Bottom Trawl Survey of Young-of-the-Year Lingcod (*Ophiodon elongatus*) in the Strait of Georgia by the *R/V Neocaligus*, July 28 – August 9, 2003

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BOTTOM TRAWL SURVEY OF YOUNG-OF-THE-YEAR LINGCOD *(Ophiodon elongatus)* IN THE STRAIT OF GEORGIA BY THE *R/V Neocaligus*, JULY 28 – AUGUST 9, 2003

by

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TABLE OF CONTENTS

ABSTRACT

Haggarty, D.R., J.R. King, and K.L. Mathias. 2004. Bottom trawl survey of young-of-the-year lingcod (*Ophiodon elongatus)* in the Strait of Georgia by the *R/V Neocaligus,* July 28 - August 9, 2003. Can. Manuscr. Rep. Fish. Aquat. Sci. 2673: 39 p.

In July 2003, we conducted a bottom trawl survey of young-of-the year lingcod (*Ophiodon elongatus*) in the Strait of Georgia. We found significant and striking difference in young of year lingcod catch densities between the northern and southern regions in the Strait of Georgia, with far fewer fish found in the south. This pattern is consistent with a previous survey conducted in 1991. We suggest that larval distribution and post-larval settlement influence the observed distribution patterns. Lingcod distribution appears to be influenced by oceanographic patterns (currents, salinity) and substrate qualities (bottom type, slope). An increase in the young of year densities was observed between 1991 and 2003 in the northern Strait of Georgia, while densities in the southern portion were similar or decreased. Lingcod year class strength was typically poor during the 1990s and we suggest that the 1998 climate regime shift has resulted in favourable oceanic conditions for lingcod resulting in improved year class strength either by 1) an increase in spawning stock biomass and improved spawning/hatching conditions; 2) increased survival of larval and post-larval lingcod. Both factors may be working in concert. However the assessments of young of year densities in the north and south reveal conflicting patterns, with young of year densities increasing in the north and decreasing or remaining similar in the south. Two hypotheses are possible: 1) two separate populations exist in the Strait of Georgia and the northern population is increasing while the southern is not; or 2) a single population exists but larval supply and/or ontogenic habitat shifts make for uneven distribution of young of year lingcod. We feel the second hypothesis is more plausible and we provide conceptual models for this mechanism.

RÉSUMÉ

Haggarty, D.R., J.R. King, and K.L. Mathias. 2004. Bottom trawl survey of young-of-the-year lingcod (*Ophiodon elongatus)* in the Strait of Georgia by the *R/V Neocaligus,* July 28 - August 9, 2003. Can. Manuscr. Rep. Fish. Aquat. Sci. 2673: 39 p.

En juillet 2003, nous avons effectué un relevé au chalut de fond des morues-lingues (*Ophiodon elongatus*) de l'année dans le détroit de Georgia. Nous avons constaté des différences frappantes et significatives entre les densités des prises de jeunes de l'année dans le nord et celles dans le sud du détroit de Georgia; la morue-lingue étant beaucoup moins abondante dans le sud du détroit. Ces résultats concordent avec ceux d'un relevé effectué en 1991. Nous suggérons que la distribution des larves et l'établissement post-larvaire influent sur la répartition observée. La répartition de la morue-lingue semble varier en fonction des régimes océanographiques (courants et salinité) et des caractéristiques du substrat (type de fond et inclinaison). Entre 1991 et 2003, une hausse du nombre de jeunes de l'année a été observée dans le nord du détroit du Georgia. Au cours de cette même période, les densités dans le sud du détroit sont demeurées semblables ou ont baissé. Les classes d'âge de morues-lingues étaient généralement peu abondantes au cours des années 1990. Nous suggérons que le changement de régime climatique de 1998 a entraîné des conditions océaniques favorables et, de ce fait, un accroissement de l'abondance des classes d'âge, soit par (1) une augmentation de la biomasse du stock reproducteur et une amélioration des conditions de fraie et d'éclosion ou par (2) une hausse de la survie des larves et des post-larves. Ces deux facteurs peuvent jouer un rôle simultanément. Cependant, les évaluations des densités des jeunes de l'année dans le nord et dans le sud du détroit donnent des résultats contradictoires : les densités augmentent dans le nord et diminuent ou restent les mêmes dans le sud. Il y a deux explications possibles à cette situation : 1) il existe deux populations distinctes dans le détroit de Georgia, et seule la population du nord devient plus nombreuse; 2) il existe une seule population, mais le nombre de larves ou les variations sur le plan de l'habitat qui influent sur l'ontogenèse font en sorte que les jeunes de l'année ne sont pas répartis uniformément. Nous croyons que la seconde explication est la plus plausible et nous présentons des modèles conceptuels expliquant celle-ci.

INTRODUCTION

Lingcod (*Ophiodon elongatus*) populations in the Strait of Georgia have been severely depressed for several decades (King 2001; King and Surry 2000; Richards and Hand 1989). The population reached historic lows in the late 1980's and continued throughout the 1990's despite management measures implemented in 1990 (King et al. 2003). Since 1990, the retention of lingcod by the commercial fishery in the Strait of Georgia (Minor Statistical Areas 13-19, 28 and 29) has been prohibited in response to conservation concerns (Richards and Hand 1989). The recreational fishery has also been subject to regulations. Prior to 2002, regulations to protect lingcod included an eight month winter non-retention period to protect nest guarding males, size limits, and reduced daily and annual catch limits. In 2002, the recreational fishery was closed for the retention of lingcod as an additional measure to protect this stock; the non-retention regulation currently remains in effect.

Assessing the success of management strategies requires reliable measures of changes in the relative abundance of lingcod. In 2003 a young-of-the-year lingcod survey was conducted as one component of a monitoring and assessment program for Strait of Georgia lingcod (King et al. 2003). The purpose of this bottom trawl survey is to index the relative abundance of young-of-the-year lingcod in the Strait of Georgia and to compare mean and median densities (using number of fish caught per area swept) of young-of-the-year lingcod to those found in a prior study conducted in 1991 (Workman et al. 1992).

The Strait of Georgia is often divided into a northern, central and southern region (Thomson 1981). For the purpose of this study, we grouped the central and southern regions as only one study site since Sidney falls just within the southern region as described by Thomson (1981). We defined the boundary between our northern and southern region as the division line between Statistical Areas 17 and 14 (Figure 1), immediately north of Nanoose Bay. This is consistent with oceanographic patterns in the Strait and is the usual division between the northern and central regions (Thomson 1981). Thomson (1981) typifies the northern Strait of Georgia as having weak and variable tidal currents with speeds of only 10 $cm \cdot s^{-1}$ except near Discovery Passage. There is a general counter-clockwise circulation with a westward drift at the north and a southward drift on the Vancouver Island side. The southern region is typified by stronger tidal currents and much greater influence of the Fraser River plume. Runoff from the Fraser River produces a well defined brackish layer at certain times of the year. A general counter-clockwise surface flow exist to the north of the southern region with a smaller clockwise current pattern to the south of the region.

Lingcod spawning begins in December and continues into March with the peak spawning activity in late January to early February (Low and Beamish 1978; Wilby 1937). Male lingcod maintain nest sites typically in rock crevices or ledges where there are strong currents (Low and Beamish 1978). Once the egg masses have been laid and fertilized, the males guard the eggs until they hatch 5 to 11 weeks later (Low and

Beamish 1978). Larvae begin to hatch in early March through late April, at a length of about 6-10 mm (Phillips and Barraclough 1977). For the first few weeks, the larvae are planktonic and are found in the upper 3 m of the water column during the day (Phillips and Barraclough 1977), but migrate to deeper waters at night (Cass et al. 1990). In late May or early June, the larvae form dense-near shore schools in particular locations as described by Phillips and Barraclough (1977). At this time, the post-larval lingcod are approximately 50-70 mm and have become demersal, inhabiting areas near kelp or eelgrass beds (Phillips and Barraclough 1977). By the middle to end of the summer, young-of-the-year lingcod in the Strait of Georgia are found in a wider range of flat bottom areas, and by age-2 begin to inhabit similar, rocky substrates as older lingcod (Cass et al. 1990). Typically, larger lingcod inhabit deep banks and reefs, while smaller lingcod inhabit shallow waters and banks (Forrester and Smith 1974).

Sampling sites for this study were distributed between Sidney and Campbell River in suitable young-of-the-year lingcod habitat (Figure 1). By mid-summer, when this survey took place, young-of-the-year lingcod are found on shallow sloping bottoms consisting of sand and sand-gravel substrates (Cass et al. 1990). Lingcod undergo a series of ontogenic habitat shifts throughout their life cycle, particularly during their first year of life. Understanding the timing and nature of these ontogenic shifts should provide a better understanding of the distribution of lingcod at any one stage.

METHODS

We surveyed nearshore waters along the East coast of Vancouver Island from Sidney to Campbell River for young-of-the-year lingcod between July 28 and August 9th, 2003. We also extended the 1991 survey area past Comox to include additional sites in Areas 14 and 13.

The 1991 survey was conducted aboard the *M/V Caligus*. Since this vessel was no longer in service, we used its replacement, the *M/V Neocaligus*, an 18.8 m long Coast Guard research vessel with a net tonnage of 48.3 t. As in 1991, the net used for the survey was a 13 m (43 ft) Marinovich flat trawl with a 1 cm mesh codend liner. The net was rigged with 20-cm aluminium floats on the headrope and 20-cm rubber bobbins footrope. Tevron steel doors (1.5 m by 1.5 m, 350 kg) provided an estimated 13 m horizontal opening. Two winches were used to deploy and retrieve the trawl net.

Hauls were usually 8-10 minutes in duration. We reduced the tow duration from 15 minutes used in 1991 to 10-8 to reduce the total catch to facilitate sampling and to reduce amounts of by-catch. A vessel speed of approximately 1.8 knots was maintained. Vessel speed did, however, have to be increased or decreased at times to counter-act current speed in order to maintain a consistent estimated ground speed. Start and finish locations, times, and depths were recorded for each haul. Tide height and substrate type was also recorded.

Substrate type was determined from a combination of nautical charts, reflectance readings of the depth sounder, and whether mud, gravel or cobbles appeared in the haul or on the doors. An indication of sandy bottoms was the "shine" of the doors (sandy bottoms polish the bottom shoe of the doors, producing a characteristic shine). Additional habitat characteristics of the site, such as plentiful kelp, sponge or other invertebrates, were also noted.

Four depth strata were sampled: 1=15-24 m; 2=25-34 m; 3=35-44 m; 4=45-54 m. We attempted to find two separate tows per depth strata per site. Depth strata 3 and 4 were only sampled at two sites, Qualicum and Bowser (Figure 1). Four suitable tows could not always be found at each site.

Where possible, we revisited the sites sampled in the previous survey in 1991 (Workman et al. 1992). However, some sites previously sampled were not revisited. We rejected most pure mud sites due to their highly variable catches (King et al. 2003; Workman et al. 1992). We planned to sample Boatswain Bank but we were unable to tow in Boatswain because of numerous crab pots. Likewise, we could not repeat 1991 tows near Nanaimo as we were unable to get as close to shore with the *Neocaligus* as they had been able to do with the smaller *Caligus*. Additionally, ferry traffic and small craft traffic made Departure Bay an untrawlable location. We chose new sites by determining areas of appropriate substrate type and slope from nautical charts. Individual tow locations within a site were selected after verifying the depth, relief and substrate type with a depth sounder prior to towing.

The characteristics of each sampling site are presented in Table 1 and their locations are noted in Figure 1.

We visually estimated the total weight of each tow from the volume of the sorter table filled (where full is approximately 1,000 pounds).All catches were sorted by species. All lingcod, kelp and whitespotted greenling (*Hexagrammos decagrammus, H. lagocephalus*) and rockfish (*Sebastes* sp.) were counted. All other species were counted only when time permitted.

All lingcod were sampled for length and weight. We sampled a portion of the young-of-the-year lingcod for stomach content analysis. We sampled up to 20 individuals per tow in the northern depth strata 1 and 2, all individuals in depth strata 3 and 4, and all individuals in the southern region. Stomachs were opened and the primary, secondary and tertiary prey items were identified to lowest taxonomic category possible or assigned a general grouping if not (e.g. fish remains). The volume of each prey item was measured (in cubic cm) using a graduated cylinder or syringe. Each prey item was also assigned a digestion code (1 = fresh, 2 = 25% digested, 3 = 50% digested, 4 = 75% digested, 5 = fully digested). Dorsal fins of year 1+ lingcod were collected for age determination. We calculated the Condition Factor of the young-of-the-year lingcod using the following formula: Weight (gm) • length^{-3} (mm) (Cailliet et al. 1986).

All whitespotted and kelp greenling were sampled for length and weight as well as otoliths and dorsal fins for age determination. All rockfish were retained for sampling in the lab. Time permitting, we measured the length of abundant species of flatfishes or other abundant species present in each tow. If the size distribution appeared consistent with previous tows at the same site, additional lengths were not taken. We also determined the sex and measured dogfish (*Squalus acanthias*), skates (*Raja* sp.), and sanddab (*Citharichthys sordidus* and *C. stigmaeus*). Dogfish stomach content analysis was performed on dogfish caught in the first tow of the day.

We calculated the catch density of young-of-the-year lingcod using the catch per area swept (number of individuals caught • (length of the tow • width of the net)$^{-1}$). We assumed a maximum spread (13 m) of the net was achieved with the heavier doors and the more powerful boat than was used in the previous study (Personal Communications, B. Barker, 2003). Relationships between density and regions, sites, depths, substrate and tide as well as length, and weights were investigated using non-parametric ANOVA (Kruskal-Wallis test) or non-parametric t-test (Mann-Whitney test) using the statistics package *Statistix*. Data from this survey were compared to data from the 1991 survey using the Kruskal-Wallis and Mann-Whitney tests.

RESULTS

We performed a total of 62 tows at 15 sites in the Strait of Georgia between July 28-August 8, 2003. Data from 5 tows were unusable. Eight sites were located in the northern region of the Strait of Georgia; seven are found in the south (Figure 1). Tow position, depth, length, duration and other bridge log information are presented in Appendix 1.

The mean estimated catch was approximately 245 kg (540 lbs), with a minimum catch weight of 45 kg (100 lbs) and maximum of 680 kg (1500 lbs). 62 species of fishes were caught as well as 67 invertebrates (identified to lowest taxonomic group possible) (Table 2). All catch data are presented in Appendix 2. Summaries of length data of many species are presented in Appendix 3. Complete data are archived in the Groundfish Biological database held at the Pacific Biological Station (3190 Hammond Bay Road, Nanaimo, BC, V9T 6N7).

2003 LINGCOD DATA

We caught a total of 648 young-of-the-year lingcod, five age 1+ lingcod and one adult (age 2+). The majority of the young-of-the-year lingcod were caught in the northern region. Only 16 young-of-the-year were caught in the southern region despite comparable habitats and consistent gear and methodology.

MEDIAN DENSITIES

Median density of lingcod varied between 0 and 559 fish / km^2 in the south and between 474 and 5800 fish / km^2 in the North (Table 3). Accordingly, we found a significantly higher density of lingcod in the north as compared to the south using the Mann-Whitney test (p= >0.001, U=33.052, df=1). Significant differences were also found among statistical areas (p=>0.001, T=33.965, df=4). Due to the major differences between regions, we separated the data by region for all other analyses. We did not look for a difference among statistical areas within regions as Areas 13, 18 and 19 were each represented by a single site. Significant differences were not observed among sampling sites (p=>0.001, T=40.4, df=14) using the Kruskal-Wallis test. There were no differences among sites within regions (North: p=0.19, T=9.98 df=37; South: p=0.12; T=10.0, df=18).

The highest median density was encountered at Cape Lazo, just north of Comox (Figure 8). High densities were also observed near Campbell River at Oyster Bay and Black Creek. The lowest density in the northern region occurred at French Creek.

DENSITY BY SUBSTRATE, DEPTH AND TIDE

We limited our analysis of densities with respect to substrate, depth and tide to the northern region, where greatest lingcod catches occurred. The northern sites consisted of three different substrate types: sand, sand-mud and sand-rock; however, no difference in density of lingcod was observed (p=0.10, T=4.64, df=2) among substrate types. There was a slight trend for greater densities over a combination of sand and rock (p=0.09, T=4.64, df=2). Four separate depth strata were sampled in the North: 15-24 m, 25-34 m, 35-44m, 45-55m. No difference among depth strata were observed (p=0.30, T=3.65, df=3). We did find a weak relationship between lingcod density and tidal stage (p=0.05, T=7.98, df=3). Lowest densities were found at low tide.

2003 SIZE DISTRIBUTION

We measured the length of 647 and weight of 635 young-of-the-year lingcod (Table 4) and calculated condition factor from these data ($CF=W/L^3$). A length-frequency histogram displays the lengths of two year classes of lingcod: young-of-the-year and year 1+ (Figure 2). The median length and weights of young-of-the-year lingcod were 160 mm and 25 g, respectively (Table 4). Although a Kruskal-Wallis test revealed significant differences of both lengths (p= >0.001, T=86.6, df=10) and weight (p= >0.001, T=56.9, df=8) of lingcod among sites, these differences are not likely to be biologically significant (Figure 3, Figure 4). The greatest difference in length occurs between Fullford Harbour and Qualicum as well as Fullford Harbour and Nanoose (Figure 3); however these results are suspect due to small sample sizes at both Fullford Harbour and Nanoose that may not be representative of the true size distributions. A pair-wise comparison of weights showed the site with the lowest mean weight, Qualicum, was significantly lower than all other sites. We found no significant difference of lingcod length between depth categories 1 and 2 (U=1.92, p=0.16, df=1) (Figure 6). Although the weight of lingcod was significantly different between depth strata 1 and 2 (U=8.13, p=0.004, df=1) it is not likely of biological significance (Figure 7). Length and weight of lingcod in depth strata 3 and 4 were not tested due to unbalanced sample sizes.

2003 DIET ANALYSIS

A total of 280 stomachs were examined. Of these, 86 (30.7%) were empty and 3 contained unidentified remains. The contents of the remaining 191 stomachs were identified to a general category (i.e. fish remains) or to species. Approximately 91% of young-of-the-year lingcod sampled consumed fish as their primary food item (fish remains + identified fish species) (Table 5). Pacific sand lance (*Ammodytes hexapterus*) were the most commonly positively identified prey item in the study at 17.8% of stomach contents.

A chi-square analysis of the three top prey items, unidentified fish remains, Pacific sandlance and Pacific tomcod (*Microgadus pacificus*), revealed that there was a significant difference in prey items consumed by fish in different depth strata (p=>0.001, X^2=62.16, 6df). Greater than expected fish remains were found in depth strata 2, while fewer than expected were found in the deeper strata (strata 3, 4). Fewer sandlance were found in the second depth strata but greater in the third. More Pacific tomcod than should be expected were found in the deepest strata. These results should, however, be viewed with caution due to limited sample sizes in the third and fourth depth strata and a possible auto-correlation with the set number. Sample size of stomachs that contained remains was also uneven between depth strata (N= 1=67, 2=78, 3=27, 4=19).

INTER-ANNUAL COMPARIONS 1991-2003

Data from the two regions (north and south) were analysed separately due to the difference in catch rates between regions during both time periods. When the data from both regions are pooled, there are no significant differences between years (p=0.67, U=0.18, df=1). Young-of-the-year lingcod density increased significantly between 1991 and 2003 in the northern region (p=0.007, U=7.381, df=1) (Table 6). All sites exhibited an increasing trend, however, the largest differences occurred at Bowser and Qualicum (Figure 8). Densities at most sites were highly variable in both years (Table 5).

Low densities of juvenile lingcod were found in the south in both time periods and lingcod were absent from many tows in both years. Young-of-the-year lingcod density decreased significantly between 1991 and 2003 (p=0.032, U=4.585, df=1); however, this difference is only attributable to the decreased density at Nanoose (p=0.05, U=3.77, df=1). However, when Nanoose is removed from the comparison, there were no significant differences among years at the southern sites. All other southern sites exhibited consistently low catches or the absence of lingcod in both years.

Length of lingcod was measured in both years and could be compared. Lingcod were significantly longer in 2003 than in 1991 ($p=>0.001$, $U=211.9$, $df=1$).

DISCUSSION

In this study, we found a dramatic difference in the catch of young-of-the-year lingcod in the northern and southern regions; with considerably greater catches to the north, and very few lingcod being caught at all in the south. French Creek, the southern-most site in the northern region, had the lowest catches in the region, further supporting the north-south trend of decreasing young-of-the-year lingcod densities. The northern and southern regions also differed when they were compared to density estimates from 1991. We found a significant increase in density from 1991 in the north; however, southern density estimates were significantly lower or consistently low. Northern young-of-the-year density was approximately 1.5 times greater while southern density was 4.5 times lower.

Some sampling bias may have occurred to influence our results. As previously noted, different research vessels were used in the two survey years as the *MV Caligus* is no longer in service. Accordingly, different trawl doors and a slightly different deployment configuration for the trawl were used. In addition, the *MV Neocaligus* is a larger boat with greater horse power. We felt that these changes definitely influenced the effectiveness of the net, which was reflected in the greater total catch weights encountered in 2003 as compared to 1991. We accounted for the difference in the spread of the net by using the maximum possible width (13m) in our density calculations. Additional bias that was not accounted for may have been due to the heavier and larger doors' ability to keep the net on the bottom. The previous doors were very light and small and may have caused the net to skip (Personal Communication, G. Workman, 2003). If this was the case, density calculations for the 1991 survey would have been underestimated. Consequently, differences between 1991 and 2003 surveys may be overestimated.

Despite these sources of bias, examining the causes of these spatial and temporal patterns is paramount to the development of a reliable young-of-the-year index of abundance. The differences in catch density between the northern and southern regions occurred despite similar habitat types (as defined by bottom substrate, slope, and depth) and consistent sampling methodology and gear. There are two possible explanations for the observed increase between sampling years in the northern region: 1) an increase in spawning stock biomass; 2) more favourable ocean conditions leading to increased survival of larval and post-larval lingcod. Both explanations are plausible and may be working in concert. Conservation measures including size and time restrictions and the closure of commercial (since 1990) and recreational fisheries (since 2002) have been implemented to protect and rebuild lingcod stocks in the Strait of Georgia. These management measures may have led to an increased spawning biomass which resulted in increased young-of-the-year catch densities. It is also conceivable that larval and post larval survival in 2003 was higher than in 1991. 1991 fell within an unfavourable ocean regime when growth and survival of young fishes and thus recruitment to fisheries was low (McFarlane et al. 2000). Conversely, environmental and biological data seem to indicate that another regime shift occurred in 1998 (McFarlane et al. 2000); therefore, 2003 young-of-the-year lingcod may be experiencing more favourable conditions. This explanation is also supported by the increase in young-of the-year lingcod length we observed in 2003 over 1991. However, the timing of the survey was two weeks later in the year in 2003 than in 1991, so increased size may be related to increased growth time as lingcod are known to have a rapid rate of growth (Cass et al. 1990).

Alternate explanations must be sought to explain the opposite results in the southern region. Catch density in the south remained consistently low in both survey years and even decreased in Nanoose Bay. One possible explanation is that spawning stocks in this region have not increased, and may have even decreased. In order for this to result in the lower young-of-the-year catch densities encountered in the south as opposed to the north, the northern and southern spawning populations would have to be distinct from each other and larval exchange limited (i.e. two closed populations). Although we have insufficient information to determine this, lingcod stocks in the Strait of Georgia are commonly thought of as a single population (Cass et al. 1990). Moreover, lingcod larvae have been found throughout the Strait of Georgia, and spend a sufficient amount of time (approximately 1 month) in the water column (Phillips and Barraclough 1977) to be transported great distances. Although many factors affect dispersal distance (oceanography, advection, diffusion, adult and larval behaviour), the amount of time larvae spend in the water column is a major predictor of dispersal distance (Largier 2003; Shanks et al. 2003). Larvae in the plankton for a month or two have been shown to exhibit dispersal distances on the order of 100 km (Largier 2003).

Larval supply and transport may help to explain the observed young-of-the-year distributions. Young-of-the-year lingcod densities in the Southern Gulf Islands may be low due to dynamics occurring at either the larval or post-larval ontogenic stages. Movement between nearshore habitats utilized by newly settled lingcod (post-larval) (eelgrass and kelp beds) and deeper sediment-dominated habitats may be limited. Alternatively, larval supply to the entire region (inside Southern Gulf Islands) may be limited. If the former case were true, we would expect a patchy-distribution of young-of-the-year lingcod. Alternatively, if larval supply to the area is limited, young-of-the-year distributions should be affected at a broader scale. Consistently low catches in this area over both time periods, would appear to support a broader scale phenomenon is occurring.

Previous studies of larval, post-larval and juvenile lingcod in the Strait of Georgia showed that larvae (6-10 mm in length) appear in the surface waters throughout the Strait of Georgia in March (Phillips and Barraclough 1977). Although they are widely distributed throughout the Strait, larvae were consistently more abundant inshore than in the open waters, in particular along the outside (eastern) shore of the Gulf Islands, around Porlier and Active passes, and in the low salinity waters of the Fraser River plume (Phillips and Barraclough 1977). Cass and Scarsbrook (1984) also found that the

Gulf Islands did not appear to be an important rearing area for pelagic stages of young lingcod in comparison to more exposed areas around Nanaimo. Therefore, larval lingcod may not be reaching sampling sites in inside southern Gulf Islands and sheltered regions of southern Vancouver Island. Catches of young-of-the-year in this area are consequently lower than expected despite the availability of presumably suitable juvenile habitat. Suitable young-of-the-year habitats on the exposed side of the Gulf Islands, do, however, appear to be limited as most of the islands have steep, rocky exposed sides. Young-of-the-year lingcod in the southern region may be concentrated on the eastern side of the Strait in the vicinity of the Fraser River Estuary, Burrard Inlet (Spanish Banks, English Bay) or the Sunshine Coast. Future studies should sample these regions. Exposed sides of the islands would require an alternate sampling method.

Past studies in the Strait of Georgia have examined age-1 lingcod distribution and abundance (Beamish et al. 1976; Beamish et al. 1978; Cass and Scarsbrook 1984). Cass and Scarsbrook (1984) found catches to be highly localized in the vicinity of Porlier Pass (although a limited area surrounding the pass was sampled) in February 1981 and 1982, just as they had been in previous years (Beamish et al. 1976; Beamish et al. 1978). We did catch 5 lingcod that we can reliably consider to be age-1 since they were all close to 270 mm in length, the estimated mean length of age-1 lingcod (Hart 1973). They were, however, only caught at the northern sites. No young-of-the-year lingcod or age-1 lingcod were found in the vicinity of Porlier Pass in this study. Perhaps young-of-the-year or age-1 fish move into this area in the winter, when the other studies were completed.

The diet analysis confirmed that by the time young-of-the-year lingcod have adopted a piscivorous habit by the time they have taken residence on benthic habitats. Pacific sandlance, not juvenile herring as cited in Cass *et al.* (1990) were the single-most identified prey item; however, many fish remains could not be identified to species. Juvenile eelpout (family *Zoarcidae*), to our knowledge, have not previously been identified as prey of juvenile lingcod; however, this prey item is not remarkable given the piscivorous nature of the lingcod and the co-occurrence of blackbelly eelpout (*Lycodopsis pacifica*) and young-of-the-year lingcod that was evident in our catches. Young-of-the-year lingcod do continue to take some invertebrates opportunistically at this stage, but invertebrates were often secondary prey items.

CONCLUSION

We found significant and striking difference in young-of-the-year lingcod catch densities between the northern and southern regions in the Strait of Georgia, with far fewer fish found in the south. This pattern is consistent with the previous survey. We suggest that larval distribution and post-larval settlement influence the observed distribution patterns. Lingcod distribution appears to be influenced by oceanographic patterns (currents, salinity) and substrate qualities (bottom type, slope). A greater understanding of how larval and juvenile lingcod move among areas and utilize the Strait of Georgia is necessary in order to draw conclusions regarding the strength of any given year class. Assessments of year-class strength made in absence of this information could lead to faulty conclusions (i.e. no difference between years was found when data from both regions were pooled). Separate assessments of young-of-the-year densities in the north and south reveal conflicting patterns with northern populations increasing and southern decreasing or remaining equally low. Two hypotheses are possible: 1) two separate populations exist in the Strait of Georgia and the northern population is increasing while the southern is not; or 2) a single population exists but larval supply and/or ontogenic habitat shifts make for uneven distribution of young-of-the-year lingcod. We feel the second hypothesis is more plausible; however, this should be confirmed by surveying eastern shores of the Strait of Georgia and/or investigating larval dispersal dynamics in the Strait. The northern sites should be re-sampled in future years in order to monitor young-of-the-year abundance and to compare year-class strength among years. We are encouraged by the increased young-of-the-year densities in the northern region and hope that this is reflective of a strong year class and an increased spawning biomass in at least part of the Strait of Georgia.

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Table 1. Locations of trawl sites for young-of-the-year Lingcod study.

Site	Name	Location	Depth Strata	Bottom Type *	Sampled in 1991
1	Sidney	Bazan Bay, Sidney Channel	1,2	S	Y
2	Walker Hook	Saltspring, S Trincomali Channel	1,2	S	Y
3	Fulford Harbour	Saltspring Island	1,2	SM	Y
5	Pylades	Pylades Channel/De Courcey group	1,2	SR	Y
5	Kuper Island	Houstoun Passage	1,2	SR, SM	N
6	Trincomali	N Trincomali Channel, near Thetis Island	1,2	S, SR	Y
7	Nanoose	Nanoose Bay	1,2	SM, M	Y
8	French Creek	N of French Creek	1,2	S, SM	N
9	Qualicum	Qualicum Bay	1,2,3,4	SG	Y
10	Bowser	N of Qualicum Bay	1,2,3,4	S	Y
11	Comox	Comox Harbour	1,2	SM	Y
12	Cape Lazo	N Comox, Cape Lazo/ Kye Bay	1,2	SR, S	Y
13	Kitty Coleman	Off of Kitty Coleman Beach	1,2	S, SR	N
14	Black Creek	Black Creek	1,2	S	N
15	Oyster Bay	S of Campbell River	1,2	SR	N

* R=Rock, S=Sand, M=Mud

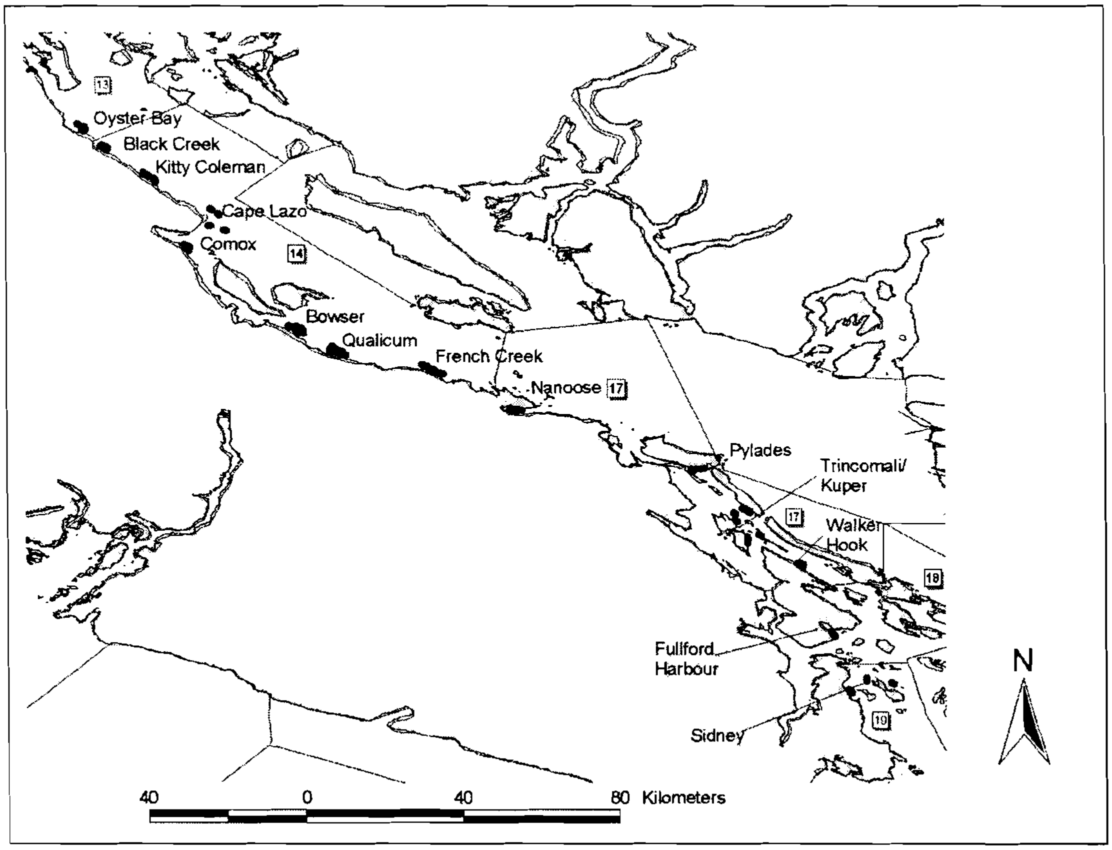

Figure 1. Trawl site locations and statistical areas. Areas 13 and 14 are in the northern Strait of Georgia; Areas 17, 18 and 19 are in the southern region.

Table 2. Common and taxonomic names of fish and invertebrate species caught in the young-of-the-year lingcod trawl survey, July 28-August 9, 2003.

Common Name	Scientific Name
Fishes	
Spiny dogfish	*Squalus acanthias*
Big skate	*Raja binoculata*
Longnose skate	*Raja rhina*
Spotted ratfish	*Hydrolagus colliei*
Giant pygmy whitefish	*Prosopium sp.*
Pacific herring	*Clupea pallasi*
Chinook salmon	*Oncorhynchus tshawytscha*
Night smelt	*Spirinchus starksi*
Plainfin midshipman	*Porichthys notatus*
Pacific cod	*Gadus macrocephalus*
Pacific hake	*Merluccius productus*
Pacific tomcod	*Microgadus proximus*
Walleye pollock	*Theragra chalcogramma*
Blackbelly eelpout	*Lycodes pacificus*
Tubesnout	*Aulorynchus flavidus*
Shiner perch	*Cymatogaster aggregata*
Pacific sandfish	*Trichodon trichodon*
Northern ronquil	*Ronquilus jordani*
Snake prickleback	*Lumpenus sagitta*
Dwarf wrymouths	*Cryptacanthodes aleutensis*
Copper rockfish	*Sebastes caurinus*
Greenstriped rockfish	*Sebastes elongatus*
Quillback rockfish	*Sebastes maliger*
Kelp greenling	*Hexagrammos decagrammus*
Whitespotted greenling	*Hexagrammos stelleri*
Lingcod	*Ophiodon elongatus*
Longspine combfish	*Zaniolepis latipinnis*
Padded sculpin	*Artedius fenestralis*
Roughback sculpin	*Chitonotus pugetensis*
Spinyhead sculpin	*Dasycottus setiger*
Buffalo sculpin	*Enophrys bison*
Red Irish lord	*Hemilepidotus hemilepidotus*
Northern sculpin	*Icelinus borealis*
Threadfin sculpin	*Icelinus filamentosus*
Spotfin sculpin	*Icelinus tenuis*
Pacific staghorn sculpin	*Leptocottus armatus*
Great sculpin	*Myoxocephalus polyacanthocephalus*
Sailfin sculpin	*Nautichthys oculofasciatus*
Slim sculpin	*Radulinus asprellus*
Grunt sculpin	*Rhamphocottus richardsoni*
Cabezon	*Scorpaenichthys marmoratus*
Roughspine sculpin	*Triglops macellus*
Ribbed sculpin	*Triglops pingeli*

Common Name	Scientific Name
Northern spearnose poacher	*Agonopsis vulsa*
Sturgeon poacher	*Podathecus acipenserinus*
Smooth alligatorfish	*Anoplagonus inermis*
Blackfin poacher	*Bathyagonus nigripinnis*
Blacktip poacher	*Xeneretmus latifrons*
Pacific sanddab	*Citharichthys sordidus*
Speckled sanddab	*Citharichthys stigmaeus*
Arrowtooth flounder	*Atheresthes stomias*
Rex sole	*Errex zachirus*
Flathead sole	*Hippoglossoides elassodon*
Butter sole	*Pleuronectes isolepis*
Rock sole	*Pleuronectes bilineatus*
Slender sole	*Eopsetta exilis*
Dover sole	*Microstomus pacificus*
English sole	*Pleuronectes vetulus*
Starry flounder	*Platichthys stellatus*
C-o sole	*Pleuronichthys coenosus*
Curlfin sole	*Pleuronichthys decurrens*
Sand sole	*Psettichthys melanostictus*
Invertebrates	
Sea mouse	Aphrodita
Lewis' moon snail	*Polinices lewisii*
Oregontriton	*Fusitriton oregonensis*
Sponge	Porifera
Rock snails	Muricidae
Jellyfish (Cyanea sp.)	Scyphozoa
Plumose anemone	*Metridium senile*
Sea whip	*Osteocella septentrionalis*
Sea pen	*Ptilosarcus gurneyi*
Sea lilies and feather stars	Crinodea
Sand star	*Luidia foliolata*
Vermillion starfish	*Mediaster aequalis*
Spiny red sea star	*Hippasteria spinosa*
Leather star	*Dermasterias imbricata*
Blood star	*Henricia leviuscula*
Morning sun starfish	*Solaster dawsoni*
Striped sun starfish	*Solaster stimpsoni*
Rose starfish	*Crossaster papposus*
Cushion star	*Pteraster tesselatus*
Sunflower starfish	*Pycnopodia helianthoides*
Fish-eating star	*Stylasterias forreri*
Long-armed sea star	*Orthasterias koehleri*
Mottled star	*Evasterias trochelii*
Purple starfish	*Pisaster ochraceus*
Pink short-spined star	*Pisaster brevispinus*
Pink nudibranch	*Tritonia diomedea*
Striped nudibranch	*Armina californica*
Odhner's dorid nudibranch	*Archidoris odhneri*

Common Name	Scientific Name
Monterey dorid nudibranch	*Archidoris montereyensis*
Giant dendronotid nudibranch	*Dendronotis iris*
Orange peel nudibranch	*Tochuina tetraquetra*
Brittle stars	Ophiurae
Clams	*Macoma sp.*
Scallop	Pectinidae
Pink scallop, (aka reddish scallop)	*Chlamys rubida*
Green false-jingle	*Pododesmus macrochisma*
Sea urchins (unidentified)	Echinacea
Green urchin	*Strongylocentrotus droebachiensis*
Red urchin	*Strongylocentrotus franciscanus*
Sea cucumber (unidentified)	Holothuroidea
Giant red sea cucumber	*Parastichopus californicus*
Scaly sea cucumber	*Psolus squamatus*
Peppered sea cucumber	*Cucumaria piperata*
White sea cucumber	*Eupentacta quinquesemita*
Nuttall cockle (aka heart cockle)	*Clinocardium nuttallii*
Horse clam	Tresus
Butter clam	*Saxidomus gigantea*
Ascidians and tunicates	Ascidiacea
Pacific bobtail squid	*Rossia pacifica*
Opalescent inshore squid	*Loligo opalescens*
Pacific red octopus	*Octopus rubescens*
Pandalid shrimp	Pandalidae
Pink shrimp	*Pandalus borealis*
Coonstripe shrimp	*Pandalus danae*
Humpback shrimp	*Pandalus hypsinotus*
Prawn	*Pandalus platyceros*
Spike shrimp (horned shrimp)	*Paracrangon echinata*
Hermit crab	Pagurus
Brown box crab	*Lopholithodes foraminatus*
Cancer branneri	*Cancer branneri*
Graceful crab	*Cancer gracilis*
Dungeness crab	*Cancer magister*
Red rock crab	*Cancer productus*
Tanner crabs	Chionoecetes
Decorator crab	*Oregonia gracilis*
Kelp crab	*Pugettia producta*
Kelp crab	*Pugettia richii*

Table 3. Lingcod density statistics per site in 2003 survey (listed from North to South).

Region	Stat. Area	Site	N	Range	Median	Mean	C.V.	St.Dev
N	13	Oyster Bay	3	1538-3600	3195.0	2777.7	39.3	1092.5
	14	Black Creek	4	308-9138	3066.0	3894.5	100.0	3894.7
	14	Kitty Coleman	4	1118-3323	1691.0	1955.8	52.4	1024.9
	14	Cape Lazo	4	1231-9310	5800.0	5535.3	62.3	3450.8
	14	Comox	3	1335-3764	2215.0	2438.0	50.4	1229.8
	14	Bowser	8	1038-2148	1540.0	1647.4	24.8	408.0
	14	Qualicum	8	277-4657	1409.0	1942.8	85.6	1662.1
	14	French Creek	4	0-1947	474.0	723.8	117.9	852.9
S	17	Nanoose	4	0-286	126.0	134.5	115.9	155.9
	17	Pylades	2	181-402	291.5	291.5	53.6	156.3
	17	Trincomali	3	0	0	0		0
	17	Kuper	3	0	0	0		0
	17	Walker Hook	2	0	0	0		0
	18	Fulford Harbour	2	0-1118	559.0	559.0	141.4	790.6
	19	Sidney	3	0	0	0		0
		Total	57	0-9166	1118	1629.5	128.2	2088.7

Table 4. Descriptive statistics for length, weight, and condition factor of young-of-the-year lingcod in 2003 and length in 1991.

Young-of-the-year Lingcod	N	Median	Mean	SD	CV (%)
2003					
Length (mm)	647	160	159.3	14.9	9.4
Weight (gm)	635	26	26.4	10.3	39.1
CF (no unit)	633	0.16	0.16	0.03	21.0
1991					
Length (mm)	501	145	144.9	16.26	11.2

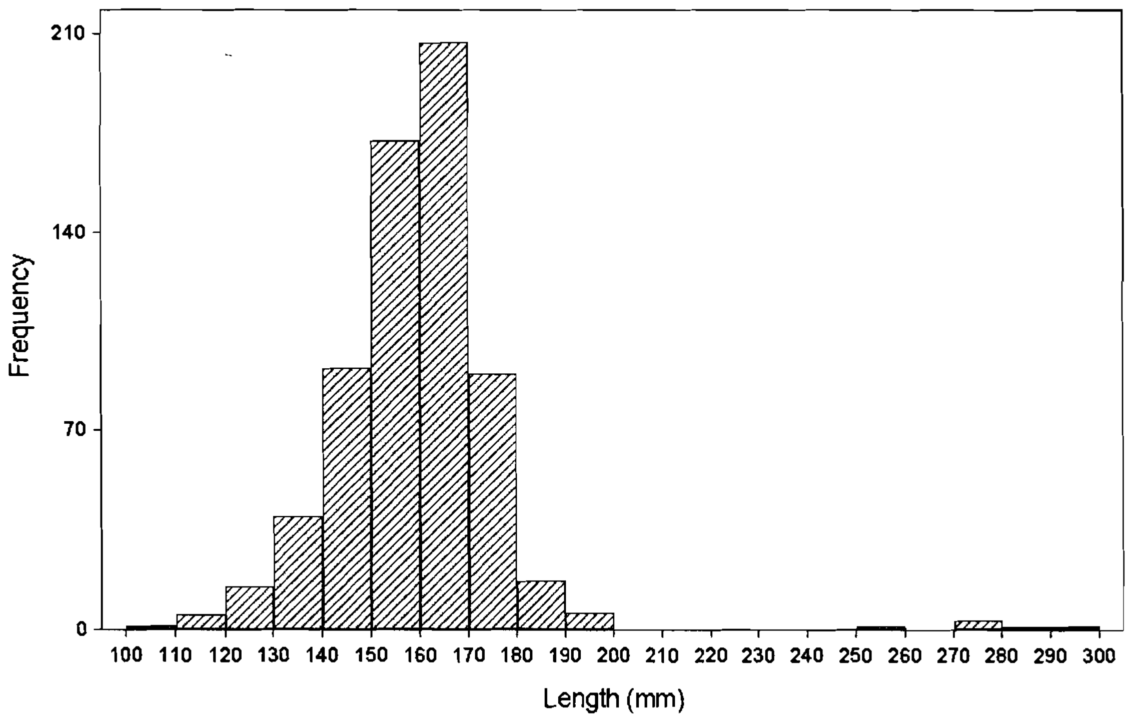

Figure 2. Length (mm) frequency histogram for young-of-the-year and year 1+ lingcod (n=651).

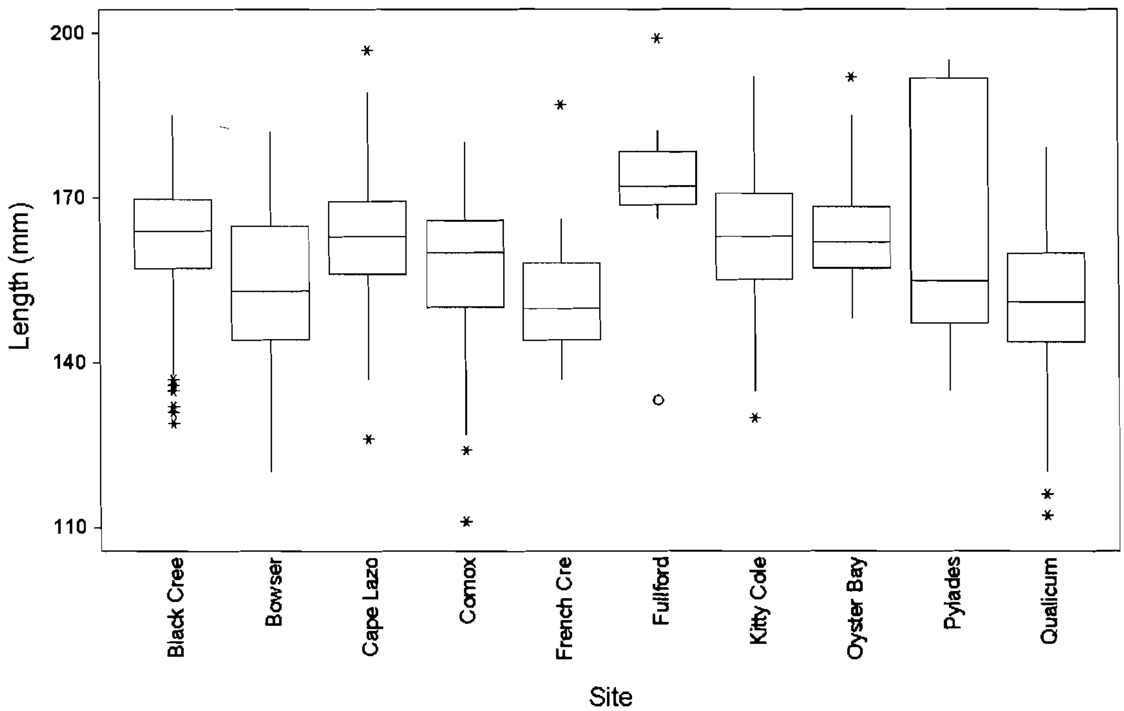

Figure 3. Boxplot representing length (mm) distribution of young-of-the-year lingcod by sampling site. The horizontal line in the centre of the box represents the median while box edges depict the 1st and 3rd quartiles. The typical range of the data are represented by the whiskers while possible and probable outliers are represented by * and ° respectively. Sample sizes are as follows: Black Creek=117; Bowser=93; Cape Lazo=140; Comox=54; French Creek=24; Fullford Harbour=7; Kitty Coleman=45; Oyster Bay=56; Pylades=5; Qualicum=101; Nanoose (not depicted)=3.

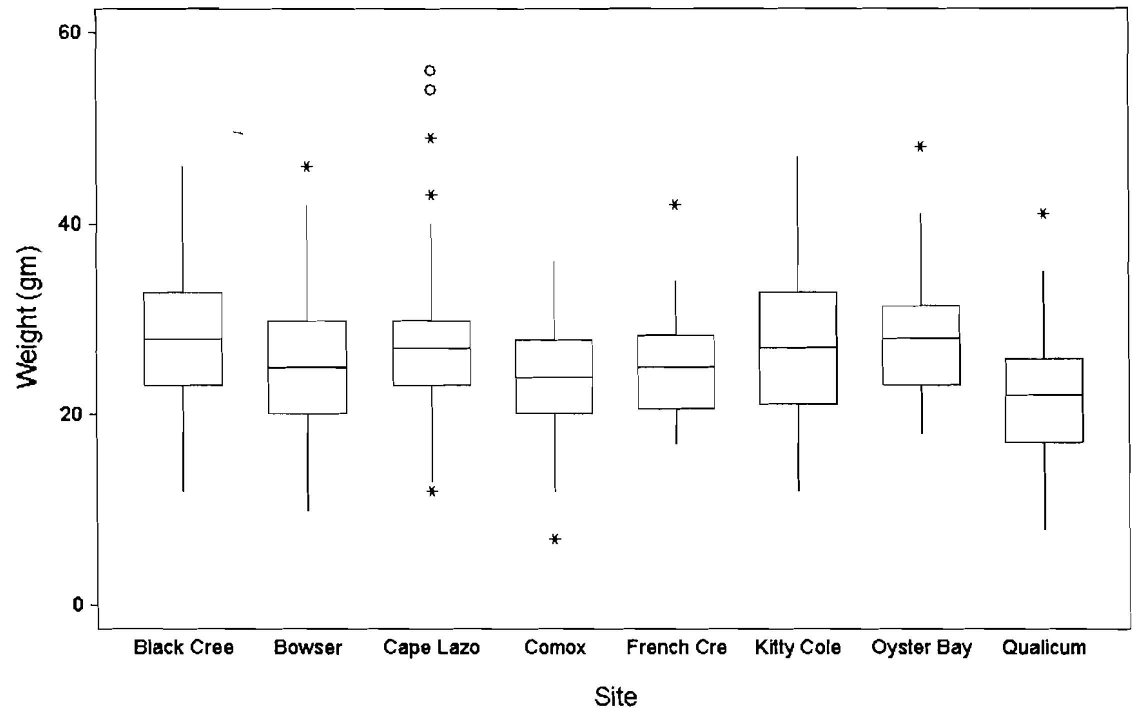

Figure 4. Boxplot representing weight (gm) distribution of young-of-the-year lingcod by sampling site. Sample sizes are as follows: Black Creek=117; Bowser=93; Cape Lazo=140; Comox=54; French Creek=24; Kitty Coleman=45; Oyster Bay=56; Qualicum=101; Nanoose (not depicted)=3.

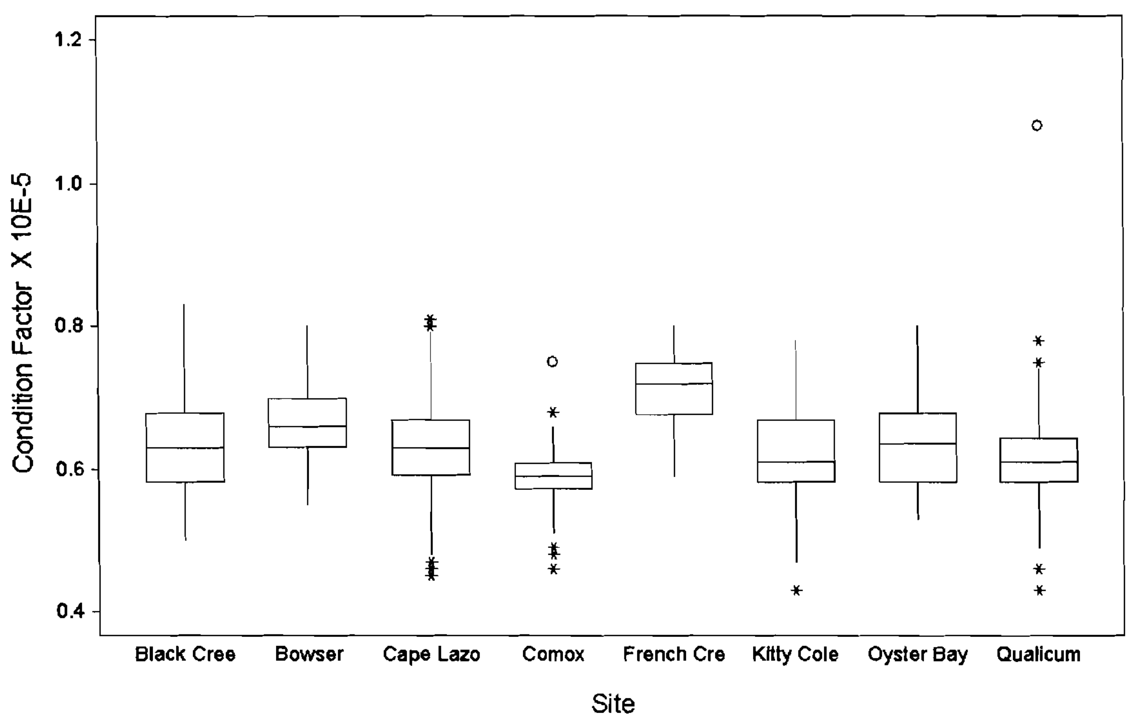

Figure 5. Boxplot representing condition factor distribution of young-of-the-year lingcod by sampling site. Sample sizes are as follows: Black Creek=117; Bowser=93; Cape Lazo=140; Comox=54; French Creek=24; Kitty Coleman=45; Oyster Bay=56; Qualicum=101; Nanoose (not depicted)=3.

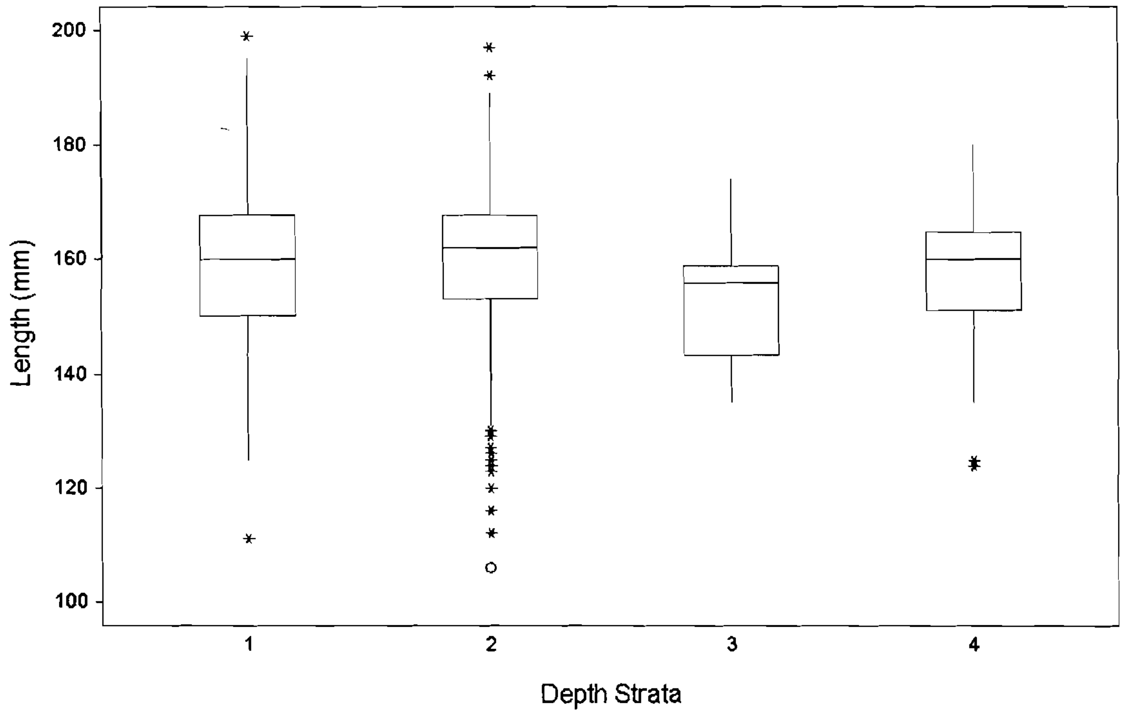

Figure 6. Boxplot of young-of-the-year lingcod length by depth strata. Sample sizes are as follows: 1=230, 2=218; 3=21; 3=33.

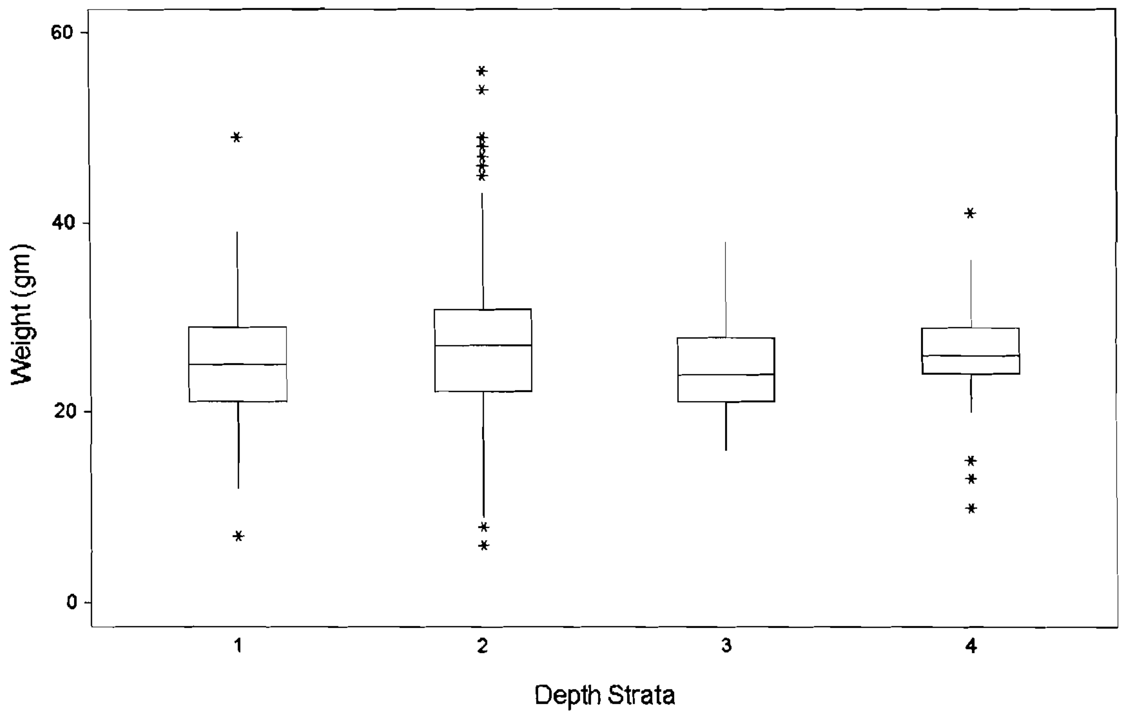

Figure 7. Boxplot of young-of-the-year lingcod weight by depth strata. Sample sizes are as follows: 1=230, 2=218; 3=21; 3=33.

Table 5. Prey items identified in stomach content analysis of young-of-the-year lingcod. N=number of stomachs containing prey item.

Prey Code	Prey Item	N	Frequency Occurrence %	Mean Volume (cc)	SD of volume	% of Volume
32	Fish remains	121	63.4	1.70	1.27	48.20
34	Pacific sandlance	34	17.8	3.7	1.4	29.18
51	Pacific tomcod	13	6.8	4.85	1.1	14.36
3	Euphausid	11	5.8	0.43	0.4	2.90
12	Invertebrate remains	5	2.6	0.28	0.4	0.36
59	Eelpouts	5	2.6	1.4	0.5	1.60
7	Amphipod	1	0.5	.1	-	0.02
20	Herring	1	0.5	6.0	-	1.37
35	Shrimp Sp. (2° prey)	2	1.05	2.0	1.41	0.91
9	Crab Sp. (2° prey)	1	0.5	0.1	-	0.02
	Total	191				

Table 6. Young-of-the-year lingcod density statistics among sites between sampling years 2003 and 1991.

Year	Site	N	Range	Median	Mean	C.V.	St. Dev.
North							
2003	Cape Lazo	4	1231-9310	5800.0	5535.3	62.3	3450.80
	Comox	3	1335-3764	2215.0	2438.0	50.4	1229.80
	Bowser	8	1038-2148	1540.5	1647.4	24.8	407.97
	Qualicum	8	277-4657	1409.0	1942.8	85.6	1662.10
1991	Cape Lazo	4	224-11,111	2220.5	3944.0	129.9	5122.60
	Comox	4	122-4467	1095.5	1695.0	113.4	1922.60
	Bowser	7	591-1307	749.0	881.6	33.1	291.43
	Qualicum	4	402-1299	882.5	866.5	45.6	395.17
Significance	U=7.381 with 1 df, p=0.007						
South							
2003	Nanoose	4	0-286	126.0	134.5	115.9	155.93
	Pylades	2	181-402	291.5	291.5	53.6	156.27
	Trincomali	6	0	0	0.0		
	Walker Hook	2	0	0	0.0		
	Fullford Harbour	2	0-1118	559.0	559.0	141.4	790.55
	Sidney	3	0	0	0.0		
1991	Nanoose	6	0-3376	954.5	1301.7	91.8	1194.80
	Pylades	1	0	0	0.0		
	Trincomali	2	0	0	0.0		
	Walker Hook	2	0	150.0	150.0	141.4	212.13
	Fullford Harbour	2	0	0	0.0		
	Sidney	4	110-647	221.0	299.8	79.7	238.96
Significance	U=4.585 with 1 df, p=0.032						

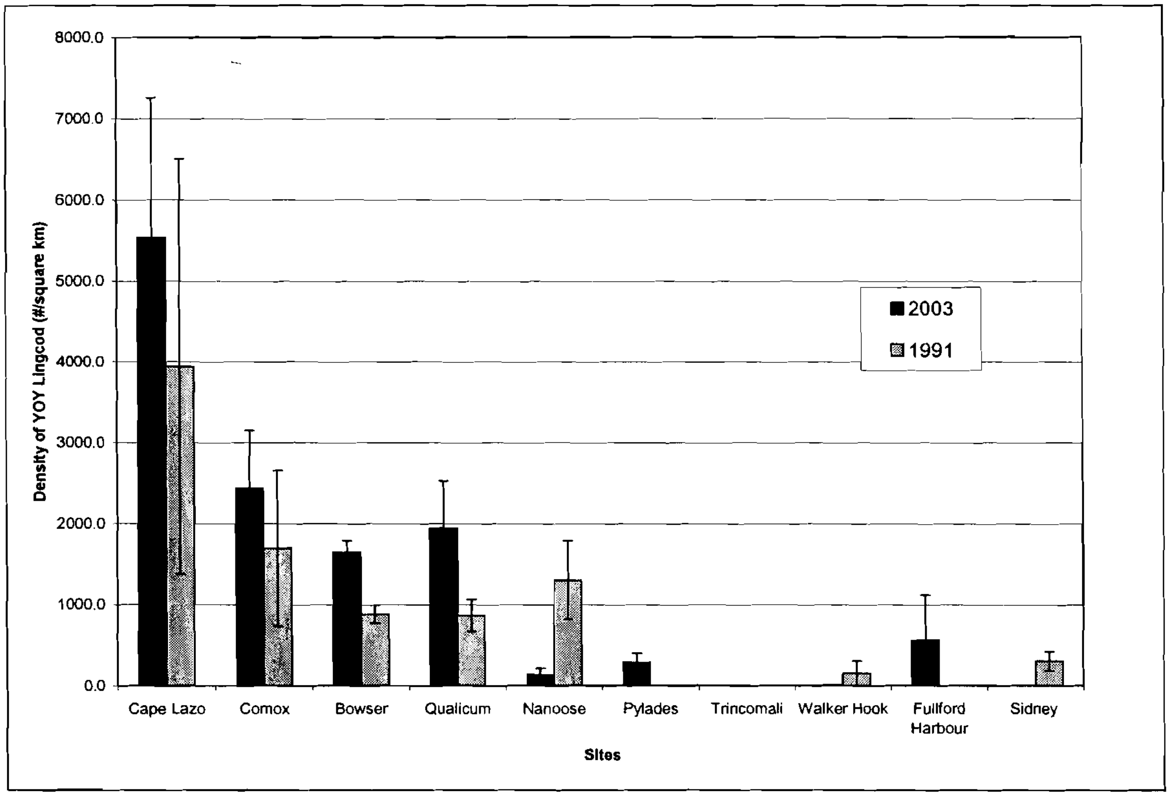

Figure 8. Comparison of young-of-the-year lingcod density by site between sampling years. Error bars represent Standard Error.

Appendix 1. Bridge log data for each tow.

Tow Number	1	2	3	4	5	6	7	8
Site Number	4	4	4	3	3	3	2	2
Date	28-Jul	28-Jul	28-Jul	29-Jul	29-Jul	29-Jul	29-Jul	29-Jul
Site	Pylades	Pylades	Pylades	Kuper	Kuper	Kuper	Walker Hook	Walker Hook
Region	S	S	S	S	S	S	S	S
Stat. Area	17	17	17	17	17	17	17	17
Start Latitude	49.7.422	49.7.583	49.7.046	48.58.01	48.57.411	48.58.331	48.54.037	48.54.393
Start Longitude	123.43.115	123.43.5	123.44.984	123.337.522	123.37.487	123.35.895	123.30.248	123.30.175
End Latitude	49.7.383	49.7.505	49.7.01	48.57.686	48.57.125	48.56.138	48.53.84	48.54.206
End Longitude	123.44.418	123.43.817	123.44.967	123.37.414	123.37.488	123.35.541	123.29.898	123.29.785
Habitat	RS	R	RS	RS	SM	SM	S	S
Tide	L	F	F	E	E	E	F	F
Start Depth	22.5	12.5	37.0	23.7	23.0	31.7	18.0	26.5
Finish depth	29.1	20.0	40.0	24.8	23.5	33.0	18.5	27.7
Modal Depth	24	15	37	24	23	32	18	27
Depth strata	1.0	1.0	2.0	1.0	1.0	2.0	1.0	2.0
Start Time	1124	1500	1612	727	925	1122	1353	1505
Finish Time	1139	1510	1617	737	935	1132	1403	1515
Time (min)	15	10	5	10	10	10	10	10
Distance of tow (m)	851.9	574.1	259.3	592.6	518.6	629.7	629.7	537.1
Speed	2.0	1.9	1.9	1.9	2.0	1.9	1.9	1.8
Direction (°T)	88	255	157	179	180	129	134	127
Area towed (m^2)	11075	7464		7704	6741	8186	8186	6982
Use-able tow	Y	Y	N	Y	Y	Y	Y	Y
Catch (kg)	600	200	60	270	270	225	125	90
# Lingcod	2	3	0	0	0	0	0	0
Lingcod Density	180.6	402.0		0.0	0.0	0.0	0.0	0.0

Appendix 1

Tow Number	9	10	11	12	13	14	15	16
Site Number	2	2	1	1	1	1	5	5
Date	29-Jul	30-Jul	30-Jul	30-Jul	30-Jul	30-Jul	31-Jul	31-Jul
Site	Fullford Harbour	Fullford Harbour	Sidney	Sidney	Sidney	Sidney	Trincomali	Trincomali
Region	S	S	S	S	S	S	S	S
Stat. Area	18	18	19	19	19	19	17	17
Start Latitude	48.44.541	48.44.906	48.36.481	48.36.661	48.38.249	48.37.671	49.1.574	49.1.713
Start Longitude	123.25.6	12325.989	123.23.055	123.23.444	123.21.164	123.17.476	123.37.324	123.37.935
End Latitude	48.44.271	48.44.682	48.36.783	48.37.008	48.38.588	48.37.842	49.1.695	49.1.929
End Longitude	123.25.439	123.25.821	123.23.219	123.23.592	123.21.153	123.17.674	123.37.453	123.38.227
Habitat	SM	SM	SM	SM	SM	RS	SRSh	S
Tide	F	E	E	E	L	F	E	E
Start Depth	33.0	17.0	20.0	22.0	32.0	24.0	19.0	39.0
Finish depth	36.0	22.0	17.0	21.0	32.0	28.0	20.0	39.0
Modal Depth	35	20	18	23	32	26	20	39
Depth strata	2.0	1.0	1.0	1.0	2.0	2.0	1.0	2.0
Start Time	1655	646	915	1036	1308	1438	1032	1151
Finish Time	1705	656	925	1046	1318	1445	1039	1201
Time (min)	10	10	10	10	10	7	7	10
Distance of tow (m)	592.6	481.5	611.2	629.7	481.5	481.5	501.9	537.1
Speed	1.9	1.9	2.0	2.0	1.6	2.2	2.3	1.7
Direction (°T)	157	154	342	244	1	323	319	141
Area towed (m^2)	7704	6260	7945	8186	6260			6982
Use-able tow	Y	Y	Y	Y	Y	N	N	Y
Catch (kg)	160	500	360	680	360	45	90	150
# Lingcod	0	7	0	0	0	0	0	0
Lingcod Density	0.0	1118.3	0.0	0.0	0.0			0.0

Appendix 1

Tow Number	17	18	19	20	21	22	23	24
Site Number	5	5	6	6	6	6	7	7
Date	31-Jul	31-Jul	01-Aug	01-Aug	01-Aug	01-Aug	02-Aug	02-Aug
Site	Trincomali	Trincomali	Nanoose	Nanoose	Nanoose	Nanoose	French Creek	French Creek
Region	S	S	S	S	S	S	N	N
Stat. Area	17	17	17	17	17	17	14	14
Start Latitude	49.0.135	49.1.177	49.15.449	49.15.674	49.15.72	49.15.681	49.20.662	49.20.632
Start Longitude	123.38.878	123.39.103	124.9.883	124.10.202	124.9.646	124.9.021	124.19.957	124.19.384
End Latitude	49.0.342	49.1.399	49.15.407	49.15.661	49.15.7	49.15.645	49.20.798	49.20.732
End Longitude	123.39.185	123.39.426	124.9.471	124.9.751	124.9.226	124.8.61	124.20.371	124.19.81
Habitat	S	S	M	SM	SM	SM	S	S
Tide	L	F	L	L	F	F	E	E
Start Depth	23.4	36.0	18.2	22.0	26.0	31.0	20.0	38.0
Finish depth	23.7	37.0	17.0	24.5	28.0	36.0	23.0	37.0
Modal Depth	23	36	17	23	27	35	22	37
Depth strata	1.0	2.0	1.0	1.0	2.0	2.0	1.0	2.0
Start Time	1352	1513	1239	1432	1623	1729	1055	1249
Finish Time	1402	1523	1249	1442	1633	1739	1105	1259
Time (min)	10	10	10	10	10	10	10	10
Distance of tow (m)	537.1	537.1	537.1	611.2	537.1	574.1	592.6	629.7
Speed	1.7	1.8	1.7	1.9	1.7	1.8	1.9	2.0
Direction (°T)	316	315	97	94	94	98	295	292
Area towed (m^2)	6982	6982	6982	7945	6982	7464	7704	8186
Use-able tow	Y	Y	Y	Y	Y	Y	Y	Y
Catch (kg)	135	180	90	545	545	360	360	180
# Lingcod	0	0	0	2	2	0	15	5
Lingcod Density	0.0	0.0	0.0	251.7	286.4	0.0	1947.0	610.8

Appendix 1

Tow Number	25	26	27	28	29	30	31	32
Site Number	7	7	8	8	8	8	8	8
Date	02-Aug	02-Aug	03-Aug	03-Aug	03-Aug	03-Aug	03-Aug	03-Aug
Site	French Creek	French Creek	Qualicum	Qualicum	Qualicum	Qualicum	Qualicum	Qualicum
Region	N	N	N	N	N	N	N	N
Stat. Area	14	14	14	14	14	14	14	14
Start Latitude	49.21.72	49.21.669	49.23.217	49.23.34	49.24.005	49.23.686	49.23.76	49.23.625
Start Longitude	124.21.693	124.21.947	124.32.784	124.33.766	124.34.908	124.34.88	124.33.573	124.33.717
End Latitude	49.21.927	49.21.862	49.23.342	49.23.251	49.23.919	49.23.581	49.23.624	49.23.572
End Longitude	124.22.126	124.22.363	124.33.181	124.33.295	124.34.789	124.34.605	124.33.223	124.33.619
Habitat	S	SM	SG	SG	SG	SG	S	S
Tide	E	L	H	H	E	E	E	E
Start Depth	36.0	25.0	37.7	28.0	34.0	30.0	56.6	47.0
Finish depth	38.5	26.0	44.0	29.0	36.2	32.8	58.0	47.6
Modal Depth	37	25	40	29	35	31	58	47
Depth strata	2.0	1.0	2.0	1.0	2.0	2.0	4.0	3.0
Start Time	1448	1607	803	946	1131	1210	1349	1456
Finish Time	1458	1617	813	956	1136	1218	1357	1501
Time (min)	10	10	10	10	5	8	8	5
Distance of tow (m)	685.2	629.7	611.2	629.7	296.3	463.0	518.6	259.3
Speed	2.1	2.0	1.9	2.0	1.9	1.9	2.1	1.7
Direction (°T)	307	306	296	105	133	119	121	122
Area towed (m^2)	8908	8186	7945	8186	3852	6019	6741	3371
Use-able tow	Y	Y	Y	Y	Y	Y	Y	Y
Catch (kg)	160	160	385	365	45	230	160	45
# Lingcod	3	0	37	19	4	25	5	6
Lingcod Density	336.8	0.0	4657.0	2321.1	1038.4	4153.5	741.7	1780.1

Appendix 1

Tow Number	33	34	35	36	37	38	39	40
Site Number	8	8	9	9	9	9	9	9
Date	03-Aug	03-Aug	04-Aug	04-Aug	04-Aug	04-Aug	04-Aug	04-Aug
Site	Qualicum	Qualicum	Bowser	Bowser	Bowser	Bowser	Bowser	Bowser
Region	N	N	N	N	N	N	N	N
Stat. Area	14	14	14	14	14	14	14	14
Start Latitude	49.24.204	49.23.803	49.26.734	49.26.478	49.27.221	49.27.076	49.27.03	49.26.91
Start Longitude	124.34.375	124.33.774	124.39.447	124.39.503	124.40.497	124.39.913	124.39.206	124.39.206
End Latitude	49.24.427	49.23.642	49.26.457	49.26.246	49.27.054	49.26.878	49.27.211	49.27.098
End Longitude	124.34.631	124.33.495	124.39.158	124.39.227	124.40.195	124.39.71	124.39.497	124.39.438
Habitat	S	SR	S	S	S	S	S	S
Tide	L	L	F	F	F	H	E	E
Start Depth	53.0	53.0	28.0	21.1	21.1	27.1	52.0	41.0
Finish depth	54.0	53.8	28.0	21.4	21.7	27.1	56.1	45.4
Modal Depth	54	53	28	21	21	27	55	45
Depth strata	4.0	4.0	2.0	1.0	1.0	2.0	4.0	3.0
Start Time	1558	1702	737	859	1029	1140	1325	1427
Finish Time	1606	1710	747	909	1037	1148	1333	1435
Time (min)	8	8	10	10	8	8	8	8
Distance of tow (m)	555.6	537.1	648.2	592.6	518.6	537.1	574.1	537.1
Speed	2.2	2.2	2.1	1.9	2.1	2.2	2.2	2.2
Direction (°T)	322	124	146	321	132	144	313	318
Area towed (m^2)	7223	6982	8427	7704	6741	6982	7464	6982
Use-able tow	Y	Y	Y	Y	Y	Y	Y	Y
Catch (kg)	270	180	320	200	160	180	180	160
# Lingcod	2	4	13	11	9	15	16	14
Lingcod Density	276.9	572.9	1542.7	1427.8	1335.1	2148.4	2143.7	2005.1

Appendix 1

Tow Number	41	42	43	44	45	46	47	48
Site Number	9	9	10	10	10	11	11	11
Date	04-Aug	04-Aug	05-Aug	05-Aug	05-Aug	05-Aug	05-Aug	05-Aug
Site	Bowser	Bowser	Comox Hrb	Comox Hrb	Comox Hrb	Cape Lazo	Cape Lazo	Cape Lazo
Region	N	N	N	N	N	N	N	N
Stat. Area	14	14	14	14	14	14	14	14
Start Latitude	49.26.673	49.26.228	49.38.164	49.38.000	49.37.575	49.41.065	49.40.427	49.42.706
Start Longitude	124.38.58	124.38.508	124.54.564	124.53.981	124.54.11	124.51.42	124.49.291	124.50.132
End Latitude	49.26.855	49.26.457	49.38.423	49.38.242	49.37.844	49.41.022	49.40.349	49.42.502
End Longitude	124.38.758	124.38.744	124.54.669	124.54.136	124.54.336	124.51.099	124.48.894	124.49.954
Habitat	S	S	SM	SM	SM	SR	SR	SR
Tide	E	L	F	F	F	F	H	E
Start Depth	41.0	41.0	41.0	41.0	41.0	41.0	41.0	41.0
Finish depth	56.1	36.0	25.1	30.5	26.8	26.5	42.5	28.2
Modal Depth	52	36	25	30	25	25	40	27
Depth strata	4.0	2.0	1.0	2.0	1.0	1.0	2.0	2.0
Start Time	1529	1624	734	900	1008	1138	1338	1532
Finish Time	1535	1632	742	908	1016	1146	1346	1540
Time (min)	6	8	8	8	8	8	8	8
Distance of tow (m)	444.5	500.0	555.6	518.6	592.6	407.4	537.1	500.0
Speed	2.4	2.0	2.2	2.1	2.3	1.7	2.2	2.0
Direction (°T)	326	325	345	336	330	100	107	151
Area towed (m^2)	5778	6501	7223	6741	7704	5297	6982	6501
Use-able tow	Y	Y	Y	Y	Y	Y	Y	Y
Catch (kg)	180	205	160	90	200	455	500	270
# Lingcod	6	10	16	9	29	37	65	30
Lingcod Density	1038.4	1538.3	2215.2	1335.1	3764.1	6985.5	9309.6	4615.0

Appendix 1

Tow Number	49	50	51	52	53	54	55	56
Site Number	11	12	12	12	12	14	14	14
Date	05-Aug	06-Aug	06-Aug	06-Aug	06-Aug	06-Aug	06-Aug	07-Aug
Site	Cape Lazo	Kitty Coleman	Kitty Coleman	Kitty Coleman	Kitty Coleman	Oyster Bay	Oyster Bay	Oyster Bay
Region	N	N	N	N	N	N	N	N
Stat. Area	14	14	14	14	14	13	13	13
Start Latitude	49.43.236	49.47.121	49.47.483	49.48.404	49.48.06	49.54.656	49.54.26	49.55.094
Start Longitude	124.50.971	124.58.583	124.58.728	125.0.243	124.59.686	125.8.196	125.8.526	125.9.112
End Latitude	49.43.421	49.29.703	49.47.561	49.48.212	49.47.928	49.54.395	49.54.102	49.54.876
End Longitude	124.51.238	124.58.902	124.58.852	125.0.108	124.59.445	125.8.09	125.8.284	125.8.87
Habitat	S	SG	SG	SG	SG	SR	SR	SR
Tide	E	L	F	F	F	H	E	E
Start Depth	41.0	41.0	41.0	41.0	41.0	41.0	41.0	41.0
Finish depth	23.5	21.4	35.4	28.3	34.7	38.6	26.0	27.0
Modal Depth	22	20	34	28	35	38	25	25
Depth strata	1.0	1.0	2.0	1.0	2.0	2.0	1.0	1.0
Start Time	1655	810	949	1118	1256	1427	1700	904
Finish Time	1703	818	955	1126	1304	1435	1708	912
Time (min)	8	8	6	8	8	8	8	8
Distance of tow (m)	500.0	481.5	314.8	463.0	463.0	500.0	481.5	555.6
Speed	2.0	2.0	1.7	1.9	1.9	2.0	1.9	2.2
Direction (°T)	316	321	315	156	113	166	135	143
Area towed (m^2)	6501	6260	4093	6019	6019	6501	6260	7223
Use-able tow	Y	Y	Y	Y	Y	Y	Y	Y
Catch (kg)	180	320	45	160	160	400	180	225
# Lingcod	8	7	5	20	13	10	20	26
Lingcod Density	1230.7	1118.3	1221.6	3322.8	2159.8	1538.3	3195.0	3599.7

Appendix 1

Tow Number	57	58	59	60	61	62
Site Number	13	13	13	13	13	7
Date	07-Aug	07-Aug	07-Aug	07-Aug	07-Aug	08-Aug
Site	Black Creek	Black Creek	Black Creek	Black Creek	Black Creek	French Creek
Region	N	N	N	N	N	N
Stat. Area	14	14	14	14	14	14
Start Latitude	49.51.845	49.51.876	49.51.72	49.51.562	49.51.686	49.21.262
Start Longitude	125.5.849	125.5.509	125.5.123	125.5.251	125.5.627	124.20.849
End Latitude	49.52.089	49.52.103	49.51.932	49.51.49	49.51.53	49.21.091
End Longitude	125.6.036	125.5.769	125.5.357	125.5.145	125.5.387	124.20.532
Habitat	SR	S	S	S	S	RS
Tide	F	F	F	F	F	L
Start Depth	41.0	41.0	41.0	41.0	41.0	41.0
Finish depth	18.0	26.2	35.7	23.5	19.5	45.9
Modal Depth	18	27	36	24	19	45
Depth strata	1.0	2.0	2.0	1.0	1.0	3.0
Start Time	959	1109	1253	1352	1434	842
Finish Time	1007	1117	1301	1356	1442	850
Time (min)	8	8	8	4	8	8
Distance of tow (m)	500.0	555.6	537.1	259.3	500.0	555.6
Speed	2.0	2.2	2.2	2.0	2.0	2.2
Direction (°T)	332	325	324	134	137	129
Area towed (m^2)	6501	7223	6982		6501	
Use-able tow	Y	Y	Y	N	Y	N
Catch (kg)	160	180	90	40	115	160
# Lingcod	11	66	31	7	2	1
Lingcod Density	1692.2	9137.7	4440.0		307.7	

Appendix 2. Catch composition by tow of useable tows. + species not counted due to time constraints.

Tow #	1	2	4	5	6	7	8	9	10	11
Fish Species										
Lingcod	2	3							7	
Whitespotted greenling	13	14	6		4	4	2		7	3
Kelp greenling										
Copper rockfish	2									
Quillback rockfish	8									
Rock sole	+	161	9	14	73	94	61	68	141	34
English sole	+	2	+	+		+		+	+	+
Plainfin midshipman	13		+	+	38	41	28	12	19	
Spiny dogfish	90	12	31	29	77	47	5	14		+
Shiner perch	109		148	149	132	31	112	60	39	34
Roughback sculpin	112		3	9	8	4	12	1	64	
Blackbelly eelpout			190	+	158	23	12	40	13	15
Pacific tomcod	6		160	32	136	22	+	+	4	
Slender sole	1		15	34	21	8		32		1
Speckled sanddab				1					57	
Longspine combfish	11	1	10	20	60	1	3	4		1
Sturgeon poacher						11	11		4	12
Pacific sanddab	181			13	31	25	9	128	39	
Pacific staghorn sculpin	5	2	3	3	3	2		1	28	
Flathead sole			130	142	70	19	47	63	4	
Rex sole			1	5	1		7	15		
Pacific herring			88		12	2	115	57	2	2
Pacific cod										
Starry flounder	2		100	+	2	4				13
Longnose skate				2				1		
Dover sole								43	17	
Spotted ratfish										
C-o sole	1								7	
Snake prickleback	3		1	1	3	2		2	7	
N. spearnose poacher	2									
Big skate			1	1				2	2	
Blacktip poacher										
Sand sole			22	34		7	2			
Butter sole	1		1			L	5	9	187	5
Slim sculpin					1			1		
Pacific sandfish			2	3	2					
Great sculpin	4		1							
Threadfin sculpin										
Buffalo sculpin		5								1
Walleye pollock								1		1
Grunt sculpin	1	1							1	
Sailfin sculpin	3									
Dwarf wrymouths										
Ribbed sculpin										
Northern ronquil										
Pacific hake					2					
Padded sculpin										
Smooth alligatorfish										
Roughspine sculpin										
Night smelt							1			
Greenstriped rockfish	1									
Cabezon										
Curlfin sole										
Chinook salmon										1
Spotfin sculpin										
Northern sculpin										
Red irish lord										
Tubesnout									1	
Spinyhead sculpin										
Blackfin poacher								10		
Arrowtooth flounder										

Appendix 2

Tow #	12	13	16	17	18	19	20	21	22	23
Fish Species										
Lingcod							2	2		15
Whitespotted greenling	8	3	2	4	10					
Kelp greenling								1		
Copper rockfish										
Quillback rockfish								1		
Rock sole	+	34	+	53	59	101	+	+	+	520
English sole	+			127	+	158	+	+	+	1760
Plainfin midshipman			11	69	29	10	18	+	12	66
Spiny dogfish	600*	165	41	18		4	15	+	31	
Shiner perch		5	51	156	49	18	+	+	+	1
Roughback sculpin	1		3	6	4					55
Blackbelly eelpout	10	4	+	+	+	15	15	+	40	5
Pacific tomcod	5		+		59	12	22	+	9	
Slender sole			131	28	28	4			4	
Speckled sanddab						113				138
Longspine combfish			8	12	17			+	1	
Sturgeon poacher	14	5								3
Pacific sanddab			14	8	22		4			20
Pacific staghorn sculpin	1		1	4	2	5	3	+		2
Flathead sole			+	110	138	30	144	+	+	
Rex sole			1		2		3			
Pacific herring	5	6	34	14	11	245	48	+	6	
Pacific cod										
Starry flounder	8	1				1	+	+	+	
Longnose skate					2					
Dover sole										1
Spotted ratfish							8	+	50	1
C-o sole										
Snake prickleback									1	
N. spearnose poacher									1	
Big skate	3			1						1
Blacktip poacher										
Sand sole					4	5	6	+	5	
Butter sole				4	2					
Slim sculpin										
Pacific sandfish				2	2		2		1	
Great sculpin	6	6								
Threadfin sculpin										
Buffalo sculpin	14	4		1						1
Walleye pollock	12	9	2							
Grunt sculpin										
Sailfin sculpin										
Dwarf wrymouths						1				
Ribbed sculpin	2	30								
Northern ronquil										
Pacific hake			1							
Padded sculpin		18				1				
Smooth alligatorfish						1		+		
Roughspine sculpin		20								
Night smelt										
Greenstriped rockfish										
Cabezon										
Curlfin sole										
Chinook salmon										
Spotfin sculpin										
Northern sculpin		1								
Red irish lord										
Tubesnout										
Spinyhead sculpin			1							
Blackfin poacher										
Arrowtooth flounder										

Appendix 2

Tow #	24	25	26	27	28	29	30	31	32	33
Species										
Lingcod	5	3		37	4	4	25	5	6	2
Whitespotted greenling										
Kelp greenling										
Copper rockfish										
Quillback rockfish	1		1		1	1		3		7
Rock sole	+		+	+	+	130	+	6	47	18
English sole	+		+	+	+	82	+	+	+	+
Plainfin midshipman	391	185	99	225	82	125	125	96	32	250
Spiny dogfish	2	1	1	31	10		9		13	23
Shiner perch	35	72	34	58	38	12	69	6	7	6
Roughback sculpin	21	39	24	39	25	3	11			
Blackbelly eelpout	1	4		57	71	17	68	13	16	22
Pacific tomcod				27	26	8	20		6	41
Slender sole		89	2	92	34	26	45	166	94	+
Speckled sanddab	138	199	252	8	30	2	27			
Longspine combfish	1			6	33	2	11	1	1	
Sturgeon poacher		13	10	1						
Pacific sanddab	16	56	14	5	3		4			
Pacific staghorn sculpin					3	5	8			
Flathead sole				9			15	38	17	36
Rex sole	15	15		26		3	25	4	1	2
Pacific herring							2	5	1	1
Pacific cod			1		1		1	1		
Starry flounder						9	35	19	3	
Longnose skate	4	4	1		1			7	1	5
Dover sole	8	22	4	6		10	6	2	2	2
Spotted ratfish										
C-o sole										
Snake prickleback										
N. spearnose poacher		1								
Big skate	1									1
Blacktip poacher				13				34	12	56
Sand sole										
Butter sole										
Slim sculpin				1	1					
Pacific sandfish										
Great sculpin										
Threadfin sculpin										
Buffalo sculpin										
Walleye pollock										
Grunt sculpin										
Sailfin sculpin										
Dwarf wrymouths										
Ribbed sculpin										
Northern ronquil								1		
Pacific hake										
Padded sculpin										
Smooth alligatorfish										
Roughspine sculpin										
Night smelt										
Greenstriped rockfish								1		
Cabezon										
Curlfin sole										
Chinook salmon										
Spotfin sculpin										
Northern sculpin										
Red irish lord										1
Tubesnout										
Spinyhead sculpin										
Blackfin poacher										
Arrowtooth flounder										

Appendix 2

Tow #	34	35	36	37	38	39	40	41	42	43
Species										
Lingcod	4	13	11	9	14	16	14	6	10	16
Whitespotted greenling			8	3	1					
Kelp greenling									1	
Copper rockfish	1	1								
Quillback rockfish	8									
Rock sole	7	+	+	+	+	+	119	42	13	2
English sole	+	+	+	+	+	+	+	+	+	+
Plainfin midshipman	175	140	10	3	30	370	290	450	210	5
Spiny dogfish	44	45	8		7		35	63	9	21
Shiner perch	11	117	35	13	1	20	67		40	400*
Roughback sculpin		36	58	54	25	29	21	33	21	1
Blackbelly eelpout	23	70	4			21	79	32	36	208
Pacific tomcod	12	32				32	19	15	7	58
Slender sole	+	55			4	68	84	82		
Speckled sanddab		208	192	211	243		38	3	5	42
Longspine combfish		16				14	43	40	49	1
Sturgeon poacher		9	17	37	16	2	1	1		
Pacific sanddab		5			2	10	2	2	10	
Pacific staghorn sculpin		3			2	1		1		
Flathead sole	68							1	1	77
Rex sole	3					3				
Pacific herring	1	2								13
Pacific cod		4			1		5	1	6	
Starry flounder	1							3	+	92
Longnose skate	7	1								
Dover sole	6	4				1			2	
Spotted ratfish										
C-o sole			20	20						
Snake prickleback		1	1	2	1					2
N. spearnose poacher										
Big skate		1								
Blacktip poacher	27	4					12	22	2	
Sand sole										
Butter sole										
Slim sculpin								1	1	
Pacific sandfish										
Great sculpin				2						
Threadfin sculpin										
Buffalo sculpin										
Walleye pollock										
Grunt sculpin										
Sailfin sculpin										
Dwarf wrymouths										1
Ribbed sculpin										
Northern ronquil										
Pacific hake										
Padded sculpin										
Smooth alligatorfish										
Roughspine sculpin										
Night smelt										
Greenstriped rockfish										
Cabezon										
Curlfin sole										
Chinook salmon										
Spotfin sculpin										
Northern sculpin										
Red irish lord										
Tubesnout										
Spinyhead sculpin										
Blackfin poacher										
Arrowtooth flounder										

Appendix 2

Tow #	44	45	46	47	48	49	50	51	52	53
Species										
Lingcod	9	29	37	65	30	8	7	5	22	14
Whitespotted greenling										
Kelp greenling								4	2	2
Copper rockfish								1	3	2
Quillback rockfish								1		
Rock sole	2		+	+	+	+	+	119	+	148
English sole	+	+	1	+	+	+	+	+	+	+
Plainfin midshipman	13	33	99	250	225	18	19		41	13
Spiny dogfish	28		12	76		30	+	3	17	6
Shiner perch	300*	225	8	9	2	4			1	
Roughback sculpin			62	62	152	54	110	5	25	16
Blackbelly eelpout	375	140	30	5						
Pacific tomcod	35	53	3	29		1	1			
Slender sole			10	+	26			28	3	22
Speckled sanddab	23	101	123	62	60	128	154	12	41	26
Longspine combfish				23					33	3
Sturgeon poacher			3	2		7	6	1	34	43
Pacific sanddab				38					3	3
Pacific staghorn sculpin		5	6				1		3	
Flathead sole	156	+		6						
Rex sole				1					32	6
Pacific herring	75	11								
Pacific cod			71	+		11	18	4	2	
Starry flounder	1	5	1							
Longnose skate							1			2
Dover sole								1		
Spotted ratfish			15	220	1		50	40	9	55
C-o sole			18		3	18	29	4	3	8
Snake prickleback	1	1	33							
N. spearnose poacher					7	4	1	1	2	2
Big skate	2		1						1	1
Blacktip poacher		1		36						
Sand sole		10	4							
Butter sole										
Slim sculpin				3						
Pacific sandfish										
Great sculpin			6							
Threadfin sculpin								5		11
Buffalo sculpin										
Walleye pollock										
Grunt sculpin										
Sailfin sculpin										
Dwarf wrymouths		1								
Ribbed sculpin										
Northern ronquil										
Pacific hake										
Padded sculpin										
Smooth alligatorfish										
Roughspine sculpin										
Night smelt										
Greenstriped rockfish										
Cabezon			1							
Curlfin sole							1			
Chinook salmon										
Spotfin sculpin					5					
Northern sculpin										
Red irish lord										
Tubesnout										
Spinyhead sculpin										
Blackfin poacher										
Arrowtooth flounder				2						

Appendix 2

Tow #	54	55	56	57	58	59	60
Species							
Lingcod	11	20	27	11	67	31	2
Whitespotted greenling				5			2
Kelp greenling						1	
Copper rockfish	2					1	
Quillback rockfish							
Rock sole	115	+	130	125	+	+	96
English sole	+	+	+	+	+	+	113
Plainfin midshipman	23	6	24	27	24	25	64
Spiny dogfish	65	90	170	10	6	14	7
Shiner perch				1	4	2	
Roughback sculpin	7	21	41	16	25	15	32
Blackbelly eelpout							
Pacific tomcod							
Slender sole						2	
Speckled sanddab		14	9	68	45	14	51
Longspine combfish				1	9		
Sturgeon poacher	5	19	5	14	24	44	4
Pacific sanddab	4				4	1	
Pacific staghorn sculpin							
Flathead sole							
Rex sole				7	10	8	2
Pacific herring	2						
Pacific cod	63	1	1	2	8	13	5
Starry flounder							
Longnose skate	2		1	2	1		3
Dover sole			1				
Spotted ratfish	350	2	170	40	18	35	1
C-o sole	1	3	3	3	2		8
Snake prickleback							
N. spearnose poacher	1		2	1	5		2
Big skate							
Blacktip poacher							
Sand sole							
Butter sole							
Slim sculpin					1		
Pacific sandfish							
Great sculpin							
Threadfin sculpin	12				3	4	1
Buffalo sculpin							
Walleye pollock							
Grunt sculpin				2			
Sailfin sculpin					2	1	
Dwarf wrymouths							
Ribbed sculpin							
Northern ronquil						1	
Pacific hake							
Padded sculpin							
Smooth alligatorfish							
Roughspine sculpin							
Night smelt							
Greenstriped rockfish							
Cabezon							
Curlfin sole							
Chinook salmon							
Spotfin sculpin							
Northern sculpin							
Red irish lord							
Tubesnout							
Spinyhead sculpin							
Blackfin poacher							
Arrowtooth flounder							

Appendix 3. Length-frequency statistics for additional species measured during young-of-the-year lingcod survey.

Species	Length (cm) 0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	80	90	100	N	Min length (cm)	Max length (cm)	Modal length (cm)	Sets sampled
Whitespotted greenling	0	0	60	18	23	5													106	10	27	14	20
Kelp greenling	0	0	0	2	5	5	0	1											13	17	35	26	7
Copper rockfish	0	0	2	5	1	3	1	0	1										13	10	43	17	8
Quillback rockfish	0	0	45	13	3	2													63	10	27	11	14
Greenstripe rockfish				2															2	15	16		2
Rock sole	0	21	554	675	627	600	375	56	3										2910	8	43	14	23
English sole	0	39	331	1048	1038	430	139	14											3039	6	39	19	18
Starry flounder	0	0	0	0	11	122	208	71	30	15	5	2							464	20	55	32	7
Dover sole	0	0	2	26	16	21													65	11	29	25	2
Slender sole	14	35	147	282	187	3													668	3	25	17	5
Flathead sole	0	1	262	332	310	77	21	2											1005	6	35	13	9
Sand sole	0	0	0	5	20	7	9	5	2										48	18	41	21	2
Rex sole	0	0	1	0	3	20	7	1											32	14	35	26	2
Butter sole	0	3	60	89	62	18	2												234	9	31	18	2
C-O sole	0	0	0	3	15	48	3												69	18	32	25	3
Pacific sanddab – F	0	0	1	11	20	42	39	3											116	12	36	27	5
Pacific sanddab – M	0	0	1	25	68	38	4												136	14	31	23	5
Speckled sanddab –F	0	7	167	29															104	9	16	12	3
Speckled sanddab – M	0	2	155	13															170	9	17	13	3
Pacific cod	0	0	1	16	0	39	124	16	1										197	14	43	31	2
Pacific tomcod	0	0	3	69	67	53	3												195	14	31	19	2
Staghorn sculpin	0	0	0	1	0	1	4												6	18	34	32	1
Buffalo sculpin	0	5	11	3															19	7	17	11	2
Great sculpin	0	1	0	2	5	1	6	1											16	7	36	31	3
Longspine combfish	0	18	52	28	83														181	7	24	22	4
Spiny dogfish – F	0	0	0	0	0	0	0	0	0	1	18	57	122	169	190	60	9	1	627	46	104	66	24
Spiny dogfish – M	0	0	0	0	0	0	0	0	0	2	8	30	69	93	216	72	3		491	48	92	70	24
Longnose skate	0	0	0	4	5	4	6	6	11	7	1	5	1	2	2				54	17	75	41	28
Big skate	0	0	1	1	2	0	0	1	1	2	0	0	1	1	1	2	1		14	11	95		13