.3	259,453.3	57.3	117.7
	184-366 m	1,333.5	179,970.1	1,618.1	226,375.9	21.3	25.8
	55-366 m	2,708.0	299,129.7	3,780.5	485,829.2	39.6	62.4
US Total							
	55-183 m	5,725.3	403,282.0	8,534.4	800,916.4	49.1	98.6
	184-366 m	4,909.3	634,216.5	6,682.2	1,020,449.7	36.1	60.9
	55-366 m	10,634.6	1,037,498.5	15,216.6	1,821,366.2	43.1	75.6
Entire Survey Area							
	55-183 m	7,244.8	558,034.8	10,429.9	1,030,692.2	44.0	84.7
	184-366 m	5,278.9	657,444.1	7,102.9	1,057,047.8	34.6	60.8
	55-366 m	12,523.7	1,215,478.9	17,532.8	2,087,740.0	40.0	71.8

Table C-6.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Pacific halibut in 1980.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	345.2	31,126.5	436.1	48,873.3	26.3	57.0
	184-366 m	48.7	1,913.3	48.7	1,913.3	0.0	0.0
	55-366 m	393.9	33,039.8	484.8	50,786.6	23.1	53.7
US Vancouver							
	55-183 m	47.7	2,272.0	54.0	2,918.2	13.3	28.4
	184-366 m	0.0	-	0.0	-		
	55-366 m	47.7	2,272.0	54.0	2,918.2	13.3	28.4
Columbia							
	55-183 m	85.6	2,030.8	171.9	8,492.3	100.9	318.2
	184-366 m	97.4	9,494.5	155.9	24,305.8	60.0	156.0
	55-366 m	183.0	11,525.2	327.8	32,798.1	79.1	184.6
Eureka							
	55-183 m	0.0	-	0.0	-		
	184-366 m	0.0	-	0.0	-		
	55-366 m	0.0	-	0.0	-		
Monterey							
	55-183 m	0.0	-	0.0	-		
	184-366 m	0.0	-	0.0	-		
	55-366 m	0.0	-	0.0	-		
US Total							
	55-183 m	133.2	4,302.7	226.0	11,410.5	69.6	165.2
	184-366 m	97.4	9,494.5	155.9	24,305.8	60.0	156.0
	55-366 m	230.7	13,797.2	381.9	35,716.3	65.5	158.9
Entire Survey Area							
	55-183 m	478.5	35,429.2	662.0	60,283.8	38.4	70.2
	184-366 m	146.2	11,407.8	204.6	26,219.1	40.0	129.8
	55-366 m	624.6	46,837.0	866.7	86,502.9	38.8	84.7

Table C-7.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for sablefish in 1980.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	7,895.6	8,240,407.8	9,960.3	12,668,986.3	26.1	53.7
	184-366 m	807.8	42,407.3	931.6	48,778.3	15.3	15.0
	55-366 m	8,703.4	8,282,815.2	10,891.9	12,717,764.6	25.1	53.5
US Vancouver							
	55-183 m	1,711.3	577,942.8	1,231.4	340,194.7	-28.0	-41.1
	184-366 m	794.0	107,355.1	968.1	125,986.5	21.9	17.4
	55-366 m	2,505.3	685,297.9	2,199.5	466,181.2	-12.2	-32.0
Columbia							
	55-183 m	9,470.0	11,728,228.0	16,951.3	46,165,256.7	79.0	293.6
	184-366 m	4,326.5	2,366,556.4	7,965.2	9,306,340.2	84.1	293.2
	55-366 m	13,796.5	14,094,784.3	24,916.5	55,471,596.9	80.6	293.6
Eureka							
	55-183 m	8,324.3	64,480,183.6	12,768.8	153,849,397.3	53.4	138.6
	184-366 m	368.4	52,302.9	429.9	53,778.9	16.7	2.8
	55-366 m	8,692.6	64,532,486.6	13,198.7	153,903,176.2	51.8	138.5
Monterey							
	55-183 m	15,814.0	157,056,602.4	25,191.0	399,599,410.8	59.3	154.4
	184-366 m	399.3	25,890.8	475.7	35,545.7	19.1	37.3
	55-366 m	16,213.3	157,082,493.2	25,666.7	399,634,956.6	58.3	154.4
US Total							
	55-183 m	35,319.5	233,842,956.7	56,142.5	599,954,259.5	59.0	156.6
	184-366 m	5,888.2	2,552,105.2	9,838.9	9,521,651.3	67.1	273.1
	55-366 m	41,207.7	236,395,062.0	65,981.4	609,475,910.9	60.1	157.8
Entire Survey Area							
	55-183 m	43,215.2	242,083,364.6	66,102.8	612,623,245.8	53.0	153.1
	184-366 m	6,696.0	2,594,512.6	10,770.5	9,570,429.6	60.9	268.9
	55-366 m	49,911.1	244,677,877.1	76,873.3	622,193,675.4	54.0	154.3

Table C-8.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for shortspine thornyhead in 1980.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	16.3	105.3	20.6	166.5	26.3	58.2
	184-366 m	100.4	2,181.9	116.9	2,966.1	16.4	35.9
	55-366 m	116.8	2,287.2	137.5	3,132.6	17.8	37.0
US Vancouver							
	55-183 m	31.2	353.4	35.4	447.2	13.3	26.6
	184-366 m	275.5	4,912.3	328.5	3,170.0	19.2	-35.5
	55-366 m	306.7	5,265.7	363.8	3,617.3	18.6	-31.3
Columbia							
	55-183 m	317.4	14,157.0	482.6	28,475.1	52.0	101.1
	184-366 m	625.4	29,185.2	1,001.6	50,659.2	60.2	73.6
	55-366 m	942.8	43,342.3	1,484.2	79,134.3	57.4	82.6
Eureka							
	55-183 m	17.5	241.8	27.0	573.1	54.1	137.0
	184-366 m	50.0	586.2	68.7	1,222.3	37.3	108.5
	55-366 m	67.5	828.0	95.7	1,795.4	41.6	116.8
Monterey							
	55-183 m	26.5	414.9	42.3	1,054.1	60.0	154.1
	184-366 m	105.5	5,408.5	126.8	7,644.7	20.2	41.3
	55-366 m	132.0	5,823.4	169.2	8,698.7	28.2	49.4
US Total							
	55-183 m	392.6	15,167.2	587.3	30,549.5	49.6	101.4
	184-366 m	1,056.4	40,092.2	1,525.6	62,696.2	44.4	56.4
	55-366 m	1,449.1	55,259.4	2,112.9	93,245.7	45.8	68.7
Entire Survey Area							
	55-183 m	408.9	15,272.4	607.9	30,716.1	48.7	101.1
	184-366 m	1,156.9	42,274.1	1,642.5	65,662.3	42.0	55.3
	55-366 m	1,565.8	57,546.6	2,250.4	96,378.4	43.7	67.5

Table C-9.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for total flatfish in 1980.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	9,316.2	4,261,807.8	11,718.7	6,089,259.7	25.8	42.9
	184-366 m	2,057.1	310,719.3	2,372.2	391,682.0	15.3	26.1
	55-366 m	11,373.3	4,572,527.1	14,090.9	6,480,941.7	23.9	41.7
US Vancouver							
	55-183 m	5,252.7	6,241,567.6	5,953.0	7,786,513.9	13.3	24.8
	184-366 m	2,902.7	815,967.8	3,266.0	782,285.7	12.5	-4.1
	55-366 m	8,155.4	7,057,535.4	9,219.0	8,568,799.6	13.0	21.4
Columbia							
	55-183 m	9,585.0	1,003,942.5	15,049.7	1,696,992.8	57.0	69.0
	184-366 m	3,259.3	413,956.7	5,143.1	747,001.7	57.8	80.5
	55-366 m	12,844.3	1,417,899.2	20,192.8	2,443,994.5	57.2	72.4
Eureka							
	55-183 m	797.1	31,636.6	1,118.1	47,267.4	40.3	49.4
	184-366 m	566.4	36,344.8	768.2	59,961.5	35.6	65.0
	55-366 m	1,363.6	67,981.3	1,886.3	107,229.0	38.3	57.7
Monterey							
	55-183 m	3,431.9	281,704.3	5,390.8	427,338.6	57.1	51.7
	184-366 m	1,786.6	324,043.6	2,161.6	407,290.3	21.0	25.7
	55-366 m	5,218.6	605,747.8	7,552.4	834,628.8	44.7	37.8
US Total							
	55-183 m	19,066.7	7,558,850.9	27,511.7	9,958,112.7	44.3	31.7
	184-366 m	8,515.1	1,590,312.8	11,338.9	1,996,539.2	33.2	25.5
	55-366 m	27,581.8	9,149,163.8	38,850.6	11,954,651.9	40.9	30.7
Entire Survey Area							
	55-183 m	28,382.9	11,820,658.8	39,230.4	16,047,372.4	38.2	35.8
	184-366 m	10,572.2	1,901,032.1	13,711.1	2,388,221.2	29.7	25.6
	55-366 m	38,955.1	13,721,690.9	52,941.5	18,435,593.6	35.9	34.4

APPENDIX D

Original and Revised Biomass Estimates for 1983

Appendix D contains original estimates of biomass and variance, revised estimates of biomass and variance when hauls with small catches of benthic fish and invertebrates are removed, and percent change in biomass and variance estimates. Change is indicated per individual strata for Pacific sanddab (*Citharichthys sordidus*), petrale sole (*Eopsetta jordani*), English sole (*Parophrys vetulus*), rex sole (*Glyptocephalus zachirus*), Dover sole (*Microstomus pacificus*), Pacific halibut (*Hippoglossus stenolepis*), sablefish (*Anoplopoma fimbria*), shortspine thornyhead (*Sebastolobus alascanus*), and all flatfish species combined.

Table D-1.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Pacific sanddab in 1983.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	486.3	109,172.8	575.4	153,110.5	18.3	40.2
	184-366 m	0.0	-	0.0	-		
	55-366 m	486.3	109,172.8	575.4	153,110.5	18.3	40.2
US Vancouver							
	55-183 m	472.5	40,730.4	505.7	43,075.5	7.0	5.8
	184-366 m	0.4	0.1	0.4	0.1		
	55-366 m	472.9	40,730.6	506.1	43,075.6	7.0	5.8
Columbia							
	55-183 m	4,724.4	499,116.9	5,157.0	581,437.6	9.2	16.5
	184-366 m	0.0	-	0.0	-		
	55-366 m	4,724.4	499,116.9	5,157.0	581,437.6	9.2	16.5
Eureka							
	55-183 m	256.7	6,107.8	277.3	6,462.5	8.0	5.8
	184-366 m	0.2	0.1	0.2	0.1		
	55-366 m	257.0	6,107.9	277.5	6,462.5	8.0	5.8
Monterey							
	55-183 m	2,467.5	382,810.0	2,559.9	408,600.2	3.7	6.7
	184-366 m	4.9	7.6	5.1	7.8	2.4	3.1
	55-366 m	2,472.4	382,817.6	2,564.9	408,608.0	3.7	6.7
US Total							
	55-183 m	7,921.1	928,765.1	8,499.8	1,039,575.8	7.3	11.9
	184-366 m	5.6	7.8	5.7	8.0	2.1	3.0
	55-366 m	7,926.7	928,772.9	8,505.5	1,039,583.8	7.3	11.9
Entire Survey Area							
	55-183 m	8,407.5	1,037,937.9	9,075.2	1,192,686.3	7.9	14.9
	184-366 m	5.6	7.8	5.7	8.0	2.1	3.0
	55-366 m	8,413.0	1,037,945.7	9,080.9	1,192,694.3	7.9	14.9

Table D-2.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for petrale sole in 1983.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	360.8	15,764.4	428.4	21,408.6	18.7	35.8
	184-366 m	2.7	3.2	2.7	3.2	0.0	0.0
	55-366 m	363.5	15,767.6	431.1	21,411.8	18.6	35.8
US Vancouver							
	55-183 m	433.1	8,068.0	492.0	9,743.0	13.6	20.8
	184-366 m	45.2	198.2	45.2	198.2	0.0	0.0
	55-366 m	478.3	8,266.2	537.2	9,941.2	12.3	20.3
Columbia							
	55-183 m	733.0	5,683.4	799.9	6,311.1	9.1	11.0
	184-366 m	30.3	61.3	31.0	65.7	2.5	7.3
	55-366 m	763.3	5,744.6	830.9	6,376.8	8.9	11.0
Eureka							
	55-183 m	95.0	738.7	108.1	915.9	13.8	24.0
	184-366 m	0.3	0.1	0.3	0.1	0.0	0.0
	55-366 m	95.3	738.8	108.4	916.0	13.8	24.0
Monterey							
	55-183 m	319.2	3,688.0	331.5	3,900.2	3.8	5.8
	184-366 m	15.9	64.6	16.1	65.0	1.2	0.6
	55-366 m	335.1	3,752.5	347.6	3,965.2	3.7	5.7
US Total							
	55-183 m	1,580.4	18,178.0	1,731.5	20,870.2	9.6	14.8
	184-366 m	91.7	324.1	92.6	329.0	1.0	1.5
	55-366 m	1,672.0	18,502.1	1,824.1	21,199.2	9.1	14.6
Entire Survey Area							
	55-183 m	1,941.1	33,942.4	2,160.0	42,278.8	11.3	24.6
	184-366 m	94.4	327.3	95.3	332.2	1.0	1.5
	55-366 m	2,035.5	34,269.7	2,255.3	42,611.0	10.8	24.3

Table D-3.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for English sole in 1983.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	793.6	51,115.0	936.1	68,268.0	17.9	33.6
	184-366 m	2.6	3.7	2.6	3.7	0.0	0.0
	55-366 m	796.2	51,118.8	938.7	68,271.8	17.9	33.6
US Vancouver							
	55-183 m	633.6	34,226.5	714.6	42,702.4	12.8	24.8
	184-366 m	28.8	177.3	28.8	177.3	0.0	0.0
	55-366 m	662.3	34,403.8	743.4	42,879.7	12.2	24.6
Columbia							
	55-183 m	2,271.5	54,418.0	2,468.7	60,330.0	8.7	10.9
	184-366 m	156.6	4,378.7	157.4	4,380.2	0.5	0.0
	55-366 m	2,428.1	58,796.7	2,626.1	64,710.1	8.2	10.1
Eureka							
	55-183 m	738.5	25,327.1	814.6	29,225.9	10.3	15.4
	184-366 m	11.9	29.3	11.9	29.3	0.0	0.0
	55-366 m	750.4	25,356.4	826.5	29,255.2	10.1	15.4
Monterey							
	55-183 m	3,167.6	317,336.9	3,288.7	334,694.2	3.8	5.5
	184-366 m	159.2	10,693.2	170.6	12,317.5	7.1	15.2
	55-366 m	3,326.8	328,030.1	3,459.3	347,011.7	4.0	5.8
US Total							
	55-183 m	6,811.2	431,308.5	7,286.6	466,952.5	7.0	8.3
	184-366 m	356.5	15,278.5	368.7	16,904.3	3.4	10.6
	55-366 m	7,167.7	446,587.0	7,655.3	483,856.8	6.8	8.3
Entire Survey Area							
	55-183 m	7,604.8	482,423.5	8,222.6	535,220.5	8.1	10.9
	184-366 m	359.1	15,282.2	371.3	16,908.0	3.4	10.6
	55-366 m	7,963.9	497,705.7	8,593.9	552,128.5	7.9	10.9

Table D-4.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for rex sole in 1983.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	951.6	100,986.6	1,127.7	136,792.5	18.5	35.5
	184-366 m	122.6	1,180.5	131.9	1,179.4	7.6	-0.1
	55-366 m	1,074.3	102,167.1	1,259.6	137,972.0	17.3	35.0
US Vancouver							
	55-183 m	293.2	3,938.7	317.6	4,450.9	8.3	13.0
	184-366 m	225.9	2,518.7	225.9	2,518.7	0.0	0.0
	55-366 m	519.1	6,457.4	543.5	6,969.7	4.7	7.9
Columbia							
	55-183 m	4,265.2	260,138.7	4,655.5	302,620.0	9.2	16.3
	184-366 m	1,270.1	39,004.5	1,286.9	39,577.3	1.3	1.5
	55-366 m	5,535.3	299,143.2	5,942.4	342,197.3	7.4	14.4
Eureka							
	55-183 m	419.6	11,079.5	457.0	11,791.0	8.9	6.4
	184-366 m	559.2	19,169.3	559.2	19,169.3	0.0	0.0
	55-366 m	978.8	30,248.8	1,016.2	30,960.3	3.8	2.4
Monterey							
	55-183 m	1,559.4	104,055.5	1,619.4	110,390.8	3.8	6.1
	184-366 m	557.5	17,410.5	590.7	18,658.2	6.0	7.2
	55-366 m	2,116.9	121,466.0	2,210.1	129,049.0	4.4	6.2
US Total							
	55-183 m	6,537.4	379,212.3	7,049.5	429,252.8	7.8	13.2
	184-366 m	2,612.7	78,103.1	2,662.7	79,923.6	1.9	2.3
	55-366 m	9,150.1	457,315.5	9,712.2	509,176.4	6.1	11.3
Entire Survey Area							
	55-183 m	7,489.1	480,198.9	8,177.3	566,045.3	9.2	17.9
	184-366 m	2,735.3	79,283.6	2,794.6	81,103.0	2.2	2.3
	55-366 m	10,224.4	559,482.5	10,971.9	647,148.3	7.3	15.7

Table D-5.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Dover sole in 1983.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	2,599.9	578,430.4	3,087.4	771,282.0	18.8	33.3
	184-366 m	179.8	2,799.7	179.4	2,806.0	-0.2	0.2
	55-366 m	2,779.7	581,230.1	3,266.8	774,088.0	17.5	33.2
US Vancouver							
	55-183 m	715.2	73,275.3	761.2	78,478.9	6.4	7.1
	184-366 m	998.4	44,871.8	998.4	44,871.8	0.0	0.0
	55-366 m	1,713.6	118,147.1	1,759.6	123,350.7	2.7	4.4
Columbia							
	55-183 m	4,911.7	436,107.7	5,383.2	506,184.5	9.6	16.1
	184-366 m	4,229.0	423,074.3	4,277.7	428,476.3	1.2	1.3
	55-366 m	9,140.7	859,182.0	9,660.9	934,660.9	5.7	8.8
Eureka							
	55-183 m	910.9	56,949.5	989.2	60,677.3	8.6	6.5
	184-366 m	1,773.6	104,519.2	1,773.6	104,519.2	0.0	0.0
	55-366 m	2,684.5	161,468.7	2,762.8	165,196.5	2.9	2.3
Monterey							
	55-183 m	2,155.7	291,256.8	2,237.8	310,753.3	3.8	6.7
	184-366 m	3,212.6	289,729.2	3,387.1	284,392.8	5.4	-1.8
	55-366 m	5,368.4	580,985.9	5,624.9	595,146.1	4.8	2.4
US Total							
	55-183 m	8,693.5	857,589.3	9,371.5	956,094.1	7.8	11.5
	184-366 m	10,213.7	862,194.5	10,436.8	862,260.2	2.2	0.0
	55-366 m	18,907.2	1,719,783.7	19,808.3	1,818,354.2	4.8	5.7
Entire Survey Area							
	55-183 m	11,293.4	1,436,019.7	12,458.9	1,727,376.1	10.3	20.3
	184-366 m	10,393.4	864,994.1	10,616.2	865,066.2	2.1	0.0
	55-366 m	21,686.8	2,301,013.8	23,075.1	2,592,442.3	6.4	12.7

Table D-6.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Pacific halibut in 1983.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	839.2	64,774.1	976.1	87,617.3	16.3	35.3
	184-366 m	82.3	4,174.7	82.3	4,174.7	0.0	0.0
	55-366 m	921.5	68,948.8	1,058.5	91,792.0	14.9	33.1
US Vancouver							
	55-183 m	436.9	13,352.4	490.1	15,737.9	12.2	17.9
	184-366 m	43.5	419.6	43.5	419.6	0.0	0.0
	55-366 m	480.4	13,772.0	533.6	16,157.5	11.1	17.3
Columbia							
	55-183 m	658.0	22,904.8	676.6	25,154.9	2.8	9.8
	184-366 m	34.1	134.5	34.1	134.5	0.0	0.0
	55-366 m	692.1	23,039.3	710.7	25,289.3	2.7	9.8
Eureka							
	55-183 m	158.2	11,851.8	158.2	11,851.8	0.0	0.0
	184-366 m	8.5	-	8.5	-	0.0	
	55-366 m	166.7	11,851.8	166.7	11,851.8	0.0	0.0
Monterey							
	55-183 m	0.0	-	0.0	-		
	184-366 m	0.0	-	0.0	-		
	55-366 m	0.0	-	0.0	-		
US Total							
	55-183 m	1,253.1	48,109.1	1,324.9	52,744.5	5.7	9.6
	184-366 m	86.1	554.1	86.1	554.1	0.0	0.0
	55-366 m	1,339.2	48,663.2	1,411.0	53,298.6	5.4	9.5
Entire Survey Area							
	55-183 m	2,092.3	112,883.2	2,301.1	140,361.8	10.0	24.3
	184-366 m	168.4	4,728.8	168.4	4,728.8	0.0	0.0
	55-366 m	2,260.7	117,612.0	2,469.5	145,090.6	9.2	23.4

Table D-7.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for sablefish in 1983.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	5,163.9	4,944,843.4	6,116.5	6,822,906.1	18.4	38.0
	184-366 m	680.6	30,686.9	721.4	37,357.6	6.0	21.7
	55-366 m	5,844.4	4,975,530.3	6,837.9	6,860,263.6	17.0	37.9
US Vancouver							
	55-183 m	430.6	68,308.0	453.6	69,561.3	5.3	1.8
	184-366 m	932.0	35,248.4	932.0	35,248.4	0.0	0.0
	55-366 m	1,362.6	103,556.5	1,385.5	104,809.7	1.7	1.2
Columbia							
	55-183 m	16,654.7	81,398,439.6	18,240.4	102,102,503.1	9.5	25.4
	184-366 m	6,643.2	2,586,369.1	6,689.5	2,589,231.2	0.7	0.1
	55-366 m	23,298.0	83,984,808.7	24,929.9	104,691,734.3	7.0	24.7
Eureka							
	55-183 m	831.9	229,504.4	834.8	229,556.6	0.3	0.0
	184-366 m	1,332.3	147,028.9	1,332.3	147,028.9	0.0	0.0
	55-366 m	2,164.3	376,533.4	2,167.1	376,585.5	0.1	0.0
Monterey							
	55-183 m	1,476.0	371,038.1	1,532.8	398,712.8	3.8	7.5
	184-366 m	2,010.7	2,314,078.4	2,161.0	2,673,296.1	7.5	15.5
	55-366 m	3,486.7	2,685,116.5	3,693.7	3,072,008.9	5.9	14.4
US Total							
	55-183 m	19,393.3	82,067,290.2	21,061.5	102,800,333.8	8.6	25.3
	184-366 m	10,918.3	5,082,724.9	11,114.7	5,444,804.7	1.8	7.1
	55-366 m	30,311.6	87,150,015.1	32,176.3	108,245,138.5	6.2	24.2
Entire Survey Area							
	55-183 m	24,557.1	87,012,133.6	27,178.0	109,623,239.9	10.7	26.0
	184-366 m	11,598.9	5,113,411.8	11,836.1	5,482,162.2	2.0	7.2
	55-366 m	36,156.0	92,125,545.4	39,014.1	115,105,402.1	7.9	24.9

Table D-8.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for shortspine thornyhead in 1983.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	93.2	3,445.8	110.6	4,821.5	18.8	39.9
	184-366 m	69.6	2,114.0	69.9	2,114.2	0.4	0.0
	55-366 m	162.8	5,559.8	180.5	6,935.6	10.9	24.7
US Vancouver							
	55-183 m	49.6	1,232.4	54.0	1,503.5	9.0	22.0
	184-366 m	227.7	7,307.7	227.7	7,307.7	0.0	0.0
	55-366 m	277.3	8,540.1	281.8	8,811.2	1.6	3.2
Columbia							
	55-183 m	158.1	2,101.1	175.2	2,616.6	10.8	24.5
	184-366 m	1,484.1	46,488.1	1,514.6	47,807.6	2.1	2.8
	55-366 m	1,642.2	48,589.2	1,689.7	50,424.2	2.9	3.8
Eureka							
	55-183 m	6.3	14.1	7.4	21.1	18.6	49.4
	184-366 m	272.0	6,656.8	272.0	6,656.8	0.0	0.0
	55-366 m	278.3	6,670.9	279.5	6,677.9	0.4	0.1
Monterey							
	55-183 m	16.9	162.5	17.6	175.1	3.8	7.8
	184-366 m	128.5	1,292.8	136.3	1,413.7	6.1	9.4
	55-366 m	145.5	1,455.3	153.9	1,588.8	5.8	9.2
US Total							
	55-183 m	230.8	3,510.1	254.2	4,316.3	10.1	23.0
	184-366 m	2,112.4	61,745.4	2,150.6	63,185.8	1.8	2.3
	55-366 m	2,343.3	65,255.5	2,404.9	67,502.1	2.6	3.4
Entire Survey Area							
	55-183 m	324.0	6,955.9	364.9	9,137.8	12.6	31.4
	184-366 m	2,182.1	63,859.4	2,220.6	65,300.0	1.8	2.3
	55-366 m	2,506.1	70,815.3	2,585.4	74,437.8	3.2	5.1

Table D-9.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for total flatfish in 1983.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	16,242.2	15,589,426.8	19,245.2	20,252,456.5	18.5	29.9
	184-366 m	727.2	26,659.9	823.6	42,251.6	13.3	58.5
	55-366 m	16,969.4	15,616,086.7	20,068.8	20,294,708.1	18.3	30.0
US Vancouver							
	55-183 m	4,138.3	315,778.7	4,524.4	320,908.4	9.3	1.6
	184-366 m	2,976.1	319,222.0	2,976.1	319,222.0	0.0	0.0
	55-366 m	7,114.4	635,000.7	7,500.5	640,130.4	5.4	0.8
Columbia							
	55-183 m	19,763.0	2,135,626.1	21,539.8	2,311,232.6	9.0	8.2
	184-366 m	6,839.1	680,293.0	6,914.3	690,190.1	1.1	1.5
	55-366 m	26,602.1	2,815,919.2	28,454.1	3,001,422.6	7.0	6.6
Eureka							
	55-183 m	2,635.7	154,047.0	2,866.7	154,243.4	8.8	0.1
	184-366 m	2,447.8	165,001.6	2,447.8	165,001.6	0.0	0.0
	55-366 m	5,083.5	319,048.6	5,314.5	319,245.0	4.5	0.1
Monterey							
	55-183 m	9,988.1	1,509,888.1	10,368.2	1,552,943.7	3.8	2.9
	184-366 m	4,012.6	417,936.0	4,235.7	406,947.3	5.6	-2.6
	55-366 m	14,000.6	1,927,824.1	14,603.9	1,959,891.0	4.3	1.7
US Total							
	55-183 m	36,525.0	4,115,340.0	39,299.1	4,339,328.1	7.6	5.4
	184-366 m	16,275.6	1,582,452.6	16,573.9	1,581,361.0	1.8	-0.1
	55-366 m	52,800.6	5,697,792.7	55,873.1	5,920,689.1	5.8	3.9
Entire Survey Area							
	55-183 m	52,767.3	19,704,766.9	58,544.3	24,591,784.6	10.9	24.8
	184-366 m	17,002.8	1,609,112.5	17,397.6	1,623,612.5	2.3	0.9
	55-366 m	69,770.1	21,313,879.4	75,941.9	26,215,397.2	8.8	23.0

APPENDIX E

Original and Revised Biomass Estimates for 1986

Appendix E contains original estimates of biomass and variance, revised estimates of biomass and variance when hauls with small catches of benthic fish and invertebrates are removed, and percent change in biomass and variance estimates. Change is indicated per individual strata for Pacific sanddab (*Citharichthys sordidus*), petrale sole (*Eopsetta jordani*), English sole (*Parophrys vetulus*), rex sole (*Glyptocephalus zachirus*), Dover sole (*Microstomus pacificus*), Pacific halibut (*Hippoglossus stenolepis*), sablefish (*Anoplopoma fimbria*), shortspine thornyhead (*Sebastolobus alascanus*), and all flatfish species combined.

Table E-1.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Pacific sanddab in 1986.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
US Vancouver							
	55-91 m	674.2	12,052.7	699.7	12,173.0	3.8	1.0
	92-183 m	335.1	8,878.5	366.9	10,738.0	9.5	20.9
	184-219 m	0.7	0.3	0.7	0.3	0.0	0.0
	220-366 m	0.0	-	0.0	-		
	55-366 m	1,010.0	20,931.5	1,067.2	22,911.3	5.7	9.5
Columbia							
	55-91 m	5,213.0	1,167,525.3	5,554.3	1,266,059.1	6.5	8.4
	92-183 m	1,243.7	42,871.7	1,243.7	42,871.7	0.0	0.0
	184-219 m	2.7	2.2	2.7	2.2	0.0	0.0
	220-366 m	0.0	-	0.0	-		
	55-366 m	6,459.4	1,210,399.2	6,800.7	1,308,933.0	5.3	8.1
Eureka							
	55-91 m	907.3	37,773.2	915.6	37,947.3	0.9	0.5
	92-183 m	540.8	8,102.8	540.8	8,102.8	0.0	0.0
	184-219 m	0.4	0.0	0.4	0.0	0.0	0.0
	220-366 m	0.0	-	0.0	-		
	55-366 m	1,448.5	45,876.0	1,456.7	46,050.1	0.6	0.4
Monterey							
	55-91 m	1,675.1	167,910.9	1,675.1	167,910.9	0.0	0.0
	92-183 m	1,171.4	43,912.8	1,171.4	43,912.8	0.0	0.0
	184-219 m	0.2	0.0	0.2	0.0	0.0	0.0
	220-366 m	0.0	-	0.0	-		
	55-366 m	2,846.7	211,823.7	2,846.7	211,823.7	0.0	0.0
US Total							
	55-91 m	8,469.7	1,638,086.3	8,844.7	1,745,800.3	4.4	6.6
	92-183 m	3,291.0	146,949.0	3,322.8	148,808.5	1.0	1.3
	184-219 m	3.9	3.1	3.9	3.1	0.0	0.0
	220-366 m	0.0	-	0.0	-		
	55-366 m	11,764.6	1,785,038.3	12,171.4	1,894,611.8	3.5	6.1

Table E-2.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for petrale sole in 1986.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
US Vancouver							
	55-91 m	45.1	786.1	46.5	790.2	3.2	0.5
	92-183 m	179.2	945.4	198.1	1,137.2	10.5	20.3
	184-219 m	8.3	21.2	8.3	21.2	0.0	0.0
	220-366 m	0.0	-	0.0	-		
	55-366 m	232.6	1,752.6	252.9	1,948.6	8.7	11.2
Columbia							
	55-91 m	377.8	6,686.8	399.1	7,105.6	5.6	6.3
	92-183 m	396.7	3,761.3	396.7	3,761.3	0.0	0.0
	184-219 m	11.7	33.7	11.7	33.7	0.0	0.0
	220-366 m	3.9	14.9	4.6	21.4	20.0	44.0
	55-366 m	790.1	10,496.7	812.2	10,922.0	2.8	4.1
Eureka							
	55-91 m	70.7	99.2	71.1	99.8	0.7	0.6
	92-183 m	69.1	157.0	69.1	157.0	0.0	0.0
	184-219 m	1.1	1.1	1.1	1.1	0.0	0.0
	220-366 m	0.0	-	0.0	-		
	55-366 m	140.8	257.3	141.3	257.9	0.3	0.2
Monterey							
	55-91 m	135.6	433.8	135.6	433.8	0.0	0.0
	92-183 m	138.3	833.7	138.3	833.7	0.0	0.0
	184-219 m	1.8	3.3	1.8	3.3	0.0	0.0
	220-366 m	0.0	-	0.0	-		
	55-366 m	275.7	1,270.8	275.7	1,270.8	0.0	0.0
US Total							
	55-91 m	629.2	8,814.7	652.4	9,281.6	3.7	5.3
	92-183 m	783.3	6,812.3	802.2	7,004.1	2.4	2.8
	184-219 m	22.9	97.8	22.9	97.8	0.0	0.0
	220-366 m	3.9	14.9	4.6	21.4	20.0	44.0
	55-366 m	1,439.2	15,739.7	1,482.1	16,404.9	3.0	4.2

Table E-3.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for English sole in 1986.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
US Vancouver							
	55-91 m	599.6	6,854.0	623.4	6,980.6	4.0	1.8
	92-183 m	434.8	6,829.3	479.7	8,203.1	10.3	20.1
	184-219 m	11.1	28.9	11.1	28.9	0.0	0.0
	220-366 m	8.2	44.2	9.5	59.2	16.7	34.1
	55-366 m	1,053.7	13,756.4	1,123.7	15,271.8	6.6	11.0
Columbia							
	55-91 m	1,937.6	59,082.1	2,059.3	65,363.8	6.3	10.6
	92-183 m	917.6	35,791.9	917.6	35,791.9	0.0	0.0
	184-219 m	63.9	913.0	63.9	913.0	0.0	0.0
	220-366 m	55.4	1,533.3	60.9	1,868.9	10.0	21.9
	55-366 m	2,974.5	97,320.2	3,101.6	103,937.6	4.3	6.8
Eureka							
	55-91 m	665.1	10,324.4	666.9	10,325.4	0.3	0.0
	92-183 m	432.5	5,674.1	432.5	5,674.1	0.0	0.0
	184-219 m	9.4	23.5	9.4	23.5	0.0	0.0
	220-366 m	6.0	6.7	6.0	6.7	0.0	0.0
	55-366 m	1,112.9	16,028.7	1,114.8	16,029.6	0.2	0.0
Monterey							
	55-91 m	1,369.6	48,129.6	1,369.6	48,129.6	0.0	0.0
	92-183 m	949.5	30,735.5	949.5	30,735.5	0.0	0.0
	184-219 m	12.3	61.9	12.3	61.9	0.0	0.0
	220-366 m	7.5	12.3	7.5	12.3	0.0	0.0
	55-366 m	2,338.9	78,939.3	2,338.9	78,939.3	0.0	0.0
US Total							
	55-91 m	4,572.0	176,333.7	4,719.2	183,226.3	3.2	3.9
	92-183 m	2,734.4	109,205.6	2,779.2	110,579.3	1.6	1.3
	184-219 m	96.6	1,207.3	96.6	1,207.3	0.0	0.0
	220-366 m	77.0	1,698.6	83.9	2,049.3	8.9	20.6
	55-366 m	7,480.0	288,445.1	7,678.9	297,062.2	2.7	3.0

Table E-4.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for rex sole in 1986.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
US Vancouver							
	55-91 m	256.4	612.8	270.6	653.0	5.6	6.6
	92-183 m	234.3	720.8	250.1	779.2	6.7	8.1
	184-219 m	66.4	510.4	66.4	510.4	0.0	0.0
	220-366 m	35.9	297.4	41.9	366.3	16.7	23.1
	55-366 m	593.1	2,141.5	629.0	2,308.9	6.1	7.8
Columbia							
	55-91 m	1,784.4	72,762.7	1,911.2	75,989.6	7.1	4.4
	92-183 m	3,256.1	96,675.2	3,256.1	96,675.2	0.0	0.0
	184-219 m	292.6	1,303.9	292.6	1,303.9	0.0	0.0
	220-366 m	735.4	24,361.4	798.2	26,016.2	8.5	6.8
	55-366 m	6,068.4	195,103.2	6,258.0	199,984.9	3.1	2.5
Eureka							
	55-91 m	482.3	17,537.3	483.9	17,542.0	0.3	0.0
	92-183 m	644.5	11,793.6	644.5	11,793.6	0.0	0.0
	184-219 m	68.7	1,025.4	68.7	1,025.4	0.0	0.0
	220-366 m	543.4	16,544.8	543.4	16,544.8	0.0	0.0
	55-366 m	1,738.9	46,901.1	1,740.4	46,905.8	0.1	0.0
Monterey							
	55-91 m	988.9	81,786.5	988.9	81,786.5	0.0	0.0
	92-183 m	1,354.6	63,894.2	1,354.6	63,894.2	0.0	0.0
	184-219 m	109.4	3,027.9	109.4	3,027.9	0.0	0.0
	220-366 m	883.4	47,715.8	883.4	47,715.8	0.0	0.0
	55-366 m	3,336.3	196,424.4	3,336.3	196,424.4	0.0	0.0
US Total							
	55-91 m	3,512.0	252,933.9	3,654.6	256,573.2	4.1	1.4
	92-183 m	5,489.5	232,029.9	5,505.3	232,088.3	0.3	0.0
	184-219 m	537.1	9,486.3	537.1	9,486.3	0.0	0.0
	220-366 m	2,198.0	146,111.8	2,266.8	147,835.4	3.1	1.2
	55-366 m	11,736.7	640,561.9	11,963.8	645,983.2	1.9	0.8

Table E-5.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Dover sole in 1986.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
US Vancouver							
	55-91 m	182.0	4,749.0	196.2	5,499.7	7.8	15.8
	92-183 m	462.7	2,557.3	499.6	2,974.7	8.0	16.3
	184-219 m	350.0	67,161.5	350.0	67,161.5	0.0	0.0
	220-366 m	345.8	8,559.4	403.4	7,332.7	16.7	-14.3
	55-366 m	1,340.5	83,027.3	1,449.3	82,968.8	8.1	-0.1
Columbia							
	55-91 m	613.3	18,473.0	666.4	20,992.3	8.7	13.6
	92-183 m	6,705.7	492,042.9	6,705.7	492,042.9	0.0	0.0
	184-219 m	681.3	25,133.0	681.3	25,133.0	0.0	0.0
	220-366 m	1,797.5	218,593.1	1,878.6	217,271.7	4.5	-0.6
	55-366 m	9,797.9	754,241.9	9,932.1	755,439.9	1.4	0.2
Eureka							
	55-91 m	307.5	6,091.2	307.8	6,091.6	0.1	0.0
	92-183 m	1,999.4	81,189.7	1,999.4	81,189.7	0.0	0.0
	184-219 m	337.6	12,445.1	337.6	12,445.1	0.0	0.0
	220-366 m	1,606.0	159,476.5	1,606.0	159,476.5	0.0	0.0
	55-366 m	4,250.5	259,202.5	4,250.7	259,202.9	0.0	0.0
Monterey							
	55-91 m	655.2	28,480.3	655.2	28,480.3	0.0	0.0
	92-183 m	4,132.1	436,087.5	4,132.1	436,087.5	0.0	0.0
	184-219 m	548.3	36,730.8	548.3	36,730.8	0.0	0.0
	220-366 m	2,595.2	458,883.9	2,595.2	458,883.9	0.0	0.0
	55-366 m	7,930.9	960,182.5	7,930.9	960,182.5	0.0	0.0
US Total							
	55-91 m	1,758.0	100,469.8	1,825.5	106,345.4	3.8	5.8
	92-183 m	13,299.9	1,433,807.4	13,336.9	1,434,224.8	0.3	0.0
	184-219 m	1,917.3	184,557.3	1,917.3	184,557.3	0.0	0.0
	220-366 m	6,344.5	1,408,352.1	6,483.2	1,405,804.1	2.2	-0.2
	55-366 m	23,319.6	3,127,186.6	23,562.9	3,130,931.6	1.0	0.1

Table E-6.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Pacific halibut in 1986.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
US Vancouver							
	55-91 m	179.1	2,315.2	188.0	2,471.4	4.9	6.7
	92-183 m	667.7	13,727.3	691.1	16,350.8	3.5	19.1
	184-219 m	39.5	421.2	39.5	421.2	0.0	0.0
	220-366 m	8.7	76.5	10.2	104.1	16.7	36.1
	55-366 m	895.0	16,540.1	928.8	19,347.4	3.8	17.0
Columbia							
	55-91 m	886.2	19,337.5	938.5	20,654.1	5.9	6.8
	92-183 m	1,296.2	50,430.8	1,296.2	50,430.8	0.0	0.0
	184-219 m	380.7	9,755.0	380.7	9,755.0	0.0	0.0
	220-366 m	88.3	2,778.3	91.6	2,900.3	3.8	4.4
	55-366 m	2,651.3	82,301.5	2,706.9	83,740.2	2.1	1.7
Eureka							
	55-91 m	164.8	9,625.0	166.1	9,626.1	0.8	0.0
	92-183 m	148.5	9,946.4	148.5	9,946.4	0.0	0.0
	184-219 m	7.5	23.7	7.5	23.7	0.0	0.0
	220-366 m	4.1	8.1	4.1	8.1	0.0	0.0
	55-366 m	324.8	19,603.2	326.1	19,604.3	0.4	0.0
Monterey							
	55-91 m	311.2	44,921.4	311.2	44,921.4	0.0	0.0
	92-183 m	261.4	53,786.4	261.4	53,786.4	0.0	0.0
	184-219 m	0.0	-	0.0	-		
	220-366 m	0.0	-	0.0	-		
	55-366 m	572.6	98,707.8	572.6	98,707.8	0.0	0.0
US Total							
	55-91 m	1,541.2	122,418.8	1,603.7	124,485.5	4.1	1.7
	92-183 m	2,373.7	183,188.4	2,397.2	185,811.9	1.0	1.4
	184-219 m	427.6	11,584.4	427.6	11,584.4	0.0	0.0
	220-366 m	101.1	3,147.2	105.9	3,296.9	4.7	4.8
	55-366 m	4,443.6	320,338.9	4,534.4	325,178.7	2.0	1.5

Table E-7.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for sablefish in 1986.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
US Vancouver							
	55-91 m	26.9	364.5	27.2	364.6	0.9	0.1
	92-183 m	1,644.3	207,965.4	1,786.2	255,860.2	8.6	23.0
	184-219 m	149.7	739.1	149.7	739.1	0.0	0.0
	220-366 m	655.9	143,635.5	765.3	184,357.7	16.7	28.4
	55-366 m	2,476.9	352,704.4	2,728.3	441,321.6	10.2	25.1
Columbia							
	55-91 m	1,891.7	1,843,734.2	1,959.1	1,895,109.6	3.6	2.8
	92-183 m	4,347.6	823,262.9	4,347.6	823,262.9	0.0	0.0
	184-219 m	943.1	37,876.1	943.1	37,876.1	0.0	0.0
	220-366 m	2,392.4	342,445.2	2,534.4	334,702.4	5.9	-2.3
	55-366 m	9,574.9	3,047,318.4	9,784.3	3,090,951.0	2.2	1.4
Eureka							
	55-91 m	769.6	322,376.1	769.9	322,376.4	0.0	0.0
	92-183 m	3,152.5	3,669,735.5	3,152.5	3,669,735.5	0.0	0.0
	184-219 m	331.8	49,061.7	331.8	49,061.7	0.0	0.0
	220-366 m	276.4	3,019.6	276.4	3,019.6	0.0	0.0
	55-366 m	4,530.4	4,044,192.9	4,530.6	4,044,193.2	0.0	0.0
Monterey							
	55-91 m	1,655.8	1,508,156.1	1,655.8	1,508,156.1	0.0	0.0
	92-183 m	7,190.0	20,022,061.9	7,190.0	20,022,061.9	0.0	0.0
	184-219 m	518.7	144,733.4	518.7	144,733.4	0.0	0.0
	220-366 m	307.3	5,945.8	307.3	5,945.8	0.0	0.0
	55-366 m	9,671.8	21,680,897.2	9,671.8	21,680,897.2	0.0	0.0
US Total							
	55-91 m	4,344.1	5,069,305.5	4,412.0	5,120,695.0	1.6	1.0
	92-183 m	16,334.5	41,909,588.3	16,476.3	41,957,483.1	0.9	0.1
	184-219 m	1,943.4	402,771.8	1,943.4	402,771.8	0.0	0.0
	220-366 m	3,632.1	535,867.7	3,883.4	568,847.1	6.9	6.2
	55-366 m	26,254.0	47,917,533.2	26,715.1	48,049,797.0	1.8	0.3

Table E-8.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for shortspine thornyhead in 1986.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
US Vancouver							
	55-91 m	0.0	-	0.0	-		
	92-183 m	21.2	75.6	22.5	78.6	5.9	3.9
	184-219 m	33.8	83.6	33.8	83.6	0.0	0.0
	220-366 m	148.0	4,407.2	172.6	5,318.8	16.7	20.7
	55-366 m	203.0	4,566.5	228.9	5,481.0	12.8	20.0
Columbia							
	55-91 m	14.6	50.4	15.3	55.6	5.1	10.3
	92-183 m	283.4	3,062.4	283.4	3,062.4	0.0	0.0
	184-219 m	254.9	4,388.9	254.9	4,388.9	0.0	0.0
	220-366 m	1,009.4	96,821.7	1,122.3	115,979.7	11.2	19.8
	55-366 m	1,562.3	104,323.4	1,675.9	123,486.6	7.3	18.4
Eureka							
	55-91 m	0.7	0.1	0.7	0.1	4.4	7.5
	92-183 m	8.8	6.4	8.8	6.4	0.0	0.0
	184-219 m	12.3	34.2	12.3	34.2	0.0	0.0
	220-366 m	108.8	796.8	108.8	796.8	0.0	0.0
	55-366 m	130.6	837.5	130.6	837.5	0.0	0.0
Monterey							
	55-91 m	0.5	0.2	0.5	0.2	0.0	0.0
	92-183 m	7.3	14.0	7.3	14.0	0.0	0.0
	184-219 m	12.5	96.3	12.5	96.3	0.0	0.0
	220-366 m	145.0	2,112.7	145.0	2,112.7	0.0	0.0
	55-366 m	165.2	2,223.3	165.2	2,223.3	0.0	0.0
US Total							
	55-91 m	15.7	54.5	16.5	60.1	4.9	10.3
	92-183 m	320.8	3,486.1	322.0	3,489.1	0.4	0.1
	184-219 m	313.4	4,753.0	313.4	4,753.0	0.0	0.0
	220-366 m	1,411.1	108,931.1	1,548.7	129,000.7	9.7	18.4
	55-366 m	2,061.0	117,224.8	2,200.6	137,303.0	6.8	17.1

Table E-9.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for total flatfish in 1986.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
US Vancouver							
	55-91 m	2,007.0	25,188.3	2,097.3	25,904.3	4.5	2.8
	92-183 m	5,356.3	152,307.9	5,809.4	166,100.0	8.5	9.1
	184-219 m	1,442.9	112,269.5	1,442.9	112,269.5	0.0	0.0
	220-366 m	1,156.0	81,563.4	1,348.7	62,216.0	16.7	-23.7
	55-366 m	9,962.3	371,329.2	10,698.3	366,489.8	7.4	-1.3
Columbia							
	55-91 m	11,026.1	1,604,950.0	11,754.8	1,635,527.6	6.6	1.9
	92-183 m	17,684.0	1,028,143.9	17,684.0	1,028,143.9	0.0	0.0
	184-219 m	2,100.3	59,984.4	2,100.3	59,984.4	0.0	0.0
	220-366 m	3,337.6	373,623.9	3,572.7	331,313.7	7.0	-11.3
	55-366 m	34,148.0	3,066,702.1	35,111.7	3,054,969.4	2.8	-0.4
Eureka							
	55-91 m	2,679.4	79,625.2	2,693.3	79,703.7	0.5	0.1
	92-183 m	3,982.8	140,004.6	3,982.8	140,004.6	0.0	0.0
	184-219 m	445.6	21,513.9	445.6	21,513.9	0.0	0.0
	220-366 m	2,209.2	261,375.5	2,209.2	261,375.5	0.0	0.0
	55-366 m	9,317.0	502,519.2	9,330.9	502,597.7	0.1	0.0
Monterey							
	55-91 m	5,306.2	362,112.0	5,306.2	362,112.0	0.0	0.0
	92-183 m	8,228.5	752,862.7	8,228.5	752,862.7	0.0	0.0
	184-219 m	690.9	62,977.7	690.9	62,977.7	0.0	0.0
	220-366 m	3,546.8	752,444.5	3,546.8	752,444.5	0.0	0.0
	55-366 m	17,772.4	1,930,396.9	17,772.4	1,930,396.9	0.0	0.0
US Total							
	55-91 m	21,018.6	2,574,420.7	21,851.5	2,612,082.9	4.0	1.5
	92-183 m	35,251.6	2,893,438.3	35,704.7	2,907,230.3	1.3	0.5
	184-219 m	4,679.6	340,631.0	4,679.6	340,631.0	0.0	0.0
	220-366 m	10,249.7	2,387,599.2	10,677.4	2,325,941.5	4.2	-2.6
	55-366 m	71,199.6	8,196,089.2	72,913.2	8,185,885.8	2.4	-0.1

APPENDIX F

Original and Revised Biomass Estimates for 1989

Appendix F contains original estimates of biomass and variance, revised estimates of biomass and variance when hauls with small catches of benthic fish and invertebrates are removed, and percent change in biomass and variance estimates. Change is indicated per individual strata for Pacific sanddab (*Citharichthys sordidus*), petrale sole (*Eopsetta jordani*), English sole (*Parophrys vetulus*), rex sole (*Glyptocephalus zachirus*), Dover sole (*Microstomus pacificus*), Pacific halibut (*Hippoglossus stenolepis*), sablefish (*Anoplopoma fimbria*), shortspine thornyhead (*Sebastolobus alascanus*), and all flatfish species combined.

Table F-1.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Pacific sanddab in 1989.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	1,508.9	327,336.5	1,557.6	348,529.3	3.2	6.5
	184-366 m	0.0	-	0.0	-		
	55-366 m	1,508.9	327,336.5	1,557.6	348,529.3	3.2	6.5
US Vancouver							
	55-183 m	1,061.3	60,113.6	1,080.8	61,635.6	1.8	2.5
	184-366 m	0.0	-	0.0	-		
	55-366 m	1,061.3	60,113.6	1,080.8	61,635.6	1.8	2.5
Total Vancouver							
	55-183 m	2,570.2	420,501.6	2,638.5	445,307.0	2.7	5.9
	184-366 m	0.0	-	0.0	-		
	55-366 m	2,570.2	420,501.6	2,638.5	445,307.0	2.7	5.9
Columbia							
	55-183 m	22,745.7	124,853,597.0	24,355.3	145,258,338.9	7.1	16.3
	184-366 m	0.0	-	0.0	-		
	55-366 m	22,745.7	124,853,597.0	24,355.3	145,258,338.9	7.1	16.3
Eureka							
	55-183 m	1,411.8	222,647.2	1,571.3	269,985.1	11.3	21.3
	184-366 m	0.0	-	0.0	-		
	55-366 m	1,411.8	222,647.2	1,571.3	269,985.1	11.3	21.3
Monterey							
	55-183 m	6,367.2	528,103.9	6,562.2	548,320.5	3.1	3.8
	184-366 m	80.6	4,619.5	81.0	4,620.4	0.5	0.0
	55-366 m	6,447.8	532,723.5	6,643.2	552,940.9	3.0	3.8
Conception							
	55-183 m	2,626.7	1,422,684.1	2,626.7	1,422,684.1	0.0	0.0
	184-366 m	6.1	29.8	11.9	117.9	93.8	295.2
	55-366 m	2,632.8	1,422,713.9	2,638.6	1,422,802.0	0.2	0.0
US Total							
	55-183 m	34,212.7	127,295,951.1	36,196.3	147,769,769.4	5.8	16.1
	184-366 m	86.7	4,650.5	92.9	4,740.3	7.1	1.9
	55-366 m	34,299.5	127,300,601.6	36,289.2	147,774,509.7	5.8	16.1
Total							
	55-183 m	35,721.6	127,656,339.1	37,754.0	148,153,440.7	5.7	16.1
	184-366 m	86.7	4,650.5	92.9	4,740.3	7.1	1.9
	55-366 m	35,808.4	127,660,989.6	37,846.8	148,158,181.1	5.7	16.1

Table F-2.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for petrale sole in 1989.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	934.2	36,930.6	965.3	38,958.0	3.3	5.5
	184-366 m	23.3	369.4	23.3	369.4	0.0	0.0
	55-366 m	957.5	37,300.0	988.6	39,327.4	3.2	5.4
US Vancouver							
	55-183 m	219.8	1,087.7	225.9	1,128.6	2.8	3.8
	184-366 m	9.9	38.6	10.0	38.7	0.8	0.1
	55-366 m	229.7	1,126.4	235.9	1,167.3	2.7	3.6
Total Vancouver							
	55-183 m	1,154.0	41,417.1	1,191.2	43,669.7	3.2	5.4
	184-366 m	33.2	621.2	33.3	621.3	0.2	0.0
	55-366 m	1,187.2	42,038.4	1,224.5	44,291.0	3.1	5.4
Columbia							
	55-183 m	1,536.5	519,652.9	1,630.0	605,406.0	6.1	16.5
	184-366 m	15.1	69.3	17.0	85.7	12.3	23.7
	55-366 m	1,551.6	519,722.2	1,647.0	605,491.7	6.1	16.5
Eureka							
	55-183 m	223.5	3,215.3	249.0	3,817.2	11.4	18.7
	184-366 m	1.7	1.7	2.0	2.6	23.1	50.1
	55-366 m	225.1	3,217.0	251.0	3,819.8	11.5	18.7
Monterey							
	55-183 m	1,196.6	33,172.0	1,229.5	34,594.5	2.7	4.3
	184-366 m	41.8	611.0	42.2	614.4	0.9	0.6
	55-366 m	1,238.5	33,783.0	1,271.7	35,208.9	2.7	4.2
Conception							
	55-183 m	125.3	786.9	125.3	786.9	0.0	0.0
	184-366 m	44.3	881.0	88.6	2,983.0	100.0	238.6
	55-366 m	169.6	1,667.9	213.9	3,769.8	26.1	126.0
US Total							
	55-183 m	3,301.7	558,764.2	3,459.7	646,582.5	4.8	15.7
	184-366 m	112.9	1,602.4	159.9	3,725.4	41.6	132.5
	55-366 m	3,414.6	560,366.6	3,619.6	650,307.9	6.0	16.1
Total							
	55-183 m	4,235.9	599,093.6	4,425.0	689,123.6	4.5	15.0
	184-366 m	136.1	2,185.1	183.2	4,308.0	34.5	97.2
	55-366 m	4,372.0	601,278.6	4,608.2	693,431.7	5.4	15.3

Table F-3.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for English sole in 1989.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	1,834.3	164,108.0	1,895.3	173,497.0	3.3	5.7
	184-366 m	6.9	18.3	6.9	18.3	0.0	0.0
	55-366 m	1,841.2	164,126.4	1,902.2	173,515.3	3.3	5.7
US Vancouver							
	55-183 m	1,282.3	137,615.1	1,313.0	144,340.4	2.4	4.9
	184-366 m	20.0	137.8	21.1	141.9	5.2	3.0
	55-366 m	1,302.4	137,752.8	1,334.1	144,482.3	2.4	4.9
Total Vancouver							
	55-183 m	3,116.7	333,704.4	3,208.4	351,650.6	2.9	5.4
	184-366 m	26.9	193.0	28.0	197.1	3.9	2.1
	55-366 m	3,143.6	333,897.4	3,236.3	351,847.7	2.9	5.4
Columbia							
	55-183 m	5,441.8	1,165,921.6	5,755.6	1,294,941.9	5.8	11.1
	184-366 m	123.2	6,641.9	177.0	15,485.4	43.7	133.1
	55-366 m	5,565.0	1,172,563.5	5,932.6	1,310,427.3	6.6	11.8
Eureka							
	55-183 m	452.1	13,693.6	503.8	16,288.1	11.4	18.9
	184-366 m	3.5	2.5	4.3	3.6	23.1	42.5
	55-366 m	455.6	13,696.2	508.1	16,291.7	11.5	19.0
Monterey							
	55-183 m	4,865.6	568,914.0	4,998.7	591,611.9	2.7	4.0
	184-366 m	214.8	16,415.1	218.3	16,465.8	1.6	0.3
	55-366 m	5,080.4	585,329.1	5,217.0	608,077.8	2.7	3.9
Conception							
	55-183 m	133.8	2,395.7	133.8	2,395.7	0.0	0.0
	184-366 m	1.0	1.1	1.4	1.9	33.3	77.8
	55-366 m	134.8	2,396.7	135.2	2,397.6	0.3	0.0
US Total							
	55-183 m	12,175.6	2,030,271.1	12,704.9	2,191,309.3	4.3	7.9
	184-366 m	362.6	23,295.1	422.1	32,225.3	16.4	38.3
	55-366 m	12,538.2	2,053,566.2	13,127.1	2,223,534.6	4.7	8.3
Total							
	55-183 m	14,010.0	2,226,360.5	14,600.3	2,398,619.5	4.2	7.7
	184-366 m	369.5	23,350.3	429.0	32,280.6	16.1	38.2
	55-366 m	14,379.5	2,249,710.8	15,029.3	2,430,900.0	4.5	8.1

Table F-4.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for rex sole in 1989.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	3,956.0	536,567.0	4,085.9	564,490.8	3.3	5.2
	184-366 m	342.9	9,190.4	342.9	9,190.4	0.0	0.0
	55-366 m	4,298.9	545,757.4	4,428.8	573,681.2	3.0	5.1
US Vancouver							
	55-183 m	773.6	23,342.0	789.8	24,541.2	2.1	5.1
	184-366 m	329.9	2,443.0	331.3	2,458.0	0.4	0.6
	55-366 m	1,103.5	25,785.0	1,121.1	26,999.2	1.6	4.7
Total Vancouver							
	55-183 m	4,729.6	610,153.8	4,875.7	641,910.7	3.1	5.2
	184-366 m	672.8	17,249.2	674.2	17,264.1	0.2	0.1
	55-366 m	5,402.4	627,402.9	5,549.9	659,174.8	2.7	5.1
Columbia							
	55-183 m	6,708.8	516,270.9	7,048.7	564,524.0	5.1	9.3
	184-366 m	721.4	21,916.2	897.6	34,006.8	24.4	55.2
	55-366 m	7,430.2	538,187.1	7,946.3	598,530.7	6.9	11.2
Eureka							
	55-183 m	511.9	13,316.0	569.4	15,634.6	11.2	17.4
	184-366 m	419.2	21,601.4	515.0	29,148.2	22.9	34.9
	55-366 m	931.1	34,917.4	1,084.4	44,782.8	16.5	28.3
Monterey							
	55-183 m	2,354.8	62,127.8	2,423.4	64,189.6	2.9	3.3
	184-366 m	630.0	51,854.4	656.6	52,959.6	4.2	2.1
	55-366 m	2,984.8	113,982.1	3,080.0	117,149.2	3.2	2.8
Conception							
	55-183 m	81.9	441.7	81.9	441.7	0.0	0.0
	184-366 m	428.4	84,452.9	850.3	291,961.9	98.5	245.7
	55-366 m	510.3	84,894.6	932.1	292,403.6	82.7	244.4
US Total							
	55-183 m	10,431.0	633,413.7	10,913.1	687,246.4	4.6	8.5
	184-366 m	2,528.9	182,756.1	3,250.8	411,270.2	28.5	125.0
	55-366 m	12,959.9	816,169.8	14,163.9	1,098,516.6	9.3	34.6
Total							
	55-183 m	14,387.0	1,220,225.5	14,999.1	1,304,615.9	4.3	6.9
	184-366 m	2,871.8	197,562.3	3,593.7	426,076.4	25.1	115.7
	55-366 m	17,258.8	1,417,787.8	18,592.7	1,730,692.3	7.7	22.1

Table F-5.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Dover sole in 1989.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	7,785.0	3,408,466.3	8,044.3	3,606,363.3	3.3	5.8
	184-366 m	1,649.1	215,238.1	1,649.1	215,238.1	0.0	0.0
	55-366 m	9,434.1	3,623,704.4	9,693.4	3,821,601.4	2.7	5.5
US Vancouver							
	55-183 m	988.0	33,264.4	1,009.7	35,132.1	2.2	5.6
	184-366 m	939.5	39,322.5	941.6	39,328.7	0.2	0.0
	55-366 m	1,927.5	72,586.9	1,951.3	74,460.8	1.2	2.6
Total Vancouver							
	55-183 m	8,773.0	3,746,003.5	9,053.9	3,963,441.6	3.2	5.8
	184-366 m	2,588.6	382,439.5	2,590.7	382,445.7	0.1	0.0
	55-366 m	11,361.6	4,128,443.0	11,644.7	4,345,887.3	2.5	5.3
Columbia							
	55-183 m	5,918.2	506,953.9	6,227.9	556,357.3	5.2	9.7
	184-366 m	866.9	23,733.2	1,059.1	29,346.3	22.2	23.7
	55-366 m	6,785.0	530,687.1	7,287.0	585,703.6	7.4	10.4
Eureka							
	55-183 m	1,978.7	374,216.1	2,204.8	451,376.5	11.4	20.6
	184-366 m	944.5	57,367.3	1,162.4	67,144.7	23.1	17.0
	55-366 m	2,923.1	431,583.3	3,367.2	518,521.2	15.2	20.1
Monterey							
	55-183 m	2,384.0	153,970.1	2,452.7	160,576.0	2.9	4.3
	184-366 m	2,036.7	256,143.0	2,158.6	261,632.8	6.0	2.1
	55-366 m	4,420.7	410,113.0	4,611.3	422,208.8	4.3	2.9
Conception							
	55-183 m	108.1	2,123.0	108.1	2,123.0	0.0	0.0
	184-366 m	1,204.2	574,417.4	2,342.6	1,962,090.5	94.5	241.6
	55-366 m	1,312.3	576,540.4	2,450.7	1,964,213.5	86.7	240.7
US Total							
	55-183 m	11,376.9	1,083,169.7	12,003.1	1,218,207.2	5.5	12.5
	184-366 m	5,991.8	962,484.3	7,664.4	2,375,399.8	27.9	146.8
	55-366 m	17,368.7	2,045,654.0	19,667.6	3,593,606.9	13.2	75.7
Total							
	55-183 m	19,161.9	4,795,908.9	20,047.4	5,146,516.7	4.6	7.3
	184-366 m	7,640.9	1,305,601.2	9,313.5	2,718,516.7	21.9	108.2
	55-366 m	26,802.8	6,101,510.1	29,360.9	7,865,033.4	9.5	28.9

Table F-6.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Pacific halibut in 1989.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	2,385.8	606,050.4	2,465.2	644,294.2	3.3	6.3
	184-366 m	552.3	117,868.1	552.3	117,868.1	0.0	0.0
	55-366 m	2,938.1	723,918.5	3,017.5	762,162.3	2.7	5.3
US Vancouver							
	55-183 m	872.0	25,284.4	896.4	26,152.1	2.8	3.4
	184-366 m	208.0	10,771.7	208.0	10,771.7	0.0	0.0
	55-366 m	1,080.0	36,056.0	1,104.4	36,923.8	2.3	2.4
Total Vancouver							
	55-183 m	3,257.8	687,713.0	3,361.6	730,315.8	3.2	6.2
	184-366 m	760.3	196,350.3	760.3	196,350.3	0.0	0.0
	55-366 m	4,018.0	884,063.3	4,121.9	926,666.1	2.6	4.8
Columbia							
	55-183 m	2,393.9	442,424.0	2,533.1	503,021.7	5.8	13.7
	184-366 m	496.1	103,769.6	559.9	128,731.2	12.9	24.1
	55-366 m	2,890.0	546,193.6	3,093.0	631,752.8	7.0	15.7
Eureka							
	55-183 m	237.1	15,917.3	264.2	19,612.4	11.4	23.2
	184-366 m	203.4	6,239.5	250.4	8,619.6	23.1	38.1
	55-366 m	440.5	22,156.8	514.6	28,232.1	16.8	27.4
Monterey							
	55-183 m	200.2	6,487.0	205.8	6,821.7	2.8	5.2
	184-366 m	0.0	-	0.0	-		
	55-366 m	200.2	6,487.0	205.8	6,821.7	2.8	5.2
Conception							
	55-183 m	0.0	-	0.0	-		
	184-366 m	0.0	-	0.0	-		
	55-366 m	0.0	-	0.0	-		
US Total							
	55-183 m	3,703.2	519,583.8	3,899.5	585,079.2	5.3	12.6
	184-366 m	907.5	120,780.7	1,018.2	148,122.5	12.2	22.6
	55-366 m	4,610.7	640,364.5	4,917.7	733,201.6	6.7	14.5
Total							
	55-183 m	6,089.0	1,182,012.4	6,364.7	1,289,242.9	4.5	9.1
	184-366 m	1,459.8	306,359.4	1,570.5	333,701.1	7.6	8.9
	55-366 m	7,548.8	1,488,371.8	7,935.2	1,622,944.0	5.1	9.0

Table F-7.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for sablefish in 1989.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	6,873.1	10,081,669.5	7,042.3	10,754,754.7	2.5	6.7
	184-366 m	849.9	135,682.8	849.9	135,682.8	0.0	0.0
	55-366 m	7,723.0	10,217,352.3	7,892.2	10,890,437.5	2.2	6.6
US Vancouver							
	55-183 m	2,260.9	1,178,664.9	2,326.9	1,251,035.5	2.9	6.1
	184-366 m	770.8	112,957.8	772.2	112,965.2	0.2	0.0
	55-366 m	3,031.7	1,291,622.7	3,099.1	1,364,000.7	2.2	5.6
Total Vancouver							
	55-183 m	9,134.0	12,322,787.1	9,369.2	13,138,235.5	2.6	6.6
	184-366 m	1,620.7	348,275.4	1,622.1	348,282.7	0.1	0.0
	55-366 m	10,754.7	12,671,062.4	10,991.2	13,486,518.2	2.2	6.4
Columbia							
	55-183 m	9,908.9	23,546,392.8	10,361.5	25,323,616.2	4.6	7.5
	184-366 m	4,082.5	3,965,748.6	4,838.2	4,962,622.9	18.5	25.1
	55-366 m	13,991.4	27,512,141.4	15,199.7	30,286,239.1	8.6	10.1
Eureka							
	55-183 m	354.2	42,841.4	375.9	53,021.0	6.1	23.8
	184-366 m	3,475.1	5,258,804.5	4,272.5	7,807,841.3	22.9	48.5
	55-366 m	3,829.3	5,301,645.9	4,648.4	7,860,862.3	21.4	48.3
Monterey							
	55-183 m	15,536.1	194,154,684.7	15,939.3	204,223,785.3	2.6	5.2
	184-366 m	871.2	59,179.3	920.9	61,943.5	5.7	4.7
	55-366 m	16,407.3	194,213,864.0	16,860.2	204,285,728.8	2.8	5.2
Conception							
	55-183 m	112.3	1,066.6	112.3	1,066.6	0.0	0.0
	184-366 m	366.3	17,681.3	699.7	25,840.8	91.0	46.1
	55-366 m	478.6	18,747.9	812.0	26,907.4	69.7	43.5
US Total							
	55-183 m	28,172.3	218,927,950.1	29,115.8	230,856,824.2	3.3	5.4
	184-366 m	9,566.0	9,416,717.4	11,503.6	12,974,913.5	20.3	37.8
	55-366 m	37,738.3	228,344,667.5	40,619.4	243,831,737.7	7.6	6.8
Total							
	55-183 m	35,045.4	230,072,072.3	36,158.1	242,744,024.3	3.2	5.5
	184-366 m	10,415.9	9,652,035.0	12,353.5	13,210,231.0	18.6	36.9
	55-366 m	45,461.3	239,724,107.3	48,511.6	255,954,255.3	6.7	6.8

Table F-8.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for shortspine thornyhead in 1989.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	55.0	1,109.3	56.9	1,183.5	3.3	6.7
	184-366 m	184.5	2,378.5	184.5	2,378.5	0.0	0.0
	55-366 m	239.5	3,487.8	241.4	3,562.0	0.8	2.1
US Vancouver							
	55-183 m	47.3	958.1	48.6	1,017.4	2.8	6.2
	184-366 m	235.3	3,523.9	236.4	3,534.2	0.4	0.3
	55-366 m	282.6	4,482.0	285.0	4,551.6	0.8	1.6
Total Vancouver							
	55-183 m	102.3	2,306.4	105.5	2,455.3	3.1	6.5
	184-366 m	419.8	7,975.8	420.9	7,986.1	0.2	0.1
	55-366 m	522.1	10,282.2	526.3	10,441.4	0.8	1.5
Columbia							
	55-183 m	167.2	1,169.0	172.6	1,235.7	3.3	5.7
	184-366 m	772.2	42,753.8	918.4	53,332.3	18.9	24.7
	55-366 m	939.4	43,922.8	1,091.1	54,568.0	16.1	24.2
Eureka							
	55-183 m	54.7	1,247.5	60.9	1,542.4	11.4	23.6
	184-366 m	164.1	2,175.7	201.6	2,720.4	22.9	25.0
	55-366 m	218.7	3,423.2	262.5	4,262.9	20.0	24.5
Monterey							
	55-183 m	1.3	1.6	1.3	1.7	2.6	5.2
	184-366 m	223.8	3,154.6	253.3	4,277.3	13.1	35.6
	55-366 m	225.1	3,156.2	254.6	4,279.0	13.1	35.6
Conception							
	55-183 m	0.3	0.1	0.3	0.1	0.0	0.0
	184-366 m	88.0	2,759.1	157.2	9,146.8	78.7	231.5
	55-366 m	88.2	2,759.2	157.5	9,146.9	78.4	231.5
US Total							
	55-183 m	270.7	3,459.3	283.7	3,880.3	4.8	12.2
	184-366 m	1,483.4	56,440.2	1,766.8	76,396.9	19.1	35.4
	55-366 m	1,754.1	59,899.5	2,050.6	80,277.2	16.9	34.0
Total							
	55-183 m	325.7	4,807.6	340.6	5,318.2	4.6	10.6
	184-366 m	1,667.9	60,892.1	1,951.3	80,848.8	17.0	32.8
	55-366 m	1,993.6	65,699.7	2,292.0	86,167.0	15.0	31.2

Table F-9.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for total flatfish in 1989.

INPFC Area	Depth Stratum	Original estimates Biomass (t)	Original estimates Variance	Revised estimates Biomass (t)	Revised estimates Variance	Percent change Biomass (t)	Percent change Variance
Canadian Vancouver							
	55-183 m	55,510.6	110,739,883.1	57,350.0	116,575,023.2	3.3	5.3
	184-366 m	6,250.0	3,095,464.7	6,250.0	3,095,464.7	0.0	0.0
	55-366 m	61,760.7	113,835,347.8	63,600.0	119,670,487.8	3.0	5.1
US Vancouver							
	55-183 m	13,903.9	17,483,683.0	14,284.6	18,505,482.0	2.7	5.8
	184-366 m	4,624.5	724,502.1	4,637.3	724,495.6	0.3	0.0
	55-366 m	18,528.4	18,208,185.1	18,921.9	19,229,977.5	2.1	5.6
Total Vancouver							
	55-183 m	69,414.5	140,556,658.1	71,634.6	148,079,416.2	3.2	5.4
	184-366 m	10,874.5	5,693,346.3	10,887.4	5,693,339.8	0.1	0.0
	55-366 m	80,289.1	146,250,004.5	82,522.0	153,772,756.0	2.8	5.1
Columbia							
	55-183 m	49,835.7	143,904,138.6	52,821.4	165,636,775.8	6.0	15.1
	184-366 m	3,882.2	515,691.0	4,641.4	613,713.6	19.6	19.0
	55-366 m	53,717.9	144,419,829.6	57,462.8	166,250,489.5	7.0	15.1
Eureka							
	55-183 m	4,985.3	840,655.2	5,550.7	955,240.2	11.3	13.6
	184-366 m	1,676.9	151,542.0	2,063.0	166,883.2	23.0	10.1
	55-366 m	6,662.2	992,197.2	7,613.7	1,122,123.4	14.3	13.1
Monterey							
	55-183 m	17,832.9	2,324,789.8	18,350.1	2,362,462.4	2.9	1.6
	184-366 m	3,057.4	387,627.1	3,213.5	395,928.8	5.1	2.1
	55-366 m	20,890.3	2,712,416.8	21,563.6	2,758,391.3	3.2	1.7
Conception							
	55-183 m	3,105.3	1,445,933.4	3,105.3	1,445,933.4	0.0	0.0
	184-366 m	1,697.8	1,130,964.7	3,321.4	3,814,116.3	95.6	237.2
	55-366 m	4,803.1	2,576,898.1	6,426.7	5,260,049.7	33.8	104.1
US Total							
	55-183 m	89,663.1	166,765,346.6	94,112.2	189,672,040.5	5.0	13.7
	184-366 m	14,938.8	2,928,478.9	17,876.6	5,739,176.0	19.7	96.0
	55-366 m	104,601.9	169,693,825.4	111,988.8	195,411,216.5	7.1	15.2
Total							
	55-183 m	145,173.8	289,838,321.7	151,462.2	319,245,974.7	4.3	10.1
	184-366 m	21,188.8	7,897,323.0	24,126.6	10,708,020.2	13.9	35.6
	55-366 m	166,362.6	297,735,644.7	175,588.9	329,953,994.9	5.5	10.8

APPENDIX G

Original and Revised Biomass Estimates for 1992

Appendix G contains original estimates of biomass and variance, revised estimates of biomass and variance when hauls with small catches of benthic fish and invertebrates are removed, and percent change in biomass and variance estimates. Change is indicated per individual strata for Pacific sanddab (*Citharichthys sordidus*), petrale sole (*Eopsetta jordani*), English sole (*Parophrys vetulus*), rex sole (*Glyptocephalus zachirus*), Dover sole (*Microstomus pacificus*), Pacific halibut (*Hippoglossus stenolepis*), sablefish (*Anoplopoma fimbria*), shortspine thornyhead (*Sebastolobus alascanus*), and all flatfish species combined.

Table G-1.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Pacific sanddab in 1992.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	1,056.3	148,792.7	1,062.0	148,846.0	0.5	0.0
	184-366 m	0.0	0.0	0.0	0.0	0.0	0.0
	55-366 m	1,056.3	148,792.7	1,062.0	148,846.0	0.5	0.0
US Vancouver							
	55-183 m	986.2	51,614.9	1,061.7	61,072.0	7.7	18.3
	184-366 m	0.3	0.1	0.3	0.1	0.0	0.0
	55-366 m	986.5	51,615.0	1,062.1	61,072.1	7.7	18.3
Total Vancouver							
	55-183 m	2,042.5	219,119.8	2,123.7	230,050.6	4.0	5.0
	184-366 m	0.4	0.1	0.4	0.1	0.0	0.0
	55-366 m	2,042.9	219,120.0	2,124.1	230,050.7	4.0	5.0
Columbia							
	55-183 m	11,864.2	3,028,409.2	11,864.2	3,028,409.2	0.0	0.0
	184-366 m	0.0	-	0.0	-		
	55-366 m	11,864.2	3,028,409.2	11,864.2	3,028,409.2	0.0	0.0
Eureka							
	55-183 m	2,356.1	708,655.9	2,356.1	708,655.9	0.0	0.0
	184-366 m	0.0	-	0.0	-		
	55-366 m	2,356.1	708,655.9	2,356.1	708,655.9	0.0	0.0
Monterey							
	55-183 m	3,294.5	408,597.3	3,585.8	493,316.2	8.8	20.7
	184-366 m	1.9	3.7	1.9	3.7	0.0	0.0
	55-366 m	3,296.5	408,600.9	3,587.7	493,319.8	8.8	20.7
Conception							
	55-183 m	288.9	5,450.5	389.6	7,747.4	34.9	42.1
	184-366 m	0.0	-	0.0	-		
	55-366 m	288.9	5,450.5	389.6	7,747.4	34.9	42.1
US Total							
	55-183 m	18,789.9	4,294,283.8	19,257.4	4,390,798.0	2.5	2.2
	184-366 m	2.3	3.8	2.3	3.8	0.0	0.0
	55-366 m	18,792.2	4,294,287.6	19,259.7	4,390,801.7	2.5	2.2
Total							
	55-183 m	19,846.2	4,461,788.8	20,319.4	4,559,776.5	2.4	2.2
	184-366 m	2.3	3.8	2.3	3.8	0.0	0.0
	55-366 m	19,848.5	4,461,792.6	20,321.7	4,559,780.4	2.4	2.2

Table G-2.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for petrale sole in 1992.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	327.0	5,403.6	328.4	5,407.1	0.4	0.1
	184-366 m	45.0	193.3	45.0	193.3	0.0	0.0
	55-366 m	372.0	5,596.9	373.4	5,600.4	0.4	0.1
US Vancouver							
	55-183 m	179.4	2,548.3	198.0	3,176.8	10.4	24.7
	184-366 m	25.5	50.1	25.5	50.1	0.0	0.0
	55-366 m	204.9	2,598.3	223.6	3,226.8	9.1	24.2
Total Vancouver							
	55-183 m	506.4	8,793.9	526.4	9,520.4	4.0	8.3
	184-366 m	70.6	356.6	70.6	356.6	0.0	0.0
	55-366 m	576.9	9,150.6	597.0	9,877.0	3.5	7.9
Columbia							
	55-183 m	971.6	11,411.9	971.6	11,411.9	0.0	0.0
	184-366 m	95.1	1,337.6	95.1	1,337.6	0.0	0.0
	55-366 m	1,066.7	12,749.5	1,066.7	12,749.5	0.0	0.0
Eureka							
	55-183 m	168.4	1,898.1	168.4	1,898.1	0.0	0.0
	184-366 m	31.2	352.4	33.3	397.8	6.7	12.9
	55-366 m	199.6	2,250.5	201.7	2,295.9	1.0	2.0
Monterey							
	55-183 m	243.4	1,751.3	256.2	1,888.8	5.2	7.9
	184-366 m	24.7	129.1	24.7	129.1	0.0	0.0
	55-366 m	268.2	1,880.4	280.9	2,017.9	4.8	7.3
Conception							
	55-183 m	8.4	15.6	9.4	25.3	12.3	62.1
	184-366 m	0.0	-	0.0	-		
	55-366 m	8.4	15.6	9.4	25.3	12.3	62.1
US Total							
	55-183 m	1,571.1	18,297.5	1,603.6	19,100.4	2.1	4.4
	184-366 m	176.6	2,015.1	178.7	2,060.5	1.2	2.3
	55-366 m	1,747.7	20,312.7	1,782.3	21,160.9	2.0	4.2
Total							
	55-183 m	1,898.1	24,543.2	1,931.9	25,444.0	1.8	3.7
	184-366 m	221.7	2,321.7	223.8	2,367.1	0.9	2.0
	55-366 m	2,119.8	26,864.9	2,155.7	27,811.1	1.7	3.5

Table G-3.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for English sole in 1992.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	1,934.7	112,985.1	1,941.2	113,056.1	0.3	0.1
	184-366 m	45.7	398.5	45.7	398.5	0.0	0.0
	55-366 m	1,980.4	113,383.5	1,986.8	113,454.6	0.3	0.1
US Vancouver							
	55-183 m	1,159.4	82,248.4	1,245.2	94,855.7	7.4	15.3
	184-366 m	94.7	2,714.3	94.7	2,714.3	0.0	0.0
	55-366 m	1,254.1	84,962.7	1,339.9	97,570.0	6.8	14.8
Total Vancouver							
	55-183 m	3,094.1	212,605.6	3,186.4	227,177.4	3.0	6.9
	184-366 m	140.4	3,915.3	140.4	3,915.3	0.0	0.0
	55-366 m	3,234.5	216,520.9	3,326.8	231,092.7	2.9	6.7
Columbia							
	55-183 m	6,508.6	710,721.9	6,508.6	710,721.9	0.0	0.0
	184-366 m	365.7	28,697.7	365.7	28,697.7	0.0	0.0
	55-366 m	6,874.3	739,419.5	6,874.3	739,419.5	0.0	0.0
Eureka							
	55-183 m	301.1	5,425.4	301.1	5,425.4	0.0	0.0
	184-366 m	56.4	1,731.0	60.2	1,962.1	6.7	13.4
	55-366 m	357.6	7,156.4	361.3	7,387.5	1.1	3.2
Monterey							
	55-183 m	1,434.0	49,973.9	1,543.7	56,855.4	7.7	13.8
	184-366 m	307.1	8,818.6	307.6	8,818.4	0.1	0.0
	55-366 m	1,741.2	58,792.5	1,851.3	65,673.8	6.3	11.7
Conception							
	55-183 m	23.1	83.9	28.4	151.1	22.6	80.0
	184-366 m	0.3	0.1	0.5	-	100.0	
	55-366 m	23.4	84.0	28.9	151.1	23.4	79.8
US Total							
	55-183 m	9,426.2	1,061,335.5	9,627.0	1,080,899.4	2.1	1.8
	184-366 m	824.3	42,091.6	828.8	42,322.2	0.5	0.5
	55-366 m	10,250.5	1,103,427.1	10,455.8	1,123,221.6	2.0	1.8
Total							
	55-183 m	11,361.0	1,191,692.7	11,568.2	1,213,221.0	1.8	1.8
	184-366 m	870.0	43,292.6	874.4	43,523.2	0.5	0.5
	55-366 m	12,230.9	1,234,985.3	12,442.6	1,256,744.2	1.7	1.8

Table G-4.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for rex sole in 1992.

INPFC Area	Depth Stratum	Original estimates Biomass (t)	Original estimates Variance	Revised estimates Biomass (t)	Revised estimates Variance	Percent change Biomass (t)	Percent change Variance
Canadian Vancouver							
	55-183 m	2,907.5	265,146.0	2,911.3	265,178.5	0.1	0.0
	184-366 m	489.4	20,470.2	489.4	20,470.2	0.0	0.0
	55-366 m	3,396.9	285,616.2	3,400.7	285,648.7	0.1	0.0
US Vancouver							
	55-183 m	1,085.8	62,416.3	1,136.0	68,187.5	4.6	9.2
	184-366 m	357.2	3,649.4	357.2	3,649.4	0.0	0.0
	55-366 m	1,443.1	66,065.7	1,493.3	71,836.9	3.5	8.7
Total Vancouver							
	55-183 m	3,993.3	354,176.4	4,047.3	360,846.9	1.4	1.9
	184-366 m	846.6	36,223.2	846.6	36,223.2	0.0	0.0
	55-366 m	4,839.9	390,399.6	4,893.9	397,070.1	1.1	1.7
Columbia							
	55-183 m	7,393.0	655,671.7	7,393.0	655,671.7	0.0	0.0
	184-366 m	1,721.0	72,808.8	1,721.0	72,808.8	0.0	0.0
	55-366 m	9,114.1	728,480.5	9,114.1	728,480.5	0.0	0.0
Eureka							
	55-183 m	729.5	25,609.7	729.5	25,609.7	0.0	0.0
	184-366 m	218.4	4,021.7	232.7	4,363.0	6.5	8.5
	55-366 m	947.9	29,631.4	962.2	29,972.6	1.5	1.2
Monterey							
	55-183 m	878.7	13,300.0	938.3	15,672.6	6.8	17.8
	184-366 m	306.5	11,545.3	315.7	11,461.3	3.0	-0.7
	55-366 m	1,185.2	24,845.3	1,254.0	27,133.9	5.8	9.2
Conception							
	55-183 m	5.1	2.9	5.0	5.3	-2.2	84.6
	184-366 m	62.8	1,418.1	67.9	1,392.2	8.1	-1.8
	55-366 m	67.9	1,420.9	72.9	1,397.5	7.3	-1.6
US Total							
	55-183 m	10,092.1	1,020,717.5	10,201.8	1,028,863.7	1.1	0.8
	184-366 m	2,666.0	94,745.6	2,694.5	94,883.8	1.1	0.1
	55-366 m	12,758.1	1,115,463.1	12,896.3	1,123,747.5	1.1	0.7
Total							
	55-183 m	12,999.6	1,312,477.6	13,113.1	1,321,523.1	0.9	0.7
	184-366 m	3,155.3	127,319.3	3,183.9	127,457.6	0.9	0.1
	55-366 m	16,155.0	1,439,797.0	16,297.0	1,448,980.7	0.9	0.6

Table G-5.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Dover sole in 1992.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	5,137.5	1,505,186.6	5,140.3	1,505,192.1	0.1	0.0
	184-366 m	2,341.1	788,537.9	2,341.1	788,537.9	0.0	0.0
	55-366 m	7,478.6	2,293,724.4	7,481.3	2,293,729.9	0.0	0.0
US Vancouver							
	55-183 m	842.2	17,167.0	878.6	18,141.7	4.3	5.7
	184-366 m	1,068.4	83,148.5	1,068.4	83,148.5	0.0	0.0
	55-366 m	1,910.6	100,315.4	1,947.0	101,290.2	1.9	1.0
Total Vancouver							
	55-183 m	5,979.7	1,655,804.3	6,018.9	1,656,930.9	0.7	0.1
	184-366 m	3,409.5	1,326,569.7	3,409.5	1,326,569.7	0.0	0.0
	55-366 m	9,389.2	2,982,374.0	9,428.3	2,983,500.6	0.4	0.0
Columbia							
	55-183 m	4,424.8	312,183.2	4,424.8	312,183.2	0.0	0.0
	184-366 m	3,959.1	447,568.7	3,959.1	447,568.7	0.0	0.0
	55-366 m	8,383.9	759,751.9	8,383.9	759,751.9	0.0	0.0
Eureka							
	55-183 m	396.7	38,284.8	396.7	38,284.8	0.0	0.0
	184-366 m	1,370.4	199,035.4	1,460.4	218,209.9	6.6	9.6
	55-366 m	1,767.1	237,320.2	1,857.1	256,494.7	5.1	8.1
Monterey							
	55-183 m	143.5	1,546.0	153.0	1,688.9	6.6	9.2
	184-366 m	1,584.4	164,600.8	1,608.5	164,021.7	1.5	-0.4
	55-366 m	1,727.9	166,146.8	1,761.5	165,710.6	1.9	-0.3
Conception							
	55-183 m	1.6	0.8	2.2	1.5	38.5	82.5
	184-366 m	97.0	3,646.9	110.4	3,468.7	13.8	-4.9
	55-366 m	98.6	3,647.7	112.6	3,470.2	14.2	-4.9
US Total							
	55-183 m	5,808.7	431,020.2	5,855.3	432,138.6	0.8	0.3
	184-366 m	8,079.4	913,703.8	8,206.8	931,478.5	1.6	1.9
	55-366 m	13,888.1	1,344,724.0	14,062.1	1,363,617.1	1.3	1.4
Total							
	55-183 m	10,946.2	2,069,657.5	10,995.5	2,070,927.7	0.5	0.1
	184-366 m	10,420.5	2,157,125.1	10,547.9	2,174,899.8	1.2	0.8
	55-366 m	21,366.7	4,226,782.6	21,543.5	4,245,827.5	0.8	0.5

Table G-6.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Pacific halibut in 1992.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	818.7	76,970.1	825.9	77,156.4	0.9	0.2
	184-366 m	241.6	6,704.1	241.6	6,704.1	0.0	0.0
	55-366 m	1,060.3	83,674.2	1,067.6	83,860.5	0.7	0.2
US Vancouver							
	55-183 m	811.4	119,504.0	907.9	152,547.0	11.9	27.7
	184-366 m	933.2	306,952.3	933.2	306,952.3	0.0	0.0
	55-366 m	1,744.5	426,456.3	1,841.1	459,499.4	5.5	7.7
Total Vancouver							
	55-183 m	1,630.0	220,775.5	1,733.9	258,967.4	6.4	17.3
	184-366 m	1,174.8	383,069.3	1,174.8	383,069.3	0.0	0.0
	55-366 m	2,804.9	603,844.8	2,908.7	642,036.7	3.7	6.3
Columbia							
	55-183 m	2,132.7	257,658.5	2,132.7	257,658.5	0.0	0.0
	184-366 m	1,339.2	128,086.7	1,339.2	128,086.7	0.0	0.0
	55-366 m	3,472.0	385,745.3	3,472.0	385,745.3	0.0	0.0
Eureka							
	55-183 m	136.9	5,526.8	136.9	5,526.8	0.0	0.0
	184-366 m	62.6	826.2	66.8	924.3	6.7	11.9
	55-366 m	199.5	6,353.0	203.7	6,451.2	2.1	1.5
Monterey							
	55-183 m	132.3	6,850.5	135.8	7,208.0	2.6	5.2
	184-366 m	0.0	-	0.0	-		
	55-366 m	132.3	6,850.5	135.8	7,208.0	2.6	5.2
Conception							
	55-183 m	0.0	-	0.0	-		
	184-366 m	0.0	-	0.0	-		
	55-366 m	0.0	-	0.0	-		
US Total							
	55-183 m	3,213.2	404,917.6	3,313.3	438,318.2	3.1	8.2
	184-366 m	2,335.0	452,173.9	2,339.2	452,272.0	0.2	0.0
	55-366 m	5,548.3	857,091.5	5,652.5	890,590.2	1.9	3.9
Total							
	55-183 m	4,031.9	506,189.2	4,139.2	544,738.6	2.7	7.6
	184-366 m	2,576.7	528,290.8	2,580.9	528,388.9	0.2	0.0
	55-366 m	6,608.6	1,034,480.0	6,720.1	1,073,127.5	1.7	3.7

Table G-7.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for sablefish in 1992.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	2,949.9	1,598,619.2	3,015.6	1,642,923.2	2.2	2.8
	184-366 m	804.7	76,285.1	804.7	76,285.1	0.0	0.0
	55-366 m	3,754.6	1,674,904.3	3,820.3	1,719,208.3	1.8	2.6
US Vancouver							
	55-183 m	6,651.2	26,016,747.0	7,526.3	33,873,921.9	13.2	30.2
	184-366 m	813.5	13,651.0	813.5	13,651.0	0.0	0.0
	55-366 m	7,464.7	26,030,398.1	8,339.8	33,887,573.0	11.7	30.2
Total Vancouver							
	55-183 m	9,601.2	31,644,342.1	10,541.9	40,725,828.2	9.8	28.7
	184-366 m	1,618.2	134,424.1	1,618.2	134,424.1	0.0	0.0
	55-366 m	11,219.3	31,778,766.2	12,160.1	40,860,252.3	8.4	28.6
Columbia							
	55-183 m	10,745.4	5,430,178.0	10,745.4	5,430,178.0	0.0	0.0
	184-366 m	36,537.0	187,824,887.0	36,537.0	187,824,887.0	0.0	0.0
	55-366 m	47,282.4	193,255,065.0	47,282.4	193,255,065.0	0.0	0.0
Eureka							
	55-183 m	43.9	247.5	43.9	247.5	0.0	0.0
	184-366 m	1,130.3	213,997.1	1,190.5	240,425.7	5.3	12.3
	55-366 m	1,174.2	214,244.6	1,234.4	240,673.2	5.1	12.3
Monterey							
	55-183 m	691.7	31,778.1	718.5	33,937.1	3.9	6.8
	184-366 m	435.2	7,367.5	442.1	7,320.2	1.6	-0.6
	55-366 m	1,127.0	39,145.6	1,160.6	41,257.3	3.0	5.4
Conception							
	55-183 m	14.1	60.6	17.9	97.3	26.8	60.8
	184-366 m	62.0	1,917.4	65.9	1,902.9	6.1	-0.8
	55-366 m	76.2	1,978.0	83.8	2,000.2	10.0	1.1
US Total							
	55-183 m	18,146.4	31,736,724.1	19,051.9	39,596,278.8	5.0	24.8
	184-366 m	38,978.1	188,085,635.8	39,049.0	188,111,950.1	0.2	0.0
	55-366 m	57,124.5	219,822,359.9	58,100.9	227,708,228.9	1.7	3.6
Total							
	55-183 m	21,096.3	37,364,319.1	22,067.6	46,448,185.1	4.6	24.3
	184-366 m	39,782.8	188,206,408.9	39,853.7	188,232,723.2	0.2	0.0
	55-366 m	60,879.1	225,570,728.0	61,921.2	234,680,908.3	1.7	4.0

Table G-8.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for shortspine thornyhead in 1992.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	75.3	1,479.4	75.3	1,479.4	-0.1	0.0
	184-366 m	218.6	7,170.6	218.6	7,170.6	0.0	0.0
	55-366 m	294.0	8,650.1	293.9	8,650.1	0.0	0.0
US Vancouver							
	55-183 m	6.1	5.9	5.2	5.0	-14.9	-14.1
	184-366 m	300.1	12,147.7	300.1	12,147.7	0.0	0.0
	55-366 m	306.2	12,153.5	305.3	12,152.7	-0.3	0.0
Total Vancouver							
	55-183 m	81.4	1,615.9	80.5	1,614.9	-1.2	-0.1
	184-366 m	518.7	25,879.6	518.7	25,879.6	0.0	0.0
	55-366 m	600.1	27,495.5	599.2	27,494.6	-0.2	0.0
Columbia							
	55-183 m	35.7	232.5	35.7	232.5	0.0	0.0
	184-366 m	1,298.6	67,787.4	1,298.6	67,787.4	0.0	0.0
	55-366 m	1,334.3	68,020.0	1,334.3	68,020.0	0.0	0.0
Eureka							
	55-183 m	0.3	0.1	0.3	0.1	0.0	0.0
	184-366 m	140.0	3,413.2	148.6	3,816.1	6.2	11.8
	55-366 m	140.3	3,413.3	148.9	3,816.2	6.1	11.8
Monterey							
	55-183 m	0.0	-	0.0	-		
	184-366 m	145.5	1,160.7	145.5	1,160.7	0.0	0.0
	55-366 m	145.5	1,160.7	145.5	1,160.7	0.0	0.0
Conception							
	55-183 m	0.2	0.0	0.3	0.1	38.5	91.7
	184-366 m	6.3	0.2	6.3	0.2	0.0	0.0
	55-366 m	6.5	0.3	6.6	0.3	1.1	11.3
US Total							
	55-183 m	42.2	252.6	41.4	251.8	-2.0	-0.3
	184-366 m	1,890.5	85,656.3	1,899.1	86,059.2	0.5	0.5
	55-366 m	1,932.7	85,908.9	1,940.5	86,311.0	0.4	0.5
Total							
	55-183 m	117.6	1,862.6	116.7	1,861.7	-0.8	0.0
	184-366 m	2,109.1	99,388.2	2,117.7	99,791.1	0.4	0.4
	55-366 m	2,226.7	101,250.8	2,234.4	101,652.8	0.3	0.4

Table G-9.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for total flatfish in 1992.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	21,387.3	9,284,367.4	21,423.0	9,284,757.7	0.2	0.0
	184-366 m	4,570.1	1,811,466.6	4,570.1	1,811,466.6	0.0	0.0
	55-366 m	25,957.4	11,095,834.0	25,993.0	11,096,224.3	0.1	0.0
US Vancouver							
	55-183 m	6,552.9	752,347.4	7,027.9	821,557.3	7.2	9.2
	184-366 m	3,725.4	409,001.7	3,725.4	409,001.7	0.0	0.0
	55-366 m	10,278.3	1,161,349.1	10,753.3	1,230,559.0	4.6	6.0
Total Vancouver							
	55-183 m	27,940.2	10,931,400.9	28,450.9	11,011,395.2	1.8	0.7
	184-366 m	8,295.4	3,312,685.8	8,295.4	3,312,685.8	0.0	0.0
	55-366 m	36,235.6	14,244,086.7	36,746.3	14,324,081.0	1.4	0.6
Columbia							
	55-183 m	36,151.0	9,166,309.1	36,151.0	9,166,309.1	0.0	0.0
	184-366 m	8,894.3	1,140,431.7	8,894.3	1,140,431.7	0.0	0.0
	55-366 m	45,045.3	10,306,740.7	45,045.3	10,306,740.7	0.0	0.0
Eureka							
	55-183 m	4,336.3	799,393.9	4,336.3	799,393.9	0.0	0.0
	184-366 m	1,943.5	291,931.2	2,071.5	314,926.5	6.6	7.9
	55-366 m	6,279.8	1,091,325.1	6,407.8	1,114,320.4	2.0	2.1
Monterey							
	55-183 m	6,347.0	687,250.8	6,848.9	793,221.3	7.9	15.4
	184-366 m	2,235.7	261,165.1	2,269.4	260,030.2	1.5	-0.4
	55-366 m	8,582.7	948,415.9	9,118.4	1,053,251.6	6.2	11.1
Conception							
	55-183 m	342.7	5,754.1	452.9	7,806.5	32.2	35.7
	184-366 m	160.1	9,605.3	178.8	9,256.0	11.7	-3.6
	55-366 m	502.8	15,359.4	631.7	17,062.6	25.6	11.1
US Total							
	55-183 m	53,729.8	12,895,814.3	54,817.0	13,073,069.0	2.0	1.4
	184-366 m	16,959.1	2,141,687.4	17,139.4	2,161,939.4	1.1	0.9
	55-366 m	70,688.9	15,037,501.7	71,956.4	15,235,008.4	1.8	1.3
Total							
	55-183 m	75,117.1	23,074,867.8	76,240.0	23,262,906.8	1.5	0.8
	184-366 m	21,529.1	5,045,371.5	21,709.5	5,065,623.5	0.8	0.4
	55-366 m	96,646.3	28,120,239.2	97,949.4	28,328,530.3	1.3	0.7

APPENDIX H

Original and Revised Biomass Estimates for 1995

Appendix H contains original estimates of biomass and variance, revised estimates of biomass and variance when hauls with small catches of benthic fish and invertebrates are removed, and percent change in biomass and variance estimates. Change is indicated per individual strata for Pacific sanddab (*Citharichthys sordidus*), petrale sole (*Eopsetta jordani*), English sole (*Parophrys vetulus*), rex sole (*Glyptocephalus zachirus*), Dover sole (*Microstomus pacificus*), Pacific halibut (*Hippoglossus stenolepis*), sablefish (*Anoplopoma fimbria*), shortspine thornyhead (*Sebastolobus alascanus*), and all flatfish species combined.

Table H-1.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Pacific sanddab in 1995.

INPFC Area	Depth Stratum	Original estimates Biomass (t)	Original estimates Variance	Revised estimates Biomass (t)	Revised estimates Variance	Percent change Biomass (t)	Percent change Variance
Canadian Vancouver							
	55-183 m	3,725.7	1,124,213.3	3,725.7	1,124,213.3	0.0	0.0
	184-366 m	0.0	-	0.0	-		
	367-500 m	0.0	-	0.0	-		
	55-366 m	3,725.7	1,124,213.3	3,725.7	1,124,213.3	0.0	0.0
	55-500 m	3,725.7	1,124,213.3	3,725.7	1,124,213.3	0.0	0.0
US Vancouver							
	55-183 m	2,430.4	662,097.9	2,464.5	672,745.1	1.4	1.6
	184-366 m	0.0	-	0.0	-		
	367-500 m	0.0	-	0.0	-		
	55-366 m	2,430.4	662,097.9	2,464.5	672,745.1	1.4	1.6
	55-500 m	2,430.4	662,097.9	2,464.5	672,745.1	1.4	1.6
Total Vancouver							
	55-183 m	6,156.1	1,956,654.8	6,190.2	1,967,302.0	0.6	0.5
	184-366 m	0.0	-	0.0	-		
	367-500 m	0.0	-	0.0	-		
	55-366 m	6,156.1	1,956,654.8	6,190.2	1,967,302.0	0.6	0.5
	55-500 m	6,156.1	1,956,654.8	6,190.2	1,967,302.0	0.6	0.5
Columbia							
	55-183 m	26,950.3	33,253,795.9	27,061.8	33,367,746.5	0.4	0.3
	184-366 m	0.2	0.0	0.2	0.0	0.0	0.0
	367-500 m	0.0	-	0.0	-		
	55-366 m	26,950.5	33,253,796.0	27,062.0	33,367,746.6	0.4	0.3
	55-500 m	26,950.5	33,253,796.0	27,062.0	33,367,746.6	0.4	0.3
Eureka							
	55-183 m	2,809.9	932,246.2	3,246.5	1,206,261.5	15.5	29.4
	184-366 m	1.0	1.1	1.0	1.1	0.0	0.0
	367-500 m	0.0	-	0.0	-		
	55-366 m	2,810.9	932,247.3	3,247.5	1,206,262.5	15.5	29.4
	55-500 m	2,810.9	932,247.3	3,247.5	1,206,262.5	15.5	29.4
Monterey							
	55-183 m	11,347.2	2,828,309.6	11,347.2	2,828,309.6	0.0	0.0
	184-366 m	68.6	4,552.0	68.6	4,552.0	0.0	0.0
	367-500 m	0.0	-	0.0	-		
	55-366 m	11,415.7	2,832,861.6	11,415.7	2,832,861.6	0.0	0.0
	55-500 m	11,415.7	2,832,861.6	11,415.7	2,832,861.6	0.0	0.0
Conception							
	55-183 m	2,151.5	1,495,121.8	2,292.4	1,717,254.8	6.5	14.9
	184-366 m	37.4	1,400.4	37.4	1,400.4	0.0	0.0
	367-500 m	0.0	-	0.0	-		
	55-366 m	2,188.9	1,496,522.1	2,329.9	1,718,655.2	6.4	14.8
	55-500 m	2,188.9	1,496,522.1	2,329.9	1,718,655.2	6.4	14.8

Table H-1.--Continued.

INPFC Area	Depth Stratum	Original estimates Biomass (t)	Original estimates Variance	Revised estimates Biomass (t)	Revised estimates Variance	Percent change Biomass (t)	Percent change Variance
US Total							
	55-183 m	45,689.3	40,530,722.5	46,412.4	41,221,132.5	1.6	1.7
	184-366 m	107.2	11,002.3	107.2	11,002.3	0.0	0.0
	367-500 m	0.0	-	0.0	-		
	55-366 m	45,796.5	40,541,724.8	46,519.7	41,232,134.8	1.6	1.7
	55-500 m	45,796.5	40,541,724.8	46,519.7	41,232,134.8	1.6	1.7
Total							
	55-183 m	49,415.0	41,825,279.4	50,138.1	42,515,689.4	1.5	1.7
	184-366 m	107.2	11,002.3	107.2	11,002.3	0.0	0.0
	367-500 m	0.0	-	0.0	-		
	55-366 m	49,522.2	41,836,281.7	50,245.4	42,526,691.7	1.5	1.7
	55-500 m	49,522.2	41,836,281.7	50,245.4	42,526,691.7	1.5	1.7

Table H-2.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for petrale sole in 1995.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	698.6	23,343.4	698.6	23,343.4	0.0	0.0
	184-366 m	4.1	6.5	4.1	6.5	0.0	0.0
	367-500 m	0.0	-	0.0	-		
	55-366 m	702.7	23,349.9	702.7	23,349.9	0.0	0.0
	55-500 m	702.7	23,349.9	702.7	23,349.9	0.0	0.0
US Vancouver							
	55-183 m	261.0	7,709.4	262.3	7,714.4	0.5	0.1
	184-366 m	4.6	11.4	4.6	11.4	0.0	0.0
	367-500 m	0.0	-	0.0	-		
	55-366 m	265.7	7,720.9	267.0	7,725.8	0.5	0.1
	55-500 m	265.7	7,720.9	267.0	7,725.8	0.5	0.1
Total Vancouver							
	55-183 m	959.6	34,242.8	960.9	34,247.8	0.1	0.0
	184-366 m	8.8	23.9	8.8	23.9	0.0	0.0
	367-500 m	0.0	-	0.0	-		
	55-366 m	968.4	34,266.8	969.7	34,271.7	0.1	0.0
	55-500 m	968.4	34,266.8	969.7	34,271.7	0.1	0.0
Columbia							
	55-183 m	795.1	11,371.0	799.3	11,424.3	0.5	0.5
	184-366 m	28.2	104.6	28.2	104.6	0.0	0.0
	367-500 m	0.0	-	0.0	-		
	55-366 m	823.3	11,475.6	827.5	11,528.9	0.5	0.5
	55-500 m	823.3	11,475.6	827.5	11,528.9	0.5	0.5
Eureka							
	55-183 m	257.3	5,733.5	293.5	7,380.2	14.1	28.7
	184-366 m	4.2	12.8	4.2	12.8	0.0	0.0
	367-500 m	0.0	-	0.0	-		
	55-366 m	261.5	5,746.3	297.7	7,393.0	13.9	28.7
	55-500 m	261.5	5,746.3	297.7	7,393.0	13.9	28.7
Monterey							
	55-183 m	811.2	17,230.0	811.2	17,230.0	0.0	0.0
	184-366 m	63.6	1,365.2	63.6	1,365.2	0.0	0.0
	367-500 m	0.3	0.1	0.3	0.1	0.0	0.0
	55-366 m	874.7	18,595.2	874.7	18,595.2	0.0	0.0
	55-500 m	875.0	18,595.3	875.0	18,595.3	0.0	0.0
Conception							
	55-183 m	108.4	735.0	111.0	760.8	2.4	3.5
	184-366 m	31.4	315.2	33.5	333.1	6.8	5.7
	367-500 m	0.0	-	0.0	-		
	55-366 m	139.7	1,050.2	144.5	1,093.9	3.4	4.2
	55-500 m	139.7	1,050.2	144.5	1,093.9	3.4	4.2

Table H-2.--Continued.

INPFC Area	Depth Stratum	Original estimates Biomass (t)	Original estimates Variance	Revised estimates Biomass (t)	Revised estimates Variance	Percent change Biomass (t)	Percent change Variance
US Total							
	55-183 m	2,232.9	46,983.7	2,277.3	48,747.0	2.0	3.8
	184-366 m	132.0	2,820.9	134.1	2,838.8	1.6	0.6
	367-500 m	0.3	0.1	0.3	0.1	0.0	0.0
	55-366 m	2,364.9	49,804.6	2,411.4	51,585.8	2.0	3.6
	55-500 m	2,365.2	49,804.7	2,411.7	51,585.8	2.0	3.6
Total							
	55-183 m	2,931.5	73,517.1	2,975.9	75,280.4	1.5	2.4
	184-366 m	136.1	2,833.4	138.3	2,851.3	1.6	0.6
	367-500 m	0.3	0.1	0.3	0.1	0.0	0.0
	55-366 m	3,067.6	76,350.5	3,114.2	78,131.7	1.5	2.3
	55-500 m	3,067.9	76,350.6	3,114.4	78,131.7	1.5	2.3

Table H-3.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for English sole in 1995.

INPFC Area	Depth Stratum	Original estimates Biomass (t)	Original estimates Variance	Revised estimates Biomass (t)	Revised estimates Variance	Percent change Biomass (t)	Percent change Variance
Canadian Vancouver							
	55-183 m	2,342.3	200,619.7	2,342.3	200,619.7	0.0	0.0
	184-366 m	53.2	1,299.9	53.2	1,299.9	0.0	0.0
	367-500 m	0.0	-	0.0	-		
	55-366 m	2,395.5	201,919.6	2,395.5	201,919.6	0.0	0.0
	55-500 m	2,395.5	201,919.6	2,395.5	201,919.6	0.0	0.0
US Vancouver							
	55-183 m	896.0	55,583.3	902.4	55,760.6	0.7	0.3
	184-366 m	37.3	224.2	37.3	224.2	0.0	0.0
	367-500 m	0.0	-	0.0	-		
	55-366 m	933.4	55,807.5	939.7	55,984.8	0.7	0.3
	55-500 m	933.4	55,807.5	939.7	55,984.8	0.7	0.3
Total Vancouver							
	55-183 m	3,238.4	281,645.0	3,244.7	281,822.4	0.2	0.1
	184-366 m	90.5	2,281.3	90.5	2,281.3	0.0	0.0
	367-500 m	0.0	-	0.0	-		
	55-366 m	3,328.9	283,926.3	3,335.2	284,103.7	0.2	0.1
	55-500 m	3,328.9	283,926.3	3,335.2	284,103.7	0.2	0.1
Columbia							
	55-183 m	3,656.2	292,867.8	3,677.0	294,766.1	0.6	0.6
	184-366 m	213.5	4,545.9	213.5	4,545.9	0.0	0.0
	367-500 m	4.4	19.4	4.4	19.4	0.0	0.0
	55-366 m	3,869.8	297,413.7	3,890.5	299,312.0	0.5	0.6
	55-500 m	3,874.2	297,433.1	3,894.9	299,331.4	0.5	0.6
Eureka							
	55-183 m	228.1	6,123.6	263.7	7,919.3	15.6	29.3
	184-366 m	63.2	1,541.5	63.2	1,541.5	0.0	0.0
	367-500 m	0.0	-	0.0	-		
	55-366 m	291.3	7,665.2	326.9	9,460.9	12.2	23.4
	55-500 m	291.3	7,665.2	326.9	9,460.9	12.2	23.4
Monterey							
	55-183 m	4,540.3	364,425.4	4,540.3	364,425.4	0.0	0.0
	184-366 m	292.6	17,196.9	292.6	17,196.9	0.0	0.0
	367-500 m	33.4	459.2	33.4	459.2	0.0	0.0
	55-366 m	4,832.9	381,622.2	4,832.9	381,622.2	0.0	0.0
	55-500 m	4,866.3	382,081.5	4,866.3	382,081.5	0.0	0.0
Conception							
	55-183 m	195.2	2,793.8	204.9	3,020.1	5.0	8.1
	184-366 m	70.6	4,397.0	70.6	4,397.0	0.0	0.0
	367-500 m	3.8	14.2	3.8	14.2	0.0	0.0
	55-366 m	265.8	7,190.9	275.5	7,417.2	3.7	3.1
	55-500 m	269.5	7,205.1	279.3	7,431.4	3.6	3.1

Table H-3.--Continued.

INPFC Area	Depth Stratum	Original estimates Biomass (t)	Original estimates Variance	Revised estimates Biomass (t)	Revised estimates Variance	Percent change Biomass (t)	Percent change Variance
US Total							
	55-183 m	9,515.8	749,254.4	9,588.3	754,512.5	0.8	0.7
	184-366 m	677.3	44,133.2	677.3	44,133.2	0.0	0.0
	367-500 m	41.6	540.5	41.6	540.5	0.0	0.0
	55-366 m	10,193.1	793,387.6	10,265.6	798,645.7	0.7	0.7
	55-500 m	10,234.7	793,928.1	10,307.1	799,186.2	0.7	0.7
Total							
	55-183 m	11,858.1	975,316.1	11,930.6	980,574.3	0.6	0.5
	184-366 m	730.5	46,190.3	730.5	46,190.3	0.0	0.0
	367-500 m	41.6	540.5	41.6	540.5	0.0	0.0
	55-366 m	12,588.6	1,021,506.5	12,661.1	1,026,764.6	0.6	0.5
	55-500 m	12,630.2	1,022,047.0	12,702.7	1,027,305.1	0.6	0.5

Table H-4.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for rex sole in 1995.

INPFC Area	Depth Stratum	Original estimates Biomass (t)	Original estimates Variance	Revised estimates Biomass (t)	Revised estimates Variance	Percent change Biomass (t)	Percent change Variance
Canadian Vancouver							
	55-183 m	4,343.0	342,451.3	4,343.0	342,451.3	0.0	0.0
	184-366 m	447.6	25,433.4	447.6	25,433.4	0.0	0.0
	367-500 m	221.7	3,009.1	221.7	3,009.1	0.0	0.0
	55-366 m	4,790.6	367,884.7	4,790.6	367,884.7	0.0	0.0
	55-500 m	5,012.3	370,893.8	5,012.3	370,893.8	0.0	0.0
US Vancouver							
	55-183 m	719.4	10,348.3	729.4	10,418.6	1.4	0.7
	184-366 m	548.9	14,080.6	548.9	14,080.6	0.0	0.0
	367-500 m	42.8	18.3	42.8	18.3	0.0	0.0
	55-366 m	1,268.3	24,429.0	1,278.3	24,499.3	0.8	0.3
	55-500 m	1,311.1	24,447.3	1,321.1	24,517.6	0.8	0.3
Total Vancouver							
	55-183 m	5,062.4	384,037.6	5,072.4	384,107.9	0.2	0.0
	184-366 m	996.5	56,588.3	996.5	56,588.3	0.0	0.0
	367-500 m	264.5	3,029.1	264.5	3,029.1	0.0	0.0
	55-366 m	6,058.9	440,625.9	6,068.9	440,696.2	0.2	0.0
	55-500 m	6,323.4	443,655.0	6,333.4	443,725.3	0.2	0.0
Columbia							
	55-183 m	6,172.4	345,529.4	6,205.1	346,281.7	0.5	0.2
	184-366 m	2,166.0	72,338.6	2,166.0	72,338.6	0.0	0.0
	367-500 m	1,034.8	43,303.3	1,034.8	43,303.3	0.0	0.0
	55-366 m	8,338.4	417,867.9	8,371.2	418,620.2	0.4	0.2
	55-500 m	9,373.3	461,171.2	9,406.0	461,923.5	0.3	0.2
Eureka							
	55-183 m	288.5	2,520.9	324.2	3,052.9	12.4	21.1
	184-366 m	451.2	14,352.6	451.2	14,352.6	0.0	0.0
	367-500 m	660.1	46,576.8	660.1	46,576.8	0.0	0.0
	55-366 m	739.7	16,873.5	775.4	17,405.6	4.8	3.2
	55-500 m	1,399.8	63,450.3	1,435.5	63,982.4	2.5	0.8
Monterey							
	55-183 m	1,723.3	110,479.6	1,723.3	110,479.6	0.0	0.0
	184-366 m	1,001.2	39,968.9	1,001.2	39,968.9	0.0	0.0
	367-500 m	1,140.3	71,892.4	1,140.3	71,892.4	0.0	0.0
	55-366 m	2,724.5	150,448.5	2,724.5	150,448.5	0.0	0.0
	55-500 m	3,864.7	222,341.0	3,864.7	222,341.0	0.0	0.0
Conception							
	55-183 m	17.2	49.3	18.5	55.6	7.4	12.7
	184-366 m	822.1	175,981.0	1,021.9	254,202.8	24.3	44.4
	367-500 m	877.0	35,090.3	877.0	35,090.3	0.0	0.0
	55-366 m	839.3	176,030.3	1,040.4	254,258.4	24.0	44.4
	55-500 m	1,716.3	211,120.6	1,917.4	289,348.7	11.7	37.1

Table H-4.--Continued.

INPFC Area	Depth Stratum	Original estimates Biomass (t)	Original estimates Variance	Revised estimates Biomass (t)	Revised estimates Variance	Percent change Biomass (t)	Percent change Variance
US Total							
	55-183 m	8,920.8	486,860.3	9,000.5	488,681.2	0.9	0.4
	184-366 m	4,989.4	319,605.3	5,189.2	397,827.1	4.0	24.5
	367-500 m	3,755.0	240,369.8	3,755.0	240,369.8	0.0	0.0
	55-366 m	13,910.2	806,465.6	14,189.6	886,508.3	2.0	9.9
	55-500 m	17,665.2	1,046,835.5	17,944.7	1,126,878.2	1.6	7.6
Total							
	55-183 m	13,263.8	860,549.6	13,343.4	862,370.5	0.6	0.2
	184-366 m	5,437.0	362,113.0	5,636.8	440,334.8	3.7	21.6
	367-500 m	3,976.7	243,380.6	3,976.7	243,380.6	0.0	0.0
	55-366 m	18,700.8	1,222,662.6	18,980.3	1,302,705.3	1.5	6.5
	55-500 m	22,677.5	1,466,043.1	22,956.9	1,546,085.9	1.2	5.5

Table H-5.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Dover sole in 1995.

INPFC Area	Depth Stratum	Original estimates Biomass (t)	Original estimates Variance	Revised estimates Biomass (t)	Revised estimates Variance	Percent change Biomass (t)	Percent change Variance
Canadian Vancouver							
	55-183 m	6,926.3	1,850,805.1	6,926.3	1,850,805.1	0.0	0.0
	184-366 m	818.6	21,735.0	818.6	21,735.0	0.0	0.0
	367-500 m	599.5	25,615.3	599.5	25,615.3	0.0	0.0
	55-366 m	7,744.9	1,872,540.1	7,744.9	1,872,540.1	0.0	0.0
	55-500 m	8,344.4	1,898,155.5	8,344.4	1,898,155.5	0.0	0.0
US Vancouver							
	55-183 m	976.9	19,819.3	987.0	19,911.4	1.0	0.5
	184-366 m	1,542.2	94,621.5	1,542.2	94,621.5	0.0	0.0
	367-500 m	267.5	5,669.2	267.5	5,669.2	0.0	0.0
	55-366 m	2,519.1	114,440.9	2,529.2	114,532.9	0.4	0.1
	55-500 m	2,786.6	120,110.1	2,796.7	120,202.1	0.4	0.1
Total Vancouver							
	55-183 m	7,903.2	2,035,798.0	7,913.3	2,035,890.0	0.1	0.0
	184-366 m	2,360.8	148,566.0	2,360.8	148,566.0	0.0	0.0
	367-500 m	867.0	33,858.3	867.0	33,858.3	0.0	0.0
	55-366 m	10,264.0	2,184,364.0	10,274.1	2,184,456.0	0.1	0.0
	55-500 m	11,131.0	2,218,222.3	11,141.1	2,218,314.3	0.1	0.0
Columbia							
	55-183 m	5,117.4	531,695.5	5,150.5	532,680.3	0.6	0.2
	184-366 m	3,436.6	209,083.9	3,436.6	209,083.9	0.0	0.0
	367-500 m	3,069.1	250,661.7	3,069.1	250,661.7	0.0	0.0
	55-366 m	8,554.0	740,779.4	8,587.1	741,764.2	0.4	0.1
	55-500 m	11,623.0	991,441.0	11,656.1	992,425.9	0.3	0.1
Eureka							
	55-183 m	258.6	12,456.2	299.0	16,335.7	15.6	31.1
	184-366 m	1,338.5	118,046.9	1,338.5	118,046.9	0.0	0.0
	367-500 m	1,481.0	137,747.3	1,481.0	137,747.3	0.0	0.0
	55-366 m	1,597.2	130,503.1	1,637.6	134,382.6	2.5	3.0
	55-500 m	3,078.1	268,250.5	3,118.6	272,129.9	1.3	1.4
Monterey							
	55-183 m	1,822.7	107,002.7	1,822.7	107,002.7	0.0	0.0
	184-366 m	2,926.2	378,780.2	2,926.2	378,780.2	0.0	0.0
	367-500 m	5,396.9	1,023,843.8	5,396.9	1,023,843.8	0.0	0.0
	55-366 m	4,748.8	485,782.9	4,748.8	485,782.9	0.0	0.0
	55-500 m	10,145.8	1,509,626.7	10,145.8	1,509,626.7	0.0	0.0
Conception							
	55-183 m	7.6	6.2	7.9	6.7	4.7	8.0
	184-366 m	1,063.2	166,861.8	1,323.3	219,816.5	24.5	31.7
	367-500 m	3,429.9	267,997.7	3,429.9	267,997.7	0.0	0.0
	55-366 m	1,070.7	166,868.0	1,331.2	219,823.2	24.3	31.7
	55-500 m	4,500.6	434,865.7	4,761.1	487,820.9	5.8	12.2

Table H-5.--Continued.

INPFC Area	Depth Stratum	Original estimates Biomass (t)	Original estimates Variance	Revised estimates Biomass (t)	Revised estimates Variance	Percent change Biomass (t)	Percent change Variance
US Total							
	55-183 m	8,183.1	691,386.4	8,267.1	696,945.3	1.0	0.8
	184-366 m	10,306.7	975,487.6	10,566.8	1,028,442.3	2.5	5.4
	367-500 m	13,644.4	2,145,172.5	13,644.4	2,145,172.5	0.0	0.0
	55-366 m	18,489.8	1,666,874.1	18,833.9	1,725,387.7	1.9	3.5
	55-500 m	32,134.2	3,812,046.6	32,478.3	3,870,560.2	1.1	1.5
Total							
	55-183 m	15,109.5	2,707,365.1	15,193.5	2,712,924.0	0.6	0.2
	184-366 m	11,125.3	1,029,432.1	11,385.4	1,082,386.8	2.3	5.1
	367-500 m	14,243.9	2,173,361.6	14,243.9	2,173,361.6	0.0	0.0
	55-366 m	26,234.7	3,736,797.2	26,578.9	3,795,310.8	1.3	1.6
	55-500 m	40,478.6	5,910,158.8	40,822.7	5,968,672.4	0.9	1.0

Table H-6.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for Pacific halibut in 1995.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	1,895.6	104,999.0	1,895.6	104,999.0	0.0	0.0
	184-366 m	412.6	10,978.3	412.6	10,978.3	0.0	0.0
	367-500 m	272.8	10,922.5	272.8	10,922.5	0.0	0.0
	55-366 m	2,308.2	115,977.4	2,308.2	115,977.4	0.0	0.0
	55-500 m	2,581.1	126,899.8	2,581.1	126,899.8	0.0	0.0
US Vancouver							
	55-183 m	2,725.4	3,304,747.7	2,727.5	3,304,781.4	0.1	0.0
	184-366 m	315.4	11,090.6	315.4	11,090.6	0.0	0.0
	367-500 m	0.0	-	0.0	-		
	55-366 m	3,040.8	3,315,838.3	3,042.9	3,315,872.0	0.1	0.0
	55-500 m	3,040.8	3,315,838.3	3,042.9	3,315,872.0	0.1	0.0
Total Vancouver							
	55-183 m	4,621.0	3,913,562.0	4,623.1	3,913,595.8	0.0	0.0
	184-366 m	728.0	30,304.9	728.0	30,304.9	0.0	0.0
	367-500 m	272.8	10,922.5	272.8	10,922.5	0.0	0.0
	55-366 m	5,349.0	3,943,866.9	5,351.2	3,943,900.7	0.0	0.0
	55-500 m	5,621.8	3,954,789.4	5,624.0	3,954,823.2	0.0	0.0
Columbia							
	55-183 m	3,053.7	570,027.1	3,060.6	570,388.3	0.2	0.1
	184-366 m	872.4	97,736.0	872.4	97,736.0	0.0	0.0
	367-500 m	70.8	5,006.9	70.8	5,006.9	0.0	0.0
	55-366 m	3,926.0	667,763.1	3,933.0	668,124.3	0.2	0.1
	55-500 m	3,996.8	672,769.9	4,003.8	673,131.2	0.2	0.1
Eureka							
	55-183 m	742.8	85,454.3	858.8	111,527.9	15.6	30.5
	184-366 m	243.8	20,888.0	243.8	20,888.0	0.0	0.0
	367-500 m	0.0	-	0.0	-		
	55-366 m	986.6	106,342.3	1,102.6	132,415.9	11.8	24.5
	55-500 m	986.6	106,342.3	1,102.6	132,415.9	11.8	24.5
Monterey							
	55-183 m	248.5	10,409.5	248.5	10,409.5	0.0	0.0
	184-366 m	6.1	36.8	6.1	36.8	0.0	0.0
	367-500 m	0.0	-	0.0	-		
	55-366 m	254.6	10,446.3	254.6	10,446.3	0.0	0.0
	55-500 m	254.6	10,446.3	254.6	10,446.3	0.0	0.0
Conception							
	55-183 m	0.0	-	0.0	-		
	184-366 m	0.0	-	0.0	-		
	367-500 m	0.0	-	0.0	-		
	55-366 m	0.0	-	0.0	-		
	55-500 m	0.0	-	0.0	-		

Table H-6.--Continued.

INPFC Area	Depth Stratum	Original estimates Biomass (t)	Original estimates Variance	Revised estimates Biomass (t)	Revised estimates Variance	Percent change Biomass (t)	Percent change Variance
US Total							
	55-183 m	6,770.3	3,974,553.7	6,895.5	4,001,243.1	1.8	0.7
	184-366 m	1,437.7	137,318.1	1,437.7	137,318.1	0.0	0.0
	367-500 m	70.8	5,006.9	70.8	5,006.9	0.0	0.0
	55-366 m	8,208.0	4,111,871.8	8,333.2	4,138,561.2	1.5	0.6
	55-500 m	8,278.8	4,116,878.7	8,403.9	4,143,568.1	1.5	0.6
Total							
	55-183 m	8,666.0	4,583,368.0	8,791.1	4,610,057.4	1.4	0.6
	184-366 m	1,850.3	156,532.4	1,850.3	156,532.4	0.0	0.0
	367-500 m	343.6	15,929.3	343.6	15,929.3	0.0	0.0
	55-366 m	10,516.2	4,739,900.4	10,641.4	4,766,589.9	1.2	0.6
	55-500 m	10,859.8	4,755,829.8	10,985.0	4,782,519.2	1.2	0.6

Table H-7.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for sablefish in 1995.

INPFC Area	Depth Stratum	Original estimates Biomass (t)	Original estimates Variance	Revised estimates Biomass (t)	Revised estimates Variance	Percent change Biomass (t)	Percent change Variance
Canadian Vancouver							
	55-183 m	5,617.4	21,444,418.8	5,617.4	21,444,418.8	0.0	0.0
	184-366 m	497.6	13,851.3	497.6	13,851.3	0.0	0.0
	367-500 m	249.4	35,599.6	249.4	35,599.6	0.0	0.0
	55-366 m	6,115.0	21,458,270.0	6,115.0	21,458,270.0	0.0	0.0
	55-500 m	6,364.4	21,493,869.6	6,364.4	21,493,869.6	0.0	0.0
US Vancouver							
	55-183 m	770.4	59,999.7	772.0	60,052.3	0.2	0.1
	184-366 m	353.6	7,117.9	353.6	7,117.9	0.0	0.0
	367-500 m	71.7	1,060.1	71.7	1,060.1	0.0	0.0
	55-366 m	1,124.0	67,117.6	1,125.6	67,170.2	0.1	0.1
	55-500 m	1,195.7	68,177.7	1,197.3	68,230.3	0.1	0.1
Total Vancouver							
	55-183 m	6,387.8	23,398,091.4	6,389.4	23,398,144.1	0.0	0.0
	184-366 m	851.2	30,167.9	851.2	30,167.9	0.0	0.0
	367-500 m	321.1	36,674.5	321.1	36,674.5	0.0	0.0
	55-366 m	7,239.0	23,428,259.3	7,240.6	23,428,311.9	0.0	0.0
	55-500 m	7,560.1	23,464,933.8	7,561.7	23,464,986.4	0.0	0.0
Columbia							
	55-183 m	4,432.3	2,609,841.8	4,437.6	2,610,405.0	0.1	0.0
	184-366 m	7,952.4	10,839,407.6	7,952.4	10,839,407.6	0.0	0.0
	367-500 m	3,828.8	587,285.6	3,828.8	587,285.6	0.0	0.0
	55-366 m	12,384.8	13,449,249.4	12,390.1	13,449,812.5	0.0	0.0
	55-500 m	16,213.5	14,036,535.0	16,218.8	14,037,098.1	0.0	0.0
Eureka							
	55-183 m	288.7	8,056.2	330.5	10,395.2	14.5	29.0
	184-366 m	1,213.9	61,895.5	1,213.9	61,895.5	0.0	0.0
	367-500 m	1,493.8	228,824.9	1,493.8	228,824.9	0.0	0.0
	55-366 m	1,502.5	69,951.6	1,544.4	72,290.7	2.8	3.3
	55-500 m	2,996.3	298,776.5	3,038.2	301,115.5	1.4	0.8
Monterey							
	55-183 m	698.9	19,460.0	698.9	19,460.0	0.0	0.0
	184-366 m	918.4	69,838.5	918.4	69,838.5	0.0	0.0
	367-500 m	692.3	16,995.2	692.3	16,995.2	0.0	0.0
	55-366 m	1,617.4	89,298.4	1,617.4	89,298.4	0.0	0.0
	55-500 m	2,309.6	106,293.7	2,309.6	106,293.7	0.0	0.0
Conception							
	55-183 m	43.1	409.8	46.3	465.8	7.5	13.7
	184-366 m	751.8	35,379.7	578.6	21,459.1	-23.0	-39.3
	367-500 m	454.6	5,159.4	454.6	5,159.4	0.0	0.0
	55-366 m	794.9	35,789.6	624.9	21,925.0	-21.4	-38.7
	55-500 m	1,249.6	40,949.0	1,079.6	27,084.4	-13.6	-33.9

Table H-7.--Continued.

INPFC Area	Depth Stratum	Original estimates Biomass (t)	Original estimates Variance	Revised estimates Biomass (t)	Revised estimates Variance	Percent change Biomass (t)	Percent change Variance
US Total							
	55-183 m	6,233.4	2,703,389.7	6,285.4	2,706,744.8	0.8	0.1
	184-366 m	11,190.1	11,024,291.9	11,016.9	11,010,371.3	-1.5	-0.1
	367-500 m	6,541.2	844,248.0	6,541.2	844,248.0	0.0	0.0
	55-366 m	17,423.6	13,727,681.5	17,302.4	13,717,116.0	-0.7	-0.1
	55-500 m	23,964.8	14,571,929.5	23,843.6	14,561,364.0	-0.5	-0.1
Total							
	55-183 m	11,850.8	26,041,481.4	11,902.8	26,044,836.5	0.4	0.0
	184-366 m	11,687.7	11,047,341.9	11,514.5	11,033,421.3	-1.5	-0.1
	367-500 m	6,790.7	879,862.4	6,790.7	879,862.4	0.0	0.0
	55-366 m	23,538.5	37,088,823.3	23,417.3	37,078,257.8	-0.5	0.0
	55-500 m	30,329.2	37,968,685.7	30,208.0	37,958,120.2	-0.4	0.0

Table H-8.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for shortspine thornyhead in 1995.

INPFC Area	Depth Stratum	Original estimates		Revised estimates		Percent change	
		Biomass (t)	Variance	Biomass (t)	Variance	Biomass (t)	Variance
Canadian Vancouver							
	55-183 m	10.1	35.9	10.1	35.9	0.0	0.0
	184-366 m	159.2	2,152.7	159.2	2,152.7	0.0	0.0
	367-500 m	235.5	4,139.0	235.5	4,139.0	0.0	0.0
	55-366 m	169.3	2,188.6	169.3	2,188.6	0.0	0.0
	55-500 m	404.7	6,327.6	404.7	6,327.6	0.0	0.0
US Vancouver							
	55-183 m	3.4	6.7	3.5	7.1	2.7	6.2
	184-366 m	460.0	11,498.6	460.0	11,498.6	0.0	0.0
	367-500 m	104.8	593.2	104.8	593.2	0.0	0.0
	55-366 m	463.4	11,505.3	463.5	11,505.8	0.0	0.0
	55-500 m	568.2	12,098.6	568.3	12,099.0	0.0	0.0
Total Vancouver							
	55-183 m	13.5	45.8	13.6	46.2	0.7	0.9
	184-366 m	619.2	17,301.2	619.2	17,301.2	0.0	0.0
	367-500 m	340.2	5,158.4	340.2	5,158.4	0.0	0.0
	55-366 m	632.7	17,346.9	632.8	17,347.4	0.0	0.0
	55-500 m	972.9	22,505.4	973.0	22,505.8	0.0	0.0
Columbia							
	55-183 m	99.3	1,474.0	99.6	1,478.5	0.3	0.3
	184-366 m	1,453.9	144,712.8	1,453.9	144,712.8	0.0	0.0
	367-500 m	2,969.7	322,920.9	2,969.7	322,920.9	0.0	0.0
	55-366 m	1,553.2	146,186.8	1,553.5	146,191.3	0.0	0.0
	55-500 m	4,522.9	469,107.7	4,523.2	469,112.2	0.0	0.0
Eureka							
	55-183 m	1.7	1.6	2.0	2.1	15.6	33.2
	184-366 m	221.1	7,081.0	221.1	7,081.0	0.0	0.0
	367-500 m	461.2	11,843.6	461.2	11,843.6	0.0	0.0
	55-366 m	222.8	7,082.5	223.1	7,083.1	0.1	0.0
	55-500 m	684.0	18,926.2	684.3	18,926.7	0.0	0.0
Monterey							
	55-183 m	0.0	-	0.0	-		
	184-366 m	279.1	8,420.5	279.1	8,420.5	0.0	0.0
	367-500 m	311.9	3,519.4	311.9	3,519.4	0.0	0.0
	55-366 m	279.1	8,420.5	279.1	8,420.5	0.0	0.0
	55-500 m	591.0	11,939.9	591.0	11,939.9	0.0	0.0
Conception							
	55-183 m	0.0	-	0.0	-		
	184-366 m	18.5	51.1	23.1	66.8	25.0	30.8
	367-500 m	230.2	4,251.2	230.2	4,251.2	0.0	0.0
	55-366 m	18.5	51.1	23.1	66.8	25.0	30.8
	55-500 m	248.7	4,302.3	253.4	4,318.0	1.9	0.4

Table H-8.--Continued.

INPFC Area	Depth Stratum	Original estimates Biomass (t)	Original estimates Variance	Revised estimates Biomass (t)	Revised estimates Variance	Percent change Biomass (t)	Percent change Variance
US Total							
	55-183 m	104.4	1,525.6	105.1	1,533.8	0.6	0.5
	184-366 m	2,432.7	172,538.2	2,437.3	172,553.9	0.2	0.0
	367-500 m	4,077.7	343,284.5	4,077.7	343,284.5	0.0	0.0
	55-366 m	2,537.1	174,063.8	2,542.4	174,087.7	0.2	0.0
	55-500 m	6,614.8	517,348.3	6,620.1	517,372.2	0.1	0.0
Total							
	55-183 m	114.5	1,564.7	115.2	1,572.8	0.6	0.5
	184-366 m	2,591.9	178,340.7	2,596.5	178,356.5	0.2	0.0
	367-500 m	4,313.2	347,849.7	4,313.2	347,849.7	0.0	0.0
	55-366 m	2,706.4	179,905.4	2,711.7	179,929.3	0.2	0.0
	55-500 m	7,019.6	527,755.1	7,024.8	527,779.0	0.1	0.0

Table H-9.--Original biomass (metric tons (t)) and variance estimates, revised biomass and variance estimates when "Water hauls" are removed from the calculations, and the percent change in biomass and variance estimates for total flatfish in 1995.

INPFC Area	Depth Stratum	Original estimates Biomass (t)	Original estimates Variance	Revised estimates Biomass (t)	Revised estimates Variance	Percent change Biomass (t)	Percent change Variance
Canadian Vancouver							
	55-183 m	44,432.1	50,865,184.8	44,432.1	50,865,184.8	0.0	0.0
	184-366 m	5,474.6	1,678,198.5	5,474.6	1,678,198.5	0.0	0.0
	367-500 m	1,981.8	192,685.2	1,981.8	192,685.2	0.0	0.0
	55-366 m	49,906.7	52,543,383.3	49,906.7	52,543,383.3	0.0	0.0
	55-500 m	51,888.5	52,736,068.5	51,888.5	52,736,068.5	0.0	0.0
US Vancouver							
	55-183 m	10,502.0	4,648,824.8	10,571.0	4,657,435.4	0.7	0.2
	184-366 m	4,643.8	320,146.1	4,643.8	320,146.1	0.0	0.0
	367-500 m	331.0	6,290.2	331.0	6,290.2	0.0	0.0
	55-366 m	15,145.7	4,968,970.9	15,214.8	4,977,581.4	0.5	0.2
	55-500 m	15,476.8	4,975,261.0	15,545.8	4,983,871.6	0.4	0.2
Total Vancouver							
	55-183 m	54,934.1	60,648,814.6	55,003.2	60,657,425.1	0.1	0.0
	184-366 m	10,118.4	2,995,659.2	10,118.4	2,995,659.2	0.0	0.0
	367-500 m	2,312.9	201,308.0	2,312.9	201,308.0	0.0	0.0
	55-366 m	65,052.4	63,644,473.8	65,121.5	63,653,084.3	0.1	0.0
	55-500 m	67,365.3	63,845,781.8	67,434.4	63,854,392.3	0.1	0.0
Columbia							
	55-183 m	48,375.6	34,215,664.2	48,601.7	34,307,817.1	0.5	0.3
	184-366 m	9,150.9	2,547,107.6	9,150.9	2,547,107.6	0.0	0.0
	367-500 m	4,442.3	462,545.0	4,442.3	462,545.0	0.0	0.0
	55-366 m	57,526.6	36,762,771.8	57,752.6	36,854,924.7	0.4	0.3
	55-500 m	61,968.9	37,225,316.7	62,194.9	37,317,469.7	0.4	0.2
Eureka							
	55-183 m	4,716.0	1,262,140.7	5,436.2	1,570,871.3	15.3	24.5
	184-366 m	2,433.8	224,340.6	2,433.8	224,340.6	0.0	0.0
	367-500 m	2,234.7	235,243.5	2,234.7	235,243.5	0.0	0.0
	55-366 m	7,149.8	1,486,481.4	7,870.0	1,795,211.9	10.1	20.8
	55-500 m	9,384.5	1,721,724.8	10,104.7	2,030,455.4	7.7	17.9
Monterey							
	55-183 m	20,949.8	4,505,919.0	20,949.8	4,505,919.0	0.0	0.0
	184-366 m	4,476.2	621,608.7	4,476.2	621,608.7	0.0	0.0
	367-500 m	6,599.1	1,579,742.0	6,599.1	1,579,742.0	0.0	0.0
	55-366 m	25,425.9	5,127,527.8	25,425.9	5,127,527.8	0.0	0.0
	55-500 m	32,025.1	6,707,269.8	32,025.1	6,707,269.8	0.0	0.0
Conception							
	55-183 m	2,501.4	1,488,395.3	2,657.4	1,704,332.4	6.2	14.5
	184-366 m	2,096.0	452,360.6	2,571.0	559,906.0	22.7	23.8
	367-500 m	4,326.2	427,700.9	4,326.2	427,700.9	0.0	0.0
	55-366 m	4,597.3	1,940,755.8	5,228.4	2,264,238.4	13.7	16.7
	55-500 m	8,923.5	2,368,456.7	9,554.6	2,691,939.3	7.1	13.7

Table H-9.--Continued.

INPFC Area	Depth Stratum	Original estimates Biomass (t)	Original estimates Variance	Revised estimates Biomass (t)	Revised estimates Variance	Percent change Biomass (t)	Percent change Variance
US Total							
	55-183 m	87,044.7	47,656,907.2	88,216.1	48,338,676.1	1.3	1.4
	184-366 m	22,800.7	4,284,279.5	23,275.7	4,391,824.9	2.1	2.5
	367-500 m	17,933.3	3,478,842.9	17,933.3	3,478,842.9	0.0	0.0
	55-366 m	109,845.4	51,941,186.7	111,491.8	52,730,501.1	1.5	1.5
	55-500 m	127,778.6	55,420,029.6	129,425.1	56,209,343.9	1.3	1.4
Total							
	55-183 m	131,476.8	103,656,897.0	132,648.3	104,338,665.9	0.9	0.7
	184-366 m	28,275.2	6,959,792.6	28,750.2	7,067,338.0	1.7	1.5
	367-500 m	19,915.1	3,673,860.7	19,915.1	3,673,860.7	0.0	0.0
	55-366 m	159,752.1	110,616,689.6	161,398.5	111,406,003.9	1.0	0.7
	55-500 m	179,667.2	114,290,550.3	181,313.6	115,079,864.7	0.9	0.7