New Zealand Fisheries
Assessment Report
2007/37
October 2007
ISSN 1175-1584

Relative abundance, size, and age structure of blue cod in Paterson Inlet (BCO 5), November 2006

G. Carbines

Relative abundance, size, and age structure of blue cod in Paterson Inlet (BCO 5), November 2006

G. Carbines

Stock Monitoring Services
P O Box 89234
Torbay
North Shore 0742

New Zealand Fisheries Assessment Report 2007/37
October 2007

Published by Ministry of Fisheries
Wellington
2007

ISSN 1175-1584

Citation:
Carbines, G. (2007).
Relative abundance, size, and age structure of blue cod in Paterson Inlet (BCO 5),
November 2006.
New Zealand Fisheries Assessment Report 2007/37. 31 p.

This series continues the informal
New Zealand Fisheries Assessment Research Document series
which ceased at the end of 1999.

EXECUTIVE SUMMARY

Carbines, G.D. (2007). Relative abundance, size, and age structure of blue cod in Paterson Inlet (BCO 5), November 2006. ***New Zealand Fisheries Assessment Report 2007/37.*** **31 p.**

This report describes the results of a relative abundance survey of blue cod (*Parapercis colias*) in Paterson Inlet (Stewart Island) carried out using cod pots in November 2006. Thirty-four stations were successfully surveyed (6 pots per station = 204 pot lifts) from five strata throughout Paterson Inlet. During phase 1, 150 pot lifts were completed (74%) with 54 in phase 2. The occurrence of running ripe gonad stages indicates that some spawning had begun during the survey in early November 2006.

The total blue cod catch was 950 kg, consisting of 1638 fish; the overall survey mean catch rate for all blue cod was 4.99 kg per lift with a c.v. of 8.40%. Catch rates ranged from 1.45 kg per pot per hour in the Big Glory Bay stratum to 8.42 kg per pot per hour for the outermost stratum at the entrance to Paterson Inlet. For blue cod 30 cm total length and over (minimum legal size in BCO 3), the overall mean catch rate and c.v. was 3.86 kg per hour and 7.79%, proportional catch rates by strata mirrored those of all fish ranging from 1.38 to 5.62 kg per pot per hour. For blue cod 33 cm total length and over (local minimum legal size BCO 5) the overall mean catch rate and c.v. was 3.14 kg per pot per hour and 9.56%. However, catch rates of legal sized fish were highest at 4.68 kg per pot per hour in the Ulva Island / Te Wharawhara Marine Reserve stratum, and lowest in the Big Glory Bay stratum at 1.36 kg per pot per hour.

The results of this survey provide the first MFish standardised abundance index of blue cod from potting in Paterson Inlet. The overall c.v. of 8.40% for all blue cod is excellent given that no previous survey data could be used to optimise allocation of stations. The mean catch rates varied among all strata but were highest at the outermost strata, generally declining with increasing penetration into the inlet. Relative abundance of blue cod in Paterson Inlet is rather low compared to other surveyed areas such as north Otago, Dusky Sound, and north Canterbury. While catch rates in Paterson Inlet were generally higher than those in the Marlborough Sounds, they were most similar to those from Banks Peninsula.

Forty-three percent of the 1638 blue cod caught exceeded the BCO 5 minimum legal size (33 cm and over) and 61% exceeded the BCO 3 minimum legal size (30 cm and over). Size ranged from 15 to 47 cm total length, with an overall average length of 31.5 cm for the total survey area. The three most inner strata of Paterson Inlet had similar length frequency distributions with average length constrained between 32.9 and 33.9 cm. By comparison, blue cod from the outermost seaward strata were smaller (mean 29.2 cm) and blue cod from the Big Glory Bay stratum were larger (mean 35.31 cm). Age frequency distributions were derived from otolith subsamples (n = 228) collected throughout potting stations of all strata except the marine reserve. The overall survey-derived age ranged from 3 to 13 years old with an average age of 7.6 years old and a mean weighted c.v. of 18.8%. The three most inner strata of Paterson Inlet had the most similar age frequency distributions with the average age and c.v.s ranging from of 8.0 to 8.3 years old and 22.0% to 22.9% respectively. By comparison blue cod from the outermost strata were younger (mean 6.9 years, c.v. 17.9%) while blue cod from the Big Glory Bay stratum were older (mean 8.64 years, c.v. 28.88%).

A relatively high estimate of total mortality (0.52) was derived from the overall age frequency distribution in Paterson Inlet using catch curve analysis. Paterson Inlet may therefore be considered a vulnerable fishery with both high total mortality and low relative abundance. The results of this survey support the recent reductions in the daily bag limits of blue cod in Paterson Inlet. While differences between the relative blue cod abundance and size structure of strata may be to some extent the result of less suitable habitat in the more inner areas of Paterson Inlet, the extent to which fishing pressure has determined the relative abundance and size structure of blue cod in the outer areas of the Inlet should become more apparent over time as the marine reserve included as a stratum in the ongoing potting survey time series may be used in a comparative sense.

1. INTRODUCTION

In the South Island, blue cod (*Parapercis colias*) is a particularly desirable finfish that is mostly caught by pot or line from small vessels fishing over reef edges on shingle/gravel or sandy bottoms often close to rocky outcrops (Carbines 2003). The 2000 survey of marine recreational fishing found blue cod to be the third most frequently landed finfish species nationally, and the most frequently landed species in the South Island (Boyd & Reilly 2002). Blue cod caught in the Southland Fisheries Management Area (FMA) BCO 5 account for 14% of all recreational (estimated 1188–2093 t in (Boyd & Reilly 2002), and 60% of all commercial blue cod landings nationally (2452 t in Ministry of Fisheries Science Group 2006). Blue cod is also an important species for Maori customary fishers in all areas, but the catch is unknown.

Tagging experiments reveal that most blue cod have a restricted home range (Rapson 1956, Mace & Johnston 1983, Mutch 1983, Carbines & McKenzie 2004, Carbines 2004a), and stocks of this species largely consist of many independent substocks within each Fisheries Management Area (FMA) (Carbines 2004a). Due to this philopatric behaviour, blue cod are especially susceptible to localised depletion within subareas of FMAs, and in response to local fishing pressure, managed bag limit strategies have been varied among local subareas within all South Island FMAs (Ministry of Fisheries Science Group 2006).

In an aerial survey of Stewart Island, James et al. (2004) found that most of recreational fishing trips were in Paterson Inlet (Figure 1) and trip reports showed that most trips on Stewart Island targeted blue cod. Paterson Inlet has long been prized for its fisheries, and blue cod has always been the main finfish species harvested (Elvy et al. 1997) with an estimated 54% of recreational fishing trips in Paterson Inlet targeting blue cod (Carbines 1998). The Inlet supported a commercial handline fishery from dinghies from the 1920s to the 1950s (Warren et al. 1997), but since 1992 commercial fishing has been prohibited (Elvy et al. 1997). Because of the popularity of recreational fishing for blue cod in Paterson Inlet, and on the recommendation of the Paterson Inlet Working Group, the daily bag limit for blue cod was reduced from 30 to 15 fish per person per day in 1994 (Elvy et al. 1997). In 2004 Paterson Inlet was declared Te Whaka ä Te Wera Mätaitai Reserve and Tangata Tiaki/Kaitiaki further reduced the daily bag limit for blue cod from 15 to 10 fish per person per day in 2006 (Te Rûnanga o Ngâi Tahu 2007). The no-take Ulva Island/Te Wharawhara Marine Reserve was also established in Paterson Inlet around Ulva Island in 2004 (Figure 1).

South Island recreational blue cod stocks are currently monitored using relative abundance/biomass indices and size/age structure generated by standardised potting surveys conducted approximately every third year (Carbines et al. Unpublished results). The Ministry of Fisheries has initiated a network of potting surveys in strategic key recreational fisheries locations and begun a number of time series of relative abundance indices as a means to monitor the status of blue cod stocks and gauge the effectiveness of ongoing management regimes. To date, standardised blue cod potting surveys have been undertaken in the Marlborough Sounds (Blackwell 1997, 1998, 2002, 2005), north Canterbury (Carbines & Beentjes 2006a), Banks Peninsula (Beentjes & Carbines 2003 & 2006), north Otago (Carbines & Beentjes 2006b), and Dusky Sound (Carbines & Beentjies 2003).

With the cooperation of the Te Whaka ä Te Wera Mätaitai Reserve Tangata Tiaki, an initial standardised potting survey was completed in Paterson Inlet (November 2006) to provide the first regionally and temporally comparable blue cod relative abundance index and size/age. It is envisaged that further surveys will be undertaken every third year and a time series of relative abundance indices and size/age structure developed as a means to monitor the status of blue cod in Paterson Inlet. With the cooperation of the Department of Conservation, it was also possible to include the Ulva Island/Te Wharawhara Marine Reserve as an unfished "control" area to both monitor blue cod within the reserve and over time assess the comparative impact of fishing in the remainder of Paterson Inlet.

2. METHODS

2.1 Timing

A potting survey was carried out in Paterson Inlet between 6 and 15 November 2006. November was chosen as blue cod are likely to have begun spawning at this time of year (Rapson 1956, Mutch 1983, Carbines 2004a) and longer daylight hours allow more efficient sampling. Sampling during over the spawning season is consistent with the spring/summer timing of all other blue cod potting surveys (Blackwell 1997, 1998, 2002, 2005, Beentjes & Carbines 2003 & 2006, Carbines & Beentjes 2003, 2006a, 2006b) and provides a better indication of the size at maturity.

2.2 Survey area

The survey area was defined after discussions with local Southland recreational fishers, commercial fishers who previously fished the Inlet[1], the matatai tangata tiaki, Ministry of Fisheries (Dunedin), Department of Conservation (Invercargill), and the South Recreational Advisory Committee. Fishers were given charts of the area and asked to mark discrete locations (possible potting stations) throughout Paterson Inlet where blue cod have commonly been caught. The survey area boundary was defined as inside a line from Ackers Point to Bullers Point and the Inlet was divided arbitrarily into five strata, including Big Glory Bay and the new marine reserve around Ulva Island (Figure 1).

The area of the five strata was chosen so as to contain roughly equal distributions of possible potting stations, and the length of coastline within each stratum was taken as a measure of available habitat for blue cod.

2.3 Survey design

The survey used a two-phase stratified random station design (Francis 1984), adapted to allow for the use of pots (Beentjes & Carbines 2005). Before the survey, a minimum of 10 possible potting stations or sampling sites per stratum were marked on charts as described above. As no previous data are available for Paterson Inlet, an equal sampling allocation was used initially between strata, and five stations per stratum were randomly selected for phase 1, with the condition that they were at least 300 m apart.

The total survey design consisted of 5 strata, 34 stations, and 204 pot sets. In phase 1, about three-quarters of the stations were allocated (74%) and the remainder (26%) allocated to phase 2. Allocation of phase 2 stations was based on the mean catch rate (kg per pot per hour) of all blue cod per stratum and optimised using the "area mean squared" method of Francis (1984). In this way, stations were assigned iteratively to the stratum in which the expected gain is greatest, where expected gain is given by:

$$expected\ gain_i = area_i^{\,2}\ mean_i^{\,2} / (n_i(n_i+1))$$

where for the ith stratum $mean_i$ is the mean catch rate of blue cod per pot, $area_i$ is the size of the stratum (length of coastline), and n_i is the number of pots. At each station, pots were always allocated in groups of six which equates to one set.

[1] Before the exclusion of commercial fishing as part of the Paterson Inlet Fisheries Plan (1 October 1994).

2.4 Vessel and gear

The survey was conducted from *Golden Bay* (registration number 6097), a Stewart Island based commercial vessel equipped to set and lift rock lobster and blue cod pots. The vessel was chartered and skippered by the owner. The vessel specifications are: 12 m length, 3 m breadth, 12 t, fibreglass monohull, powered by a 127 hp 6LXB Gardner diesel engine with propeller propulsion.

Six custom designed and built cod pots were used on the survey. Pot specifications are: length 1200 mm, width 900 mm, depth 500 mm, synthetic inner mesh, 30 mm diameter; 50 mm cyclone wire outer mesh, 4 entrances. Pots were marked with a number from 1 to 6, and baited with paua guts. These pots are the same as those used to survey Banks Peninsula in 2002 and 2005 (Beentjes & Carbines 2003, 2006), Dusky Sound in 2002 (Carbines & Beentjes 2003), North Canterbury in 2004—05 (Carbines & Beentjes 2006a), and north Otago in 2005 (Carbines & Beentjes 2006b).

2.5 Sampling methods

At each station six pots were set and left to fish (soak) for 1 h during daylight hours. Soak time was standardised with all previous potting surveys in the Marlborough Sounds (Blackwell 1997, 1998, 2002), Banks Peninsula (Beentjes & Carbines 2003, 2006), Fiordland (Carbines & Beentjes 2003), north Canterbury (Carbines & Beentjes 2006a), and north Otago (Carbines & Beentjes 2006b). The six pots were set in clusters, separated by at least 100 m. Once on station, the position of each of the six pots was determined by the skipper using local knowledge and the vessel sounder to locate an area of foul ground. After a station was completed (six pot lifts) the next closest randomly selected station in the stratum was fished. For logistical reasons no allowance could be made for time of day or tides. The order that strata and stations were surveyed was dependent on the prevailing weather conditions.

As each pot was set, a record was made on customised forms of pot number, latitude and longitude from GPS, depth, time of day, and standard trawl survey physical oceanographic data[2], including wind direction, wind force, air temperature, air pressure, cloud cover, sea condition, sea colour, swell height, swell direction, bottom type, bottom contour, sea surface temperature, sea bottom temperature, wind speed, and water visibility (secchi depth).

After 1 h pots were lifted aboard using the vessel's hydraulic pot lifter, emptied, and the contents sorted by species. Total weight per pot was recorded for each species to the nearest 10 g using 5 kg Seaway scales. The number of individuals of each species per pot was also recorded.

For all blue cod, total length rounded down to the nearest centimetre was measured. However, due to concerns raised by the Te Whaka ä Te Wera Mätaitai Reserve Tangata Tiaki sex was not determined for all fish (a terminal procedure) as in other surveys (Blackwell 1997, 1998, 2002, Beentjes & Carbines 2003, 2006, Carbines & Beentjes 2003, Carbines & Beentjes 2006 a & b); instead, most (75%) were returned to the water alive and unsexed. As a condition of the Department of Conservation permit to fish in the Ulva Island/Te Wharawhara Marine Reserve (stratum 3) no fish were dissected, and in this stratum all blue cod were measured and returned to the water alive and unsexed. The survival of returned pot-caught blue cod is expected to be near total (Carbines 1999). Sex ratios were determined from 25% of fish randomly collected over the available size range (15 to 47 cm) by dissecting gonads for macroscopic examination (Carbines 2004a). Gonads were recorded as one of five stages as follows: 1, immature or resting; 2, maturing (oocytes visible in females); 3, mature (hyaline oocytes in females, milt expressible in males); 4, running ripe (eggs and milt free flowing); 5, spent. Blue cod were taken for dissection from throughout the Inlet (excluding the marine reserve) and 14% of all fish (up to five fish of each sex per 1 cm size class) were also weighed to the nearest 10 g and the sagittal otolith removed (rinsed with water, air-dried, and stored in paper envelopes).

[2] This is the first blue cod survey to record standard trawl survey physical oceanographic data.

2.6 Data analysis

To allow comparisons of relative abundance among blue cod surveys in FMAs with different minimum legal size (MLS) limits, catch rates were analysed separately for three size classes. For each stratum and all strata combined: catch rates for all blue cod, blue cod 30 cm and over (BCO 3 minimum legal size (MLS) – east coast South Island) and blue cod 33 cm and over (local MLS, BCO 5 - Southland), were estimated as the mean kilograms per pot per hour. Coefficients of variation (c.v.) for each stratum were determined from:

$$cv_i = se_i / mean_i$$

where for the ith stratum se_i is the standard error, and $mean_i$ is the mean catch rate (kg per pot per hour) .

The overall weighted mean catch rate for all strata was determined by weighting each stratum mean by the stratum coastline length ($area_i$) divided by the sum of all strata coastline length ($area_{total}$).

$$mean_{overall} = \Sigma((mean_i * area_i)/area_{total})$$

The overall weighted mean standard error of the means was determined by squaring each standard error times its weighting, summing them, and then taking the square root.

$$se_{overall} = SQRT\ (\Sigma(se_i(area_i/area_{total}))^2)$$

The overall coefficient of variation for the survey was then determined from the overall mean and standard errors providing a weighted c.v.

$$cv_{overall} = se_{overall} / mean_{overall}$$

Length frequencies for blue cod are presented by individual stratum and all strata combined. Length frequency data were not scaled as the area fished by a pot is unknown. Mean length was calculated for individual strata and overall for all strata combined.

The length-weight relationship was determined from the linear regression model ln W = b(ln L) + ln a, where W = weight (g), L = length (cm), a and b are the regression coefficients. Weights of individual blue cod 30 cm and over (MLS in BCO 3) and individual blue cod 33 cm and over (local MLS in BCO 5) were calculated from the length-weight relationship (see Results). Individual fish weights were used to determine catch rates of blue cod 30 and 33 cm and over.

2.7 Otolith preparation and reading

During the survey the largest pair of otoliths, the sagittae, were removed from a total of 235 fish, the target being up to five fish of each sex per 1-cm size class over the available length range (15–47 cm). Due to the small size of blue cod otoliths, the most precise method for ageing is the thin section technique (Carbines 2004b). Collected otoliths were embedded in Araldite polymer resin and sectioned to about 0.5 mm thickness along the transverse plane with a diamond-tipped cut-off wheel. To remove saw marks, sections were sanded with 600-grit sandpaper and the coated with a slide mountant before viewing. Sections were observed at x40 and x100 magnification under transmitted light with a compound microscope.

Sections exhibit alternating opaque and translucent zones and age estimates are made by counting the number of annuli (opaque zones) from the core to the distal edge of the section, a technique previously validated by Carbines (2004b). Translucent zones are used to define each complete opaque zone, i.e., annuli are counted only if they have a translucent zone on both sides. The readability of each otolith was also graded from 1 (excellent) to 5 (unreadable). Otoliths were read independently by two experienced readers (G. Carbines & D. Kater). Where counts differed, readers consulted to resolve the final age estimate.

2.8 Catch at age

An age-length key was used to calculate the age structure of catches of blue cod within Paterson Inlet using the method described by Davies & Walsh (1995). Proportional age frequency for blue cod is presented by individual stratum and all strata combined. Age frequency data were not scaled as the area fished by a pot is unknown. Mean age was calculated for individual strata and overall for all strata combined. An estimate of total mortality was determined from catch curve analysis (Ricker 1975) of the overall Paterson Inlet proportional age frequency distribution.

3. RESULTS

3.1 Stations surveyed

Thirty-four stations (= sets) were surveyed (6 pots per station = 204 pot lifts) in five strata throughout Paterson Inlet between 6 and 15 November 2006 (Table 1, Figure 1, Appendix 1). Of the 34 stations, 25 were carried out in phase 1 (5 per stratum) and 9 allocated throughout strata 1(3), 2(2), 3(1), 4(2), and 5(1) in phase 2. Depth ranged from about 2 to 33 m.

3.2 Catch

A total of 1075 kg of catch was taken on the survey, of which 950 kg (88%) was blue cod, consisting of 1638 fish (Table 2). Bycatch included seven fish species, the most common of which were spotties (*Notolabrus celidotus*) and banded wrasse (*Notolabrus fucicola*) (Table 2).

Mean catch rates of all blue cod (Table 3), those 30 cm and over (MLS – BCO 3, Table 4), and those 33 cm and over (MLS – BCO 5, Table 5) were all highest in the two outermost seaward strata (Strata 3 and 4). However, for blue cod 33 cm and over (local MLS – BCO 5) mean catch rate was highest in the marine reserve stratum 3 (Table 5). The overall survey mean catch rate and c.v. for all blue cod was 4.99 kg per pot lift/hour and 8.40% respectively (Table 3). Catch rates ranged from 1.47 kg per pot per hour in the Big Glory Bay stratum to 8.42 kg per pot per hour for the outermost stratum at the entrance to Paterson Inlet (Figure 1). For blue cod 30 cm total length and over, the overall catch rate and c.v. was 3.86 kg per hour and 7.79% (Table 4). Proportional catch rates by strata of blue cod 30 cm and over mirrored those of all fish, ranging from 1.38 to 5.62 kg per hour (Table 4). For blue cod 33 cm total length and over the overall mean catch rate and c.v. was 3.14 kg per hour and 9.56% (Table 5). Catch rates of legal sized fish were highest in the marine reserve stratum at 4.68 kg per hour, and lowest in the Big Glory Bay stratum at 1.36 kg per hour.

3.3 Biological and length frequency data

Of the 1638 blue cod caught on the survey, all were measured for length, 406 were dissected and sexed (72% males), and otoliths were taken from 134 males (15–47 cm) and 94 females (15–37 cm). Sex ratio ranged from 83% males from the innermost stratum 1, to 51% males in the northernmost stratum 2 (Table 6).

Forty-three percent of all blue cod caught exceeded the BCO 5 minimum legal size (33 cm and over) and 61% exceeded the BCO 3 minimum legal size of 30 cm and over (Figures 2 & 3). Size ranged from 15 to 47 centimetres total length, with an overall average length of 31.54 cm for the total survey area. While the marine reserve stratum (See Figure 1) contained proportionally more large fish, the three most inner strata of Paterson Inlet had similar length frequency distributions with average length constrained between 32.87 and 33.89 cm. By comparison, blue cod from the outermost seaward strata were smaller (mean 29.15 cm) and blue cod from the Big Glory Bay stratum were larger (mean 35.31 cm) (Figure 2).

Of the 406 blue cod dissected, 59% had mature stage gonads and 12% were running ripe (Table 7). As only one female was recorded as spent it, appears that spawning was only beginning in Paterson Inlet at the time of the survey in early November 2006 (Table 7). Only fish which had otoliths removed were weighed (14%) and length-weight parameters were derived for males (n = 108, a = 0.00703, b = 3.2208 and R^2 = 0.99), females (n = 69, a = 0.00814, b = 3.1824 and R^2 = 0.98) and both sexes pooled (n = 177, a = 0.00782, b = 3.192 and R^2 = 0.99).

3.4 Age frequency data

Age frequency distributions were derived from a length frequency and age-length key (n = 228) approach. Otolith samples were collected throughout the potting stations of all strata except the marine reserve (Appendix 3). The overall survey-derived age ranged from 3 to 13 years old with an average age and mean weighted cumulative variance (c.v.) of 7.58 years old and 18.79% (Figure 4). The three most inner strata of Paterson Inlet had most similar age frequency distributions, with the average age and c.v. ranging from 7.96 to 8.25 years old and 21.98% to 22.91% respectively (Figure 5). By comparison, blue cod from the outermost stratum (4) were younger (mean 6.88 years, c.v. 17.89%) and blue cod from the Big Glory Bay stratum were older (mean 8.64 years, c.v. 28.88%).

Setting recruitment at 8 years, a total mortality rate of 0.52 was derived from the overall age frequency distribution of Paterson Inlet (See Figure 4) using standard catch curve analysis (Ricker 1975).

3.5 Environmental data

This is the first blue cod potting survey to collect standard Ministry of Fisheries environmental data (trawl database) at every station (Appendix 2). Although several environmental variables are correlated with each other (e.g., depth is significantly correlated with wind direction, cloud cover, swell direction ($p<0.05$) and sea colour ($p<0.01$)), a simple correlation matrix was used as an initial indicator of important variables determining blue cod catch (Table 8). The catch rate of blue cod (both number and weight) was positively correlated with depth, bottom type, and bottom contour, and negatively correlated with the number and weight of *Notolabrus celidotus*, wind direction, cloud cover, sea condition, sea colour, swell direction, and wind speed (Table 8). For blue cod weight the Pearson correlation coefficient was statistically significant for depth ($p<0.05$) and sea colour ($p<0.01$). For blue cod numbers the Pearson correlation coefficient was statistically significant for bottom type and wind direction at $p<0.05$; and for depth, sea colour, and swell direction at $p<0.01$. Tidal height or tidal phase (derived from tide charts) were only weekly correlated (negatively) with the number and weight of *Notolabrus celidotus* ($p<0.1$).

4. DISCUSSION

The results of this survey provide the first standardised potting relative abundance/biomass index of blue cod in Paterson Inlet (See Figure 1). The overall c.v. of 8.40% for all blue cod is remarkable given that no previous surveys could be used to optimise allocation of stations (See Table 3). The mean catch rates varied among strata, but generally declined with increased penetration into the Inlet (i.e., distance from the sea). Catches were highest in the outermost seaward stratum (4) for both total blue cod and 30 cm and over blue cod (Tables 3 and 4), whereas the mean catch rate of legal size blue cod (33 cm and over, Table 5) was marginally higher in the marine reserve stratum (3) around Ulva Island (See Figure 1).

With any fishing method there is potential selectivity bias so that size and species composition from potting may differ from other methods such as trawling (Furevik 1994) or line fishing (Blackwell 2002, 2005, Carbines 1999). While bait type and soak time are standardised in all blue cod potting surveys, other factors such as inter- and intra-species interactions, fish behaviour, pot interference, and features of the environment can also be important in passive capture methods such as potting (Whitelaw et al. 1991, Furevik 1994, Fogarty & Addison 1997, Robichaud et al. 2000). Cole et al. (2001) found blue cod catch rates unrelated to both time and tide in the Marlborough Sounds, but there may be potential for tide to affect the selectivity of potting in some areas (Warren et al. 1997). Paterson Inlet is the first blue cod survey to record environmental variables, and initial results indicate that neither tidal height nor tidal phase (derived from tide charts) were correlated with blue cod catch by weight or numbers (Table 8). However, future surveys might consider measuring actual current flow to determine if this is an important environmental variable affecting catch rates in each survey area.

Environment data collected at each potting station showed a strong positive effect of depth on blue cod numbers and weight (Table 8). However, as depth was also significantly correlated with several other environmental variables, including cloud cover and sea colour, a multivariate analysis of environmental variables may be a better approach to examine their effect on blue cod catchability. However, a multivariate approach should be employed once environmental variables have been collected from all survey areas currently monitored for blue cod by the Ministry of Fisheries.

Pots appear to be selective for blue cod over 15 cm (See Figure 2) (Cole et al. 2001, 2003, Carbines 2004a) and under-sample small blue cod compared to diver transects (Cole et al. 2001, 2003). At a localised scale, Cole et al. (2001) found a positive but weak relationship between blue cod catch from pots and diver transects. However Beentjes & Carbines (2005) considered potting to be a suitable method at the larger spatial scale of a potting survey. Potting surveys appear to provide a good tool for monitoring relative biomass indices of blue cod within each of the surveyed areas, but populations may grow at different rates (Carbines 2004a) and local features of the environment (hence catchability) may also differ and make it difficult to undertake formal statistical comparisons between survey areas. However, as all previous blue cod potting surveys (with the exception of Banks Peninsula) have been restricted to the spring to summer months of the protracted spawning period (Rapson 1956, Mutch 1983, Carbines 2003) it is possible to make some general comparisons (Table 9). In a simple ranking of South Island blue cod surveys the relative abundance indices of blue cod in Paterson Inlet were higher than in the Marlborough Sounds, Kaikoura, and Dusky Sound, similar to Banks Peninsula (2005), and considerably lower than in Motunau and north Otago (Table 9). The average size of blue cod in Paterson Inlet was also greater than in the Marlborough Sounds, Motunau, and inshore Banks Peninsular, similar to north Otago, and smaller than in Kaikoura, Dusky Sound, and offshore Banks Peninsula (Table 9).

Survey catch rates do not provide any indication of the level of depletion before each survey series. However, age structure provides a further tool to gauge exploitation rate. In a simple ranking of South Island blue cod surveys the average age of blue cod in Paterson Inlet (See Figure 4) was older than in the Marlborough Sounds, Motunau, inshore Banks Peninsula, and north Otago, similar to Dusky Sound, and younger than in Kaikoura and offshore Banks Peninsula (Table 9). A relatively high estimate of total mortality was derived from the overall proportional age frequency distribution of Paterson Inlet using catch curve analysis (Ricker 1975). Ranked against other surveyed areas the estimate of total mortality for Paterson Inlet blue cod was only lower than in the Marlborough Sounds and Motunau, similar to inshore Banks Peninsula, and considerably higher than in Kaikoura, offshore Banks Peninsula, north Otago, and Dusky Sound (Table 9).

While not considered an "at risk" fishery such as the Marlborough Sounds and possibly inshore Banks Peninsula (Carbines et al. Unpublished results), Paterson Inlet appears to be a vulnerable fishery with comparably high total mortality and only average relative abundance indices (Table 9). The results of this survey support the need for recent reductions in the daily bag limits of blue cod in Paterson Inlet (Te Rûnanga o Ngâi Tahu 2007). Differences in relative abundance seen among strata of Paterson Inlet may to some degree be the result of less suitable habitat in the inner areas of the Inlet (See Figure 1, strata 1 and 5). However, the extent to which fishing pressure influences the relative abundance and population structure of blue cod in the outer areas of Paterson Inlet (See Figure 1, strata 2–4) should become more apparent over time with the new marine reserve (established 2004) acting as a no-take control area in the ongoing blue cod potting survey time series of Paterson Inlet.

5. ACKNOWLEDGMENTS

This research was carried out by NIWA under contract to the Ministry of Fisheries (MFish Project BCO2005/02). Thanks to Gareth Hamilton for a providing vessel and skipper to undertake the survey. Thanks also to Derck Kater, Cameron Walsh, Mike Beentjes and Evan Baddock for their contributions. Thanks to Stephen Parker for reviewing the manuscript, and Mike Beardsell for editorial comments.

6. REFERENCES

Beentjes, M.P.; Carbines, G.D. (2003). Abundance of blue cod off Banks Peninsula in 2002. *New Zealand Fisheries Assessment Report 2003/16.* 25 p.

Beentjes, M.P.; Carbines, G.D. (2005). Population structure and relative abundance of blue cod (*Parapercis colias*) off Banks Peninsula and in Dusky Sound, New Zealand. *New Zealand Journal of Marine and Freshwater Research 39*: 77–90.

Beentjes, M.P.; Carbines, G.D. (2006). Abundance of blue cod off Banks Peninsula in 2005. *New Zealand Fisheries Assessment Report 2006/1.* 24 p.

Blackwell, R.G. (1997). Abundance, size composition, and sex ratio of blue cod in the Marlborough Sounds, September 1995. *NIWA Technical Report 88.* 52 p.

Blackwell, R.G. (1998). Abundance, size and age composition, and yield–per–recruit of blue cod in the Marlborough Sounds, September 1996. *NIWA Technical Report 30.* 47 p.

Blackwell, R.G. (2002). Abundance, size and age composition of recruited blue cod in the Marlborough Sounds, September 2001. Final Research Report for Ministry of Fisheries Project BCO2001/01. (Unpublished report held by Ministry of Fisheries, Wellington.)

Blackwell, R.G. (2005). Abundance and size composition of recruited blue cod in the Marlborough Sounds, September 2005. Final Research report for the Ministry of fisheries Research Project BCO2003/01. (Unpublished report held by Ministry of Fisheries, Wellington.)

Boyd, R.O.; Reilly, J.L. (2002). 1999/2000 National marine recreational fishing survey: harvest estimates. Final Research Report for Ministry of Fisheries Research Project REC9803. (Unpublished report held by Ministry of Fisheries, Wellington.)

Carbines, G.D. (1998). Estimation of recreational catch and effort in Paterson Inlet from a diary survey. Final Research Report for Ministry of Fisheries Research Project REC9704. Objectives 1 & 2. (Unpublished report held by Ministry of Fisheries, Wellington.)

Carbines, G.D. (1999). Large hooks reduce catch-and-release mortality of blue cod *Parapercis colias* in the Marlborough Sounds of New Zealand. *North American Journal of Fisheries Management. 19*: 992–998.

Carbines, G. (2003). Blue cod. Chapter 23 (pp. 182–185). In: Andrew, N.; Francis, M. (eds). The living reef. The ecology of New Zealand's rocky reefs. Craig Potton Publishing, Nelson.

Carbines, G. (2004a). Age, growth, movement and reproductive biology of blue cod (*Parapercis colias*–Pinguipedidae): Implications for fisheries management in the South Island of New Zealand. Unpublished Ph.D. thesis, University of Otago, Dunedin, New Zealand. 224 p.

Carbines, G. (2004b). Age determination, validation, and growth of blue cod, *Parapercis colias*, in Foveaux Strait, New Zealand. *New Zealand Journal of Marine and Freshwater Research.38*: 201–214.

Carbines, G. D.; Beentjes, M. P. (2003). Relative abundance of blue cod in Dusky Sound in 2002. *New Zealand Fisheries Assessment Report 2003/37*. 25 p.

Carbines, G.; Beentjes, M.P. (2006a). Abundance of blue cod in north Canterbury in 2004 and 2005. *New Zealand Fisheries Assessment Report 2006/30*. 26 p.

Carbines, G.; Beentjes, M.P. (2006b). Abundance of blue cod in north Otago in 2005. *New Zealand Fisheries Assessment Report 2006/29*. 20 p.

Carbines, G. D.; McKenzie, J. (2004). Movement patterns and stock mixing of blue cod in Dusky Sound in 2002. *New Zealand Fisheries Assessment Report 2004/36*. 28 p.

Cole, R.G.: Tindale, D.S.; Blackwell, R.G. (2001). A comparison of diver and pot sampling for blue cod (*Parapercis colias*: Pinguipedidae). *Fisheries Research 52*: 191–201.

Cole, R.G.; Alcock, N.K. Hadley, S.L; Grange, K.R.; Black, S.; Cairney, D.; Day, J: Ford, S.; Jerret, A.R. (2003). Selective capture of blue cod *Parapercis colias* by potting: behavioral observations and effects of capture method on peri-mortem fatigue. *Fisheries Research 60*: 381–392.

Davies, N.M.; Walsh, C. (1995). Length and age composition of commercial snapper landings in the Auckland Fishery Management Area 1988–94. *New Zealand Fisheries Data Report No.58*. 85 p.

Elvy, D; Teirney, L.; Suter, H. (1997). Paterson Inlet Fisheries Plan. Paterson Inlet Fisheries Working Group Report. 37 p. Unpublished report held by the Ministry of Fisheries, Dunedin, New Zealand.

Fogarty, M.J.; Addison, J.T. (1997). Modelling capture processes in individual traps: entry, escapement and soak time. *ICES Journal of Marine Science 54*: 193–205.

Francis, R.I.C.C. (1984). An adaptive strategy for stratified random trawl surveys. *New Zealand Journal of Marine and Freshwater Research 18*: 59–71.

Furevik, D. 1994. Behaviour of fish in relation to pots. In: Ferno, A.; Olsen, S (eds) Marine fish behaviour in capture and abundance estimation. United States, Fishing News Books. pp 28-44.

James, G.D.; Unwin, M.J.; Carbines, G. 2004. Stewart Island Marine Recreational Fishing Survey 2002/2003. Final Research Report for Ministry of Fisheries Project REC2001/04. 20 p.

Mace, J.T.; Johnston, A.D. (1983). Tagging experiments on blue cod (*Parapercis colias*) in the Marlborough Sounds, New Zealand. *New Zealand Journal of Marine and Freshwater Research 17*: 207–211.

Ministry of Fisheries, Science Group (comps.) (2006). Report from the Fishery Assessment Plenary, May 2006: stock assessments and yield estimates. 875 p. (Unpublished report held in NIWA library, Wellington.)

Mutch, P.G. (1983). Factors influencing the density and distribution of the blue cod (*Parapercis colias*) (Pisces: Mugilodae). Unpublished MSc Thesis, University of Auckland, New Zealand. 76 p.

Rapson, A.M. (1956). Biology of the blue cod (*Parapercis colias* Forster) of New Zealand. Unpublished PhD thesis, Victoria University, Wellington, New Zealand. 103 p.

Ricker, W.E. (1975). Computation and interpretation of biological statistics of fish populations. *Bulletin of the Fisheries Research Board of Canada. 191*: 29–73.

Robichaud , D; Hunte, W.; Chapman, M.R. (2000). Factors affecting the catchability of reef fishes in antillean fish traps. *Bulletin of Marine Science 67(2)*: 831–844.

Te Rûnanga o Ngâi Tahu (2007). *Te Whaka a Te Wera Mâtaitai Management Plan.* Unpublished report held by Toitû Te Whenua Te Rûnanga o Ngâi Tahu, Christchurch, New Zealand.

Warren, E.; Grindley, R.; Carbines, G.; Teirney, L. (1997). Characterisation of the Southland blue cod fishery (1991–1996). 38 p. (Unpublished report held by Ministry of Fisheries, Dunedin.)

Whitelaw, A.W; Sainsbury, K.J; Dews, G.J; Campbell, R.A. (1991). Catching characteristics of four fish-trap types on the North West Shelf of Australia. *Australian Journal of Marine and Freshwater Research 42*: 369–382.

Table 1: Stratum coastline length, number of phase 1 and 2 stations, pot lifts, and depth.

Stratum	Size of strata (coastline km)	Number of sets		Number of pot lifts	Depth (m)	
		Phase 1	Phase 2		Mean	Range
1	22.1	5	3	48	5.8	4–9
2	44.5	5	2	42	6.8	4–15
3	24.9	5	1	36	7.9	4–16
4	40.8	5	2	42	12.6	4–33
5	24.8	5	1	36	6.3	2–17
Total	156.3	25	9	204	7.9	2–33

Table 2: Catch weights and numbers of species caught on the survey and percentage of total weight.

Common name	Scientific name	Catch (kg)	Number	Percent of catch (kg)
Blue cod	*Parapercis colias*	950.12	1638	88.40
Spotty	*Notolabrus celidotus*	102.4	965	9.53
Banded wrasse	*Notolabrus fucicola*	9.88	16	0.92
Conger eel	*Conger verreauxi*	5.59	1	0.52
Scarlet wrasse	*Pseudolabrus miles*	2.95	14	0.27
Girdled wrasse	*Notolabrus cinctus*	1.86	3	0.18
Trumpeter	*Latris lineata*	1.68	4	0.16
Leatherjacket	*Parika scaber*	0.30	2	0.03

Table 3: Mean catch rate, standard error, and c.v. per stratum and overall for all blue cod (n = 1638).

Stratum	Pot lifts (N)	Mean (kg/lift)	s.e.	c.v. (%)
1	48	3.12	0.50	16.12
2	42	4.13	0.60	14.62
3	36	6.11	1.13	18.51
4	42	8.42	1.25	14.80
5	36	1.47	0.49	33.19
Overall	204	4.99	0.42	8.40

Table 4: Mean catch rate, standard error, and c.v. per strata and overall for blue cod 30 cm and over (minimum legal size BCO 3) (n = 1011).

Stratum	Pot lifts (N)	Mean (kg/lift)	s.e.	c.v. (%)
1	30	2.90	0.42	14.61
2	60	3.30	0.50	15.03
3	42	5.31	0.96	18.12
4	30	5.62	0.77	13.62
5	42	1.38	0.45	32.15
Overall	204	3.86	0.30	7.79

Table 5: Mean catch rate, standard error, and c.v. per strata and overall for blue cod 33 cm and over (minimum legal size BCO 5) (n =717).

Stratum	Pot lifts (N)	Mean (kg/lift)	s.e.	c.v. (%)
1	48	2.32	0.42	18.19
2	42	2.85	0.50	17.42
3	36	4.68	0.96	20.54
4	42	4.06	0.77	18.84
5	36	1.36	0.45	32.77
Overall	204	3.14	0.30	9.56

Table 6: Mean lengths of blue cod by strata and sex: m, male; f, female; u, unsexed.

Strata	Sex	N	Mean length (cm)
1	m	54	33.2
	f	11	29.8
	u	198	33.3
	Total	263	33.1
2	m	29	30.5
	f	28	28.7
	u	178	35.1
	Total	235	33.7
3	m	0	-
	f	0	-
	u	312	34.1
	Total	312	34.1
4	m	159	33.4
	f	56	28.2
	u	543	28.3
	Total	758	29.4
5	m	52	37.7
	f	17	28.8
	u	1	33.0
	Total	70	35.5
Overall	m	294	33.8
	f	112	28.6
	u	1232	31.8
	Total	1638	31.8

Table 7: Gonad stages of blue cod. 1, immature or resting; 2, maturing (oocytes visible in females); 3, mature (hyaline oocytes in females, milt expressible in males); 4, running ripe (eggs and milt free flowing); 5, spent.

	Gonad stage (%)					
	1	2	3	4	5	N
Males	0.7	34.4	52.4	12.6	0.0	294
Females	1.8	8.9	76.8	11.6	0.9	112

Table 8: Correlation matrix of station environmental variables (see Appendix 2) and standardised station catch rate (per hour per six pot lifts) for blue cod (BCO) and *Notolabrus celidotus* (STY) weight and numbers. Tide height and tide phase are derived from the thirty minutes after the set time of the third pots set (Appendix 1). Tide phase is defined as either being one hour either side of slack water (zero) or during the tide (1).

	Set No.	BCO Weight	BCO No.	STY Weight	STY No.	Stratum No.	Bottom Depth	Wind Direct	Wind Force	Air Temp	Air Pressur	Cloud Cover	Sea Condit	Sea Color	Swell Height	Swell Direct	Bottom Type	Bottom Cont	Surf Temp	Bottom Temp	Wind Speed	Secchi Depth	Tide Hight	Tide Phase
Set no.	1.000																							
BCO weight	0.106	1.000																						
BCO no.	0.077	0.929	1.000																					
STY weight	0.066	-0.225	-0.283	1.000																				
STY no.	-0.060	-0.240	-0.263	0.919	1.000																			
Stratum no.	-0.182	0.096	0.150	-0.026	0.081	1.000																		
Bottom depth	0.064	0.377	0.586	-0.517	-0.439	0.308	1.000																	
Wind direction	0.118	-0.283	-0.374	0.052	0.006	-0.219	-0.368	1.000																
Wind force	0.055	-0.093	-0.134	-0.042	-0.069	-0.147	0.068	0.115	1.000															
Air temp	0.443	0.193	0.128	0.235	0.104	-0.325	-0.024	-0.119	0.140	1.000														
Air pressure	-0.241	0.094	0.174	-0.049	-0.104	-0.336	0.084	-0.343	0.010	0.417	1.000													
Cloud cover	-0.156	-0.211	-0.333	-0.104	0.015	-0.312	-0.373	0.433	-0.064	-0.293	-0.283	1.000												
Sea condition	0.001	-0.261	-0.256	-0.175	-0.196	-0.406	-0.029	0.137	0.514	-0.065	0.109	0.149	1.000											
Sea colour	-0.069	-0.468	-0.543	0.237	0.175	-0.096	-0.454	0.302	0.006	0.076	0.051	0.255	-0.212	1.000										
Swell height	0.000	-0.064	-0.096	0.212	0.079	-0.154	-0.069	0.085	0.365	0.172	0.094	-0.130	0.297	0.019	1.000									
Swell direction	-0.084	-0.320	-0.469	0.241	0.176	-0.195	-0.421	0.228	0.050	0.187	-0.039	0.369	-0.058	0.635	0.062	1.000								
Bottom type	-0.366	0.254	0.376	0.096	0.113	0.148	0.173	-0.215	-0.138	-0.400	0.119	-0.150	-0.048	-0.164	0.097	-0.431	1.000							
Bottom contour	-0.051	0.190	0.242	0.008	-0.070	0.222	0.308	-0.169	-0.018	0.223	0.219	-0.355	-0.273	-0.023	-0.225	-0.004	-0.023	1.000						
Surface temp	-0.082	0.201	0.130	0.014	0.095	-0.113	-0.313	-0.284	-0.175	0.180	0.209	0.158	0.048	-0.025	0.008	0.024	0.137	-0.306	1.000					
Bottom temp	-0.103	0.176	0.076	0.308	0.233	-0.194	-0.203	-0.399	-0.032	0.468	0.465	-0.223	0.015	-0.093	0.017	0.275	-0.085	0.303	0.272	1.000				
Wind speed	-0.061	-0.190	-0.231	-0.017	-0.051	-0.134	0.042	0.232	0.925	0.059	-0.017	-0.041	0.502	0.091	0.367	0.120	-0.168	0.052	-0.372	-0.071	1.000			
Secchi depth	-0.227	0.189	0.317	-0.323	-0.276	0.040	0.368	-0.169	0.133	0.043	0.303	-0.316	-0.185	-0.020	-0.042	-0.203	0.186	0.216	-0.153	0.018	0.195	1.000		
Tide hight	0.073	0.019	0.041	-0.304	-0.252	0.013	0.124	-0.082	-0.220	-0.065	0.047	-0.101	0.039	-0.031	-0.212	-0.052	-0.163	-0.055	0.198	0.102	-0.256	-0.189	1.000	
Tide phase	0.082	0.006	-0.067	0.121	0.136	0.068	-0.325	0.187	-0.019	0.060	-0.108	-0.146	-0.068	-0.057	-0.077	-0.185	-0.177	-0.332	0.171	-0.050	0.000	0.071	0.046	1.000

Table 9: Summary statistics from standardized blue cod potting surveys done throughout the South Island. Presented for each survey (including subareas of the Marlborough Sounds and Banks Peninsula) is the reference source, mean size and age of female and male blue cod caught. The relative abundance indices (mean kg per pot per hour, CV in parentheses) are given for all sizes of blue cod in the top line and recruited blue cod (defined as the BCO 3 legal size, 30 cm and over) in brackets in the bottom line. The strata range of abundance indices is given for the survey area/subareas (all fish top and recruited fish below), the average total mortality (from 5—8 year olds) (CV).

Area/Year (Reference source)	Mean length Female	Mean length Male	Mean age Female	Mean age Male	Abundance indices kg/h (CV)	Indices strata range kg/h	Mean mortality Z (CV)
Marlborough Sounds September 2001 (Blackwell 2002)					1.6 (7.0 %) [1.1 (7.0 %)]	0.2 – 5.9 [0.1 – 4.5]	0.54 (16 %)
— D'Urville Island	27.3	30.5	7.2	7.2	not reported	5.9 [4.5]	0.47 (33 %)
— Pelorus Sound	22.3	27.8	3.9	4.9	not reported	0.2 - 1.5 [0.1 – 1.0]	0.84 (23 %)
— Queen Charlotte Sound	24.2	28.7	4.4	5.4	not reported	0.6 - 1.7 [0.4 – 1.2]	0.50 (23 %)
Marlborough Sounds September/October 2004 (Blackwell 2005)					1.6 (5.8 %) [0.8 (6.6 %)]	0.3 – 4.7 [0.0 – 2.8]	0.71 (15 %)
— D'Urville Island	27.9	30.8	6.8	6.9	not reported	4.0 - 4.7 [0.0 – 2.8]	0.55 (22 %)
— Pelorus Sound	23.6	28.2	4.5	4.8	not reported	0.3 - 3.0 [0.1 – 1.8]	0.81 (23 %)
— Queen Charlotte Sound	24.4	28.6	5.8	5.8	not reported	0.4 - 2.0 [0.2 – 1.1]	0.94 (23 %)
Kaikoura December 2004 (Carbines & Beentjes 2006a)	31.2	33.4	8.9	8.1	2.6 (8.7 %) [1.9 (7.9 %)]	0.60 – 8.0 [0.3 – 7.5	0.28 (25 %)
Motunau February 2005 (Carbines & Beentjes 2006a)	25.6	29.1	5.3	4.3	10.2 (7.3 %) [6.0 (9.8 %)]	8.7 - 15.4 [3.2 – 7.5]	0.62 (27 %)
Banks Peninsula January/April 2002 (Beentjes & Carbines 2003)					2.1 (10.8 %) [1.6 (13.2 %)]	0.0 – 4.7 [0.0 – 4.2]	0.26 (33 %)
— Inshore	25.3	28.3	4.9	5.5	not reported	0.0 - 2.6 [0.0 – 1.2]	0.70 (35 %)
— Offshore	36.6	37.7	10.9	10.5	not reported	2.0 - 4.7 [1.8 – 4.2]	0.15 (47 %)
Banks Peninsular April/May 2005 (Beentjes & Carbines 2006)					4.4 (5.7 %) [4.0 (7.0 %)]	1.0 – 7.3 [0.8 – 7.3]	0.27 (26 %)
— Inshore	27.1	32.7	5.4	6.7	not reported	1.0 - 4.2 [0.8 -3.2]	0.51 (25 %)
— Offshore	37.3	41.2	9.0	11.4	not reported	5.7 - 7.3 [5.2 – 7.3]	0.17 (45 %)
North Otago January 2005 (Carbines & Beentjes 2006b)	27.9	32.9	6.1	7.2	10.1 (5.4 %) [8.2 (5.3 %)]	7.5 - 14.5 [5.4 – 11.7]	0.41 (22 %)
Dusky Sound October 2002 (Carbines & Beentjes 2003)	30.1	34.7	6.9	7.6	2.7 (6.7 %) [2.2 (7.2 %)]	1.3 - 8.4 [0.81 – 5.5]	0.22 (18 %)
Paterson Inlet November 2007	28.6	38.3	7.6		5.0 (8.4 %) [3.9 (7.8%)]	1.47 - 8.42 [1.4 – 5.6]	0.52

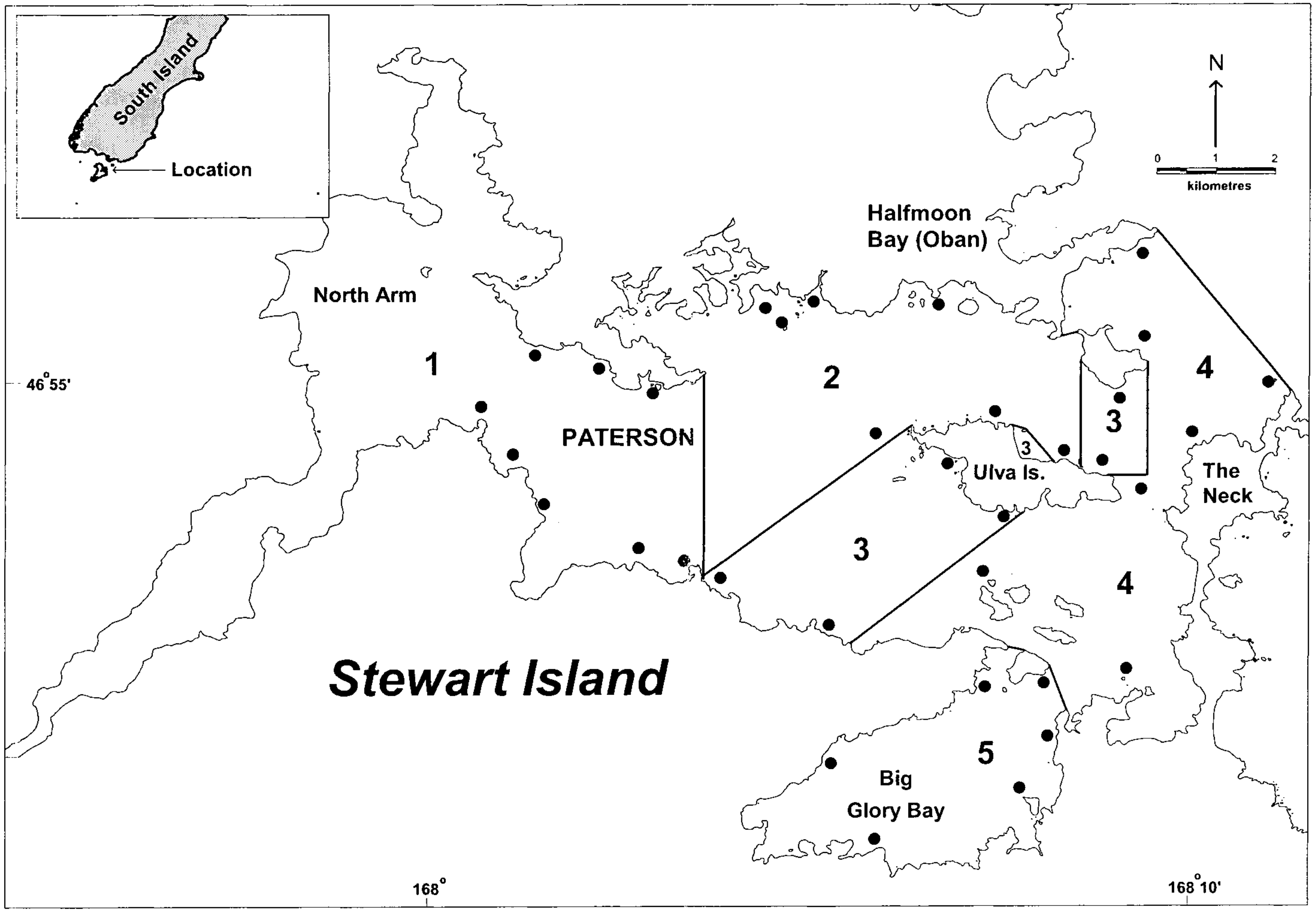

Figure 1: Map of Paterson Inlet coast showing the survey area, strata, and stations where pots (n = 6) were set. Note that the disjointed stratum 3 around Ulva Island is the marine reserve.

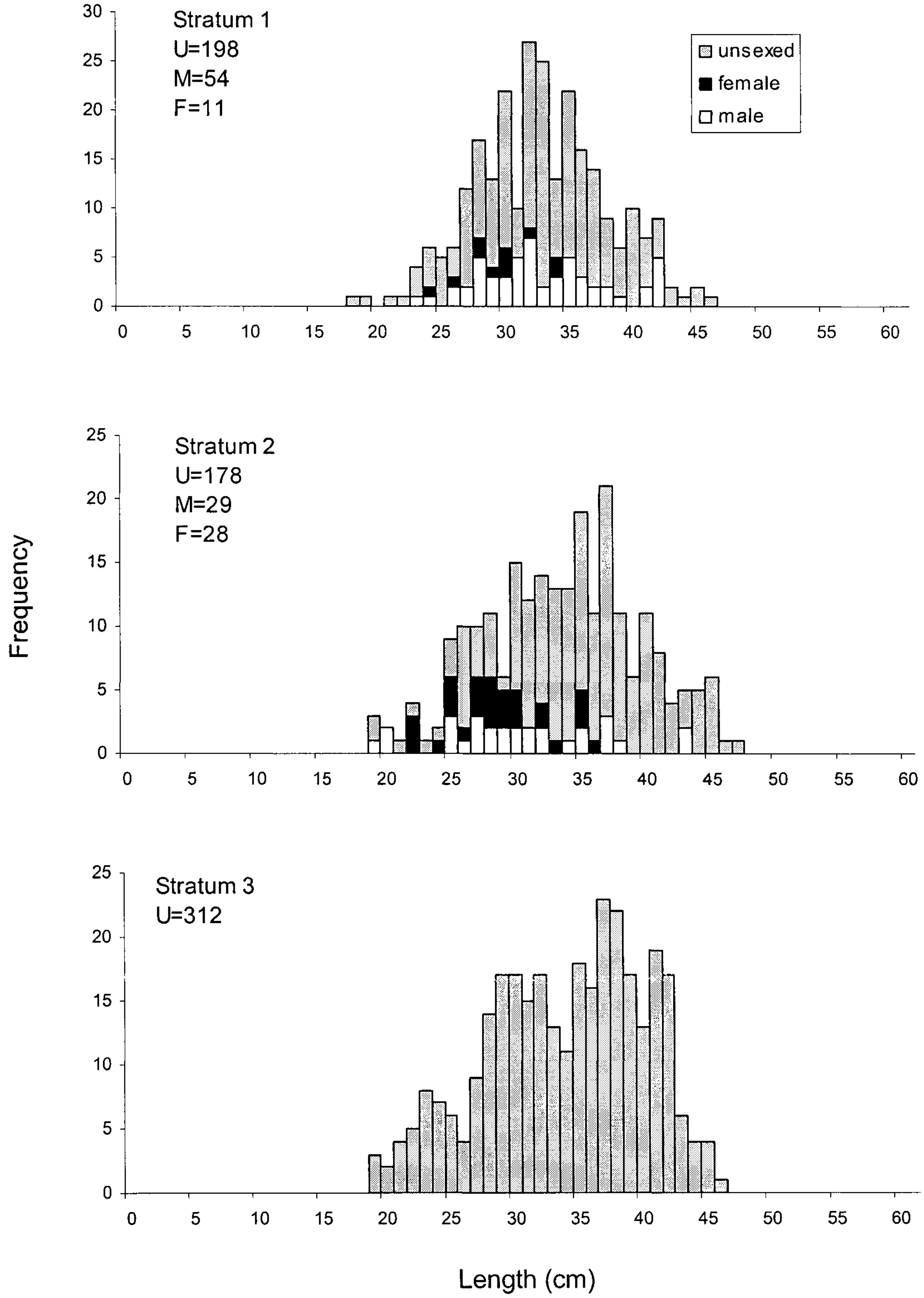

Figure 2: Length frequency distributions of blue cod for each stratum (1–5) and all strata combined.

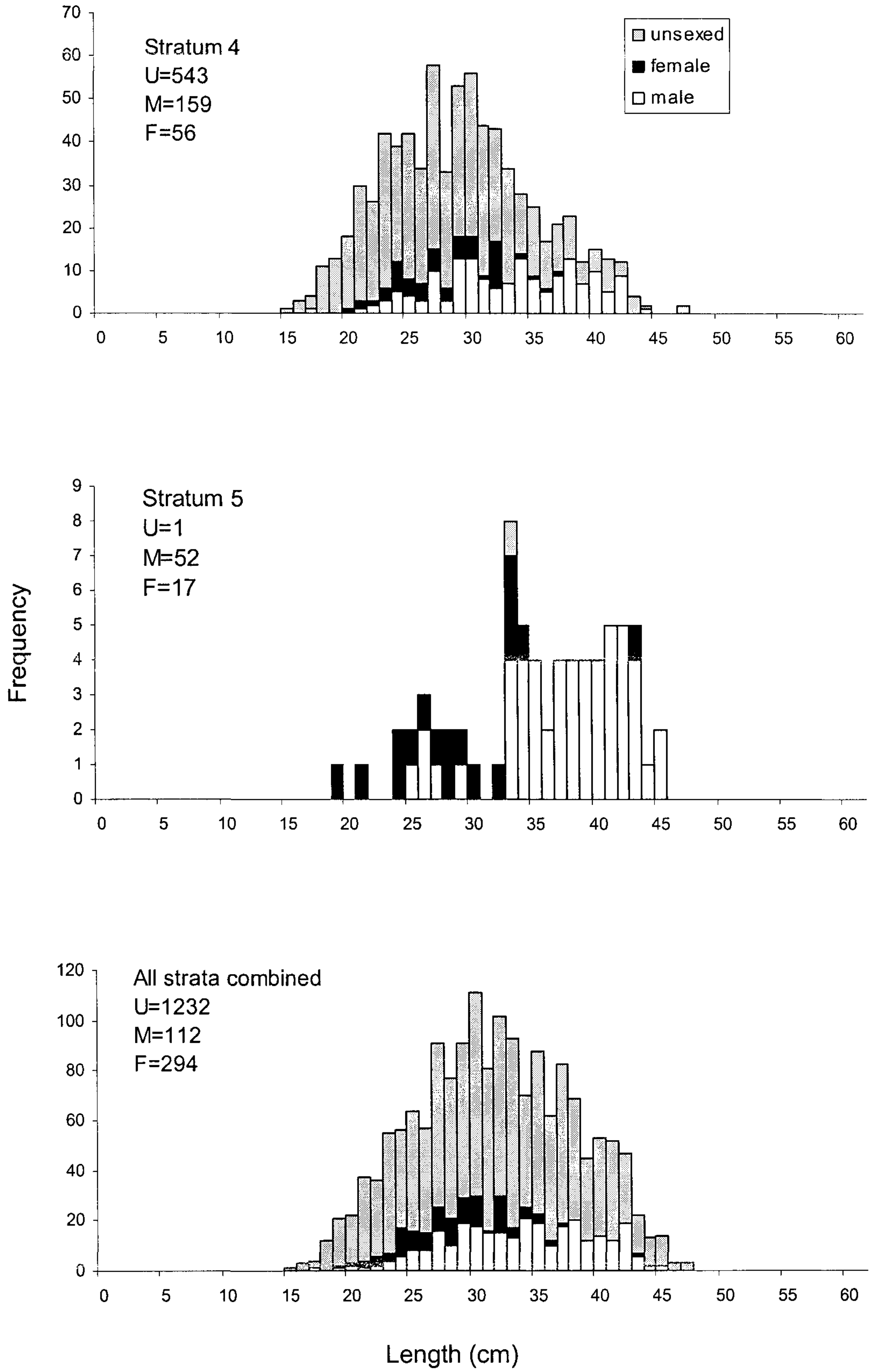

Figure 2 – *continued*

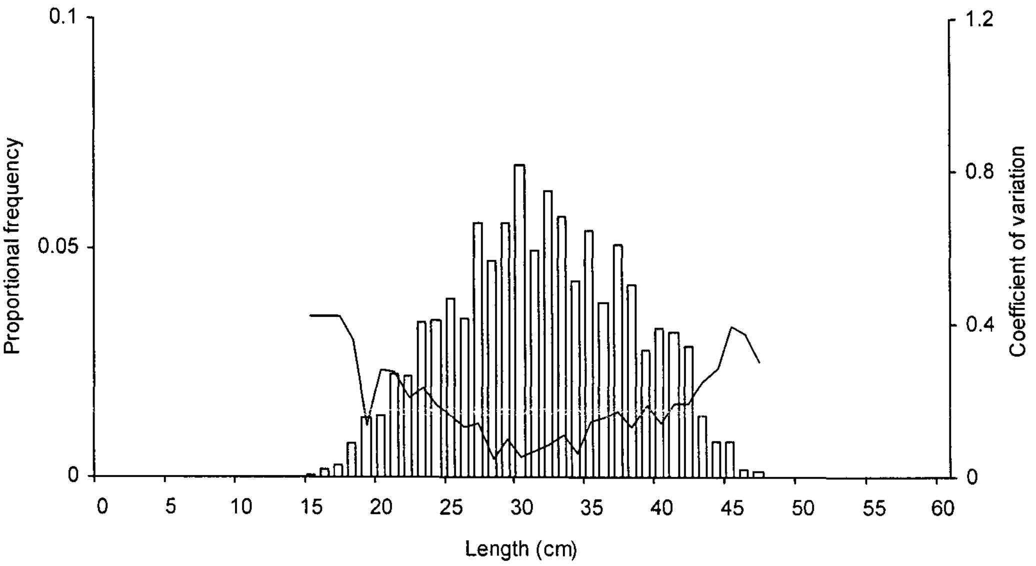

Figure 3: Proportional length frequency distributions of all blue cod (n=1638) from all strata combined (bars). The coefficient of variation (line) is show on the second axis.

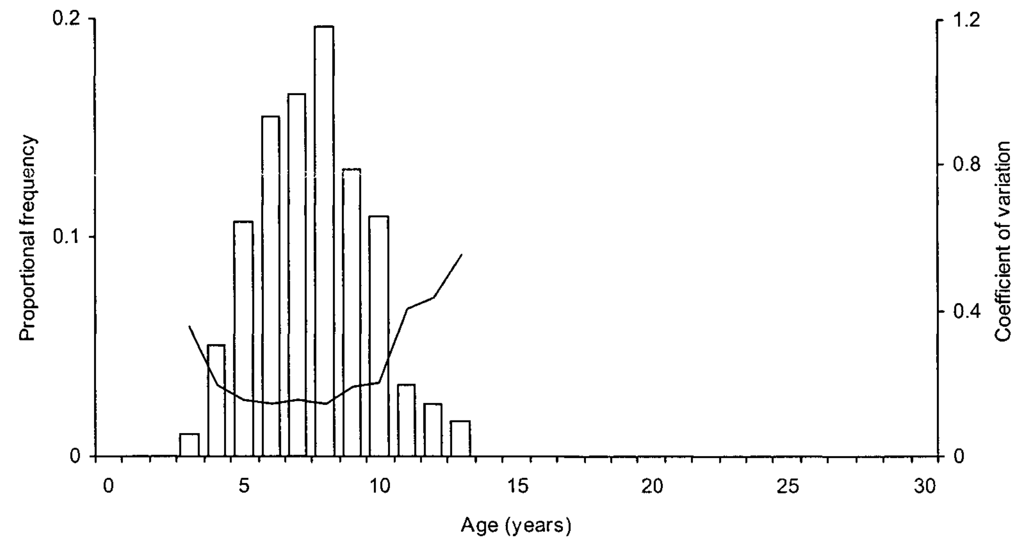

Figure 4: Proportional age frequency distributions derived from the catch of all blue cod (n=1638) for all strata combined (bars) using an age-length key derived from 228 otoliths (Appendix 3). The coefficient of variation (line) is show on the second axis.

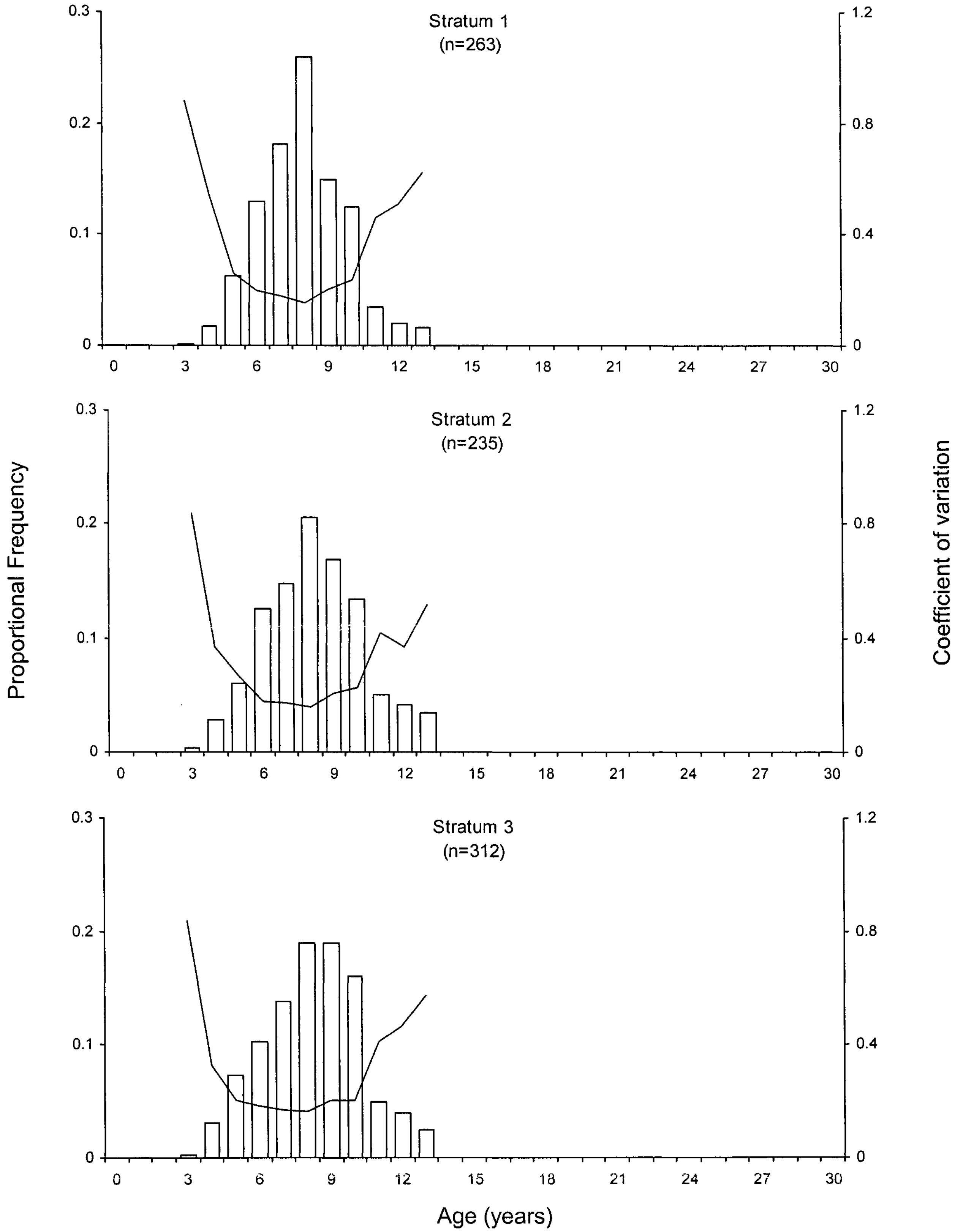

Figure 5: Proportional age frequency distributions derived from the catch of blue cod from individual stratum (bars) using an age-length key derived from 228 otoliths (Appendix 3). The coefficient of variation (line) is show on the second axis.

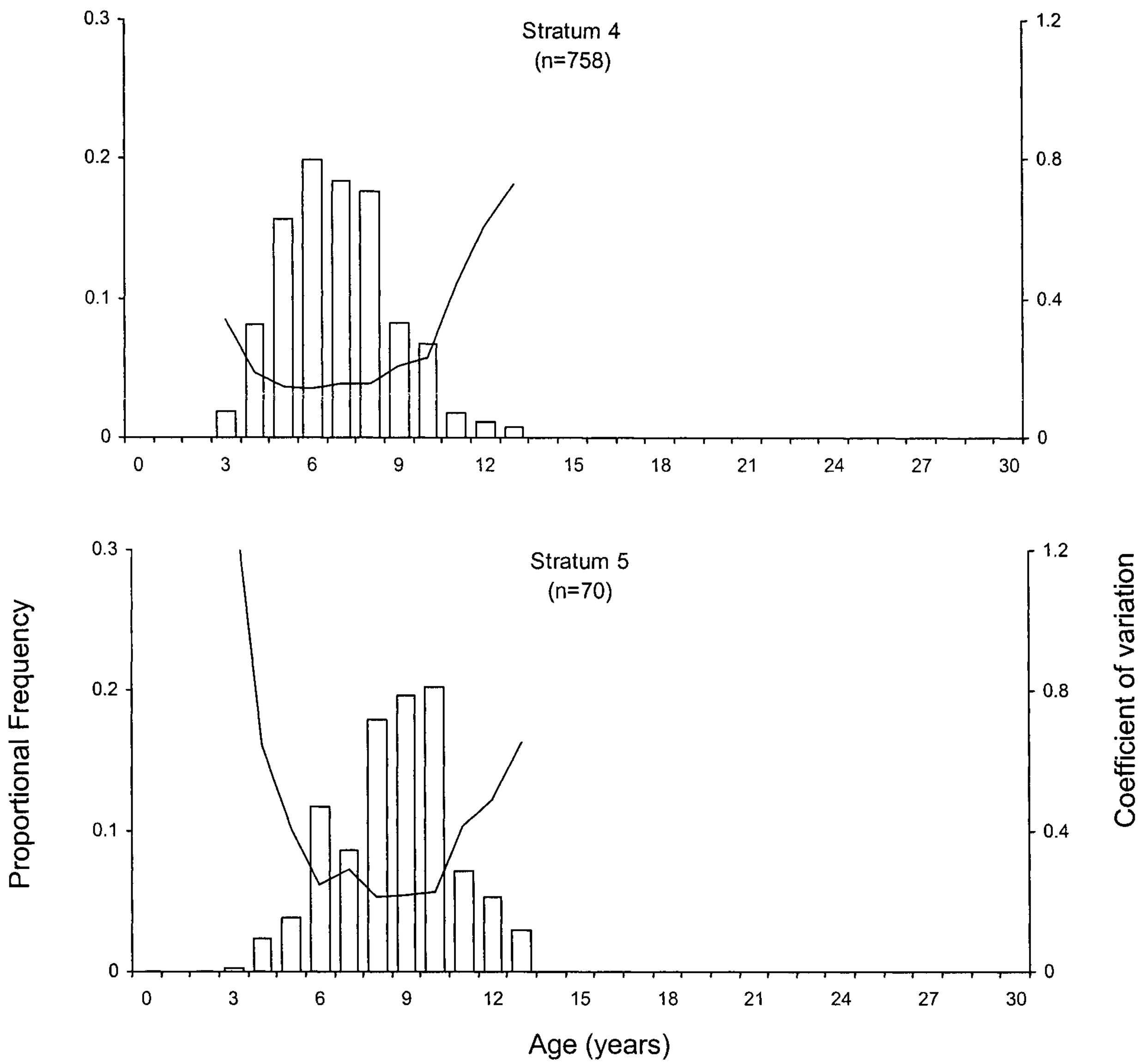

Figure 5 – ***continued***

Appendix 1: Summary of pot lift station data.

Set	Date	Phase	Stratum	Pot lift station	Depth (m)	Time set	Pot label	Catch of blue cod Weight (kg)	Number of fish
1	06-Nov-06	1	2	2E	12.8	1422	3	2.50	4
1	06-Nov-06	1	2	2E	11.7	1427	1	4.40	12
1	06-Nov-06	1	2	2E	10.1	1430	2	3.30	8
1	06-Nov-06	1	2	2E	10.1	1440	5	13.00	31
1	06-Nov-06	1	2	2E	9.9	1446	4	0.10	1
1	06-Nov-06	1	2	2E	9.0	1455	6	0.10	1
2	07-Nov-06	1	1	1C	6.6	0818	6	11.99	19
2	07-Nov-06	1	1	1C	5.9	0821	4	12.28	28
2	07-Nov-06	1	1	1C	6.4	0823	5	8.63	16
2	07-Nov-06	1	1	1C	9.1	0827	2	0.00	0
2	07-Nov-06	1	1	1C	4.6	0832	1	1.68	2
2	07-Nov-06	1	1	1C	4.4	0837	3	5.94	7
3	07-Nov-06	1	4	4I	8.2	1113	3	4.30	13
3	07-Nov-06	1	4	4I	5.5	1117	1	7.14	17
3	07-Nov-06	1	4	4I	5.7	1124	2	13.85	25
3	07-Nov-06	1	4	4I	5.7	1128	5	19.60	37
3	07-Nov-06	1	4	4I	7.7	1135	4	22.08	30
3	07-Nov-06	1	4	4I	7.7	1140	6	31.07	53
4	07-Nov-06	1	5	5A	6.4	1549	6	0.00	0
4	07-Nov-06	1	5	5A	7.3	1554	4	11.68	17
4	07-Nov-06	1	5	5A	7.3	1601	5	0.98	2
4	07-Nov-06	1	5	5A	7.3	1607	2	0.00	0
4	07-Nov-06	1	5	5A	11.0	1614	1	0.00	0
4	07-Nov-06	1	5	5A	14.6	1620	3	0.00	0
5	08-Nov-06	1	5	5J	7.3	0802	3	0.00	0
5	08-Nov-06	1	5	5J	4.6	0807	1	0.00	0
5	08-Nov-06	1	5	5J	5.5	0813	5	0.00	0
5	08-Nov-06	1	5	5J	3.7	0818	2	0.00	0
5	08-Nov-06	1	5	5J	7.3	0825	4	0.00	0
5	08-Nov-06	1	5	5J	7.1	0830	6	7.36	11
6	08-Nov-06	1	5	5I	13.7	0940	6	0.00	0
6	08-Nov-06	1	5	5I	12.8	0943	4	0.00	0
6	08-Nov-06	1	5	5I	9.1	0952	2	0.00	0
6	08-Nov-06	1	5	5I	5.5	1000	5	0.00	0
6	08-Nov-06	1	5	5I	16.8	1006	1	1.85	7
6	08-Nov-06	1	5	5I	4.6	1020	3	10.44	12
7	08-Nov-06	1	5	5G	3.7	1136	3	5.70	6
7	08-Nov-06	1	5	5G	5.5	1140	1	2.03	2
7	08-Nov-06	1	5	5G	3.7	1145	5	3.90	3
7	08-Nov-06	1	5	5G	5.5	1151	2	0.00	0
7	08-Nov-06	1	5	5G	7.3	1156	4	0.00	0
7	08-Nov-06	1	5	5G	4.6	1203	6	1.58	2
8	08-Nov-06	1	5	5C	5.5	1418	6	0.00	0
8	08-Nov-06	1	5	5C	5.5	1422	4	3.41	3
8	08-Nov-06	1	5	5C	4.6	1429	2	2.62	4
8	08-Nov-06	1	5	5C	3.7	1435	5	1.45	1
8	08-Nov-06	1	5	5C	3.7	1438	1	0.00	0

Set	Date	Phase	Stratum	Pot lift station	Depth (m)	Time set	Pot label	Catch of blue cod Weight (kg)	Number of fish
9	08-Nov-06	1	4	4G	7.3	1622	3	1.77	3
9	08-Nov-06	1	4	4G	7.3	1627	1	0.74	1
9	08-Nov-06	1	4	4G	9.1	1633	5	0.53	2
9	08-Nov-06	1	4	4G	3.7	1638	2	0.00	0
9	08-Nov-06	1	4	4G	5.5	1641	4	9.56	13
9	08-Nov-06	1	4	4G	5.5	1646	6	14.90	19
10	09-Nov-06	1	4	4E	18.3	0754	6	20.31	53
10	09-Nov-06	1	4	4E	22.3	0804	4	12.20	36
10	09-Nov-06	1	4	4E	18.3	0814	5	17.52	63
10	09-Nov-06	1	4	4E	14.6	0824	2	17.02	22
10	09-Nov-06	1	4	4E	5.5	0834	1	0.00	0
10	09-Nov-06	1	4	4E	6.4	0846	3	0.00	0
11	09-Nov-06	1	4	4F	11.0	1005	3	1.15	1
11	09-Nov-06	1	4	4F	16.8	1015	1	0.06	1
11	09-Nov-06	1	4	4F	14.6	1026	2	0.20	3
11	09-Nov-06	1	4	4F	14.4	1035	5	4.50	12
11	09-Nov-06	1	4	4F	14.6	1045	4	3.55	7
11	09-Nov-06	1	4	4F	17.2	1055	6	6.00	12
12	09-Nov-06	1	1	1J	7.3	1255	6	4.60	12
12	09-Nov-06	1	1	1J	7.3	1305	4	1.92	3
12	09-Nov-06	1	1	1J	9.1	1315	5	0.00	0
12	09-Nov-06	1	1	1J	9.1	1325	2	1.10	4
12	09-Nov-06	1	1	1J	5.1	1335	1	0.00	0
12	09-Nov-06	1	1	1J	7.3	1345	3	0.00	0
13	09-Nov-06	1	1	1I	7.3	1450	3	0.79	1
13	09-Nov-06	1	1	1I	7.3	1500	1	4.90	6
13	09-Nov-06	1	1	1I	6.4	1510	2	6.35	9
13	09-Nov-06	1	1	1I	5.5	1520	5	0.00	0
13	09-Nov-06	1	1	1I	5.5	1530	4	0.00	0
13	09-Nov-06	1	1	1I	6.4	1540	6	2.17	3
14	09-Nov-06	1	1	1G	9.1	1650	6	5.86	10
14	09-Nov-06	1	1	1G	8.2	1655	4	0.79	1
14	09-Nov-06	1	1	1G	7.3	1700	5	0.00	0
14	09-Nov-06	1	1	1G	7.3	1705	2	8.82	9
14	09-Nov-06	1	1	1G	3.7	1710	1	0.00	0
14	09-Nov-06	1	1	1G	5.5	1715	3	0.00	0
15	10-Nov-06	1	1	1H	3.7	0813	3	0.00	0
15	10-Nov-06	1	1	1H	5.5	0818	1	0.00	0
15	10-Nov-06	1	1	1H	3.7	0823	2	0.00	0
15	10-Nov-06	1	1	1H	3.7	0828	5	0.00	0
15	10-Nov-06	1	1	1H	3.7	0833	4	0.00	0
15	10-Nov-06	1	1	1H	3.7	0838	6	0.22	1
16	10-Nov-06	1	2	2F	3.7	1007	6	1.53	1
16	10-Nov-06	1	2	2F	5.5	1012	4	0.00	0
16	10-Nov-06	1	2	2F	3.7	1016	5	0.00	0
16	10-Nov-06	1	2	2F	3.7	1021	2	10.18	9
16	10-Nov-06	1	2	2F	3.7	1026	1	0.00	0
16	10-Nov-06	1	2	2F	3.7	1031	3	2.02	2
17	10-Nov-06	1	2	2G	14.6	1145	3	7.00	14

Set	Date	Phase	Stratum	Pot lift station	Depth (m)	Time set	Pot label	Catch of blue cod	
								Weight (kg)	Number of fish
17	10-Nov-06	1	2	2G	6.4	1150	1	5.20	9
17	10-Nov-06	1	2	2G	9.1	1155	2	2.36	4
17	10-Nov-06	1	2	2G	13.7	1200	5	0.00	0
17	10-Nov-06	1	2	2G	5.5	1205	4	4.87	6
18	10-Nov-06	1	2	2G	3.7	1210	6	4.45	6
18	10-Nov-06	1	2	2H	5.5	1331	6	1.35	2
18	10-Nov-06	1	2	2H	5.5	1333	4	7.48	8
18	10-Nov-06	1	2	2H	3.7	1337	5	1.43	3
18	10-Nov-06	1	2	2H	3.7	1342	2	0.00	0
18	10-Nov-06	1	2	2H	5.5	1347	1	10.94	10
19	10-Nov-06	1	2	2H	5.5	1352	3	0.00	0
19	10-Nov-06	1	2	2A	11.0	1531	3	1.20	1
19	10-Nov-06	1	2	2A	9.1	1534	1	4.00	5
19	10-Nov-06	1	2	2A	7.3	1540	2	3.90	6
19	10-Nov-06	1	2	2A	9.1	1550	5	9.65	8
19	10-Nov-06	1	2	2A	7.3	1600	4	2.60	2
20	10-Nov-06	1	2	2A	7.3	1610	6	2.55	4
20	11-Nov-06	1	3	3E	11.0	0940	6	5.74	7
20	11-Nov-06	1	3	3E	11.0	0945	4	5.80	5
20	11-Nov-06	1	3	3E	5.5	0954	5	4.80	8
20	11-Nov-06	1	3	3E	5.5	1000	2	8.75	8
20	11-Nov-06	1	3	3E	5.5	1005	1	20.36	24
21	11-Nov-06	1	3	3E	7.3	1011	3	0.00	0
21	11-Nov-06	1	3	3F	12.8	1557	3	0.00	0
21	11-Nov-06	1	3	3F	11.0	1308	1	1.20	3
21	11-Nov-06	1	3	3F	3.7	1319	2	0.00	0
21	11-Nov-06	1	3	3F	9.1	1325	5	5.49	10
21	11-Nov-06	1	3	3F	13.4	1333	4	1.24	6
22	11-Nov-06	1	3	3F	4.6	1340	6	7.63	12
22	11-Nov-06	1	4	4C	12.4	1514	6	12.13	28
22	11-Nov-06	1	4	4C	12.3	1524	4	4.56	13
22	11-Nov-06	1	4	4C	10.6	1532	5	3.30	10
22	11-Nov-06	1	4	4C	12.8	1540	2	15.50	22
22	11-Nov-06	1	4	4C	11.5	1548	1	2.82	6
23	11-Nov-06	1	4	4C	11.5	1556	3	11.80	15
23	12-Nov-06	1	3	3I	7.3	0947	3	5.90	7
23	12-Nov-06	1	3	3I	3.7	0954	1	1.90	4
23	12-Nov-06	1	3	3I	3.7	1000	2	11.80	12
23	12-Nov-06	1	3	3I	5.5	1005	5	22.32	21
23	12-Nov-06	1	3	3I	7.3	1012	4	7.80	14
24	12-Nov-06	1	3	3I	7.3	1019	6	0.00	0
24	12-Nov-06	1	3	3B	14.6	1158	6	5.67	16
24	12-Nov-06	1	3	3B	6.4	1203	4	7.41	8
24	12-Nov-06	1	3	3B	8.0	1210	5	0.00	0
24	12-Nov-06	1	3	3B	9.1	1216	2	1.50	3
24	12-Nov-06	1	3	3B	11.5	1223	1	4.56	5
25	12-Nov-06	1	3	3B	10.1	1229	3	3.10	3
25	12-Nov-06	1	3	3J	5.5	1416	3	8.75	13

Set	Date	Phase	Stratum	Pot lift station	Depth (m)	Time set	Pot label	Catch of blue cod Weight (kg)	Number of fish
25	12-Nov-06	1	3	3J	4.6	1426	2	0.00	0
25	12-Nov-06	1	3	3J	4.0	1430	5	0.00	0
25	12-Nov-06	1	3	3J	7.3	1434	4	0.00	0
25	12-Nov-06	1	3	3J	7.3	1439	6	5.32	5
26	13-Nov-06	2	1	1F	3.7	1100	6	0.00	0
26	13-Nov-06	2	1	1F	3.7	1107	4	0.00	0
26	13-Nov-06	2	1	1F	5.5	1114	5	0.00	0
26	13-Nov-06	2	1	1F	3.7	1120	2	7.87	13
26	13-Nov-06	2	1	1F	7.3	1125	1	7.10	13
26	13-Nov-06	2	1	1F	5.5	1127	3	7.90	16
27	13-Nov-06	2	1	1B	5.5	1254	3	8.23	16
27	13-Nov-06	2	1	1B	5.5	1302	1	4.80	9
27	13-Nov-06	2	1	1B	3.7	1308	2	2.94	4
27	13-Nov-06	2	1	1B	8.4	1313	5	6.79	11
27	13-Nov-06	2	1	1B	3.7	1318	4	3.60	7
27	13-Nov-06	2	1	1B	3.7	1324	6	3.14	5
28	13-Nov-06	2	1	1D	6.4	1443	6	5.15	7
28	13-Nov-06	2	1	1D	5.5	1446	4	2.44	3
28	13-Nov-06	2	1	1D	4.6	1452	5	5.29	9
28	13-Nov-06	2	1	1D	4.6	1457	2	0.57	1
28	13-Nov-06	2	1	1D	5.5	1502	1	2.80	5
28	13-Nov-06	2	1	1D	7.3	1508	3	3.00	6
29	14-Nov-06	2	2	2I	3.7	0755	3	7.55	8
29	14-Nov-06	2	2	2I	5.5	0804	1	5.10	7
29	14-Nov-06	2	2	2I	5.5	0808	2	9.37	13
29	14-Nov-06	2	2	2I	5.5	0914	5	1.96	5
29	14-Nov-06	2	2	2I	6.4	0824	4	1.85	3
29	14-Nov-06	2	2	2I	6.4	0830	6	2.47	2
30	14-Nov-06	2	3	3A	5.5	1000	6	18.46	21
30	14-Nov-06	2	3	3A	8.2	1009	4	5.66	6
30	14-Nov-06	2	3	3A	5.5	1012	5	6.40	11
30	14-Nov-06	2	3	3A	10.2	1017	2	27.85	47
30	14-Nov-06	2	3	3A	16.5	1027	1	0.00	0
30	14-Nov-06	2	3	3A	10.8	1030	3	11.12	28
31	14-Nov-06	2	2	2B	6.4	1340	3	2.34	4
31	14-Nov-06	2	2	2B	6.0	1346	1	9.46	12
31	14-Nov-06	2	2	2B	5.5	1356	2	3.34	3
31	14-Nov-06	2	2	2B	4.6	1404	5	9.33	16
31	14-Nov-06	2	2	2B	6.2	1408	4	0.25	1
31	14-Nov-06	2	2	2B	4.6	1415	6	14.52	16
32	15-Nov-06	2	4	4D	16.1	0811	6	4.30	20
32	15-Nov-06	2	4	4D	15.4	0819	4	1.80	9
32	15-Nov-06	2	4	4D	13.7	0827	5	17.58	38
32	15-Nov-06	2	4	4D	12.3	0838	2	13.60	17
32	15-Nov-06	2	4	4D	11.7	0845	1	2.80	4
32	15-Nov-06	2	4	4D	13.7	0852	3	2.62	
33	15-Nov-06	2	4	4B	32.9	1029	3	1.39	1
33	15-Nov-06	2	4	4B	24.7	1035	1	0.00	0
33	15-Nov-06	2	4	4B	20.9	1050	2	25.20	64

Set	Date	Phase	Stratum	Pot lift station	Depth (m)	Time set	Pot label	Catch of blue cod Weight(kg)	Catch of blue cod Number of fish
33	15-Nov-06	2	4	4B	19.6	1100	5	10.50	50
33	15-Nov-06	2	4	4B	10.1	1106	4	12.50	21
33	15-Nov-06	2	4	4B	12.8	1112	6	3.26	11
34	15-Nov-06	2	5	5D	2.7	1317	6	0.00	0
34	15-Nov-06	2	5	5D	3.7	1320	4	0.00	0
34	15-Nov-06	2	5	5D	2.2	1324	5	0.00	0
34	15-Nov-06	2	5	5D	3.7	1331	2	0.00	0
34	15-Nov-06	2	5	5D	3.7	1336	1	0.00	0
34	15-Nov-06	2	5	5D	3.7	1343	3	0.00	0

Appendix 2: Summary of oceanographic environmental station data recorded in the format of MFish trawl data base. Depths are measured in meters, directions in compass degrees (999 = nil), wind force in the Beaufort scale, temperatures in degrees centigrade, air pressure in millibars, cloud cover in oktas, sea condition in the Douglas scale, sea colour in a categorical scale from 1 (deep blue) to 8 (yellow green), swell height in the Douglas classification 1 (low) to 3 (heavy), bottom type in a categorical scale from 1 (mud or ooze) to 9 (stone), bottom contour in a categorical scale from 1 (smooth/flat) to 5 (very rugged), and wind speed in metres per second.

Set	Average Depth	Wind Direction	Wind Force	Air Temp	Air Pressure	Cloud Cover	Sea Condition	Sea Colour	Swell Hight	Swell Direction	Bottom Type	Bottom Contour	Surface Temp	Bottom Temp	Wind Speed	Secchi Depth
1	10.58	180	2	11.5	1012	7	2	7	1	999	4	2	12.5	11.5	3.1	6.0
2	6.16	60	2	12.1	1002	6	1	5	1	999	7	2	14.0	12.0	1.4	5.5
3	6.74	60	2	13.6	999	3	1	4	1	999	4	2	14.0	12.0	2.6	7.1
4	8.99	60	2	13.4	999	3	1	4	1	999	2	2	14.0	12.0	2.8	6.2
5	5.91	180	2	5.2	982	8	1	7	1	999	4	1	11.5	11.0	2.3	4.9
6	10.43	210	2	6	982	7	1	5	1	999	4	1	11.5	11.0	2.8	6.5
7	5.03	210	4	8	982	8	1	5	1	999	4	1	12.0	11.5	6.7	5.3
8	4.42	180	1	3.3	982	4 .	1	5	1	999	4	1	10.5	11.5	1.1	3.4
9	6.40	260	1	5.9	981	7	1	5	1	999	4	2	12.0	11.5	0.8	4.2
10	14.24	260	2	5.7	990	3	1	2	1	150	7	2	11.0	11.0	2.9	7.1
11	14.78	260	4	9.4	990	3	1	5	1	999	3	3	1.0	11.5	11.0	7.1
12	7.56	260	4	9.5	990	6	4	4	1	999	3	1	11.5	11.5	6.4	5.8
13	6.40	260	4	9.4	989	6	4	4	1	999	3	1	11.5	11.5	8.0	5.8
14	6.86	260	2	8.8	989	8	4	4	1	999	4	1	11.8	11.5	2.5	3.2
15	3.96	260	2	8.8	991	6	1	7	1	999	4	1	11.5	11.5	3.6	8.8
16	3.96	240	3	9	992	8	3	5	1	999	4	1	11.5	11.5	6.7	5.2
17	8.84	240	4	12.9	993	5	3	5	2	999	4	1	11.5	11.5	6.3	5.3
18	4.88	240	6	12.5	992	4	3	5	2	999	4	1	11.5	11.5	12.3	5.3
19	8.54	240	5	11.2	992	5	2	7	1	999	3	1	11.5	11.3	10.3	5.7
20	7.62	330	4	15.5	983	6	1	5	1	999	2	2	11.5	11.5	6.2	5.3
21	9.08	260	7	10.1	984	8	4	5	1	999	3	2	11.5	11.5	12.9	5.3
22	11.86	260	2	11.3	985	8	1	4	1	999	3	1	11.5	11.3	3.1	5.3
23	5.79	240	5	10	991	4	2	5	1	999	3	2	11.5	11.5	8.2	5.3
24	9.97	240	1	12.3	992	6	2	5	1	999	3	2	11.5	11.5	0.9	5.1
25	5.40	240	2	7.9	994	7	2	5	1	999	3	2	11.5	11.5	2.3	5.1
26	4.88	300	4	13.7	997	7	1	5	1	999	2	1	11.5	11.5	3.6	5.1
27	5.06	300	0	14.7	994	6	1	5	1	999	2	1	11.5	11.5	0.0	4.8
28	5.64	60	3	16.2	992	5	1	5	1	999	2	2	11.5	11.5	4.4	4.8
29	5.49	240	1	11	978	8	1	5	1	999	2	2	11.5	11.5	1.5	4.8
30	9.45	240	2	10.5	981	8	1	5	1	999	4	1	11.5	11.5	2.0	5.0
31	5.55	240	2	10.3	985	6	1	5	1	999	4	1	11.5	11.5	1.4	5.1
32	13.81	0	3	10.9	992	2	3	2	1	180	4	1	11.5	11.5	2.6	5.5
33	20.15	0	3	12.5	991	1	1	4	1	999	4	2	11.5	11.5	2.8	6.5
34	3.26	300	2	16.2	989	1	1	7	1	999	4	2	11.5	11.5	2.5	4.8

Appendix 3: Estimates of proportion of length at age for blue cod otoliths from Paterson Inlet.

Length																			Age (years)		No.
(cm)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	>19	aged
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0.50	0	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
16	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
17	0	0	0.67	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
18	0	0	0.30	0.60	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
19	0	0	0.14	0.86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
20	0	0	0.17	0.83	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
21	0	0	0	0.50	0.13	0.38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
22	0	0	0	0.14	0.57	0.14	0.14	0	0	0	0	0	0	0	0	0	0	0	0	0	7
23	0	0	0	0.10	0.90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
24	0	0	0	0	0.50	0.40	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	10
25	0	0	0	0	0.40	0.40	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0	10
26	0	0	0	0	0.10	0.60	0.30	0	0	0	0	0	0	0	0	0	0	0	0	0	10
27	0	0	0	0	0.09	0.64	0.09	0.18	0	0	0	0	0	0	0	0	0	0	0	0	11
28	0	0	0	0.13	0	0.38	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	8
29	0	0	0	0	0	0.30	0.50	0.20	0	0	0	0	0	0	0	0	0	0	0	0	10
30	0	0	0	0	0.20	0.10	0.30	0.40	0	0	0	0	0	0	0	0	0	0	0	0	10
31	0	0	0	0	0.10	0.10	0.50	0.30	0	0	0	0	0	0	0	0	0	0	0	0	10
32	0	0	0	0	0	0	0.44	0.44	0	0.11	0	0	0	0	0	0	0	0	0	0	9
33	0	0	0	0	0	0.13	0.13	0.63	0	0.13	0	0	0	0	0	0	0	0	0	0	8
34	0	0	0	0	0	0.11	0.11	0.33	0.33	0.11	0	0	0	0	0	0	0	0	0	0	9
35	0	0	0	0	0	0	0	0.38	0.38	0.25	0	0	0	0	0	0	0	0	0	0	8
36	0	0	0	0	0	0	0	0.50	0.38	0	0.13	0	0	0	0	0	0	0	0	0	8
37	0	0	0	0	0	0	0	0	0.50	0.17	0.17	0	0.17	0	0	0	0	0	0	0	6
38	0	0	0	0	0	0	0	0.40	0.40	0	0	0.20	0	0	0	0	0	0	0	0	5
39	0	0	0	0	0	0	0	0	0.40	0.60	0	0	0	0	0	0	0	0	0	0	5
40	0	0	0	0	0	0	0	0	0.20	0.60	0.20	0	0	0	0	0	0	0	0	0	5
41	0	0	0	0	0	0	0	0	0.40	0.60	0	0	0	0	0	0	0	0	0	0	5
42	0	0	0	0	0	0	0	0	0.33	0.33	0.17	0.17	0	0	0	0	0	0	0	0	6
43	0	0	0	0	0	0	0	0	0	0.20	0.40	0.20	0.20	0	0	0	0	0	0	0	5
44	0	0	0	0	0	0	0	0	0	0	0.40	0.40	0.20	0	0	0	0	0	0	0	5
45	0	0	0	0	0	0	0	0	0	0.20	0	0.60	0.20	0	0	0	0	0	0	0	5
46	0	0	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	3
47	0	0	0	0	0	0	0	0	0	0	0	0.50	0.50	0	0	0	0	0	0	0	2
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total																					228