A review of hoki and middle-depth trawl surveys of the Chatham Rise, January 1992–2010

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Annual trawl surveys for hoki and other middle depth species have been carried out on the Chatham Rise using *Tangaroa* from 1992 to 2010. With 19 consecutive surveys, the Chatham Rise series is the longest consistent series in New Zealand fisheries.

This report reviews all 19 surveys in the time series. The aim was to provide fisheries-independent data for a much broader range of species than is currently available in annual survey reports, informing us about which species are adequately monitored by the existing trawl series and identifying gaps where additional data need to be collected. This is particularly important in light of broader scrutiny of the effects of fishing on associated species.

This work differs from previous reviews, by being species-based rather than community-based. Results in this report are summarised by species, assembling all available survey-based information for a particular species together using a standard format.

A total of 558 species or species groups has been recorded in the 19 surveys. The number of species recorded has increased over time, mainly due to improvements in identification of benthic invertebrates. Where there has been a change in the level of identification over time, species were grouped into broader taxonomic classes. Biomass trends and spatial and depth distributions were estimated for 142 species or groups. Biomass was poorly estimated (arbitrarily defined as mean c.v. greater than 40%) for 93 of the 142 groups. For the remaining 49 groups where biomass was relatively well-estimated, biomass decreased significantly since the start of the time series for only two species: hake and rudderfish. Hoki and arrow squid decreased in the middle part of the time series but then increased. Eighteen groups increased significantly, 9 increased and then decreased, and 18 showed no clear trend.

The combined biomass of the 142 species or groups was variable, but showed no trend. There appears to have been increased incidences of sporadic high catches of poorly estimated species such as common roughy, alfonsino, and silver warehou since 2000, which has led to fluctuations in the proportion of the overall combined biomass contributed by the well estimated species. The proportion of hoki in the catch declined from nearly 60% in 1993 to 21% in 2004, but increased again to make up 30–40% of the total biomass in the past 6 years. The other two target species, ling and hake, typically made up 3–4% and less than 2% respectively of the total survey biomass.

Over one million individuals of 159 species were measured on Chatham Rise trawl surveys. Of these, 45 species had sufficient information to estimate scaled length frequency distributions by year. Most showed no clear trend in mean length over the period for which length measurements were available. Nineteen species exhibited multiple modes in length frequency data which may track changes in year-class strength. Other biological information, such as maturity stage was summarised for the species for which these data were collected. Relatively few species were recorded in spawning condition (ripe or running ripe) during the survey.

1. INTRODUCTION

The Chatham Rise is a broad bathymetric feature east of New Zealand (Figure 1). The subtropical convergence occurs over the Chatham Rise (Heath 1985), creating a region of high primary productivity (Murphy et al. 2001) that supports major commercial fisheries for hoki (*Macruronus novaezelandiae*), hake (*Merluccius australis*), ling (*Genypterus blacodes*), orange roughy (*Hoplostethus atlanticus*), and oreos (*Allocyttus niger* and *Pseudocyttus maculatus*). Hoki are the target of New Zealand's largest fishery, with annual catches of 90 000 to 250 000 t since 1986 (Ballara et al. 2010). The Chatham Rise is the major nursery ground for New Zealand hoki, and one of the main adult feeding areas (Livingston et al. 2002a).

Annual bottom trawl surveys for hoki and other middle depth species have been carried out on the Chatham Rise every January since 1992 (Table 1). All surveys in the series were carried out from RV *Tangaroa* and form the most comprehensive time series of species abundance in water depths of 200 to 800 m in New Zealand's 200-mile Exclusive Economic Zone. The surveys follow a random stratified design, with stratification by depth, longitude, and latitude across the Chatham Rise to ensure full coverage of the area (Figure 1).

Previous surveys in this time series were documented in individual survey reports (see Table 1 for references). As well as the publication of survey results for each year, trends in biomass and changes in catch and age distribution were previously reviewed for the first four surveys by Livingston & Schofield (1996) and for the 10 surveys from 1992 to 2001 by Livingston et al. (2002b). Bull et al. (2001) used data from 1992 to 1999 to describe the community structure of demersal fish on the Chatham Rise. Tuck et al. (2009) analysed the Chatham Rise trawl series data from 1992 to 2007 and derived ecosystem indicators based on measures of diversity, fish size, and trophic level in an attempt to identify the effects of fishing on fish communities. O'Driscoll et al. (2009) used acoustic data collected on Chatham Rise surveys since 2001 to estimate the abundance of mesopelagic fish, which was then related to abundance of hoki and to environmental conditions (O'Driscoll et al. 2010)

The main aim of the Chatham Rise surveys was to provide relative biomass estimates of adult and juvenile hoki. Although managed as a single stock, hoki is assessed as two stocks, western and eastern. The current hypothesis is that juveniles from both stocks mix on the Chatham Rise and recruit to their respective stocks as they approach sexual maturity. The Chatham Rise is also the principal residence area for the hoki that spawn in Cook Strait and off the east coast South Island in winter (eastern stock). The hoki fishery is now recruitment driven and therefore subject to large fluctuations in stock size. To manage the fishery and minimise potential risks, it is important to have some predictive ability concerning recruitment into the fishery. Recent stock assessments (e.g., McKenzie & Francis 2009) suggest that the index of 2-year old fish from the Chatham Rise provides the best estimate of relative hoki year class strength. Other middle depth species are also monitored by this survey time series. These include important commercial species such as hake and ling, as well as a wide range of non-commercial fish and invertebrate species. For most of these species, the trawl survey is the only fisheries-independent estimate of abundance on the Chatham Rise, and the survey time-series fulfils an important "ecosystem monitoring" role (e.g., Tuck et al. 2009), as well as providing inputs into single-species stock assessment.

The key aims of this review were to:

1. Document trends in biomass for all species caught;
2. Summarise spatial and depth distributions for all species caught;
3. Document trends in size and sex composition for the subset of species which are routinely measured.

This report provides fisheries-independent data for a much broader range of species than is currently available. Annual survey reports routinely only present biomass trends for three age groupings of hoki and 10 other 'major ' species, as well as plots showing the proportion of hoki relative to the combined biomass of 31 'core' species. This review will help inform us about which species are adequately monitored by the existing trawl series and allow us to identify gaps where additional data need to be collected. This is particularly important in light of broader scrutiny of the effects of fishing on associated species, for example as part of the Principle 2 criteria for Marine Stewardship Council certification.

This report does not summarise environmental or acoustic data collected during the Chatham Rise trawl survey series or hoki condition indices. These were reviewed previously by O'Driscoll et al. (2010).

1.1 Project objectives

This work was carried out under contract to the Ministry of Fisheries (Objective 5 of project HOK2007/02C). The specific objective for the project was:

5. To review the Chatham Rise trawl time-series 1992–2010.

2. METHODS

2.1 Survey area and design

All surveys covered depths of 200–800 m on the Chatham Rise (Figure 1). Additional deeper strata were also surveyed in 2000, 2002, 2007, 2008, and 2010. Stratification of the core survey area is based on 200-m depth intervals (i.e., 200–400 m, 400–600 m, and 600–800 m), latitude, and longitude. The stratification has undergone several changes over the time series, particularly a re-numbering of strata in 1996, and sub-stratification of many strata in 2000. Our analysis software has taken account of this by re-assigning stations to present strata numbers and by using combined stratum areas in years when strata were not separated (Appendices 1 and 2). Where stratum areas have changed over time, indices were calculated using present stratum areas. The number of stations by core stratum for all surveys in the time series is given in Table 2.

Surveys followed a two-phase random design (after Francis 1984). Recently, the surveys have been optimised to obtain target coefficient of variations (c.v.s) of 20% for 2+ hoki, 15% for total hoki, and 20% for hake (Francis 2006). Improved optimisation and rationalisation of survey timing resulted in a decrease in station numbers since 1996 (Table 2).

2.2 Vessel and gear specifications

Tangaroa is a purpose-built, research stern trawler of 70 m overall length, a beam of 14 m, 3000 kW (4000 hp) of power, and a gross tonnage of 2282 t.

The bottom trawl used in the Chatham Rise time series is an eight-seam hoki bottom trawl with 100 m sweeps, 50 m bridles, 12 m backstrops, 58.8 m groundrope, 45 m headline, and 60 mm codend mesh (see Hurst & Bagley (1994) for net plan and rigging details). The trawl doors were Super Vee type with an area of 6.1 m^2.

2.3 Trawling procedure

Trawling followed the standardised procedures described by Hurst et al. (1992). Station positions were selected randomly before the voyage using the Random Stations Generation Program developed at NIWA. A minimum distance between stations of 3 n. miles was used. If a station was found to be on foul ground, a search was made for suitable ground within 3 n. miles of the station position. If no suitable ground could be found, the station was abandoned and another random position was substituted. Core biomass tows were carried out during daylight hours (as defined by Hurst et al. (1992)).

At each station the trawl was towed for 3 n. miles at a speed over the ground of 3.5 knots. If foul ground was encountered, or the tow hauled early due to reducing daylight, the tow was included as valid only if at least 2 n. miles were covered in core strata (or 1.5 n. mile in deepwater strata). If time ran short at the end of the day and it was not possible to reach the last core station, the vessel headed towards the next station and the trawl gear was shot in time to ensure completion of the tow by sunset, as long as 50% of the steaming distance to the next station was covered.

Towing speed and gear configuration were maintained as constant as possible during the survey, following the guidelines given by Hurst et al. (1992). Tow positions were recorded by GPS and depths from the vessel's echosounder. Measurements of doorspread (from a Scanmar 400 system) and headline height (from a Furuno net monitor) were recorded every 5 minutes during each tow and average values calculated.

2.4 Catch and biological sampling

At each station all items in the catch were sorted into species and weighed on Seaway motion-compensating electronic scales accurate to about 0.2 kg. Where possible, fish, squid, and crustaceans were identified to species and other benthic fauna to species or family. The level of taxonomic identification at sea has improved over time with development of identification guides for fish (McMillan et al. in press) and benthic invertebrates (Tracey et al. 2007).

The level of biological sampling has varied between years, and has increased over the time series (see Section 3.2). In general, an approximately random sample of up to 200 individuals of each commercial, and some common non-commercial, species from every successful tow was measured and sex determined. More detailed biological data were also collected on a subset of species and included fish weight, sex, gonad stage, and gonad weight. Otoliths were taken from hake, hoki, and ling for age determination. Additional data (e.g., stomach samples, data on hoki liver condition, genetic samples) were collected in some surveys but are not described in this report.

2.5 Analysis methods

Analyses were carried out using the NIWA custom software SurvCalc. SurvCalc is a C++ computer program developed in 2008 which analyses data from stratified random surveys (Francis 2009). Its primary purpose is to calculate estimates of biomass and/or length frequencies, and associated coefficients of variation (c.v.s), from survey data. SurvCalc supersedes, and uses some code from, the program Trawlsurvey (Vignaux 1994). The main input file for SurvCalc was designed so that it fully documents all the analysis choices the user makes in calculating biomass, e.g., the choice of stations to include, and how distance towed is calculated if there is no recorded value. The SurvCalc input files are included as Appendices 1 and 2.

SurvCalc extracts data from the trawl database for all stations on these surveys which fulfil the criteria for 'biomass' tows (i.e., daylight tows with the standard bottom trawl where gear performance was satisfactory). Analyses were run on 16 July 2010.

2.5.1 Estimation of biomass

An extract of catch data from all the Chatham Rise surveys from 1992 to 2010 indicated that there are 558 biological groups (i.e., not rubbish, rocks etc) recorded (Table 3). A large number are invertebrates with very low catch weights or frequency of occurrence. We calculated biomass indices for all groups where there was more than 10 kg of catch (combined over all surveys) and that occurred in three or more survey years from 1992 to 2009. These selection criteria did not include the 2010 survey, because a decision on which groups to select was made before the 2010 data were loaded onto the *trawl* database.

A total of 211 groups fulfilled these criteria, but some of these groups were combined into larger taxonomic groupings because there has been a change in the level of identification over time (Table 3). For example, one of the common glass sponges was originally identified as 'ONG' (generic sponge), then as 'GLS' (Class Hexactinellida), and finally as 'HYA' (*Hyalascus* sp.). We grouped all sponges into a generic sponge category. Many other benthic invertebrates were similarly grouped (Table 4). In the same way many mesopelagic fish species were grouped, because their identification at sea is difficult and depended on the (variable) identification skills of staff available on the vessel. We also grouped species where knowledge has evolved over time (for example most Ray's bream are now identified as southern Ray's bream).

We estimated biomass trends for 126 species and 16 groups. This is many more than the 31 species estimated in the previous review by Livingston et al. (2002b).

Doorspread biomass was estimated by the swept area method of Francis (1981, 1989) using the formulae of Vignaux (1994) as implemented in SurvCalc (Francis 2009). Where stratum areas have changed over time, indices were calculated using present stratum areas. This means that biomass estimates may differ slightly from those previously publishd in individual survey reports (see Section 3.3). The catchability coefficient (an estimate of the proportion of fish in the path of the net which are caught) is the product of vulnerability, vertical availability, and areal availability. These factors were set at 1 for the analysis, the assumptions being that fish were randomly distributed over the bottom, that no fish were present above the height of the headline, and that all fish within the path of the trawl doors were caught.

The SurvCalc input file used to estimate biomass is given in Appendix 1.

2.5.2 Distribution and catch rate plots

The spatial distributions of the same 126 species and 16 groups that were selected for biomass estimation were summarised by depth, latitude, and longitude. Catch data was matched up to station data using trip codes and station numbers.

Depth was divided into 20 m bins and the total number of tows over the time series (1992–2010) was summed for each bin. For each species or group, the total number of tows for each depth bin in which that species or group was present was also summed. This was then divided by the total number of tows in that depth bin to give the proportion of tows in each depth bin for which the species was present. The same process was applied for latitude using bins of 0.05 degrees, and for longitude using bins of 0.5 degrees.

Catch rates were plotted for a smaller subset of 45 species which were most adequately and consistently sampled. This subset is the same group of species for which length frequencies were estimated (see Section 2.5.3). The previous review by Livingston et al. (2002b) plotted catch rates for 21 species.

2.5.3 Estimation of length frequencies

A total of 1 026 313 individuals from 159 groups was measured in surveys from 1992 to 2010 (see Table 3). Minimum, maximum, and mean sizes were tabulated for the same 126 species and 16 groups that were selected for biomass estimation. A smaller subset of 45 species were selected as having sufficient information to estimate scaled length frequency distributions (arbitrarily defined as more than 500 length measurements from 1992 to 2010 with consistent sampling across multiple years).

Length-weight parameters were estimated for these 45 species from the subset of fish individually weighed (the same length-weight values were used for all surveys in the series). Scaled length frequencies were then calculated with SurvCalc and scaled length distributions plotted by year and sex. The previous review by Livingston et al. (2002b) plotted length frequencies for 15 species.

The SurvCalc input file used to estimate length frequencies is given in Appendix 2.

2.5.4 Estimation of numbers at age

Hoki, hake, and ling otoliths were prepared and aged using validated ageing methods (hoki, Horn & Sullivan (1996) as modified by Cordue et al. (2000); hake, Horn (1997); ling, Horn (1993)). Numbers at age were calculated from observed length frequencies and age-length keys using customised NIWA catch-at-age software (Bull & Dunn 2002). For hoki, this software also applied the "consistency scoring" method of Francis (2001), which uses otolith ring radii measurents to improve the consistency of age estimation.

2.6 Gonad stage information

The reproductive condition of a subset of species was estimated during the survey and was tabulated where appropriate.

Fish were staged using a range of gonad macroscopic scales, which are defined as follows:

Middle depths gonad stages: 1, immature; 2, resting; 3, ripening; 4, ripe; 5, running ripe; 6, partially spent; 7, spent (after Hurst et al. 1992).

Deepwater gonad stages: male: 1, immature/regressed; 2, early maturation; 3, mature; 4, ripe; 5, spent; 8, partially spent: female: 1, immature/resting; 2, early maturation; 3, mature; 4, ripe; 5, running ripe; 6, spent; 7, atretic; 8, partially spent (after McMillan 1996)

Cartilaginous fish gonad stages: male: 1, immature; 2, maturing; 3, mature: female: 1, immature; 2, maturing; 3, mature; 4, Gravid I; 5, Gravid II; 6, post-partum.

2.7 Species summaries

Section 9 presents results by species for the 126 species and 16 groups defined in Section 2.5.1, assembling all available survey-based information for a particular species together using a standard format. The format is as follows.

a) Title giving common name, scientific name in parentheses, and species code (see Table 3).

b) A specimen photograph.

c) A table summarising the number of surveys where the species was caught from 1992 to 2010, the total catch weight, number measured, length range (if any were measured), number individually weighed, and length-weight parameters (for the subset of 45 species defined in Section 2.5.3 only). Length method was abbreviated as: TL, total length; FL, fork length; SL, standard length; PL, pelvic length (rays); ML, mantle length (squids); GL, chimaera length (chimaeras); CL, carapace length (scampi).

d) A paragraph of generic text. Words in **bold** have defined meanings:

> The core survey area and depth range **is / is not** appropriate for this species. It **occurs in midwater** / is found **shallower than 200 m / deeper than 800 m**.
>
> Area and depth are defined as appropriate if the species distribution is usually between 200 and 800 m and not appropriate if the distribution is typically deeper or shallower or the species is known to occur mainly in midwater.

There were **too few fish caught to determine whether the core survey area is appropriate for this species**.

Sample sizes were too small to describe the distribution.

Biomass of this species is **very well / well / moderately well / poorly** estimated in the core survey area.

- Very well = mean c.v. < 20%
- Well = mean c.v. 20–30%
- Moderately well = mean c.v. 30–40%
- Poorly = mean c.v. > 40%

Biomass has **increased / decreased/ increased then decreased / decreased then increased / shows no clear trend** since the start of the time series.

Definitions were based on a randomisation test of the ranks of the biomass indices. The series of 19 surveys was divided into three (1992–97, 1998–2004, 2005–10). The mean rank for each of the three periods was compared to a test statistic calculated from the 5th and 95th percentile of a random arrangement of ranks from 1000 bootstraps of the data. The test is illustrated graphically in Figure 2.

- If the mean rank of the biomass indices in 1992–97 was significantly ($p < 0.05$) lower and/or mean rank of biomass indices in 2005–10 was significantly higher than expected from a random arrangement of ranks then biomass had increased.
- If mean rank of the biomass indices in 1992–97 was significantly higher and/or mean rank of biomass indices in 2005–10 was significantly lower than expected then biomass had decreased.
- If the mean rank of the biomass indices in 1998–2004 was significantly lower than expected then biomass had decreased then increased.
- If the mean rank of the biomass indices in 1998–2004 was significantly higher than expected then biomass had increased then decreased.
- If the mean rank in each of the three periods was not significantly different from that expected from a random arrangement of ranks then biomass shows no clear trend.

Catch rates are highest in the **north / south / east / west.**

Describes the spatial distribution for species based on frequency of occurrence and catch rate plots where available. More than one area may be selected.

Length frequencies **are usually unimodal / bimodal/ have multiple modes which may contain information about year-class strength**.
Mean length has **increased / decreased/ increased then decreased / decreased then increased / shows no clear trend** since the start of the time series.

For the 45 species where length frequency data are presented, a brief description is provided. Definitions for trends in mean length are the same as those used for biomass indices and were based on a randomisation test of the ranks of the mean lengths (Figure 2).

Gonad stage data indicate that most fish are **immature / resting / maturing / spawning / spent / there is no gonad stage information**.

Summarised gonad stages where data were available.

e) Table of relative biomass estimates for all species and a summary of length data for selected species.

f) Plot of relative biomass estimates. Confidence intervals are based on estimated 5th and 95th percentiles.

g) Distribution plots comparing species' percent occurrence by depth, latitude, and longitude with overall survey effort (see Section 2.5.2 for details).

h) Catch rate plots by survey. Filled circle area is proportional to catch rate, with the circle size scaled to the maximum catch in the time series (Table 5). Crosses are zero catch.

i) Length frequency plots for 45 selected species only (see Section 2.5.3).

j) Plots of numbers at age for hoki, hake, and ling only (see Section 2.5.4).

k) Gonad stage summaries. Numbers show the proportion (by sex) in each gonad stage and the numbers of males and females staged. The staging method is middle depths unless stated (see Section 2.6 for definition of stages).

3. RESULTS

3.1 Survey comparability

All surveys in the time-series used the same vessel, gear, and protocols. The total number of stations ranged between 87 (in 1998) and 194 (in 1993) (see Table 2). Trawl gear parameters have remained relatively consistent within the time series (Table 6).

3.2 Catch and biological sampling

As noted in Section 2.5.1, there were 558 biological groups recorded on the catch database from Chatham Rise surveys 1992–2010 (Table 3). Note that data in Table 3 are from all stations where species were identified and may include some tows outside the core survey area. For example, additional deeper strata (greater than 800 m) were also surveyed in 2000, 2002, 2007, 2008, and (particularly) 2010.

The number of individual species or groups recorded during each survey has more than doubled over the time-series from 137 in 1992 to 286 in 2010 (Figure 3). This increase is largely because of an increase in the level of species identification of invertebrates since 2000, due to more detailed identification guides (e.g., Tracey et al. 2007). This is particularly apparent for groups like cnidarians, crustaceans, echinoderms, molluscs, and sponges (Figure 3). Overall, there was a nine-fold increase in the number of invertebrate groups identified over the time-series (from 14 in 1992 to 125 in 2010), while over the same period the number of fish groups (teleosts and elasmobranchs) identified in each survey varied by only about 30%. There were 161 fish species or groups identified in 2010, but this was inflated by the capture of deepwater species from extra tows down to 1300 m (Stevens et al. in press). The number of fish species caught within the core area has remained between 110 and 140 groups over the time series.

We conclude from Figure 3 that fish (teleosts and elasmobranchs) were relatively consistently and reliably identified over the Chatham Rise trawl time series. As noted in Section 2.5.1, an exception was mesopelagic fish where identification depended on the variable identification skills of those onboard, and several mesopelagic species were grouped (see Table 4). Our ability to correctly identify species has also increased due to taxonomic studies, e.g., most Ray's bream (*Brama brama*) are now identified as southern Ray's bream (*B. australis*), and these species were also grouped (see Table 4). The level of invertebrate indentification has increased over time, and this must be considered when carrying out any species-based analysis of biodiversity (e.g., Tuck et al. 2009). In this report, most invertebrates were grouped at a higher taxonomic level at which we believe identification has been relatively consistent.

However, some benthic invertebrates (e.g., sponges) were not recorded as part of the overall catch in some early surveys (Neil Bagley, NIWA, pers. comm.)

A total of 1 026 313 individuals from 159 groups was measured and 204 593 individuals from 141 groups were individually weighed in surveys from 1992 to 2010 (see Table 3). The level of biological sampling varied between years, but increased greatly over the time series (Figure 4). In 1992, only hoki, hake, and ling were individually weighed, but research staff on the 2010 survey weighed individuals of 122 species. There was a drop in the numbers of fish individually weighed in 2003 and 2004 as part of a short-lived attempt to rationalise data collection by rotating the collection of length and weight data (Livingston et al. 2004, Livingston & Stevens 2005). The number of fish measured varied between 30 000 and 80 000 individuals per survey, with an increase in the number of species measured since 1998 (Figure 4). There was a peak in both the number of species and the number of individuals measured in 2002 in support of an acoustic objective to determine the catchability of demersal fish species (O'Driscoll 2002, 2003).

3.3 Trends in relative biomass

Biomass was estimated for 142 species or groups (Table 7, Section 9). Biomass estimates for surveys from 1992 to 2000 differed slightly (usually less than 1%) from estimates published in the original survey reports (see Table 1) and the earlier review (Livingston et al. 2002b). This is because of small differences in stratification. In this review we re-assigned stations to current strata numbers and areas (see Section 2.1).

Biomass was poorly estimated (arbitrarily defined as mean c.v. greater than 40%) for 93 of the 142 groups (Table 7). Of the remaining 49 groups where biomass was relatively well estimated, the core survey area was considered appropriate for 25 groups: 9 had distributions shallower than 200 m, 13 had distributions deeper than 800 m, and 2 were midwater. The core survey may still provide valid relative indices of abundance for groups where the distribution extends beyond the survey boundaries as long as the proportion inside the survey area is constant.

The rank test used to determine whether there were significant changes in abundance over the time series was unsophisticated, but had the advantage over regression-based metrics (e.g., Bull et al. 2001, Livingston et al. 2002b) that simple non-linear patterns could also be detected (see Figure 2). For the 49 groups where mean c.v.s were less than 40%, biomass decreased significantly since the start of the time series for only two species: hake and rudderfish (Table 7). Hoki and arrow squid also decreased in the middle part of the time series but have subsequently increased. Eighteen groups have increased significantly, 9 increased and then decreased, and 18 showed no clear trend. Note that caution should be applied to interpreting trends in biomass for groups where there is a suggestion that these were inconsistently recorded during early surveys. This includes most benthic invertebrates.

The combined biomass of the 142 species or groups was variable, but showed no clear trend (Figure 5). Combined biomass was high in 1993–94 and 2009–10 and low in 1995, 1998, 2000, 2003, and 2007. This partially reflects changes in abundance of hoki, which were the dominant species in all surveys, but may also indicate some variability in survey catchability. The combined biomass of the 49 relatively well-estimated groups showed a similar pattern to all species (Figure 5). There were increased incidences of sporadic high catches of poorly estimated species since 2000, which has led to fluctuations in the proportion of the overall combined biomass contributed by the well-estimated species (Figure 6). These include large catches of common roughy in 2001, barracouta, alfonsino, and sponge in 2008, and silver warehou and alfonsino in 2010. The proportion of hoki in the catch declined from nearly 60% in 1993 to 21% in 2004, but increased again to make up 30–40% of the total biomass in the past 6 years (Figure 6). The other two target species, ling and hake have typically made up 3–4% and less than 2% of the total survey biomass respectively (Figure 6).

This review differs from the previous review of Livingston et al. (2002b) which focused on the (then) 31 most abundant species. The list of species included by Livingston et al. (2002b) is given in Table 8 along with their current estimated ranking based on summed biomass from 1992 to 2010. Biomasses of some of these 31 abundant species were poorly estimated (Table 8). Table 8 also lists the 49 species identified in this review which had mean c.v.s less than 40%. Our list includes several relatively low abundance species, but because biomass was well estimated, these may provide useful indicators for monitoring ecosystem change over time.

3.4 Length frequency distributions

Scaled length frequencies for 45 species are shown in Section 9. Relatively few species were consistently measured in all 19 years. However, all of the abundant species and most of the species for which biomass is relatively well estimated (see Section 3.3) have been measured since 2007. This will allow us to build up a time-series of length measurements from a broad range of species to monitor size-based ecosystem indicators into the future (e.g. Tuck et al. 2009). Because of the lack of consistent length data, the size-based indices of Tuck et al. (2009) were estimated only for a core group of 15 species (barracouta, black oreo, alfonsino, dark ghost shark, pale ghost shark, hake, hoki, lookdown dory, ling, orange roughy, red cod, spiny dogfish, smooth oreo, silver warehou, and white warehou).

Of the 45 species considered in this report, 28 showed no clear trend in mean length over the period for which length measurements were available, mean length decreased for 7 species, increased for 4 species, decreased then increased for 4 species, and increased then decreased for 2 species (see Table 7).

As well as monitoring mean length, 19 species showed multiple modes in length frequency data which may track changes in year-class strength. This was observed for hoki, hake, and ling, but other well estimated species such as lookdown dory, dark and pale ghost sharks, and sea perch also appear to have length modes which track between years (see Section 9).

3.5 Catch rates

Catch rates and distribution plots provided information on species' distributions. It is not appropriate to use these plots to draw conclusions about the distributions of 12 groups made up of multiple species which may have very different distributions. Of the remaining 130 species or groups, 109 had sufficient information to draw conclusions about depth distribution (see Table 7). Of these, 35 appeared to occur mainly within the core survey depth limits of 200–800 m, the distribution of 27 species or groups extended shallower than 200 m, 37 extended deeper than 800 m, and 10 were midwater. The relatively high number of groups whose depth distributions extend deeper than 800 m suggests that worthwhile gains in the value of the Chatham Rise survey as an ecosystem monitoring tool will be achieved by extending the survey boundaries deeper, as was trialled in 2010 when strata were added down to 1300 m (Stevens et al. in press).
The spatial distribution of individual species was variable. Area preferences ("hotspots") were detected for 63 of the 142 species or groups (see Table 7). Across these 63 groups, there was no particular part of the Chatham Rise with highest catch rates. Instead there was a relatively even distribution of hotspots: 11 groups with highest catches in the east, 14 in the north, 12 in the south, 11 in the west, and 15 with either more widespread or more localised distribution patterns (see Table 7).

3.6 Gonad stages

With the exception of hoki, hake, and ling, collection of data on gonad stages was intermittent. Table 9 summarises modal stages for 33 species. Actual proportions by species are given in Section 9. A third of the species for which gonad stage data were available were elasmobranchs, reflecting an initiative in the past two surveys to collect maturity information on this group. This included the development of an appropriate staging classification for cartilaginous fish (see Section 2.6). Relatively few species were recorded in spawning condition (ripe or running ripe) during the survey. Exceptions include hake, sea perch, barracouta, orange perch, and tarakihi (Table 9).

4. CONCLUSIONS

- With 19 consecutive surveys, the Chatham Rise series is the longest consistent time-series in New Zealand fisheries.

- The core survey area remained the same, although there have been changes in stratification and estimated stratum areas.

- Gear performance metrics were relatively consistent.

- The number of species recorded has more than doubled since the start of the time-series, mainly due to improvements in identification of benthic invertebrates. This needs to be taken into account when estimating species-based indices of diversity.

- Biomass was estimated for 142 species or groups which exceeded selection criteria of more than 10 kg of catch (combined over all surveys) and that occurred in three or more survey years from 1992 to 2009. Of these 49 species or groups were relatively well estimated by the survey (mean c.v. less than 40%).

- Only 2 of the 49 well estimated species or groups declined significantly since the start of the time series, 2 species (including hoki) decreased in the middle part of the time series but subsequently increased, 18 groups increased significantly, 9 increased and then decreased, and 18 showed no clear trend. Total biomass (for the 142 species or groups combined) shows no clear trend over the time-series.

- There was a relatively high number of groups (37) whose depth distributions extend deeper than 800 m. Worthwhile gains in the value of the Chatham Rise survey as an ecosystem monitoring tool will be achieved by extending the survey boundaries deeper, as was trialled in 2010 when strata were added down to 1300 m.

- Over one million individuals of 159 species were measured on Chatham Rise trawl surveys. Of these, 45 species had sufficient information to estimate scaled length frequency distributions by year. Most showed no clear trend in mean length over the period for which length measurements were available. Nineteen species exhibited multiple modes in length frequency data which may track changes in year-class strength.

- Few species were consistently measured in all 19 years. However, all of the abundant species and most of the species for which biomass is relatively well estimated were consistently measured since 2007. We recommend continued collection of length data for well estimated species to allow development of size-based ecosystem indicators.

- With the exception of hoki, hake, and ling, collection of data on gonad stages was intermittent, but increased in recent years, particularly for elasmobranchs. Relatively few species were observed in spawning condition (ripe or running ripe) during the survey.

- Generic input files were written to carry out analyses in SurvCalc. This will allow us to easily and efficiently update these analyses in the future. Outputs from this project can also be used to update ecosystem indicators (Tuck et al. 2009).

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6. REFERENCES

Bagley, N.W.; Hurst, R.J. (1998). Trawl survey of hoki and middle depth species on the Chatham Rise, January 1998 (TAN9801). *NIWA Technical Report 44*. 54 p.

Bagley, N.W.; Livingston, M.E. (2000). Trawl survey of hoki and middle depth species on the Chatham Rise, January 1999 (TAN9901). *NIWA Technical Report 81.* 52 p.

Ballara, S.L.; O'Driscoll, R.L.; Fu, D. (2010). Catches, size, and age structure of the 2007–08 hoki fishery, and a summary of input data used for the 2009 stock assessment. *New Zealand Fisheries Assessment Report 2010/18.* 98 p.

Bull, B.; Dunn, A. (2002). Catch-at-age user manual v1.06.2002/09/12. NIWA Internal Report 114. 23 p. (Unpublished report held in NIWA library, Wellington.)

Bull, B.; Livingston, M.E.; Hurst, R.; Bagley, N. (2001). Upper-slope fish communities on the Chatham Rise, New Zealand, 1992-1999. *New Zealand Journal of Marine and Freshwater Research 35*: 795–815.

Cordue, P.L.; Ballara, S.L.; Horn, P.L. (2000). Hoki ageing: recommendation of which data to routinely record for hoki otoliths. Final Research Report to the Ministry of Fisheries for Project MOF1999/01 (Hoki ageing). 24 p. (Unpublished report held by Ministry of Fisheries, Wellington.)

Francis, R.I.C.C. (1981) Stratified random trawl surveys of deep-water demersal fish stocks around New Zealand. *Fisheries Research Division Occasional Publication 32.* 28 p.

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.

Francis, R.I.C.C. (1989). A standard approach to biomass estimation from bottom trawl surveys. New Zealand Fisheries Assessment Research Document 89/3. 3 p. (Unpublished report held in NIWA library, Wellington.)

Francis, R.I.C.C. (2001). Improving the consistency of hoki age estimation. *New Zealand Fisheries Assessment Report 2001/12.* 18 p.

Francis, R.I.C.C. (2006). Optimum allocation of stations to strata in trawl surveys. *New Zealand Fisheries Assessment Report 2006/23*. 50 p.

Francis, R.I.C.C. (2009). SurvCalc User Manual. 39 p. (Unpublished report held at NIWA, Wellington.)

Heath, R.A. (1985). A review of the physical oceanography of the seas around New Zealand – 1982. *New Zealand Journal of Marine and Freshwater Research 19*: 79–124.

Horn, P.L. (1993). Growth, age structure, and productivity of ling, *Genypterus blacodes* (Ophidiidae), in New Zealand waters. *New Zealand Journal of Marine and Freshwater Research 27:* 385–397.

Horn, P.L. (1994a). Trawl survey of hoki and middle depth species on the Chatham Rise, December 1991-January 1992 (TAN9106). *New Zealand Fisheries Data Report No. 43*. 38 p.

Horn, P.L. (1994b). Trawl survey of hoki and middle depth species on the Chatham Rise, December 1992-January 1993 (TAN9212). *New Zealand Fisheries Data Report No. 44*. 43 p.

Horn, P.L. (1997). An ageing methodology, growth parameters and estimates of mortality for hake (*Merluccius australis*) from around the South Island, New Zealand. *Marine and Freshwater Research 48:* 201–209.

Horn, P.L.; Sullivan, K.J. (1996). Validated aging methodology using otoliths, and growth parameters for hoki (*Macruronus novaezeelandiae*) in New Zealand waters. *New Zealand Journal of Marine and Freshwater Research 30:* 161–174.

Hurst, R.J.; Bagley, N.W. (1994). Trawl survey of middle depth and inshore bottom species off Southland, February-March 1993 (TAN9301). *New Zealand Fisheries Data Report No. 52.* 58 p.

Hurst, R.J.; Bagley, N.; Chatterton, T.; Hanchet, S.; Schofield, K.; Vignaux, M. (1992). Standardisation of hoki/middle depth time series trawl surveys. MAF Fisheries Greta Point Internal Report No. 194. 89 p. (Unpublished report held in NIWA library, Wellington.)

Livingston, M.E.; Bull, B.; Stevens, D.W. (2002a). Migration patterns during the life-cycle of hoki (*Macruronus novaezelandiae*): an analysis of trawl survey data in New Zealand waters 1991–2002.

Final Research Report for Ministry of Fisheries Research Project HOK2000/01 Objective 6. (Unpublished report held by Ministry of Fisheries, Wellington.)

Livingston, M.E.; Bull, B.; Stevens, D.W.; Bagley, N.W. (2002b). A review of hoki and middle depth trawl surveys of the Chatham Rise, January 1992–2001. *NIWA Technical Report 113.* 146 p.

Livingston, M.E.; Schofield, K.A. (1996). Annual changes in the abundance of hoki year classes on the Chatham Rise (January 1992–95) and the Southern Plateau (December 1991–93). New Zealand Fisheries Assessment Research Document 96/14. 35 p. (Unpublished report held by NIWA, Wellington.)

Livingston, M.E.; Stevens, D.W. (2005). Trawl survey of hoki and middle depth species on the Chatham Rise, January 2004 (TAN0401). *New Zealand Fisheries Assessment Report 2005/21.* 62 p.

Livingston, M.E.; Stevens, D.; O'Driscoll, R.L.; Francis, R.I.C.C. (2004). Trawl survey of hoki and middle depth species on the Chatham Rise, January 2003 (TAN0301). *New Zealand Fisheries Assessment Report 2004/16*. 71 p.

McKenzie, A.; Francis, R.I.C.C. (2009). Assessment of hoki (*Macruronus novaezelandiae*) in 2009. *New Zealand Fisheries Assessment Report 2009/63*. 43 p.

McMillan, P.J. (1996). Trawl urvey design and data analysis procedures for deepwater fisheries research. NIWA Fisheries Internal Report No. 253. 26 p. (Unpublished report held by NIWA, Wellington.)

McMillan, P.J.; Francis, M.P.; James, G.D.; Paul, L.J.; Marriott, P.J.; Mackay, E.; Wood, B.A.; Griggs, L.H.; Sui, H.; Wei, F. (in press). A guide to common New Zealand trawl fishes. *New Zealand Aquatic Environment and Biodiversity Report*.

Murphy, R.J.; Pinkerton, M.H.; Richardson, K.M.; Bradford-Grieve, J.M. (2001). Phytoplankton distributions around New Zealand derived from SeaWiFS remotely-sensed ocean colour data. *New Zealand Journal of Marine and Freshwater Research 35*: 343–362.

O'Driscoll, R.L. (2002). Estimates of acoustic:trawl vulnerability ratios from the Chatham Rise and Sub-Antarctic. Final Research Report for Ministry of Fisheries Research Projects HOK 2001/02 Objective 3 and MDT2001/01 Objective 4. 46 p. (Unpublished report held by Ministry of Fisheries, Wellington.)

O'Driscoll, R.L. (2003). Determining species composition in mixed species marks: an example from the New Zealand hoki (*Macruronus novaezelandiae*) fishery. *ICES Journal of Marine Science 60*: 609–616.

O'Driscoll, R. L., Gauthier, S., and Devine, J. (2009). Acoustic surveys of mesopelagic fish: as clear as day and night? *ICES Journal of Marine Science 66*: 1310–1317.

O'Driscoll, R.L.; Hurst, R.J.; Dunn, M.R.; Gauthier, S.; Ballara, S.L. (2010). Trends in relative mesopelagic biomass using time series of acoustic backscatter data from trawl surveys. Final Research Report for Ministry of Fisheries Research Project ENV2009/04. 107 p. (Unpublished report held by Ministry of Fisheries, Wellington.)

Schofield, K.A.; Horn, P.L. (1994). Trawl survey of hoki and middle depth species on the Chatham Rise, January 1994 (TAN9401). *New Zealand Fisheries Data Report No. 53*. 54 p.

Schofield, K.A.; Livingston, M.E. (1995). Trawl survey of hoki and middle depth species on the Chatham Rise, January 1995 (TAN9501). *New Zealand Fisheries Data Report No. 59*. 53 p.

Schofield, K.A.; Livingston, M.E. (1996). Trawl survey of hoki and middle depth species on the Chatham Rise, January 1996 (TAN9601). *New Zealand Fisheries Data Report No. 71*. 50 p.

Schofield, K.A.; Livingston, M.E. (1997). Trawl survey of hoki and middle depth species on the Chatham Rise, January 1997 (TAN9701). *NIWA Technical Report 6*. 51 p.

Stevens, D.W.; Livingston, M.E.; Bagley, N.W. (2001). Trawl survey of hoki and middle depth species on the Chatham Rise, January 2000 (TAN0001). *NIWA Technical Report 104.* 55 p.

Stevens, D.W.; Livingston, M.E.; Bagley, N.W. (2002). Trawl survey of hoki and middle depth species on the Chatham Rise, January 2001 (TAN0101). *NIWA Technical Report 116.* 61 p.

Stevens, D.W.; Livingston, M.E. (2003). Trawl survey of hoki and middle depth species on the Chatham Rise, January 2002 (TAN0201). *New Zealand Fisheries Assessment Report 2003/19*. 57 p.

Stevens, D.W.; O'Driscoll, R.L. (2006). Trawl survey of hoki and middle depth species on the Chatham Rise, January 2005 (TAN0501) *New Zealand Fisheries Assessment Report 2006/13.* 73 p.

Stevens, D.W.; O'Driscoll, R.L. (2007). Trawl survey of hoki and middle depth species on the Chatham Rise, January 2006 (TAN0601) *New Zealand Fisheries Assessment Report 2007/5.* 73 p.

Stevens, D.W.; O'Driscoll, R.L.; Dunn, M.R.; MacGibbon, D.; Horn, P.L.; Gauthier, S. (in press). Trawl survey of hoki and middle depth species on the Chatham Rise, January 2010 (TAN1001). *New Zealand Fisheries Assessment Report.*

Stevens, D.W.; O'Driscoll, R.L.; Gauthier, S (2008). Trawl survey of hoki and middle depth species on the Chatham Rise, January 2007 (TAN0701) *New Zealand Fisheries Assessment Report 2008/52.* 81 p.

Stevens, D.W.; O'Driscoll, R.L.; Horn, P.L. (2009a). Trawl survey of hoki and middle depth species on the Chatham Rise, January 2008 (TAN0801). *New Zealand Fisheries Assessment Report 2009/18.* 86 p.

Stevens, D.W.; O'Driscoll, R.L.; Horn, P.L. (2009b). Trawl survey of hoki and middle depth species on the Chatham Rise, January 2009 (TAN0901). *New Zealand Fisheries Assessment Report 2009/55.* 91 p.

Tracey, D.M.; Anderson, O.F.; Naylor, J.R. (Comps.) (2007). A guide to common deepsea invertebrates in New Zealand waters. Second edition. *New Zealand Aquatic Environment and Biodiversity Report No. 10.*

Tuck, I., Cole, R., Devine, J. (2009). Ecosystem indicators for New Zealand fisheries. *New Zealand Aquatic Environment and Biodiversity Report No. 42*. 188 p.

Vignaux, M. (1994). Documentation of Trawlsurvey Analysis Program. MAF Fisheries Greta Point Internal Report No. 225. 44 p. (Unpublished report held in NIWA library, Wellington.)

7. TABLES

Table 1: Survey dates and documentation for surveys of the Chatham Rise, January 1992–2010.

Year	Trip code	Start date	End date	Reference
1992	TAN9106	28 Dec 1991	1 Feb 1992	Horn (1994a)
1993	TAN9212	30 Dec 1992	6 Feb 1993	Horn (1994b)
1994	TAN9401	2 Jan 1994	31 Jan 1994	Schofield & Horn (1994)
1995	TAN9501	4 Jan 1995	27 Jan 1995	Schofield & Livingston (1995)
1996	TAN9601	27 Dec 1995	14 Jan 1996	Schofield & Livingston (1996)
1997	TAN9701	2 Jan 1997	24 Jan 1997	Schofield & Livingston (1997)
1998	TAN9801	3 Jan 1998	21 Jan 1998	Bagley & Hurst (1998)
1999	TAN9901	3 Jan 1999	26 Jan 1999	Bagley & Livingston (2000)
2000	TAN0001	27 Dec 1999	22 Jan 2000	Stevens et al. (2001)
2001	TAN0101	28 Dec 2000	25 Jan 2001	Stevens et al. (2002)
2002	TAN0201	5 Jan 2002	25 Jan 2002	Stevens & Livingston (2003)
2003	TAN0301	29 Dec 2002	21 Jan 2003	Livingston et al. (2004)
2004	TAN0401	27 Dec 2003	23 Jan 2004	Livingston & Stevens (2005)
2005	TAN0501	27 Dec 2004	23 Jan 2005	Stevens & O'Driscoll (2006)
2006	TAN0601	27 Dec 2005	23 Jan 2006	Stevens & O'Driscoll (2007)
2007	TAN0701	27 Dec 2006	23 Jan 2007	Stevens et al. (2008)
2008	TAN0801	27 Dec 2007	23 Jan 2008	Stevens et al. (2009a)
2009	TAN0901	27 Dec 2008	23 Jan 2009	Stevens et al. (2009b)
2010	TAN1001	2 Jan 2010	28 Jan 2010	Stevens et al. (in press)

Table 2: The number of completed valid biomass stations by stratum for trawl surveys of the Chatham Rise 1992–2010. Stratum boundaries are shown in Figure 1. Boxes indicate surveys in which strata were combined.

Stratum number	Depth range (m)	Location	Area (km^2)	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	600–800	NW Chatham Rise	2 439	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
2A	600–800	NW Chatham Rise	3 253	6	6	3	3	3	4	3	4	3	3	3	3	3	3	3
2B	600–800	NE Chatham Rise	8 503	6	4	4	6					6	5	3	3	6	5	5
3	200–400	Matheson Bank	3 499	3	6	6	3	3	3	3	4	3	3	3	3	3	6	3
4	600–800	SE Chatham Rise	11 315	13	10	8	7	4	5	4	4	3	4	3	3	4	3	3
5	200–400	SE Chatham Rise	4 078	3	4	4	10	5	6	4	5	5	6	5	3	3	3	3
6	600–800	SW Chatham Rise	8 266	7	7	6	3	4	4	4	4	3	3	3	3	3	3	3
7	400–600	NW Chatham Rise	5 233	9	7	11	12	8	7	7	9	8	8	8	6	6	8	7
8A	400–600	NW Chatham Rise	3 286	7	5	5	3	5	7	7	6	3	3	3	3	3	3	3
8B	400–600	NW Chatham Rise	5 722	7	9	7	4					9	5	5	4	5	7	3
9	200–400	NE Chatham Rise	5 136	4	3	4	3	3	4	3	6	8	5	4	7	5	3	3
10A	400–600	NE Chatham Rise	2 958	10	7	5	6	3	6	3	4	4	3	2	3	5	3	3
10B	400–600	NE Chatham Rise	3 363									4	4	3	3	5	3	3
11A	400–600	NE Chatham Rise	2 966	9	12	10	13	5	5	3	4	6	6	3	3	7	5	5
11B	400–600	NE Chatham Rise	2 072									2	3	3	3	4	3	3
11C	400–600	NE Chatham Rise	3 342									7	3	3	3	4	3	3
11D	400–600	NE Chatham Rise	3 368									3	6	3	3	4	3	3
12	400–600	SE Chatham Rise	6 578	9	6	4	7	4	5	3	3	3	3	4	3	3	3	3
13	400–600	SE Chatham Rise	6 681	7	6	4	6	4	6	4	4	4	4	4	3	3	5	3
14	400–600	SW Chatham Rise	5 928	8	6	5	6	4	5	3	3	4	3	3	3	3	3	3
15	400–600	SW Chatham Rise	5 842	12	12	12	3	4	4	5	6	5	5	3	6	4	3	3
16	400–600	SW Chatham Rise	11 522	25	24	21	7	7	8	9	7	8	9	11	6	7	3	6
17	200–400	Veryan Bank	865	3	3	3	3	3	3	3	3	3	3	3	4	3	3	3
18	200–400	Mernoo Bank	4 687	9	17	23	3	5	4	5	4	8	6	9	8	3	5	5
19	200–400	Reserve Bank	9 012	16	25	10	3	8	4	4	10	5	5	4	13	6	8	6
20	200–400	Reserve Bank	9 584	8	12	7	8	4	10	7	7	8	8	6	10	5	6	5
Total			139 498	184	194	165	122	89	103	87	100	128	119	107	115	110	106	96

Table 2 continued:

Stratum number	Depth range (m)	Location	Area (km^2)	2007	2008	2009	2010
1	600–800	NW Chatham Rise	2 439	3	3	3	3
2A	600–800	NW Chatham Rise	3 253	3	3	3	3
2B	600–800	NE Chatham Rise	8 503	5	6	5	5
3	200–400	Matheson Bank	3 499	3	3	3	3
4	600–800	SE Chatham Rise	11 315	3	3	3	3
5	200–400	SE Chatham Rise	4 078	3	3	3	3
6	600–800	SW Chatham Rise	8 266	3	3	3	3
7	400–600	NW Chatham Rise	5 233	7	6	16	9
8A	400–600	NW Chatham Rise	3 286	3	3	3	3
8B	400–600	NW Chatham Rise	5 722	4	5	3	3
9	200–400	NE Chatham Rise	5 136	3	3	3	3
10A	400–600	NE Chatham Rise	2 958	3	3	3	3
10B	400–600	NE Chatham Rise	3 363	4	3	3	3
11A	400–600	NE Chatham Rise	2 966	5	5	4	3
11B	400–600	NE Chatham Rise	2 072	3	3	5	3
11C	400–600	NE Chatham Rise	3 342	3	3	3	3
11D	400–600	NE Chatham Rise	3 368	3	3	3	3
12	400–600	SE Chatham Rise	6 578	3	3	3	3
13	400–600	SE Chatham Rise	6 681	3	3	3	3
14	400–600	SW Chatham Rise	5 928	3	5	3	3
15	400–600	SW Chatham Rise	5 842	3	3	6	3
16	400–600	SW Chatham Rise	11 522	6	6	4	4
17	200–400	Veryan Bank	865	3	5	3	3
18	200–400	Mernoo Bank	4 687	5	4	4	3
19	200–400	Reserve Bank	9 012	6	6	6	5
20	200–400	Reserve Bank	9 584	8	5	7	5
Total			139 498	101	101	108	91

Table 3: Species or groups recorded on all Chatham Rise trawl surveys 1992–2010. Note that data are from all stations where species were identified and may include some tows outside the core survey area.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
ABC	*Astrobrachion constrictum*		Echinoderm	-	0.1	-	-	1
ABR	*Alepisaurus brevirostris*	Shortsnouted lancetfish	Teleost	-	3.8	2	2	1
ACA	*Acanthephyra* spp.		Crustacean	-	0.9	-	-	3
ACO	*Araeosoma coriaceum*	Tam O'Shanter urchin	Echinoderm	-	4.8	-	-	4
ACS	Actinostolidae	Deepsea anemone	Cnidaria	ANT	81.9	-	-	6
ACU	*Acutiserolis* spp.	Spiny serolid isopod	Crustacean	-	0.7	-	-	2
ADT	*Aphrodita* spp.		Other	-	0.2	-	-	2
AFO	*Aristaeomorpha foliacea*	Royal red prawn	Crustacean	-	0.1	-	-	1
AGI	*Argyropelecus gigas*	Giant hatchetfish	Teleost	-	1.5	-	-	6
AGR	*Agrostichthys parkeri*	Ribbonfish	Teleost	AGR	33.3	-	-	9
AIR	*Argyripnus iridescens*	Hatchetfish	Teleost	-	0.1	-	-	1
AMA	*Acesta maui*		Mollusc	-	2.1	-	-	5
AMO	*Aega monophthalma*	Fish biter, isopod	Crustacean	-	0.1	-	-	1
AMP	*Amphitretus* sp.	Deepwater octopod	Cephalopod	-	6.0	-	-	2
ANO	*Anoplogaster cornuta*	Fangtooth	Teleost	-	0.5	-	-	2
ANP	*Anotopterus pharao*	Daggertooth	Teleost	-	0.1	-	-	1
ANT	Anthozoa	Anemones	Cnidaria	ANT	629.6	-	-	18
ANZ	*Ancorina novaezelandiae*	Knobbly sandpaper sponge	Porifera	ONG	17.2	-	-	6
APE	*Acanthephyra pelagica*		Crustacean	-	0.5	-	-	3
APG	Epigonidae	Cardinalfish	Teleost	-	1.3	-	-	2
APH		Amphipod	Crustacean	-	1.2	-	-	3
API	*Alertichthys blacki*	Alert pigfish	Teleost	API	27.3	6	-	17
APR	*Apristurus* spp.	Catshark	Elasmobranch	APR	323.2	61	59	19
ARA	*Araeosoma* spp.	Tam O'Shanter urchin	Echinoderm	ECN	16.8	-	-	3
ASC	Ascidiacea	Sea squirt	Other	-	2.7	-	-	7
ASG	*Acesta saginata*	Lesser giant file shell	Mollusc	-	0.3	-	-	1
ASR		Asteroid (starfish)	Echinoderm	SFI	191.2	-	-	13
AST	Astronesthidae (now Stomiidae)	Snaggletooths	Teleost	-	3.8	-	-	3
ATC	*Paromola petterdi*	Antlered crab	Crustacean	CRB	54.2	-	-	12
AWA	*Astrothorax waitei*		Echinoderm	-	0.8	-	-	5
BAF		Black anglerfish	Teleost	-	0.5	-	-	3
BAM	*Bathyplotes moseleyi*		Echinoderm	HTH	20.0	-	-	6
BAN	*Borostomias antarcticus*		Teleost	-	1.4	-	-	1

Table 3 continued: Species or groups recorded on all Chatham Rise trawl surveys 1992–2010.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
BAR	*Thyrsites atun*	Barracouta	Teleost	BAR	15 091.5	4611	820	19
BAS	*Polyprion americanus*	Bass groper	Teleost	BAS	85.4	5	3	4
BAT	*Rouleina* spp.	Slickheads	Teleost	-	3.7	3	3	3
BBE	*Centriscops humerosus*	Banded bellowsfish	Teleost	BBE	11 314.1	18 078	2 858	19
BBR	*Xenobrama microlepis*	Bronze bream	Teleost	BBR	43.1	11	10	5
BCA	*Magnisudis prionosa*	Barracudina	Teleost	BCA	10.0	8	0	4
BCH	*Brisinga chathamica*		Echinoderm	-	0.2	-	-	1
BCR	*Brotulotaenia crassa*	Blue cusk eel	Teleost	-	1.3	1	1	2
BEE	*Diastobranchus capensis*	Basketwork eel	Teleost	BEE	635.9	573	281	14
BEN	*Benthodesmus* spp.	Scabbardfish	Teleost	-	2.6	-	-	4
BER	*Typhlonarke* spp.	Numbfish	Elasmobranch	BER	59.0	5	5	16
BES	*Benthopecten* spp.		Echinoderm	-	2.4	-	-	6
BGZ	*Kathetostoma* sp.	Banded giant stargazer	Teleost	BGZ	863.3	185	145	9
BHE	*Bathypectinura heros*		Echinoderm	-	0.8	-	-	6
BIV	Bivalvia	Bivalves unidentified	Mollusc	-	4.8	-	-	6
BJA	*Mesobius antipodum*	Black javelinfish	Teleost	-	169.7	188	101	5
BNE	*Benthodesmus elongatus*	Scabbard fish	Teleost	-	1.0	-	-	2
BNO	*Benthoctopus* spp.		Cephalopod	-	2.6	-	-	2
BNS	*Hyperoglyphe antarctica*	Bluenose	Teleost	BNS	1 400.3	273	160	19
BNT	*Benthodesmus tenuis*	Scabbard fish	Teleost	-	0.2	-	-	2
BOC	*Bolocera* spp.	Deepsea anemone	Cnidaria	-	2.5	-	-	4
BOE	*Allocyttus niger*	Black oreo	Teleost	BOE	10 4016	19 336	2 000	19
BOM	*Botrylloides magnocecum*		Other	-	0.1	-	-	1
BOO	*Keratoisis* spp.	Bamboo coral	Cnidaria	-	2.2	-	-	4
BPD	Brachiopoda	Lamp shells	Other	-	2.5	-	-	7
BPI	*Benthopecten pikei*		Echinoderm	-	0.6	-	-	3
BRG	Brisingida		Echinoderm	-	25.1	-	-	5
BRN	Cirripdeia	Barnacle	Crustacean	-	0.1	-	-	1
BRY		Brachyura	Crustacean	-	0.1	-	-	1
BRZ	*Xenocephalus armatus*	Brown stargazer	Teleost	-	0.1	-	-	1
BSH	*Dalatias licha*	Seal shark	Elasmobranch	BSH	2 614.0	415	358	19
BSL	*Xenodermichthys copei*	Black slickhead	Teleost	BSL	492.6	666	258	17
BSP	*Taratichthys longipinnis*	Big-scale pomfret	Teleost	BSP	54.4	9	3	11

Table 3 continued: Species or groups recorded on all Chatham Rise trawl surveys 1992–2010.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
BTA	*Brochiraja asperula*	Smooth deepsea skate	Elasmobranch	SKA	276.0	25	20	17
BTD	*Benthodytes* sp.		Echinoderm	-	1.2	-	-	2
BTG	*Benthoctopus tangaroa*		Cephalopod	-	0.5	-	-	1
BTH	*Brochiraja* spp.	Bluntnose skates deepsea skates	Elasmobranch	SKA	118.5	6	6	10
BTS	*Brochiraja spinifera*	Prickly deepsea skate	Elasmobranch	SKA	224.1	11	8	17
BYD	*Beryx decadactylus*	Longfinned beryx	Teleost	BYD	45.5	47	40	9
BYS	*Beryx splendens*	Alfonsino	Teleost	BYS	77 509.4	20 533	4 766	19
BYX	*Beryx splendens* & *B. decadactylus*	Alfonsino & long-finned beryx	Teleost	-	0.4	-	-	1
CAL	*Caenopedina* sp.	Giant purple pedinid	Echinoderm	-	0.8	-	-	2
CAM	*Camplyonotus rathbunae*	Sabre prawn	Crustacean	-	1.8	-	-	7
CAR	*Cephaloscyllium isabellum*	Carpet shark	Elasmobranch	CAR	189.9	1	-	15
CAS	*Coelorinchus aspercephalus*	Oblique banded rattail	Teleost	CAS	19 473.9	10 646	3 305	19
CAY	*Caryophyllia* spp.		Cnidaria	-	0.3	-	-	2
CBA	*Coryphaenoides dossenus*	Humpback rattail (slender rattail)	Teleost	CBA	192.4	11	7	18
CBB		Coral rubble	Cnidaria	-	9.1	-	-	1
CBE	*Notopogon lilliei*	Crested bellowsfish	Teleost	CBE	266.5	-	-	16
CBI	*Coelorinchus biclinozonalis*	Two saddle rattail	Teleost	CBI	3 202.7	1 077	499	19
CBO	*Coelorinchus bollonsi*	Bollons's rattail	Teleost	CBO	117 007.8	27 252	7 298	19
CBX	*Cubiceps baxteri*	Cubehead	Teleost	CBX	101.9	-	-	4
CCA	*Cubiceps caeruleus*	Cubehead	Teleost	-	49.5	-	-	1
CCO	*Coelorinchus cookianus*	Cooks rattail	Teleost	-	0.4	-	-	1
CCX	*Coelorinchus parvifasciatus*	Small banded rattail	Teleost	CCX	347.6	323	16	17
CDO	*Capromimus abbreviatus*	Capro dory	Teleost	CDO	426.8	56	9	19
CDX	*Coelorinchus maurofasciatus*	Dark banded rattail	Teleost	-	55.8	-	-	3
CDY	*Cosmasterias dyscrita*		Echinoderm	SFI	25.3	-	-	8
CER	*Ceratias* spp.		Teleost	-	0.6	-	-	1
CEX	*Coelorinchus celaenostomus*	Black lip rattail	Teleost	-	1.3	-	-	1
CFA	*Coelorinchus fasciatus*	Banded rattail	Teleost	CFA	1 976.4	1 479	312	19
CGX	*Coelorinchus infuscus*	Dusky rattail	Teleost	-	5.0	-	-	1
CHA	*Chauliodus sloani*	Viper fish	Teleost	-	3.5	-	-	8
CHG	*Chimaera lignaria*	Giant chimaera	Elasmobranch	CHG	151.3	6	6	7
CHI	*Chimaera* spp.	Chimaera	Elasmobranch	-	70.7	-	-	1
CHP	*Chimaera* sp.	Chimaera, brown	Elasmobranch	CHP	50.0	9	9	4

Table 3 continued: Species or groups recorded on all Chatham Rise trawl surveys 1992–2010.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
CHQ	Cranchiidae	Cranchiid squid	Cephalopod	-	9.8	-	-	14
CHR	*Chrysogorgia* spp.	Golden coral	Cnidaria	-	0.1	-	-	1
CHX	*Chaunax pictus*	Pink frogmouth	Teleost	-	0.6	-	-	3
CHY	*Coelorinchus trachycarus*	Roughhead rattail	Teleost	-	10.6	35	35	2
CID	Cidaridae	Cidarid urchin	Echinoderm	-	0.4	-	-	2
CIN	*Coelorinchus innotabilis*	Notable rattail	Teleost	CIN	115.9	348	153	19
CJA	*Crossaster multispinus*	Sun star	Echinoderm	SFI	122.7	-	-	10
CJX	*Coelorinchus mycterismus*	Upturned snout rattail	Teleost	-	0.1	-	-	1
CKA	*Coelorinchus kaiyomaru*	Kaiyomaru rattail	Teleost	-	3.2	28	28	4
CKX	*Coelorinchus trachycarus* & *C. acanthiger*	Spottyfaced rattails (roughhead)	Teleost	-	4.1	-	-	1
CLB	*Clarkcoma bollonsi*		Echinoderm	-	0.3	-	-	3
CMA	*Coelorinchus matamua*	Mahia rattail	Teleost	CMA	523.4	126	119	19
CMP	*Cheiraster monopedicellaris*		Echinoderm	-	0.2	-	-	1
CMR	*Coluzea mariae*		Mollusc	-	0.3	-	-	1
CMT	Comatulida	Feather star	Echinoderm	-	0.2	-	-	1
CMU	*Coryphaenoides murrayi*	Abyssal rattail	Teleost	CMU	41.2	1	1	6
CMX	*Coryphaenoides mcmillani*		Teleost	-	0.5	2	2	1
COB	Antipatharia (Order)	Black coral	Cnidaria	-	0.5	-	-	2
COC	*Austrovenus stutchburyi*	Cockle	Mollusc	-	2.5	-	-	1
COE	Coelenterata		Cnidaria	-	3.1	-	-	1
COF	*Flabellum* spp.	Flabellum coral	Cnidaria	-	6.6	-	-	7
COL	*Coelorinchus oliverianus*	Oliver's rattail	Teleost	COL	15 450.9	15 423	4 036	19
CON	*Conger* spp.	Conger eel	Teleost	-	14.4	-	-	2
COR	Stylasteridae (Family)	Hydrocorals	Cnidaria	-	4.2	-	-	3
COT	*Cottunculus nudus*	Bonyskull toadfish	Teleost	TOA	26.4	-	-	9
COU		Coral (unspecified)	Cnidaria	COU	199.6	-	-	13
COZ	Bryozoa (Phylum)	Bryozoan	Other	-	5.4	-	-	5
CPA	*Ceramaster patagonicus*	Pentagon star	Echinoderm	-	3.1	-	-	4
CRB		Crab	Crustacean	CRB	56.3	-	-	16
CRI	*Crinoidea*	Sea lilies	Echinoderm	-	0.3	-	-	3
CRM	*Callyspongia* cf *ramosa*	Airy finger sponge	Porifera	-	0.6	-	-	3
CRN		Sea lily, stalked crinoid	Echinoderm	-	0.2	-	-	1
CRU		Crustacea	Crustacean	-	0.7	-	-	2

Table 3 continued: Species or groups recorded on all Chatham Rise trawl surveys 1992–2010.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
CSE	*Coryphaenoides serrulatus*	Serrulate rattail	Teleost	CSE	310.6	368	270	19
CSI	*Calliostoma simulans*		Mollusc	-	0.1	-	-	1
CSQ	*Centrophorus squamosus*	Leafscale gulper shark	Elasmobranch	CSQ	4 295.6	297	255	19
CSS	*Calliostoma selectum*	Maurea	Mollusc	-	0.3	-	-	2
CSU	*Coryphaenoides subserrulatus*	Four-rayed rattail	Teleost	CSU	11 72.5	2 890	219	19
CTH	*Coelorinchus acanthiger*	Roughhead rattail	Teleost	-	1.8	-	-	1
CTR	*Coryphaenoides striaturus*	Abyssal rattail	Teleost	-	0.3	1	1	1
CUB	*Cubiceps* spp.	Cubehead	Teleost	-	8.1	-	-	6
CUC	*Chlorophthalmus nigripinnis*	Cucumber fish	Teleost	-	3.0	-	-	6
CVE	*Chiroteuthis veranyi*		Cephalopod	-	0.1	-	-	1
CVI	*Carcinoplax victoriensis*	Two-spined crab	Crustacean	-	10.1	-	-	6
CYL	*Centroscymnus coelolepis*		Elasmobranch	-	7.0	-	-	2
CYO	*Centroscymnus owstoni*	Smooth skin dogfish	Elasmobranch	CYO	3 971.1	511	388	17
CYP	*Centroscymnus crepidater*	Longnosed velvet dogfish	Elasmobranch	CYP	10 631.4	4 044	1 600	19
DAP	*Dagnaudus petterdi*	Antlered crab	Crustacean	CRB	18.1	-	-	6
DCO	*Notophycis marginata*	Dwarf cod	Teleost	DCO	10.5	-	-	18
DCS	*Halaelurus dawsoni*	Dawson's catshark	Elasmobranch	DCS	19.6	9	8	16
DDI	*Desmophyllum dianthus*		Cnidaria	-	6.2	-	-	6
DEA	*Trachipterus trachypterus*	Dealfish	Teleost	DEA	286.3	-	-	15
DGT	Callionymidae	Dragonets	Teleost	-	0.1	-	-	1
DHO	*Dermechinus horridus*	Sea urchin	Echinoderm	-	24.3	-	-	11
DIA	*Diaphus* spp.		Teleost	LAN	787.1	3	-	4
DIP	*Diplophos* spp.		Teleost	-	0.8	-	-	4
DIR	*Diacanthurus rubricatus*	Pagurid	Crustacean	-	1.2	-	-	3
DIS	*Diretmus argenteus*	Discfish	Teleost	-	1.7	-	-	8
DMG	*Dipsacaster magnificus*		Echinoderm	SFI	115.0	-	-	8
DPP	*Diplopteraster* sp.		Echinoderm	-	0.7	-	-	4
DSK	*Amblyraja hyperborea*	Deepwater spiny skate (arctic skate)	Elasmobranch	-	19.3	2	2	2
DSP	*Congiopodus coriaceus*	Deepsea pigfish	Teleost	DSP	53.8	-	-	10
DSS	*Bathylagus* spp.	Deepsea smelt	Teleost	-	5.4	-	-	8
DWD		Deepwater dogfish	Elasmobranch	-	13.1	-	-	1
DWO	*Graneledone* spp.	Deepwater octopus	Cephalopod	OCP	115.7	-	-	16
ECH		Echinodermata	Echinoderm	ECN	114.7	-	-	4

Table 3 continued: Species or groups recorded on all Chatham Rise trawl surveys 1992–2010.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
ECN		Echinoid (sea urchin)	Echinoderm	ECN	22.2	-	-	5
ECR	*Echiodon cryomargarites*	Messmate fish	Teleost	-	0.8	-	-	3
ECT	Echinothuriidae (family)		Echinoderm	-	3.8	-	-	1
EEX	*Enypniastes eximia*		Echinoderm	-	2.2	-	-	1
EGA	*Euciroa galatheae*		Mollusc	-	0.3	-	-	1
EGR	*Myliobatis tenuicaudatus*	Eagle ray	Elasmobranch	-	6.3	-	-	1
ELT	*Electrona* spp.		Teleost	-	1.9	-	-	2
EMA	*Scomber australasicus*	Blue mackerel	Teleost	EMA	66.1	41	14	12
EMG	*Emarginula* spp.		Mollusc	-	0.1	-	-	1
EPD	*Epigonus denticulatus*	White cardinalfish	Teleost	-	19.2	22	2	3
EPL	*Epigonus lenimen*	Bigeye cardinalfish	Teleost	CDL	248.0	214	55	17
EPO	*Melanostigma gelatinosum*	Limp eel pout	Teleost	-	0.1	-	-	1
EPR	*Epigonus robustus*	Robust cardinalfish	Teleost	CDL	131.7	235	89	19
EPT	*Epigonus telescopus*	Deepsea cardinalfish	Teleost	EPT	550.5	1 009	487	19
EPZ	*Epizoanthus* sp.		Cnidaria	-	1.3	-	-	4
ERA	*Torpedo fairchildi*	Electric ray	Elasmobranch	ERA	310.9	2	2	19
ERE	*Euplectella regalis*	Basket-weave horn sponge	Porifera	-	1.4	-	-	1
ERO	*Enallopsammia rostrata*	Deepwater branching coral	Cnidaria	-	0.1	-	-	1
ERR	*Errina* spp.	Red coral	Cnidaria	-	0.1	-	-	1
ETB	*Etmopterus baxteri*	Baxter's lantern dogfish	Elasmobranch	ETB	9 344.6	2 794	1 205	19
ETL	*Etmopterus lucifer*	Lucifer dogfish	Elasmobranch	ETL	2 258.9	2 380	888	19
ETP	*Etmopterus pusillus*		Elasmobranch	-	5.3	-	-	1
EUC	*Euclichthys polynemus*	Eucla cod	Teleost	-	1.4	-	-	3
EUN	*Eunice*	Eunice sea-worm, polychaete	Other	-	0.7	-	-	4
EUP		Euphausiid	Crustacean	-	4.4	-	-	5
EZE	*Enteroctopus zealandicus*	Yellow octopus	Cephalopod	OCP	160.1	-	-	6
FAN	*Pterycombus petersii*	Fanfish	Teleost	-	3.6	-	-	1
FHD	*Hoplichthys haswelli*	Deepsea flathead	Teleost	FHD	740.3	17	5	19
FIS		Fish	Teleost	-	26.1	-	-	7
FLA		Flatfish	Teleost	-	0.6	-	-	2
FMA	*Fusitriton magellanicus*		Mollusc	FMA	89.3	-	-	10
FRO	*Lepidopus caudatus*	Frostfish	Teleost	FRO	609.4	359	88	15
FRS	*Chlamydoselachus anguineus*	Frill shark	Elasmobranch	FRS	61.3	2	2	7

Table 3 continued: Species or groups recorded on all Chatham Rise trawl surveys 1992–2010.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
FUN	*Funchalia* spp.		Crustacean	-	3.1	-	-	5
GAL		Galatheid	Crustacean	-	1.1	-	-	4
GAN	*Gastroptychus novaezelandiae*		Crustacean	-	0.2	-	-	2
GAO	*Gadomus aoteanus*	Filamentous rattail	Teleost	-	0.8	2	2	1
GAS	Gastropoda	Gastropods	Mollusc	GAS	27.0	-	-	9
GAT	*Gastroptychus* spp.	.	Crustacean	-	0.1	-	-	1
GDU	*Goniocorella dumosa*	Bushy hard coral	Cnidaria	COU	49.5	-	-	5
GEL	*Gonostoma elongatum*	Elongate lightfish	Teleost	-	0.4	-	-	3
GGC	*Guttigadus globiceps*		Teleost	-	0.3	-	-	1
GIN	*Glyptometra inaequalis*		Echinoderm	-	0.2	-	-	2
GLO	*Glyphocrangon lowryi*	Goblin prawn	Crustacean	-	0.1	-	-	1
GLS	Hexactinellida (Class)	Glass sponges	Porifera	ONG	9 530.5	-	-	3
GMC	*Leptomithrax garricki*	Garrick's masking crab	Crustacean	-	1.5	-	-	2
GOC	Gorgonacea (Order)	Gorgonian coral	Cnidaria	-	2.6	-	-	7
GON	*Gonorynchus forsteri* & *G. greyi*	Sandfish	Teleost	GON	26.0	-	-	16
GOR	*Gorgonocephalus* spp.		Echinoderm	SFI	96.4	-	-	10
GOU	*Goniocidaris umbraculum*	Cidarid urchin	Echinoderm	-	2.0	-	-	7
GPA	*Goniocidaris parasol*	Sea urchin	Echinoderm	ECN	13.5	-	-	10
GPU	*Gorgonocephalus pustulatum*		Echinoderm	-	0.1	-	-	1
GRC	*Tripterophycis gilchristi*	Grenadier cod	Teleost	-	6.0	-	-	13
GRM	*Gracilechinus multidentatus*	Sea urchin	Echinoderm	ECN	673.0	-	-	15
GSC	*Jacquinotia edwardsii*	Giant spider crab	Crustacean	-	3.8	-	-	1
GSH	*Hydrolagus novaezealandiae*	Ghost shark	Elasmobranch	GSH	134 824.7	55 743	11 975	19
GSP	*Hydrolagus bemisi*	Pale ghost shark	Elasmobranch	GSP	45 453.9	19 640	7 894	19
GSQ	*Architeuthis* spp.	Giant squid	Cephalopod	-	301.7	1	1	3
GST	Gonostomatidae		Teleost	-	3.8	-	-	4
GTC	*Gastroptychus* spp.		Crustacean	-	0.4	-	-	1
GUR	*Chelidonichthys kumu*	Gurnard	Teleost	GUR	57.5	56	-	7
GVE	*Geodinella vestigifera*	Convoluted ostrich egg sponge	Porifera	ONG	19.4	-	-	5
GVO	*Provocator mirabilis*	Golden volute	Mollusc	-	2.7	-	-	5
GYM	*Gymnoscopelus* spp.		Teleost	-	0.7	-	-	3
GYS	*Gyrophyllum sibogae*	Siboga sea pen	Cnidaria	-	0.1	-	-	1
HAG	*Eptatretus cirrhatus*	Hagfish	Agnathan	HAG	33.6	-	-	16

Table 3 continued: Species or groups recorded on all Chatham Rise trawl surveys 1992–2010.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
HAK	*Merluccius australis*	Hake	Teleost	HAK	27 193.0	6 493	5 913	19
HAL	*Halosauropsis macrochir*	Abyssal halosaur	Teleost	-	1.6	-	-	4
HAP	*Polyprion oxygeneios*	Hapuku	Teleost	HAP	2 108.4	369	249	19
HAT	Sternoptychidae	Hatchetfish	Teleost	-	1.3	-	-	9
HCO	*Bassanago hirsutus*	Hairy conger	Teleost	HCO	1 496.7	18	4	19
HDR	Hydrozoa (Class)	Hydroid	Cnidaria	-	1.9	-	-	5
HEC	*Henricia compacta*		Echinoderm	-	0.2	-	-	2
HEP	*Heptranchias perlo*	Sharpnose sevengill shark	Elasmobranch	-	3.3	-	-	1
HEX	*Hexanchus griseus*	Sixgill shark	Elasmobranch	HEX	280.2	2	2	10
HIA	*Himantolophus appelii*	Prickly anglerfish	Teleost	-	0.3	-	-	1
HJO	*Halargyreus johnsonii*	Johnson's cod	Teleost	HJO	1 127.8	1 030	556	19
HMT	Hormathiidae	Deepsea anemone	Cnidaria	ANT	41.8	-	-	7
HOK	*Macruronus novaezelandiae*	Hoki	Teleost	HOK	1 400 270.6	402 886	32 890	19
HOL	*Holtbyrnia* sp.	Tubeshoulder	Teleost	-	5.4	-	-	4
HPE	*Halosaurus pectoralis*	Common halosaur	Teleost	-	7.4	-	-	5
HSI	*Haliporoides sibogae*	Jackknife prawn	Crustacean	-	0.8	-	-	5
HTH	Holothurian unidentified	Sea cucumber	Echinoderm	HTH	89.8	-	-	8
HTR	*Hippasteria phrygiana*	Trojan starfish	Echinoderm	SFI	121.3	-	-	10
HTU	*Hyalinoecia tubicola*	Quill worm	Other	-	1.1	-	-	2
HYA	*Hyalascus* sp.	Floppy tubular sponge	Porifera	ONG	13381.7	-	-	5
HYB	*Hydrolagus* sp a	Black ghost shark	Elasmobranch	-	3.2	1	1	1
HYD	*Hydrolagus* sp.		Elasmobranch	-	0.1	-	-	1
HYP	*Hydrolagus trolli*	Pointynose blue ghost shark	Elasmobranch	-	4.8	1	1	1
IDI	*Idiacanthus* spp.	Black dragonfishes	Teleost	-	1.1	-	-	6
IRC	*Ircinia* spp.	Grey sponge	Porifera	-	0.4	-	-	1
ISI	Isididae	Bamboo corals	Cnidaria	-	0.2	-	-	2
ISO		Isopod	Crustacean	-	0.2	-	-	1
JAV	*Lepidorhynchus denticulatus*	Javelinfish	Teleost	JAV	119 536.9	55 515	8 621	19
JFI		Jellyfish	Cnidaria	JFI	502.7	-	-	16
JGU	*Pterygotrigla picta*	Spotted gurnard	Teleost	-	10.8	-	-	1
JMA	*Trachurus* spp.	Jack mackerel	Teleost	-	19.1	16	15	1
JMD	*Trachurus declivis*	Greenback jack mackerel	Teleost	JMD	147.4	87	36	18
JMM	*Trachurus murphyi*	Slender jack mackerel	Teleost	JMM	5 463.3	3 548	217	19

Table 3 continued: Species or groups recorded on all Chatham Rise trawl surveys 1992–2010.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
KBL	*Durvillea* spp.	Kelp bull	Algae	-	6.2	-	-	2
KWH	*Austrofucus glans*	Knobbed whelk	Mollusc	-	0.1	-	-	1
LAE	*Laemonema* spp.		Teleost	-	0.5	-	-	1
LAG	*Laetmogone* spp.		Echinoderm	HTH	13.0	-	-	6
LAN	Myctophidae	Lantern fish	Teleost	LAN	146.7	1 238	-	18
LCH	*Harriotta raleighana*	Long-nosed chimaera	Elasmobranch	LCH	8 185.6	2 612	1 977	19
LCO	*Liocarcinus corrugatus*	Dwarf swimming crab	Crustacean	-	0.1	-	-	1
LDO	*Cyttus traversi*	Lookdown dory	Teleost	LDO	70 218.8	80 040	15 416	19
LHE	*Lampanyctodes hectoris*		Teleost	LAN	3 980.7	5	-	5
LHO	*Lipkius holthuisi*	Omega prawn	Crustacean	LHO	34.9	-	-	15
LIM		Limpets	Mollusc	-	0.1	-	-	1
LIN	*Genypterus blacodes*	Ling	Teleost	LIN	98 116.9	34 641	23 307	19
LIP	*Liponema* spp.	Deepsea anemone	Cnidaria	-	0.6	-	-	3
LIS	*Lissodendoryx* n sp1	Yellow slimey	Porifera	-	0.1	-	-	1
LLC	*Leptomithrax longipes*	Long-legged masking crab	Crustacean	-	0.2	-	-	1
LLE	*Lepidisis* spp.	Bamboo coral	Cnidaria	-	0.1	-	-	1
LLT	*Lithodes* cf. *longispinus*	Long-spined king crab	Crustacean	-	0.7	-	-	1
LMU	*Lithodes murrayi*	Murray's king crab	Crustacean	CRB	48.6	-	-	11
LNV	*Lithosoma novaezelandiae*	Rock star	Echinoderm	-	2.6	-	-	6
LOP	*Loricella profundior*		Mollusc	-	0.1	-	-	1
LPA	*Lampanyctus* spp.		Teleost	LAN	12.0	-	-	9
LPD	*Lampadena* spp.		Teleost	-	0.1	-	-	1
LPH	*Haplophryne mollis*		Teleost	-	0.1	-	-	1
LSO	*Pelotretis flavilatus*	Lemon sole	Teleost	LSO	692.2	1 256	221	19
LYC	*Lyconus* sp.		Teleost	-	1.3	-	-	1
LZE	*Lima zealandica*		Mollusc	-	0.1	-	-	1
MAK	*Isurus oxyrinchus*	Mako shark	Elasmobranch	MAK	1 013.0	-	-	8
MAL	Malacosteidae (now Stomiidae)	Loosejaw	Teleost	-	1.1	-	-	6
MAN	*Neoachiropsetta milfordi*	Finless flounder	Teleost	MAN	71.6	3	3	19
MCA	*Macrourus carinatus*	Ridge scaled rattail	Teleost	MCA	268.8	226	136	16
MDA	*Macroparalepis danae*		Teleost	-	0.2	-	-	1
MDO	*Zenopsis nebulosus*	Mirror dory	Teleost	MDO	111.9	7	2	14
MEL	*Melanonus gracilis*		Teleost	-	0.1	-	-	1

Table 3 continued: Species or groups recorded on all Chatham Rise trawl surveys 1992–2010.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
MEN	*Melanostomias* spp.		Teleost	-	0.5	-	-	3
MEZ	*Melanonus zugmayeri*		Teleost	-	0.1	-	-	1
MGA	*Munida gracilis*		Crustacean	-	0.4	-	-	3
MIQ	*Onykia ingens*	Warty squid	Cephalopod	SQX	2 264.5	41	33	18
MMA	*Macroparalepis macrugeneion*		Teleost	-	0.5	-	-	3
MMU	*Maurolicus australis*	Pearlside	Teleost	LAN	4 845.2	1 022	-	5
MNI	*Munida* spp.		Crustacean	-	2.6	-	-	4
MOC	*Madrepora oculata*		Cnidaria	-	0.2	-	-	1
MOD	Moridae	Morid cods	Teleost	-	0.4	-	-	2
MOL		Molluscs	Mollusc	-	5.8	-	-	6
MOP	*Molpadia* spp.		Echinoderm	-	0.2	-	-	1
MRQ	*Onykia robsoni*	Warty squid	Cephalopod	SQX	111.7	13	2	10
MSL	*Mediaster sladeni*	Starfish	Echinoderm	SFI	115.5	-	-	10
MSQ	*Mastigoteuthis* sp.		Cephalopod	-	1.4	-	-	1
MST	Melanostomiidae (now Stomiidae)		Teleost	-	0.7	-	-	3
MTH	*Mesothuria* spp.		Echinoderm	-	0.1	-	-	1
MUN	*Munida gregaria*		Crustacean	-	2.3	-	-	7
MUS		Mussels	Mollusc	-	0.3	-	-	1
MYS		Mysid	Crustacean	-	0.2	-	-	2
NAT		Natant decapod	Crustacean	-	2.6	-	-	4
NAU	*Notostomus auriculatus*		Crustacean	-	0.2	-	-	2
NBI	*Neomyxine biniplicata*		Teleost	-	0.2	-	-	2
NBU	*Kuronezumia bubonis*	Bulbous rattail	Teleost	-	2.9	1	1	3
NCO	*Notoscopelus* spp.		Teleost	-	0.1	-	-	1
NCU	*Nemichthys curvirostris*		Teleost	-	0.2	-	-	1
NEB	*Neolithodes brodiei*	Brodie's king crab	Crustacean	CRB	24.0	-	-	7
NEC	*Nematocarcinus* spp.		Crustacean	-	0.1	-	-	1
NEI	*Neognathophausia ingens*	Giant red mysid	Crustacean	-	0.1	-	-	1
NEM	*Nemichthys scolopaceus*	Slender snipe eel	Teleost	-	0.7	-	-	1
NEN	*Neonesthes capensis*	Deepsea snaggletooth	Teleost	-	0.1	-	-	1
NEX	Nemichthyidae	Snipe eels	Teleost	-	0.2	-	-	2
NHU	*Neommatocarcinus huttoni*	Policeman crab	Crustacean	-	0.3	-	-	1
NMA	*Notopandalus magnoculus*		Crustacean	-	0.3	-	-	2

Table 3 continued: Species or groups recorded on all Chatham Rise trawl surveys 1992–2010.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
NNA	*Nezumia namatahi*		Teleost	-	3.7	1	1	6
NOC	*Notacanthus chemnitzi*		Teleost	-	1.1	1	1	1
NOF	*Notopogon fernandezianus*	Orange bellowsfish	Teleost	-	0.3	-	-	1
NOS	*Nototodarus sloanii*	NZ southern arrow squid	Cephalopod	NOS	11 967.4	15 889	1 471	19
NSD	*Squalus griffini*	Northern spiny dogfish	Elasmobranch	NSD	500.8	161	84	18
NUD	Nudibranchia		Mollusc	-	1.2	-	-	3
OAR	*Regalecus glesne*	Oarfish	Teleost	OAR	57.6	-	-	4
OBE	*Ogmocidaris benhami*	Cidarid urchin	Echinoderm	-	0.1	-	-	1
OCP		Octopod	Cephalopod	OCP	43.9	-	-	7
OCT	*Pinnoctopus cordiformis*	Octopus	Cephalopod	OCT	252.7	-	-	11
ODT	*Odontaster* spp.	Pentagonal tooth-star	Echinoderm	-	4.3	-	-	7
OEO		Oreos	Teleost	-	0.1	-	-	1
OFH	*Ruvettus pretiosus*	Oilfish	Teleost	OFH	132.1	2	2	7
OIR	*Ophiuroglypha irrorata*		Echinoderm	-	0.1	-	-	1
OME	*Octopus mernoo*		Cephalopod	-	0.6	-	-	2
OMI	*Opostomias micripnus*		Teleost	-	1.1	-	-	1
ONG	Porifera (Phylum)	Sponges	Porifera	ONG	69 359.9	-	-	18
ONO	*Oplophorus novaezeelandiae*		Crustacean	-	2.7	-	-	8
OPA	*Hemerocoetes* spp.	Opalfish	Teleost	-	2.9	-	-	11
OPE	*Lepidoperca aurantia*	Orange perch	Teleost	OPE	11 294.3	4 091	1 427	19
OPH		Ophiuroid (brittle star)	Echinoderm	SFI	11.5	-	-	10
OPI	*Opisthoteuthis* spp.	Umbrella octopus	Cephalopod	OCP	101.4	-	-	10
OPP	*Oplophorus* spp.		Crustacean	-	0.5	-	-	1
ORH	*Hoplostethus atlanticus*	Orange roughy	Teleost	ORH	2 893.2	3 223	738	18
ORO	*Ophiacantha rosen*		Echinoderm	-	0.3	-	-	2
OSQ	Octopoteuthiidae		Cephalopod	-	0.9	-	-	2
OVI	*Oculina virgosa*		Cnidaria	-	0.3	-	-	1
OVM	*Ovalipes molleri*	Swimming crab	Crustacean	CRB	11.4	-	-	4
PAC	*Pholadidea acherontea*		Mollusc	-	0.1	-	-	1
PAG	Paguroidea	Hermit crab	Crustacean	CRB	21.9	-	-	10
PAL	Paralepididae	Barracudinas	Teleost	-	5.9	-	-	9
PAM	*Pannychia moseleyi*		Echinoderm	-	6.9	-	-	3
PAO	*Pillsburiaster aoteanus*		Echinoderm	-	3.8	-	-	7

Table 3 continued: Species or groups recorded on all Chatham Rise trawl surveys 1992–2010.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
PAS	*Pasiphaea* spp.		Crustacean	-	4.8	-	-	4
PAZ	*Pachymatisma* spp.		Porifera	-	0.3	-	-	1
PBA	*Pasiphaea barnardi*		Crustacean	-	2.6	-	-	6
PBU	*Phormosoma bursarium*	Tam O'Shanter urchin	Echinoderm	ECN	14.2	-	-	3
PCD	*Poriocidaris purpurata*	Cidarid urchin	Echinoderm	-	0.7	-	-	1
PCH	*Penion chathamensis*		Mollusc	-	2.1	-	-	4
PDE	*Propagurus deprofundis*		Crustacean	-	0.2	-	-	2
PDG	*Oxynotus bruniensis*	Prickly dogfish	Elasmobranch	PDG	6 57.3	21	19	19
PDI	*Parapagurus dimorphus*		Crustacean	-	2.7	-	-	1
PED	*Aristaeopsis edwardsiana*	Scarlet prawn	Crustacean	-	0.4	-	-	4
PER	*Persparsia kopua*		Teleost	-	1.8	-	-	5
PET	*Petrosia* spp.		Porifera	-	0.1	-	-	1
PFI	*Porcellanopagurus filholi*		Crustacean	-	0.3	-	-	3
PFL	*Pseudechinus flemingi*	Sea urchin	Echinoderm	-	0.8	-	-	4
PHB	*Phorbas* spp.	Grey fibrous massive sponge	Porifera	-	1.0	-	-	3
PHL	*Paralophaster hyalinus*		Echinoderm	-	0.1	-	-	1
PHM	*Phormosoma* spp.		Echinoderm	-	0.3	-	-	2
PHO	*Phosichthys argenteus*	Lighthouse fish	Teleost	LAN	42.0	1	-	19
PHS	*Paralomis hystrix*		Crustacean	CRB	21.4	-	-	8
PHW	*Psammocinia* cf *hawere*		Porifera	-	0.2	-	-	1
PHY		Phyllosoma	Crustacean	-	0.4	-	-	3
PIG	*Congiopodus leucopaecilus*	Pigfish	Teleost	PIG	32.4	-	-	13
PKN	*Plutonaster knoxi*	Abyssal star	Echinoderm	SFI	46.4	-	-	5
PLA	*Platyberyx* sp.		Teleost	-	6.5	-	-	1
PLC	*Plectranthias maculicauda*		Teleost	-	2.8	-	-	1
PLI	*Peribolaster lictor*	Starfish	Echinoderm	-	0.6	-	-	2
PLM	*Plesionika martia*		Crustacean	-	0.3	-	-	3
PLN	*Poecillastra laminaris*	Chipped fibreglass matt sponge	Porifera	-	1.1	-	-	1
PLS	*Centroscymnus plunketi*	Plunket's shark	Elasmobranch	PLS	1 602.6	112	98	18
PLT	*Plutonaster* spp.		Echinoderm	SFI	437.1	-	-	9
PLU	*Physiculus luminosa*		Teleost	-	0.2	-	-	1
PLY	*Polycheles* spp.	Polychelidae	Crustacean	-	4.9	-	-	8
PMO	*Pseudostichopus mollis*		Echinoderm	HTH	94.1	-	-	4

Table 3 continued: Species or groups recorded on all Chatham Rise trawl surveys 1992–2010.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
PMU	*Paramaretia peloria*	Heart urchin	Echinoderm	ECN	152.4	-	-	10
PNE	*Proserpinaster neozelanicus*		Echinoderm	-	11.0	-	-	5
PNN	*Pennatula* spp.	Purple sea pen	Cnidaria	-	1.4	-	-	3
PNR	*Penares* spp.		Porifera	-	1.2	-	-	2
POL	Polychaeta	Polychaete	Other	-	0.8	-	-	4
POS	*Lamna nasus*	Porbeagle shark	Elasmobranch	POS	275.2	1	-	4
PRA		Prawn	Crustacean	-	5.2	-	-	10
PRK	*Ibacus alticrenatus*	Prawn killer	Crustacean	-	2.4	-	-	6
PRU	*Pseudechinaster rubens*		Echinoderm	SFI	15.4	-	-	6
PSI	*Psilaster acuminatus*	Geometric star	Echinoderm	SFI	224.7	-	-	10
PSK	*Bathyraja shuntovi*	Longnosed deepsea skate	Elasmobranch	SKA	43.8	8	7	7
PSO	*Psolus* spp.		Echinoderm	-	0.2	-	-	1
PSQ	*Pholidoteuthis boschmai*		Cephalopod	-	8.0	-	-	2
PSY	*Psychrolutes microporos*	Psychrolutes	Teleost	TOA	64.6	6	6	7
PTA	*Pasiphaea* aff. *tarda*	Deepwater prawn	Crustacean	-	3.6	-	-	4
PTB	*Pteraster bathamae*		Echinoderm	-	0.1	-	-	1
PTM	*Platymaia maoria*	Dell's spider crab	Crustacean	-	0.5	-	-	1
PTU	Pennatulacea (Order)	Sea pens	Cnidaria	-	2.3	-	-	4
PVE	*Pyramodon ventralis*	Pearlfish	Teleost	-	0.1	-	-	1
PYC	Pycnogonida	Sea spiders	Other	-	0.1	-	-	1
PYR	*Pyrosoma atlanticum*		Other	SAL	428.8	-	-	6
PZE	*Paralomis zealandica*	Prickly king crab	Crustacean	CRB	12.0	-	-	7
QSC	*Zygochlamys delicatula*	Queen scallop	Mollusc	-	0.1	-	-	1
RAG	*Pseudoicichthys australis*	Ragfish	Teleost	RAG	160.3	-	-	9
RAT	Macrouridae	Rattails	Teleost	-	7.6	-	-	3
RBM	*Brama brama*	Ray’s bream	Teleost	RBM	5 733.0	2 926	832	17
RBT	*Emmelichthys nitidus*	Redbait	Teleost	RBT	1 320.1	697	165	18
RBY	*Plagiogeneion rubiginosum*	Ruby fish	Teleost	RBY	841.5	270	123	17
RCH	*Rhinochimaera pacifica*	Widenosed chimaera	Elasmobranch	RCH	743.6	124	111	18
RCO	*Pseudophycis bachus*	Red cod	Teleost	RCO	10 907.8	7 572	1 395	19
RDO	*Cyttopsis roseus*	Rosy dory	Teleost	-	5.6	16	-	1
RGR	*Radiaster gracilis*		Echinoderm	-	1.1	-	-	4
RHY	*Paratrachichthys trailli*	Common roughy	Teleost	RHY	44 541.4	924	96	19

Table 3 continued: Species or groups recorded on all Chatham Rise trawl surveys 1992–2010.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
RIB	*Mora moro*	Ribaldo	Teleost	RIB	5 038.4	2 621	1 629	19
RIS	*Bathyraja richardsoni*	Richardson's skate	Elasmobranch	-	2.5	-	-	1
ROC	*Lotella rhacinus*	Rock cod	Teleost	-	13.6	-	-	2
ROS	*Rosenblattia robusta*	Rotund cardinalfish	Teleost	-	0.7	1	1	2
RSK	*Zearaja nasuta*	Rough skate	Elasmobranch	RSK	773.4	45	43	16
RSQ	*Ommastrephes bartrami*		Cephalopod	-	292.7	3	-	13
RUD	*Centrolophus niger*	Rudderfish	Teleost	RUD	5 450.5	103	27	19
SAB	*Evermanella indica*	Sabretooth	Teleost	-	0.1	-	-	1
SAL		Salps	Other	SAL	1 568.9	-	-	15
SAU	*Scomberesox saurus*	Saury	Teleost	-	0.5	1	-	3
SAW	*Serrivomer* sp.	Sawtooth eel	Teleost	-	0.2	-	-	2
SBI	*Alepocephalus australis*	Bigscaled brown slickhead	Teleost	SBI	976.7	1 082	278	4
SBK	*Notacanthus sexspinis*	Spineback	Teleost	SBK	1 389.5	174	105	19
SBO	*Pseudopentaceros richardsoni*	Southern boarfish	Teleost	-	6.9	-	-	4
SBR	*Pseudophycis barbata*	Southern bastard cod	Teleost	-	1.6	-	-	1
SBW	*Micromesistius australis*	Southern blue whiting	Teleost	SBW	2 255.3	1 445	369	19
SCC	*Stichopus mollis*	Sea cucumber	Echinoderm	HTH	212.7	-	-	11
SCG	*Lepidotrigla brachyoptera*	Scaly gurnard	Teleost	SCG	200.9	120	-	19
SCH	*Galeorhinus galeus*	School shark	Elasmobranch	SCH	3 549.8	222	162	19
SCI	*Metanephrops challengeri*	Scampi	Crustacean	SCI	336.5	2 572	1 371	19
SCO	*Bassanago bulbiceps*	Swollenhead conger	Teleost	SCO	2 759.5	51	21	19
SCP	*Scopelarchus* sp.		Teleost	-	0.4	-	-	2
SDE	*Cryptopsaras couesi*	Seadevil	Teleost	-	6.2	-	-	9
SDF	*Azygopus pinnifasciatus*	Spotted flounder	Teleost	-	3.1	-	-	11
SDM	*Sympagurus dimorphus*	Pagurid	Crustacean	-	6.7	-	-	5
SDO	*Cyttus novaezealandiae*	Silver dory	Teleost	SDO	14 207.9	1 277	75	19
SEO		Seaweed	Algae	SEO	59.3	-	-	7
SEP	*Sergia potens*		Crustacean	-	0.5	-	-	3
SEQ	Sepiolidae	Sepiolid squid	Cephalopod	-	0.5	-	-	4
SER	*Sergestes* spp.		Crustacean	-	3.7	-	-	5
SFI	Asteroidea & Ophiuroidea	Starfish	Echinoderm	SFI	313.9	-	-	9
SHE	*Scymnodalatias sherwoodi*	Sherwoods dogfish	Elasmobranch	-	0.2	-	-	1
SIA	Scleractinia	Stony corals	Cnidaria	COU	17.6	-	-	4

Table 3 continued: Species or groups recorded on all Chatham Rise trawl surveys 1992–2010.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
SIP	Sipuncula	Unsegmented worms	Other	-	0.1	-	-	1
SKA	Rajidae Arhynchobatidae (Families)	Skate	Elasmobranch	SKA	815.2	-	-	3
SKI	*Rexea solandri*	Gemfish	Teleost	SKI	40.8	9	-	3
SLG	*Scutus breviculus*	Sea slug	Mollusc	-	0.1	-	-	1
SLT	*Stelletta* spp.		Porifera	-	0.9	-	-	1
SMC	*Lepidion microcephalus*	Small-headed cod	Teleost	SMC	59.7	44	41	16
SMK	*Teratomaia richardsoni*	Spiny masking crab	Crustacean	-	9.4	-	-	7
SMO	*Sclerasterias mollis*	Cross-fish	Echinoderm	SFI	14.2	-	-	7
SMT	*Spatangus mathesoni*		Echinoderm	-	0.1	-	-	1
SND	*Deania calcea*	Shovelnose spiny dogfish	Elasmobranch	SND	43 022.3	11 992	5 568	19
SNE	*Simenchelys parasiticus*	Snubnosed eel	Teleost	-	0.4	1	1	2
SOC	Alcyonacea (Order)	Soft coral	Cnidaria	-	1.0	-	-	3
SOP	*Somniosus pacificus*	Pacific sleeper shark	Elasmobranch	-	800.0	-	-	1
SOR	*Neocyttus rhomboidalis*	Spiky oreo	Teleost	SOR	40 271.5	16 058	3 349	19
SOT	*Solaster torulatus*		Echinoderm	SFI	35.5	-	-	9
SPD	*Squalus acanthias*	Spiny dogfish	Elasmobranch	SPD	76 401.5	28 581	7 700	19
SPE	*Helicolenus* spp.	Sea perch	Teleost	SPE	48 878.7	51 741	12 467	19
SPF	*Pseudolabrus miles*	Scarlet wrasse	Teleost	-	0.1	-	-	1
SPI		Spider crab	Crustacean	-	1.5	-	-	2
SPL	*Scopelosaurus sp.*		Teleost	-	3.2	-	-	9
SPN		Sea pen	Cnidaria	COU	18.9	-	-	9
SPO	*Mustelus lenticulatus*	Rig	Elasmobranch	-	22.6	1	-	2
SPP	*Callanthias* spp.	Splendid perch	Teleost	-	3.8	-	-	2
SPT	*Spatangus multispinus*	Heart urchin	Echinoderm	ECN	74.5	-	-	10
SQA	*Squalus* spp.		Elasmobranch	-	10.7	-	-	1
SQU	*Nototodarus sloanii* & *N. gouldi*	Arrow squid	Cephalopod	-	5.5	-	-	3
SQX		Squid	Cephalopod	SQX	17.5	-	-	14
SRB	*Brama australis*	Southern Ray's bream	Teleost	RBM	1 443.0	826	631	6
SRH	*Hoplostethus mediterraneus*	Silver roughy	Teleost	SRH	602.7	288	135	19
SRR	*Amblyraja georgiana*	Antarctic starry skate (an error?)	Elasmobranch	-	6.7	-	-	1
SSC	*Leptomithrax australis*	Giant masking crab	Crustacean	-	16.8	-	-	8
SSI	*Argentina elongata*	Silverside	Teleost	SSI	2 655.5	5 147	368	19
SSK	*Dipturus innominatus*	Smooth skate	Elasmobranch	SSK	17 245.9	824	747	19

Table 3 continued: Species or groups recorded on all Chatham Rise trawl surveys 1992–2010.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
SSM	*Alepocephalus antipodianus*	Smallscaled brown slickhead	Teleost	SSM	1 193.4	633	289	11
SSO	*Pseudocyttus maculatus*	Smooth oreo	Teleost	SSO	12 685.4	6 589	1 346	19
STA	*Kathetostoma giganteum*	Giant stargazer	Teleost	STA	31 328.2	9 428	4 794	19
STO	*Stomias* spp.	Stomiatidae	Teleost	-	1.0	-	-	4
STP	*Stephanocyathus platypus*	Solitary bowl coral	Cnidaria	-	0.1	-	-	1
STU	*Allothunnus fallai*	Slender tuna	Teleost	-	4.0	2	-	1
SUA	*Suberites affinis*	Fleshy club sponge	Porifera	ONG	19.9	-	-	6
SUH	*Schedophilus huttoni*		Teleost	SUH	121.6	1	1	8
SUM	*Schedophilus maculatus*	Pelagic butterfish	Teleost	-	1.5	-	-	1
SUN	*Mola mola*	Sunfish	Teleost	-	150.0	-	-	1
SUR	*Evechinus chloroticus*	Kina (an error probably GRM)	Echinoderm	-	21.9	-	-	2
SUS	*Schedophilus* sp.		Teleost	SUS	80.8	-	-	5
SVA	*Solenosmilia variabilis*		Cnidaria	-	0.3	-	-	1
SWA	*Seriolella punctata*	Silver warehou	Teleost	SWA	115 932.0	25 889	7 858	19
SYM	*Symbolophorus* spp.		Teleost	-	1020.2	-	-	3
TAM	Echinothuriidae & Phormosomatidae	Tam O'Shanter urchin	Echinoderm	ECN	170.2	-	-	13
TAR	*Nemadactylus macropterus*	Tarakihi	Teleost	TAR	2 326.7	1 719	300	19
TAS	*Taractes asper*	Flathead pomfret	Teleost	-	4.5	-	-	1
TDI	*Talochlamys dichroa*		Mollusc	-	0.1	-	-	1
TDQ	*Taningia danae*	Giant squid	Cephalopod	-	5.6	-	-	1
TET	*Tetragonurus cuvieri*	Squaretail	Teleost	-	2.1	1	1	2
TFA	*Trichopeltarion fantasticum*	Frilled crab	Crustacean	-	10.9	-	-	8
THE	Thermiphione	Thermiphione scaleworm	Other	-	0.1	-	-	1
THN	*Thenea novaezelandiae*	Yoyo sponge	Porifera	-	0.8	-	-	2
THO	*Thouarella* spp.	Bottlebrush coral	Cnidaria	-	2.3	-	-	6
THR	*Alopias vulpinus*	Thresher shark	Elasmobranch	-	150.0	-	-	1
TLD	*Tetilla leptoderma*	Furry oval sponge	Porifera	-	5.2	-	-	4
TOA	*Neophrynichthys* sp.	Toadfish	Teleost	TOA	27.3	-	-	3
TOD	*Neophrynichthys latus*	Dark toadfish	Teleost	TOA	114.4	1	-	8
TOP	*Ambophthalmos angustus*	Pale toadfish	Teleost	TOA	2 770.9	24	3	19
TPE	*Teuthowenia pellucida*		Cephalopod	-	1.6	-	-	1
TRA	Trachichthyidae (Family)	Roughies	Teleost	-	3.6	-	-	1
TRS	*Trachyscorpia eschmeyeri*		Teleost	-	10.6	8	8	1

Table 3 continued: Species or groups recorded on all Chatham Rise trawl surveys 1992–2010.

Code	Scientific name	Common name	Type	Group	Catch (kg)	No. measured	No. weighed	No. of surveys
TRU	*Latris lineata*	Trumpeter	Teleost	TRU	97.5	12	6	11
TRX	*Trachonurus gagates*	Velvet rattail	Teleost	-	0.2	-	-	1
TSQ	*Todarodes filippovae*		Cephalopod	SQX	593.5	71	55	14
TTA	*Typhlonarke tarakea*	Oval electric ray	Elasmobranch	-	6.0	-	-	4
TTH	*Tethyopsis* spp.		Porifera	-	0.2	-	-	1
TUB	*Tubbia tasmanica*		Teleost	TUB	112.6	-	-	8
TVI	*Trachonurus villosus*		Teleost	-	0.2	-	-	1
UNI		Unidentified	Other	-	23.5	-	-	11
URP	*Uroptychus* spp.		Crustacean	-	0.8	-	-	3
VCO	*Antimora rostrata*	Violet cod	Teleost	-	8.4	28	28	6
VIN	*Vinciguerria* spp.		Teleost	-	0.3	-	-	1
VIT	*Vitjazmaia latidactyla*	Deep sea spider crab	Crustacean	-	2.9	-	-	2
VKI	*Veprichlamys kiwaensis*		Mollusc	-	0.2	-	-	2
VNI	*Lucigadus nigromaculatus*	Blackspot rattail	Teleost	VNI	77.7	26	16	19
VOL	Volutidae (Family)	Volute	Mollusc	-	2.6	-	-	6
VSQ	*Histioteuthis* spp.	Violet squid	Cephalopod	SQX	35.4	-	-	18
WHR	*Trachyrincus longirostris*	Unicorn rattail	Teleost	-	0.3	1	1	1
WHX	*Trachyrincus aphyodes*	White rattail	Teleost	WHX	2 643.7	489	319	19
WIT	*Arnoglossus scapha*	Witch	Teleost	WIT	200.1	17	12	19
WLP	*Lepidoperca tasmanica*	Wavy line perch	Teleost	-	0.6	-	-	1
WOE	*Allocyttus verrucosus*	Warty oreo	Teleost	-	15.5	38	38	1
WSQ	*Onykia* spp.	Warty squid	Cephalopod	SQX	508.9	-	-	4
WWA	*Seriolella caerulea*	White warehou	Teleost	WWA	36 293.0	16 462	5 055	19
YBO	*Pentaceros decacanthus*	Yellow boarfish	Teleost	-	3.4	1	-	8
YCO	*Parapercis gilliesi*	Yellow cod	Teleost	-	8.3	4	2	11
ZDO	*Zenion leptolepis*	Zenion dory	Teleost	-	0.4	-	-	2
ZEL	*Zu elongatus*	Scalloped dealfish	Teleost	-	4.5	-	-	1
ZOR	*Zoroaster spp.*	Rat-tail star	Echinoderm	SFI	137.0	-	-	10
ZSU	*Zoroaster spinulosus*		Echinoderm	-	0.1	-	-	1
ZTE		Ctenophore	Other	-	0.1	-	-	1
Total					**3 012 739.4**	**1 026 313**	**204 593**	**19**

Table 4: Groups of organisms analysed in this report. Species names are given in Table 3.

Group code	Group	Species or groups included in grouping
ANT	Anenomes	ACS, ANT, HMT
CDL	Deepsea cardinalfish	EPL, EPR
COU	Corals	COU, GDU, SIA, SPN
CRB	Crabs	ATC, CRB DAP, PAG, PZE, SSC, LMU, NEB, OVM, PHS
ECN	Urchins	ARA, DHO, ECH, ECN, GPA, GRM, PBU, PMU, SPT, TAM
GAS	Gastropods	FMA, GAS
HTH	Sea cucumbers	BAM, HTH, LAG, PMO, SCC
LAN	Mesopelagic fish[1]	DIA, LAN, LHE, LPA, MMU, PHO, SYM
OCP	Octopus	DWO, EZE, OCP, OCT, OPI
ONG	Sponge	ANZ, GLS, HYA, ONG, SUA
RBM	Ray's bream[2]	RBM, SRB
SAL	Salps	PYR, SAL
SFI	Starfish	ASR, CDY, CJA, DMG, GOR, HTR, MSL, OPH, PKN, PT, PRU, PSI, SFI, SMO, SOT, ZOR
SKA	Deepsea skates	BTA, BTH, BTS, PSK, SKA
SQX	Squid (excluding arrow squid)	MIQ, MRQ, RSQ, SQX, TSQ, VSQ, WSQ
TOA	Toadfish	COT, PSY, TOA, TOD, TOP

[1] MMU and PHO are of the families Sternoptychidae and Phosichthyidae respectively, not Myctophidae, but may have been mis-coded as LAN in the past.

[2] Likely to be mainly SRB, which was misclassified as RBM in the past.

Table 5: Maximum catch rates used to scale distribution maps in Section 9. Species names are given in Table 3.

Species code	Max. catch rate (kg km^{-2})
BAR	3 651
BBE	268
BOE	12 107
BYS	18 101
CAS	1 586
CBI	319
CBO	2 316
CFA	106
COL	526
CYP	681
EPT	48
ETB	1 100
ETL	46
GSH	10 692
GSP	329
HAK	1 323
HOK	37 789
JAV	2 510
JMM	626
LCH	150
LDO	456
LIN	1 786
LSO	32
NOS	1 592
OPE	2 481
ORH	295
RBM	528
RBT	816
RCO	2 291
RHY	34 088
RIB	74
SBW	688
SCI	8
SDO	3 166
SND	1 556
SOR	4 392
SPD	5 368
SPE	492
SRB	272
SSI	106
SSK	379
SSO	1352
STA	1614
SWA	26 088
TAR	250
WWA	4629

Table 6: Summary of trawl gear parameters for surveys of the Chatham Rise, January 1992–2010.

	Speed (knots)		Distance (n.mile)		Doorspread (m)		Headline height (m)	
Year	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.
1992	3.5	0.05	3.0	0.30	120.3	6.5	6.6	0.41
1993	3.5	0.10	3.0	0.12	121.9	8.1	6.5	0.40
1994	3.6	0.12	3.0	0.20	117.3	5.4	6.5	0.41
1995	3.5	0.04	3.0	0.19	117.0	5.7	6.9	0.47
1996	3.5	0.09	2.9	0.26	116.6	1.8	7.0	0.40
1997	3.5	0.08	3.0	0.15	121.0	5.7	6.8	0.29
1998	3.5	0.11	3.0	0.17	118.2	7.1	6.8	0.34
1999	3.5	0.07	2.9	0.26	116.9	5.1	6.3	0.28
2000	3.5	0.08	2.9	0.22	114.2	6.1	7.0	0.31
2001	3.5	0.11	2.9	0.25	117.9	6.2	6.9	0.36
2002	3.5	0.10	2.9	0.24	119.6	7.8	6.3	0.42
2003	3.5	0.10	3.0	0.19	118.4	5.7	6.5	0.37
2004	3.5	0.05	3.0	0.19	116.6	5.5	6.9	0.21
2005	3.5	0.09	2.9	0.25	115.1	5.8	6.9	0.32
2006	3.5	0.05	2.9	0.20	116.8	5.8	6.9	0.17
2007	3.5	0.03	3.0	0.14	116.3	5.9	6.8	0.24
2008	3.5	0.04	3.0	0.09	114.5	6.4	6.8	0.16
2009	3.5	0.05	3.0	0.21	115.4	5.8	7.0	0.30
2010	3.5	0.07	3.0	0.18	117.9	4.9	6.9	0.35

Table 7: Summary of relative biomass estimates and length frequencies for the 142 species or groups for which biomass was estimated. Scientific names are provided in Table 3. "Biomass estimates" is a categorical description of survey precision based on mean c.v. (see Section 2.7 for definitions).

Code	Common name	Distribution	Peak catch rates	Biomass estimates	Biomass trend	Length distribution	Mean length trend
AGR	Ribbonfish	midwater		poor			
ANT	Anemones	group		moderately well	increase then decrease		
API	Alert pigfish	insufficient data		poor			
APR	Catshark	>800	south	poor			
BAR	Barracouta	<200	east	poor		unimodal	decrease then increase
BAS	Bass groper	insufficient data		poor			
BBE	Banded bellowsfish	appropriate	north, east	very well	increase	unimodal	increase
BBR	Bronze bream	insufficient data		poor			
BCA	Barracudina	insufficient data		poor			
BEE	Basketwork eel	>800	south	poor			
BER	Numbfish	appropriate		poor			
BGZ	Banded giant stargazer	<200	east	poor			
BNS	Bluenose	appropriate	north, east	poor			
BOE	Black oreo	>800	south, west	moderately well	increase then decrease	unimodal	increase
BSH	Seal shark	>800	north	moderately well	no change		
BSL	Black slickhead	>800	east	poor			
BSP	Big-scale pomfret	insufficient data		poor			
BYD	Longfinned beryx	insufficient data		poor			
BYS	Alfonsino	appropriate	north	poor		unimodal	no change
CAR	Carpet shark	<200		poor			
CAS	Oblique banded rattail	appropriate	Veryan	very well	no change	bimodal	no change
CBA	Humpback rattail	>800	south	poor			
CBE	Crested bellowsfish	<200		poor			
CBI	Two saddle rattail	<200	west	moderately well	increase	bimodal	no change
CBO	Bollons's rattail	appropriate	west	very well	no change	unimodal	no change
CBX	Cubehead	insufficient data		poor			
CCX	Small banded rattail	appropriate		poor			
CDL	Cardinalfish (EPL and EPR)	>800	east	moderately well	increase		
CDO	Capro dory	appropriate	east	poor			
CDX	Dark banded rattail	insufficient data		poor			
CFA	Banded rattail	>800	south	well	no change	bimodal	no change
CHG	Giant chimaera	>800	south	poor			
CHP	Chimaera, brown	insufficient data		poor			

Table 7 continued: Summary of relative biomass estimates and length frequencies for the 142 species or groups for which biomass was estimated.

Code	Common name	Distribution	Peak catch rates	Biomass estimates	Biomass trend	Length distribution	Mean length trend
CIN	Notable rattail	>800		poor			
CMA	Mahia rattail	>800	north, east	poor			
CMU	Abyssal rattail	>800		poor			
COL	Oliver's rattail	appropriate	southwest	well	increase	unimodal	no change
COU	Coral (unspecified)	group		poor			
CRB	Crab	group		poor			
CSE	Serrulate rattail	>800	north	poor			
CSQ	Leafscale gulper shark	>800	north, east	poor			
CSU	Four-rayed rattail	>800	north	poor			
CYO	Smooth skin dogfish	>800	north	poor			
CYP	Longnose velvet dogfish	>800	north	poor		bimodal	no change
DCO	Dwarf cod	appropriate		poor			
DCS	Dawson's catshark	appropriate		poor			
DEA	Dealfish	midwater		poor			
DSP	Deepsea pigfish	<200		poor			
ECN	Echinoid (sea urchin)	group		poor			
EMA	Blue mackerel	insufficient data		poor			
EPT	Deepsea cardinalfish	>800	north	poor		unimodal	no change
ERA	Electric ray	insufficient data		poor			
ETB	Baxter's lantern dogfish	>800	southwest	moderately well	no change	unimodal	no change
ETL	Lucifer dogfish	appropriate	south, west	very well	no change	multimodal	no change
FHD	Deepsea flathead	appropriate		very well	increase		
FRO	Frostfish	<200		poor			
FRS	Frill shark	insufficient data		poor			
GAS	Gastropods	group		well	increase		
GON	Sandfish	insufficient data		poor			
GSH	Ghost shark	<200	Veryan	very well	increase	multimodal	decrease
GSP	Pale ghost shark	>800	south	very well	no change	multimodal	decrease
GUR	Gurnard	<200		poor			
HAG	Hagfish	insufficient data		poor			
HAK	Hake	appropriate	north	very well	decrease	multimodal	no change
HAP	Hapuku	<200	north	poor			
HCO	Hairy conger	appropriate		well	increase then decrease		

Table 7 continued: Summary of relative biomass estimates and length frequencies for the 142 species or groups for which biomass was estimated.

Code	Common name	Distribution	Peak catch rates	Biomass estimates	Biomass trend	Length distribution	Mean length trend
HEX	Sixgill shark	insufficient data		poor			
HJO	Johnson's cod	>800		poor			
HOK	Hoki	appropriate	west	very well	decrease then increase	multimodal	no change
HTH	Sea cucumber	group		poor			
JAV	Javelinfish	appropriate	west	very well	increase	bimodal	no change
JFI	Jellyfish	midwater		poor			
JMD	Greenback jack mackerel	<200		poor			
JMM	Slender jack mackerel	appropriate		poor		unimodal	increase
LAN	Mesopelagic fish	midwater	southwest	moderately well	increase		
LCH	Long-nosed chimaera	>800	south	very well	no change	multimodal	no change
LDO	Lookdown dory	appropriate		very well	no change	multimodal	decrease then increase
LHO	Omega prawn	>800		moderately well	increase		
LIN	Ling	appropriate		very well	no change	multimodal	decrease then increase
LSO	Lemon sole	<200	east	well	increase then decrease	unimodal	decrease
MAK	Mako shark	midwater		poor			
MAN	Finless flounder	appropriate	south	poor			
MCA	Ridge scaled rattail	>800	south	poor			
MDO	Mirror dory	<200		poor			
NOS	NZ southern arrow squid	appropriate	west	well	decrease then increase	unimodal	increase then decrease
NSD	Northern spiny dogfish	<200	east	poor			
OAR	Oarfish	midwater		poor			
OCP	Octopod	group		poor			
OFH	Oilfish	insufficient data	north	poor			
ONG	Sponges	group		poor			
OPE	Orange perch	<200		poor		unimodal	no change
ORH	Orange roughy	>800	north, east	poor		unimodal	no change
PDG	Prickly dogfish	appropriate		moderately well	increase then decrease		
PIG	Pigfish	<200		poor			
PLS	Plunket’s shark	>800		poor			
POS	Porbeagle shark	midwater		poor			
RAG	Ragfish	appropriate		poor			
RBM	Ray's bream	midwater	west	moderately well	increase	multimodal	no change
RBT	Redbait	<200		poor		unimodal	no change

Table 7 continued: Summary of relative biomass estimates and length frequencies for the 142 species or groups for which biomass was estimated.

Code	Common name	Distribution	Peak catch rates	Biomass estimates	Biomass trend	Length distribution	Mean length trend
RBY	Ruby fish	<200	east	poor			
RCH	Widenosed chimaera	>800	south	poor			
RCO	Red cod	<200	west	poor		multimodal	no change
RHY	Common roughy	appropriate	east	poor		unimodal	no change
RIB	Ribaldo	>800	north, west	very well	no change	multimodal	decrease
RSK	Rough skate	appropriate		poor			
RUD	Rudderfish	appropriate		well	decrease		
SAL	Salps	midwater		poor			
SBI	Bigscaled brown slickhead	>800		poor			
SBK	Spineback	>800		well	increase		
SBW	Southern blue whiting	appropriate	south	poor		multimodal	increase
SCG	Scaly gurnard	<200	north	poor			
SCH	School shark	<200		moderately well	increase		
SCI	Scampi	appropriate		very well	increase then decrease	unimodal	no change
SCO	Swollenhead conger	appropriate		well	no change		
SDO	Silver dory	<200	east	poor		unimodal	no change
SEO	Seaweed	midwater		poor			
SFI	Starfish	group		very well	increase		
SKA	Skate	group		well	no change		
SKI	Gemfish	insufficient data		poor			
SMC	Small-headed cod	>800		poor			
SND	Shovelnose spiny dogfish	>800	north	well	no change	multimodal	no change
SOR	Spiky oreo	>800	northeast	poor		unimodal	no change
SPD	Spiny dogfish	<200		very well	increase	multimodal	increase then decrease
SPE	Sea perch	appropriate	north, west	very well	increase	multimodal	decrease
SQX	Squid	group		very well	no change		
SRH	Silver roughy	appropriate	north	moderately well	increase		
SSI	Silverside	<200	west	well	increase then decrease	unimodal	no change
SSK	Smooth skate	appropriate		well	increase	broad	no change
SSM	Smallscaled brown slickhead	>800		poor			
SSO	Smooth oreo	>800	south	poor		multimodal	no change
STA	Giant stargazer	<200	west	very well	no change	multimodal	decrease
SUH	*Schedophilus huttoni*	insufficient data		poor			

Table 7 continued: Summary of relative biomass estimates and length frequencies for the 142 species or groups for which biomass was estimated.

Code	Common name	Distribution	Peak catch rates	Biomass estimates	Biomass trend	Length distribution	Mean length trend
SUS	*Schedophilus* sp.	insufficient data		poor			
SWA	Silver warehou	appropriate	west	poor		multimodal	no change
TAR	Tarakihi	<200	east	poor		unimodal	decrease
TOA	Toadfish	group		well	increase then decrease		
TRU	Trumpeter	insufficient data		poor			
TUB	*Tubbia tasmanica*	insufficient data		poor			
VNI	Blackspot rattail	>800		well	no change		
WHX	White rattail	>800		poor			
WIT	Witch	<200	north	moderately well	no change		
WWA	White warehou	appropriate	west	moderately well	increase then decrease	multimodal	decrease then increase

Table 8: Comparison of the 31 species included in the review by Livingston et al. (2002b) and the 49 groups which were well estimated in this review. Rank is based on the summed biomass 1992–2010. Species in bold feature in both lists. Species codes are defined in Table 3.

Livingston et al. (2002b)

Code	Rank	Mean c.v. (%)
BAR	23	53
BOE	**2**	**33**
BYS	9	61
CAS	**26**	**19**
CBO	**6**	**11**
COL	**20**	**25**
GSH	**7**	**14**
GSP	**14**	**9**
HAK	**19**	**16**
HAP	**52**	**47**
HOK	**1**	**11**
JAV	**3**	**13**
JMM	38	50
LDO	**11**	**8**
LIN	**8**	**9**
LSO	73	27
NOS	**31**	**29**
OPE	28	56
RBT	58	50
RCO	30	45
RIB	**36**	**16**
SCH	**39**	**39**
SND	**16**	**21**
SOR	12	41
SPD	**10**	**15**
SPE	**13**	**11**
SSO	21	62
STA	**18**	**17**
SWA	4	43
TAR	49	52
WWA	**17**	**30**

This report

Code	Rank	Mean c.v. (%)
ANT	64	33
BBE	27	15
BOE	**2**	**33**
BSH	47	32
CAS	**26**	**19**
CBI	43	40
CBO	**6**	**11**
CDL	80	37
CFA	45	24
COL	**20**	**25**
ETB	24	38
ETL	46	18
FHD	66	18
GAS	106	26
GSH	**7**	**14**
GSP	**14**	**9**
HAK	**19**	**16**
HCO	55	27
HOK	**1**	**11**
JAV	**3**	**13**
LAN	117	35
LCH	29	19
LDO	**11**	**8**
LHO	131	31
LIN	**8**	**9**
LSO	73	27
NOS	**31**	**29**
PDG	71	39
RBM	35	33
RIB	**36**	**16**
RUD	33	25
SBK	53	24
SCH	**39**	**39**
SCI	89	20
SCO	41	25
SFI	48	18
SKA	57	25
SND	**16**	**21**
SPD	**10**	**15**
SPE	**13**	**11**
SQX	37	16
SRH	72	34
SSI	42	22
SSK	22	23
STA	**18**	**17**
TOA	44	22
VNI	107	28
WIT	97	36
WWA	**17**	**30**

Table 9: Summary of modal maturity stages for the 33 species which had sufficient gonad stage data. Scientific names are given in Table 3.

Code	Common name	Modal gonad stage(s)
BAR	Barracouta	Mature/Spawning
BOE	Black oreo	Immature/Resting
BYS	Alfonsino	Immature/Resting
CBI	Two saddle rattail	All stages except running ripe
CBO	Bollons's rattail	Immature/Resting
CSQ	Leafscale gulper shark	Immature
CYO	Smooth skin dogfish	Mature
CYP	Longnose velvet dogfish	All stages
ETB	Baxter's lantern dogfish	All stages
ETL	Lucifer dogfish	Mature
GSH	Ghost shark	All stages
GSP	Pale ghost shark	All stages
HAK	Hake	All stages
HAP	Hapuku	Resting
HOK	Hoki	Immature/Resting
JAV	Javelinfish	Immature/Resting
LCH	Long-nosed chimaera	All stages
LDO	Lookdown dory	Immature/Resting/Maturing
LIN	Ling	Immature/Resting
OPE	Orange perch	Maturing/Ripe
ORH	Orange roughy	Immature/Resting
RCO	Red cod	Immature/Resting
RIB	Ribaldo	Resting
SND	Shovelnose spiny dogfish	Immature/Maturing
SOR	Spiky oreo	Immature/Resting/Maturing
SPD	Spiny dogfish	All stages
SPE	Sea perch	Immature/Resting/Spawning
SSK	Smooth skate	Immature
SSO	Smooth oreo	Immature/Resting/Maturing
STA	Giant stargazer	Immature/Resting
SWA	Silver warehou	Resting
TAR	Tarakihi	Maturing/Spawning
WWA	White warehou	Immature/Resting

8. FIGURES

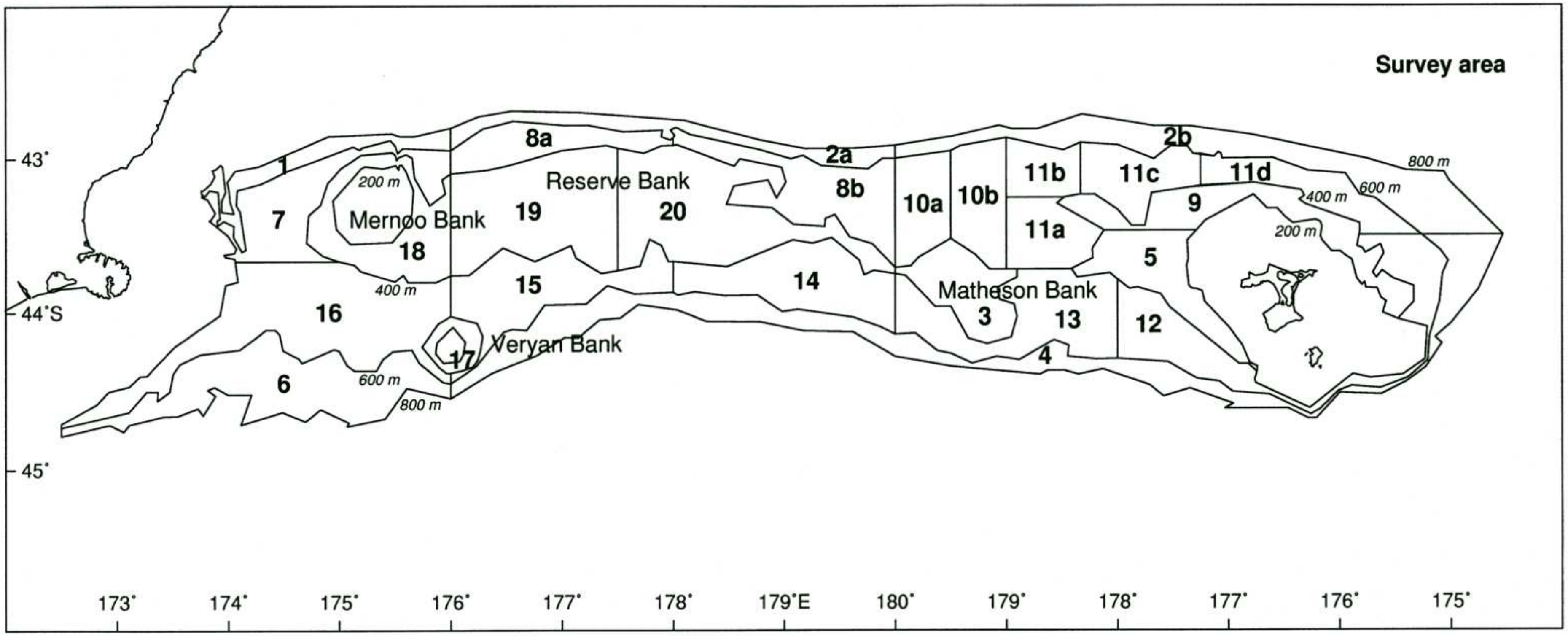

Figure 1: Chatham Rise trawl survey area showing stratification of core survey area.

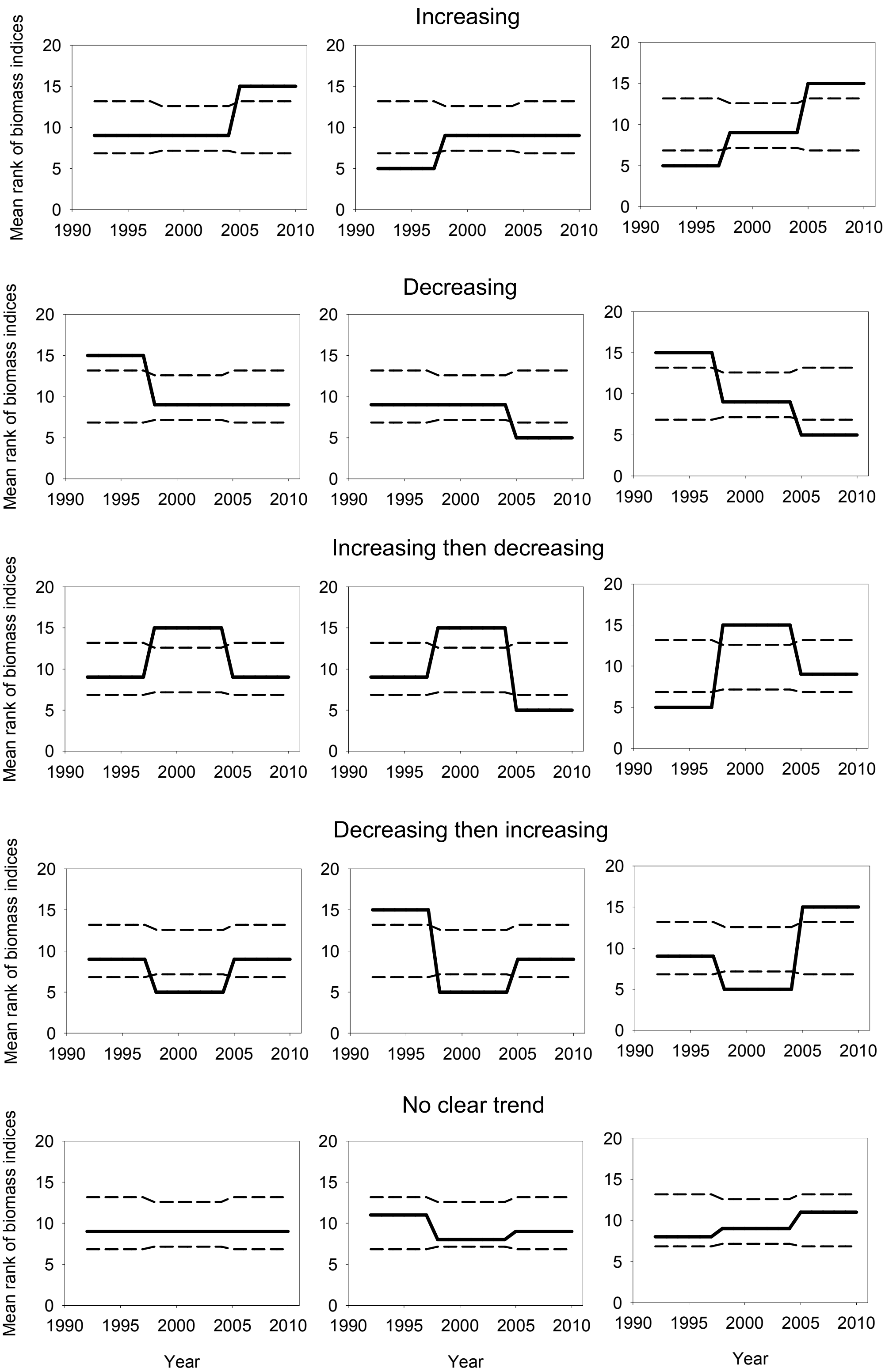

Figure 2: Examples of how trends in biomass indices were assessed using the ranks randomisation test. Solid lines are mean ranks or biomass indices for 1992–97, 1998–2004, and 2005–10. Dashed lines are 5% and 95% percentiles of a random arrangement of ranks from 1000 bootstraps of the data.

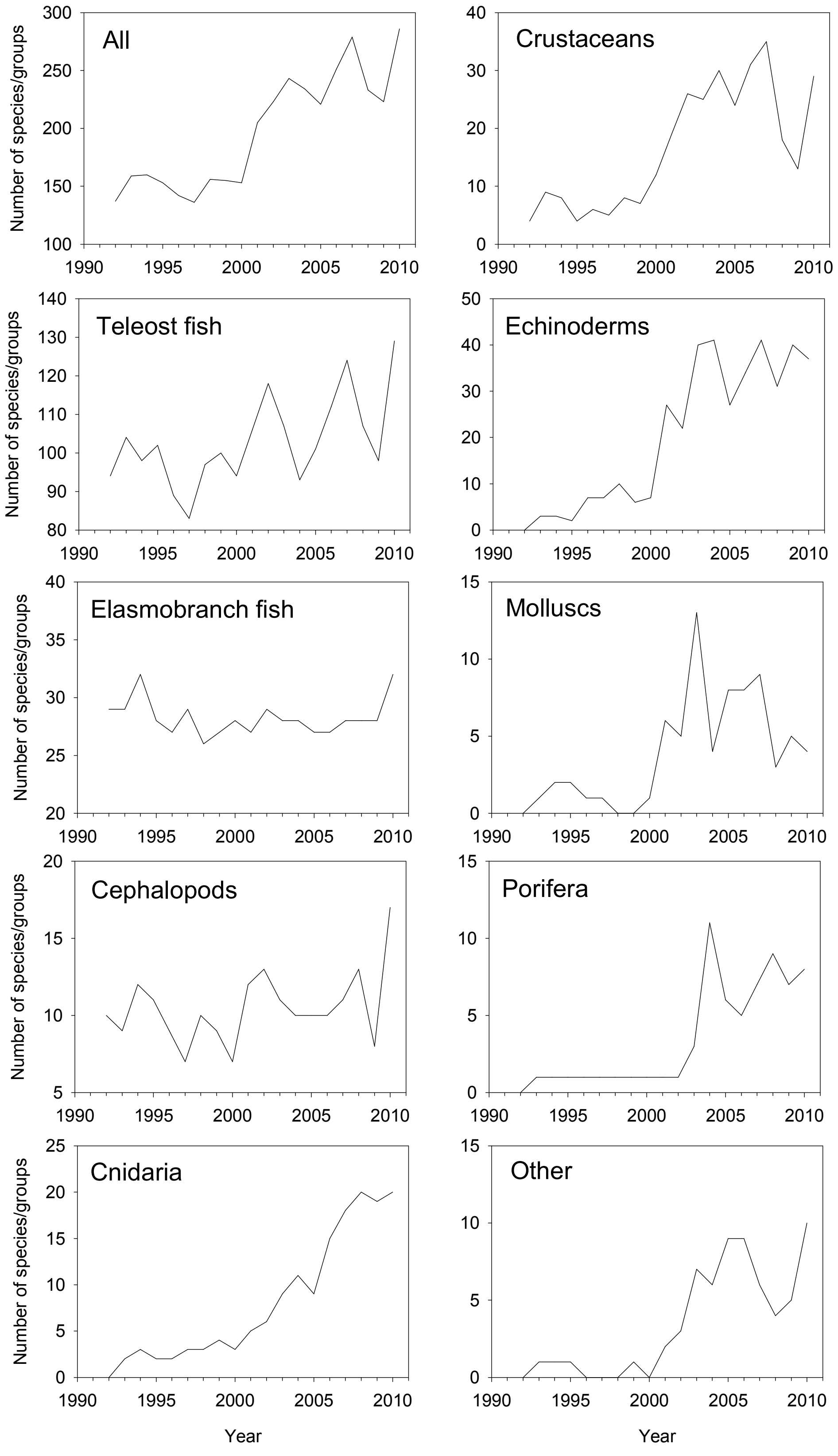

Figure 3: Number of species or groups identified on each Chatham Rise survey 1992–2010. Data are from all stations where species were identified and may include some tows outside the core survey area.

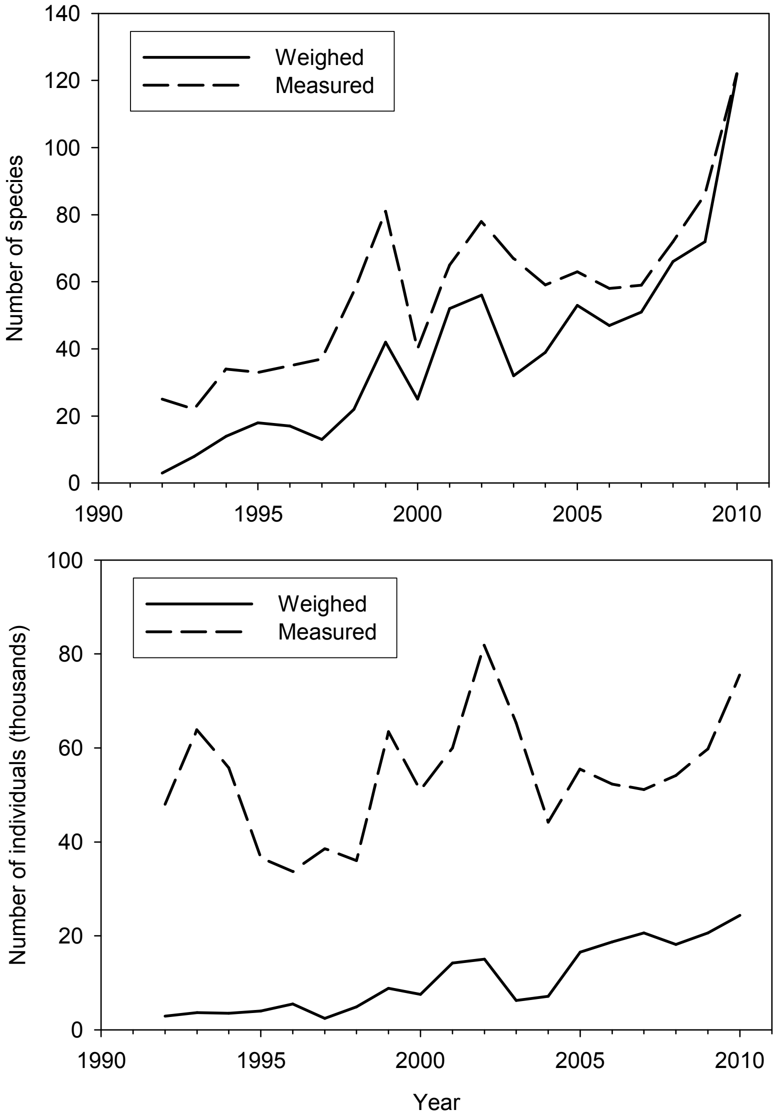

Figure 4: Number of species (upper panel) and individuals (lower panel) weighed and measured on each Chatham Rise survey 1992–2010. Data are from all stations and may include some tows outside the core survey area.

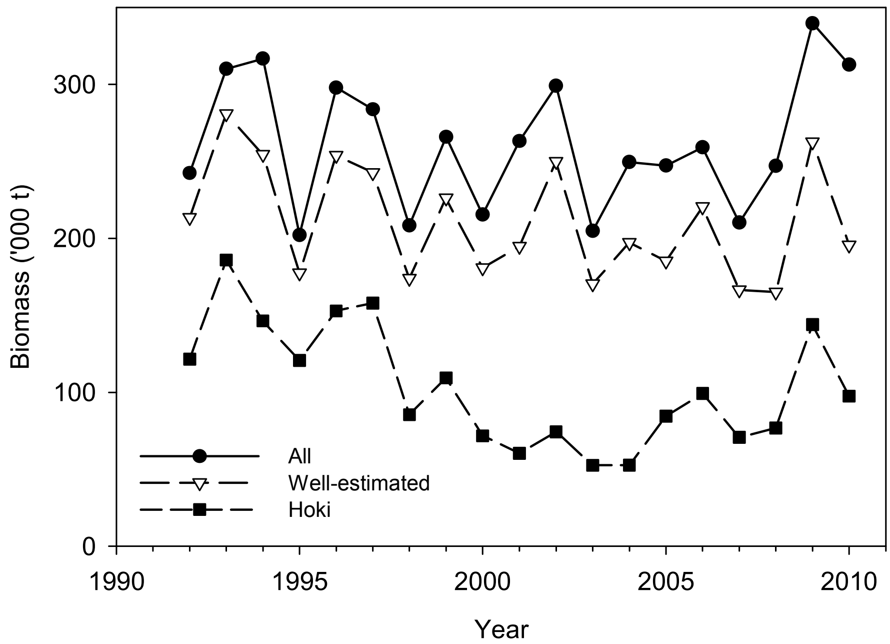

Figure 5: Combined biomass of the 142 species for which biomass was estimated (All), the 49 species where mean c.v. was less than 40% (Well-estimated), and hoki.

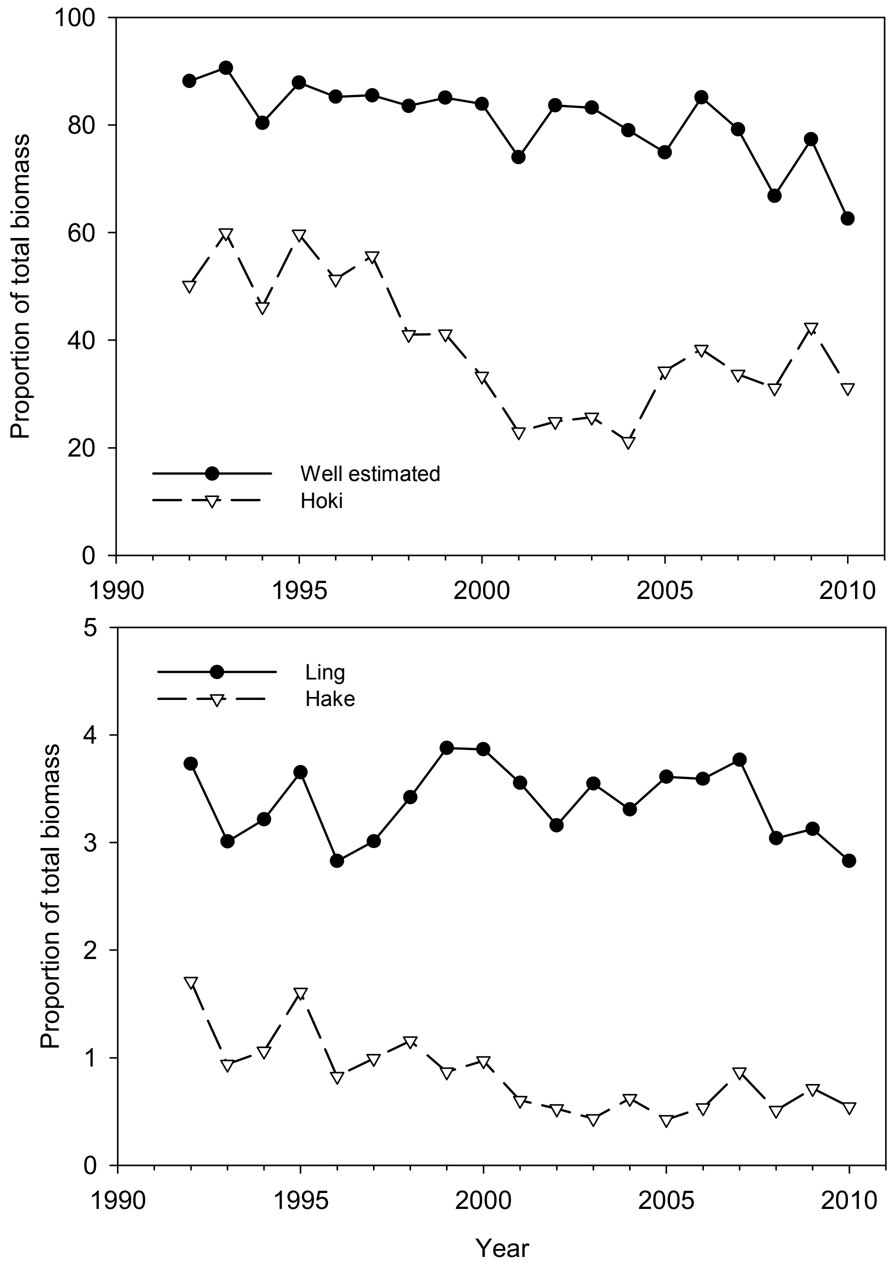

Figure 6: Relative biomass of well-estimated species, hoki, hake, and ling expressed as a percentage of the combined biomass of the 142 species for which biomass was estimated.

9. SPECIES SUMMARIES
(this content available on CD-ROM – see disk in pocket on inside back cover)

APPENDIX 1: SurvCalc code used to estimate biomass indices

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tan0901 tan1001

@species tan9106
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      BTH   BTS   BYD   BYS   CAR   CAS   CBA   CBE   CBI   CBO   CBX   CCX
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      ETL   EZE   FHD   FIS   FMA   FRO   FRS   GAS   GDU   GLS   GON   GOR
      GPA   GRM   GSH   GSP   GUR   GVE   HAG   HAK   HAP   HCO   HEX   HJO
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      MMU   MRQ   MSL   NEB   NOS   NSD   OAR   OCP   OCT   OFH   ONG   OPE
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      SRB   SRH   SSC   SSI   SSK   SSM   SSO   STA   SUA   SUH   SUS   SWA
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@species tan9212
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      HMT   HOK   HTH   HTR   HYA   JAV   JFI   JMD   JMM   LAG   LAN   LCH
      LDO   LHE   LHO   LIN   LMU   LPA   LSO   MAK   MAN   MCA   MDO   MIQ
      MMU   MRQ   MSL   NEB   NOS   NSD   OAR   OCP   OCT   OFH   ONG   OPE
      OPH   OPI   ORH   OVM   PAG   PBU   PDG   PHO   PHS   PIG   PKN   PLS
      PLT   PMO   PMU   POS   PRU   PSI   PSK   PSY   PYR   PZE   RAG   RBM
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@species tan9401
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@species tan9501
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@species tan9901
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        DIA    DMG    DSP    DWO    ECH    ECN    EMA    EPL    EPR    EPT    ERA    ETB
        ETL    EZE    FHD    FIS    FMA    FRO    FRS    GAS    GDU    GLS    GON    GOR
        GPA    GRM    GSH    GSP    GUR    GVE    HAG    HAK    HAP    HCO    HEX    HJO
        HMT    HOK    HTH    HTR    HYA    JAV    JFI    JMD    JMM    LAG    LAN    LCH
        LDO    LHE    LHO    LIN    LMU    LPA    LSO    MAK    MAN    MCA    MDO    MIQ
        MMU    MRQ    MSL    NEB    NOS    NSD    OAR    OCP    OCT    OFH    ONG    OPE
        OPH    OPI    ORH    OVM    PAG    PBU    PDG    PHO    PHS    PIG    PKN    PLS
        PLT    PMO    PMU    POS    PRU    PSI    PSK    PSY    PYR    PZE    RAG    RBM
        RBT    RBY    RCH    RCO    RHY    RIB    ROK    RSK    RSQ    RUB    RUD    SAL
        SBI    SBK    SBW    SCC    SCG    SCH    SCI    SCO    SDO    SEO    SFI    SIA
        SKA    SKI    SMC    SMO    SND    SOR    SOT    SPD    SPE    SPN    SPT    SQX
        SRB    SRH    SSC    SSI    SSK    SSM    SSO    STA    SUA    SUH    SUS    SWA
        SYM    TAM    TAR    TOA    TOD    TOP    TRU    TSQ    TUB    UNI    VNI    VSQ
        WHX    WIT    WOD    WSQ    WWA    ZOR

@species tan0301
codes   ACS    AGR    ANT    ANZ    API    APR    ARA    ASR    ATC    BAM    BAR    BAS
        BBE    BBR    BCA    BEE    BER    BGZ    BNS    BOE    BSH    BSL    BSP    BTA
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          BTH    BTS    BYD    BYS    CAR    CAS    CBA    CBE    CBI    CBO    CBX    CCX
          CDO    CDX    CDY    CFA    CHG    CHP    CIN    CJA    CMA    CMU    COL    COT
          COU    CRB    CSE    CSQ    CSU    CYO    CYP    DAP    DCO    DCS    DEA    DHO
          DIA    DMG    DSP    DWO    ECH    ECN    EMA    EPL    EPR    EPT    ERA    ETB
          ETL    EZE    FHD    FIS    FMA    FRO    FRS    GAS    GDU    GLS    GON    GOR
          GPA    GRM    GSH    GSP    GUR    GVE    HAG    HAK    HAP    HCO    HEX    HJO
          HMT    HOK    HTH    HTR    HYA    JAV    JFI    JMD    JMM    LAG    LAN    LCH
          LDO    LHE    LHO    LIN    LMU    LPA    LSO    MAK    MAN    MCA    MDO    MIQ
          MMU    MRQ    MSL    NEB    NOS    NSD    OAR    OCP    OCT    OFH    ONG    OPE
          OPH    OPI    ORH    OVM    PAG    PBU    PDG    PHO    PHS    PIG    PKN    PLS
          PLT    PMO    PMU    POS    PRU    PSI    PSK    PSY    PYR    PZE    RAG    RBM
          RBT    RBY    RCH    RCO    RHY    RIB    ROK    RSK    RSQ    RUB    RUD    SAL
          SBI    SBK    SBW    SCC    SCG    SCH    SCI    SCO    SDO    SEO    SFI    SIA
          SKA    SKI    SMC    SMO    SND    SOR    SOT    SPD    SPE    SPN    SPT    SQX
          SRB    SRH    SSC    SSI    SSK    SSM    SSO    STA    SUA    SUH    SUS    SWA
          SYM    TAM    TAR    TOA    TOD    TOP    TRU    TSQ    TUB    UNI    VNI    VSQ
          WHX    WIT    WOD    WSQ    WWA    ZOR

@species tan0401
codes     ACS AGR    ANT    ANZ    API    APR    ARA    ASR    ATC    BAM    BAR    BAS
          BBE    BBR    BCA    BEE    BER    BGZ    BNS    BOE    BSH    BSL    BSP    BTA
          BTH    BTS    BYD    BYS    CAR    CAS    CBA    CBE    CBI    CBO    CBX    CCX
          CDO    CDX    CDY    CFA    CHG    CHP    CIN    CJA    CMA    CMU    COL    COT
          COU    CRB    CSE    CSQ    CSU    CYO    CYP    DAP    DCO    DCS    DEA    DHO
          DIA    DMG    DSP    DWO    ECH    ECN    EMA    EPL    EPR    EPT    ERA    ETB
          ETL    EZE    FHD    FIS    FMA    FRO    FRS    GAS    GDU    GLS    GON    GOR
          GPA    GRM    GSH    GSP    GUR    GVE    HAG    HAK    HAP    HCO    HEX    HJO
          HMT    HOK    HTH    HTR    HYA    JAV    JFI    JMD    JMM    LAG    LAN    LCH
          LDO    LHE    LHO    LIN    LMU    LPA    LSO    MAK    MAN    MCA    MDO    MIQ
          MMU    MRQ    MSL    NEB    NOS    NSD    OAR    OCP    OCT    OFH    ONG    OPE
          OPH    OPI    ORH    OVM    PAG    PBU    PDG    PHO    PHS    PIG    PKN    PLS
          PLT    PMO    PMU    POS    PRU    PSI    PSK    PSY    PYR    PZE    RAG    RBM
          RBT    RBY    RCH    RCO    RHY    RIB    ROK    RSK    RSQ    RUB    RUD    SAL
          SBI    SBK    SBW    SCC    SCG    SCH    SCI    SCO    SDO    SEO    SFI    SIA
          SKA    SKI    SMC    SMO    SND    SOR    SOT    SPD    SPE    SPN    SPT    SQX
          SRB    SRH    SSC    SSI    SSK    SSM    SSO    STA    SUA    SUH    SUS    SWA
          SYM    TAM    TAR    TOA    TOD    TOP    TRU    TSQ    TUB    UNI    VNI    VSQ
          WHX    WIT    WOD    WSQ    WWA    ZOR

@species tan0501
codes     ACS AGR    ANT    ANZ    API    APR    ARA    ASR    ATC    BAM    BAR    BAS
          BBE    BBR    BCA    BEE    BER    BGZ    BNS    BOE    BSH    BSL    BSP    BTA
          BTH    BTS    BYD    BYS    CAR    CAS    CBA    CBE    CBI    CBO    CBX    CCX
          CDO    CDX    CDY    CFA    CHG    CHP    CIN    CJA    CMA    CMU    COL    COT
          COU    CRB    CSE    CSQ    CSU    CYO    CYP    DAP    DCO    DCS    DEA    DHO
          DIA    DMG    DSP    DWO    ECH    ECN    EMA    EPL    EPR    EPT    ERA    ETB
          ETL    EZE    FHD    FIS    FMA    FRO    FRS    GAS    GDU    GLS    GON    GOR
          GPA    GRM    GSH    GSP    GUR    GVE    HAG    HAK    HAP    HCO    HEX    HJO
          HMT    HOK    HTH    HTR    HYA    JAV    JFI    JMD    JMM    LAG    LAN    LCH
          LDO    LHE    LHO    LIN    LMU    LPA    LSO    MAK    MAN    MCA    MDO    MIQ
          MMU    MRQ    MSL    NEB    NOS    NSD    OAR    OCP    OCT    OFH    ONG    OPE
          OPH    OPI    ORH    OVM    PAG    PBU    PDG    PHO    PHS    PIG    PKN    PLS
          PLT    PMO    PMU    POS    PRU    PSI    PSK    PSY    PYR    PZE    RAG    RBM
          RBT    RBY    RCH    RCO    RHY    RIB    ROK    RSK    RSQ    RUB    RUD    SAL
          SBI    SBK    SBW    SCC    SCG    SCH    SCI    SCO    SDO    SEO    SFI    SIA
          SKA    SKI    SMC    SMO    SND    SOR    SOT    SPD    SPE    SPN    SPT    SQX
          SRB    SRH    SSC    SSI    SSK    SSM    SSO    STA    SUA    SUH    SUS    SWA
          SYM    TAM    TAR    TOA    TOD    TOP    TRU    TSQ    TUB    UNI    VNI    VSQ
          WHX    WIT    WOD    WSQ    WWA    ZOR

@species tan0601
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codes    ACS AGR    ANT    ANZ    API    APR    ARA    ASR    ATC    BAM    BAR    BAS
         BBE    BBR    BCA    BEE    BER    BGZ    BNS    BOE    BSH    BSL    BSP    BTA
         BTH    BTS    BYD    BYS    CAR    CAS    CBA    CBE    CBI    CBO    CBX    CCX
         CDO    CDX    CDY    CFA    CHG    CHP    CIN    CJA    CMA    CMU    COL    COT
         COU    CRB    CSE    CSQ    CSU    CYO    CYP    DAP    DCO    DCS    DEA    DHO
         DIA    DMG    DSP    DWO    ECH    ECN    EMA    EPL    EPR    EPT    ERA    ETB
         ETL    EZE    FHD    FIS    FMA    FRO    FRS    GAS    GDU    GLS    GON    GOR
         GPA    GRM    GSH    GSP    GUR    GVE    HAG    HAK    HAP    HCO    HEX    HJO
         HMT    HOK    HTH    HTR    HYA    JAV    JFI    JMD    JMM    LAG    LAN    LCH
         LDO    LHE    LHO    LIN    LMU    LPA    LSO    MAK    MAN    MCA    MDO    MIQ
         MMU    MRQ    MSL    NEB    NOS    NSD    OAR    OCP    OCT    OFH    ONG    OPE
         OPH    OPI    ORH    OVM    PAG    PBU    PDG    PHO    PHS    PIG    PKN    PLS
         PLT    PMO    PMU    POS    PRU    PSI    PSK    PSY    PYR    PZE    RAG    RBM
         RBT    RBY    RCH    RCO    RHY    RIB    ROK    RSK    RSQ    RUB    RUD    SAL
         SBI    SBK    SBW    SCC    SCG    SCH    SCI    SCO    SDO    SEO    SFI    SIA
         SKA    SKI    SMC    SMO    SND    SOR    SOT    SPD    SPE    SPN    SPT    SQX
         SRB    SRH    SSC    SSI    SSK    SSM    SSO    STA    SUA    SUH    SUS    SWA
         SYM    TAM    TAR    TOA    TOD    TOP    TRU    TSQ    TUB    UNI    VNI    VSQ
         WHX    WIT    WOD    WSQ    WWA    ZOR

@species tan0701
codes    ACS AGR    ANT    ANZ    API    APR    ARA    ASR    ATC    BAM    BAR    BAS
         BBE    BBR    BCA    BEE    BER    BGZ    BNS    BOE    BSH    BSL    BSP    BTA
         BTH    BTS    BYD    BYS    CAR    CAS    CBA    CBE    CBI    CBO    CBX    CCX
         CDO    CDX    CDY    CFA    CHG    CHP    CIN    CJA    CMA    CMU    COL    COT
         COU    CRB    CSE    CSQ    CSU    CYO    CYP    DAP    DCO    DCS    DEA    DHO
         DIA    DMG    DSP    DWO    ECH    ECN    EMA    EPL    EPR    EPT    ERA    ETB
         ETL    EZE    FHD    FIS    FMA    FRO    FRS    GAS    GDU    GLS    GON    GOR
         GPA    GRM    GSH    GSP    GUR    GVE    HAG    HAK    HAP    HCO    HEX    HJO
         HMT    HOK    HTH    HTR    HYA    JAV    JFI    JMD    JMM    LAG    LAN    LCH
         LDO    LHE    LHO    LIN    LMU    LPA    LSO    MAK    MAN    MCA    MDO    MIQ
         MMU    MRQ    MSL    NEB    NOS    NSD    OAR    OCP    OCT    OFH    ONG    OPE
         OPH    OPI    ORH    OVM    PAG    PBU    PDG    PHO    PHS    PIG    PKN    PLS
         PLT    PMO    PMU    POS    PRU    PSI    PSK    PSY    PYR    PZE    RAG    RBM
         RBT    RBY    RCH    RCO    RHY    RIB    ROK    RSK    RSQ    RUB    RUD    SAL
         SBI    SBK    SBW    SCC    SCG    SCH    SCI    SCO    SDO    SEO    SFI    SIA
         SKA    SKI    SMC    SMO    SND    SOR    SOT    SPD    SPE    SPN    SPT    SQX
         SRB    SRH    SSC    SSI    SSK    SSM    SSO    STA    SUA    SUH    SUS    SWA
         SYM    TAM    TAR    TOA    TOD    TOP    TRU    TSQ    TUB    UNI    VNI    VSQ
         WHX    WIT    WOD    WSQ    WWA    ZOR

@species tan0801
codes    ACS AGR    ANT    ANZ    API    APR    ARA    ASR    ATC    BAM    BAR    BAS
         BBE    BBR    BCA    BEE    BER    BGZ    BNS    BOE    BSH    BSL    BSP    BTA
         BTH    BTS    BYD    BYS    CAR    CAS    CBA    CBE    CBI    CBO    CBX    CCX
         CDO    CDX    CDY    CFA    CHG    CHP    CIN    CJA    CMA    CMU    COL    COT
         COU    CRB    CSE    CSQ    CSU    CYO    CYP    DAP    DCO    DCS    DEA    DHO
         DIA    DMG    DSP    DWO    ECH    ECN    EMA    EPL    EPR    EPT    ERA    ETB
         ETL    EZE    FHD    FIS    FMA    FRO    FRS    GAS    GDU    GLS    GON    GOR
         GPA    GRM    GSH    GSP    GUR    GVE    HAG    HAK    HAP    HCO    HEX    HJO
         HMT    HOK    HTH    HTR    HYA    JAV    JFI    JMD    JMM    LAG    LAN    LCH
         LDO    LHE    LHO    LIN    LMU    LPA    LSO    MAK    MAN    MCA    MDO    MIQ
         MMU    MRQ    MSL    NEB    NOS    NSD    OAR    OCP    OCT    OFH    ONG    OPE
         OPH    OPI    ORH    OVM    PAG    PBU    PDG    PHO    PHS    PIG    PKN    PLS
         PLT    PMO    PMU    POS    PRU    PSI    PSK    PSY    PYR    PZE    RAG    RBM
         RBT    RBY    RCH    RCO    RHY    RIB    ROK    RSK    RSQ    RUB    RUD    SAL
         SBI    SBK    SBW    SCC    SCG    SCH    SCI    SCO    SDO    SEO    SFI    SIA
         SKA    SKI    SMC    SMO    SND    SOR    SOT    SPD    SPE    SPN    SPT    SQX
         SRB    SRH    SSC    SSI    SSK    SSM    SSO    STA    SUA    SUH    SUS    SWA
         SYM    TAM    TAR    TOA    TOD    TOP    TRU    TSQ    TUB    UNI    VNI    VSQ
         WHX    WIT    WOD    WSQ    WWA    ZOR
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@species tan0901
codes    ACS AGR   ANT   ANZ   API   APR   ARA   ASR   ATC   BAM   BAR   BAS
      BBE   BBR   BCA   BEE   BER   BGZ   BNS   BOE   BSH   BSL   BSP   BTA
      BTH   BTS   BYD   BYS   CAR   CAS   CBA   CBE   CBI   CBO   CBX   CCX
      CDO   CDX   CDY   CFA   CHG   CHP   CIN   CJA   CMA   CMU   COL   COT
      COU   CRB   CSE   CSQ   CSU   CYO   CYP   DAP   DCO   DCS   DEA   DHO
      DIA   DMG   DSP   DWO   ECH   ECN   EMA   EPL   EPR   EPT   ERA   ETB
      ETL   EZE   FHD   FIS   FMA   FRO   FRS   GAS   GDU   GLS   GON   GOR
      GPA   GRM   GSH   GSP   GUR   GVE   HAG   HAK   HAP   HCO   HEX   HJO
      HMT   HOK   HTH   HTR   HYA   JAV   JFI   JMD   JMM   LAG   LAN   LCH
      LDO   LHE   LHO   LIN   LMU   LPA   LSO   MAK   MAN   MCA   MDO   MIQ
      MMU   MRQ   MSL   NEB   NOS   NSD   OAR   OCP   OCT   OFH   ONG   OPE
      OPH   OPI   ORH   OVM   PAG   PBU   PDG   PHO   PHS   PIG   PKN   PLS
      PLT   PMO   PMU   POS   PRU   PSI   PSK   PSY   PYR   PZE   RAG   RBM
      RBT   RBY   RCH   RCO   RHY   RIB   ROK   RSK   RSQ   RUB   RUD   SAL
      SBI   SBK   SBW   SCC   SCG   SCH   SCI   SCO   SDO   SEO   SFI   SIA
      SKA   SKI   SMC   SMO   SND   SOR   SOT   SPD   SPE   SPN   SPT   SQX
      SRB   SRH   SSC   SSI   SSK   SSM   SSO   STA   SUA   SUH   SUS   SWA
      SYM   TAM   TAR   TOA   TOD   TOP   TRU   TSQ   TUB   UNI   VNI   VSQ
      WHX   WIT   WOD   WSQ   WWA   ZOR

@species tan1001
codes    ACS AGR   ANT   ANZ   API   APR   ARA   ASR   ATC   BAM   BAR   BAS
      BBE   BBR   BCA   BEE   BER   BGZ   BNS   BOE   BSH   BSL   BSP   BTA
      BTH   BTS   BYD   BYS   CAR   CAS   CBA   CBE   CBI   CBO   CBX   CCX
      CDO   CDX   CDY   CFA   CHG   CHP   CIN   CJA   CMA   CMU   COL   COT
      COU   CRB   CSE   CSQ   CSU   CYO   CYP   DAP   DCO   DCS   DEA   DHO
      DIA   DMG   DSP   DWO   ECH   ECN   EMA   EPL   EPR   EPT   ERA   ETB
      ETL   EZE   FHD   FIS   FMA   FRO   FRS   GAS   GDU   GLS   GON   GOR
      GPA   GRM   GSH   GSP   GUR   GVE   HAG   HAK   HAP   HCO   HEX   HJO
      HMT   HOK   HTH   HTR   HYA   JAV   JFI   JMD   JMM   LAG   LAN   LCH
      LDO   LHE   LHO   LIN   LMU   LPA   LSO   MAK   MAN   MCA   MDO   MIQ
      MMU   MRQ   MSL   NEB   NOS   NSD   OAR   OCP   OCT   OFH   ONG   OPE
      OPH   OPI   ORH   OVM   PAG   PBU   PDG   PHO   PHS   PIG   PKN   PLS
      PLT   PMO   PMU   POS   PRU   PSI   PSK   PSY   PYR   PZE   RAG   RBM
      RBT   RBY   RCH   RCO   RHY   RIB   ROK   RSK   RSQ   RUB   RUD   SAL
      SBI   SBK   SBW   SCC   SCG   SCH   SCI   SCO   SDO   SEO   SFI   SIA
      SKA   SKI   SMC   SMO   SND   SOR   SOT   SPD   SPE   SPN   SPT   SQX
      SRB   SRH   SSC   SSI   SSK   SSM   SSO   STA   SUA   SUH   SUS   SWA
      SYM   TAM   TAR   TOA   TOD   TOP   TRU   TSQ   TUB   UNI   VNI   VSQ
      WHX   WIT   WOD   WSQ   WWA   ZOR


@LF_scaling numbers_in_population

@preferences tan9106
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan9212
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan9401
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded
```

```
@preferences tan9501
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan9601
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan9701
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan9801
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan9901
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0001
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0101
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0201
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0301
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0401
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0501
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0601
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0701
```

```
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0801
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0901
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan1001
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@output_tables
sub_biomass_by_stratum T
biomass_by_species T
biomass_by_species_stratum T
biomass_by_species_trip T
LFs_by_stratum F
LFs_by_station F
Number_measured T
LF_totals T

@output_precision
quantity density   biomass    LF_number         cv       gain
type  dec_place  dec_place    sig_fig  dec_place  dec_place
precision     1       0          8          1          1

@input_from_database
database Empress


@where tan9106
t_station  station_no !match '118|143'

@where tan9212
t_station station_no !match '155' and gear_perf match '1|2'

@where tan9401
t_station gear_perf match '1|2'

@where tan9501
t_station station_no !match '7|45|66|76|106' and categories match 'RD'

@where tan9601
t_station station_no !match '4|23|43|60'

@where tan9701
t_station station_no !match '29|93'

@where tan9801
t_station gear_perf match '1|2' and categories match 'RD'
t_stratum stratum !match '0021|0022'

@where tan9901
```

```
t_station gear_perf match '1|2' and categories match 'RD'
t_stratum stratum !match '0021'

@where tan0001
t_station gear_perf match '1|2' and categories match 'P1|P2'
t_stratum stratum !match '0021'

@where tan0101
t_station gear_perf match '1|2' and categories match 'P1|P2'

@where tan0201
t_station gear_perf match '1|2' and categories match 'P1|P2'
t_stratum stratum !match '0022'

@where tan0301
t_station gear_perf match '1|2' and categories match 'P1|P2'

@where tan0401
t_station gear_perf match '1|2' and categories match 'P1|P2'

@where tan0501
t_station gear_perf match '1|2' and categories match 'P1|P2'

@where tan0601
t_station gear_perf match '1|2' and categories match 'P1'

@where tan0701
t_station gear_perf match '1|2' and categories match 'P1|P2'
t_stratum stratum !match '0022'

@where tan0801
t_station gear_perf match '1|2' and categories match 'P1|P2'
t_stratum stratum !match '0022'

@where tan0901
t_station gear_perf match '1|2' and categories match 'P1|P2'

@where tan1001
t_station gear_perf match '1|2' and categories match 'P1|P2|RD'
t_stratum stratum !match
'HAKE|021A|021B|0022|0023|0024|0025|0026|0027|0028|0029'

#tan9106 0001 0002 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013
0014 0015 0016 0017 0018 0019 0020 0021 0022 0023 0024
#tan9212 0001 0002 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013
0014 0015 0016 0017 0018 0019 0020 0021 0022 0023 0024 0025
#tan9401 0001 0002 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013
0014 0015 0016 0017 0018 0019 0020 0021 0022 0023 0024 0025
#tan9501 0001 0002 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013
0014 0015 0016 0017 0018 0019 0020 0021 0022 0023 0024 0025
#tan9601 0001 0002 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013
0014 0015 0016 0017 0018 0019 0020
#tan9701 0001 0002 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013
0014 0015 0016 0017 0018 0019 0020
#tan9801 0001 0002 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013
0014 0015 0016 0017 0018 0019 0020 0021
#tan9901 0001 0002 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013
0014 0015 0016 0017 0018 0019 0020 0021
#tan0001 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020 0021
```

```
#tan0101 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020
#tan0201 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020 0022
#tan0301 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020
#tan0401 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020
#tan0501 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020
#tan0601 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020
#tan0701 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020 0022
#tan0801 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020 0022
#tan0901 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020


# tan9106
@change_strata tan9106
from 0002 0003 0005 0008 0009  0017 0021 0022 0023 0024
to   002A 002B 0004 008A 008B  0016 0003 0005 0009 0017

@change_stratum_area tan9106
strata     0004     0016
new_areas  10704    11540

# tan9212
@change_strata tan9212
from 0002 0003 0005 0008 0009  0017 0021 0022 0023 0024
to   002A 002B 0004 008A 008B  0016 0003 0005 0009 0017

@change_stratum_area tan9212
strata     0004     0016
new_areas  11318    11558

# tan9401
@change_strata tan9401
from 0002 0003 0005 0008 0009  0017 0021 0022 0023 0024
to   002A 002B 0004 008A 008B  0016 0003 0005 0009 0017

@change_stratum_area tan9401
strata     0004     0016
new_areas   11319   11521


# tan9501
@change_strata tan9501
from 0002 0003 0005 0008 0009  0017 0021 0022 0023 0024
to   002A 002B 0004 008A 008B  0016 0003 0005 0009 0017

@change_stratum_area tan9501
strata     0004     0016
new_areas  11304    11522
```

APPENDIX 2: SurvCalc code used to estimate length frequencies

```
@trips   tan9106 tan9212 tan9401 tan9501 tan9601 tan9701 tan9801 tan9901
tan0001 tan0101 tan0201 tan0301 tan0401 tan0501 tan0601 tan0701 tan0801
tan0901 tan1001

@species tan9106
codes   BAR        BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA
      SWA   TAR   WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB
      RBT   SSI   SND

@species tan9212
codes   BAR        BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA
      SWA   TAR   WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB
      RBT   SSI   SND

@species tan9401
codes   BAR        BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA
      SWA   TAR   WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB
      RBT   SSI   SND

@species tan9501
codes   BAR        BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA
      SWA   TAR   WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB
      RBT   SSI   SND

@species tan9601
codes   BAR        BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA
      SWA   TAR   WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB
      RBT   SSI   SND

@species tan9701
codes   BAR        BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA
      SWA   TAR   WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB
      RBT   SSI   SND

@species tan9801
codes   BAR        BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA
      SWA   TAR   WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB
      RBT   SSI   SND

@species tan9901
codes   BAR        BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA
      SWA   TAR   WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB
      RBT   SSI   SND

@species tan0001
codes   BAR        BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA
      SWA   TAR   WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB
      RBT   SSI   SND

@species tan0101
codes   BAR        BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA
      SWA   TAR   WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB
      RBT   SSI   SND

@species tan0201
codes   BAR        BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA
      SWA   TAR   WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB
      RBT   SSI   SND
```

```
@species tan0301
codes  BAR  BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA   SWA
       TAR  WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB   RBT
       SSI  SND

@species tan0401
codes   BAR       BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA
       SWA  TAR   WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB
       RBT  SSI   SND

@species tan0501
codes   BAR       BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA
       SWA  TAR   WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB
       RBT  SSI   SND

@species tan0601
codes   BAR       BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA
       SWA  TAR   WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB
       RBT  SSI   SND

@species tan0701
codes   BAR       BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA
       SWA  TAR   WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB
       RBT  SSI   SND

@species tan0801
codes   BAR       BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA
       SWA  TAR   WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB
       RBT  SSI   SND

@species tan0901
codes   BAR       BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA
       SWA  TAR   WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB
       RBT  SSI   SND

@species tan1001
codes   BAR       BOE   HAK   HOK   LDO   LIN   ORH   SBW   SOR   SSO   STA
       SWA  TAR   WWA   EPT   SSK   RCO   SPE   LSO   GSH   RBM   CYP   ETB
       RBT  SSI   SND


@LF_scaling numbers_in_population

@preferences tan9106
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan9212
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan9401
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan9501
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
```

```
catch_weight   recorded

@preferences tan9601
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan9701
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan9801
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan9901
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0001
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0101
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0201
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0301
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0401
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0501
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0601
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0701
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded
```

```
@preferences tan0801
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan0901
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@preferences tan1001
distance_towed recorded_distance recorded_speed*time from_lat_long
width_swept recorded_doorspread
catch_weight   recorded

@output_tables
sub_biomass_by_stratum T
biomass_by_species T
biomass_by_species_stratum T
biomass_by_species_trip T
LFs_by_stratum F
LFs_by_station F
Number_measured T
LF_totals T

@output_precision
quantity density   biomass    LF_number         cv       gain
type  dec_place  dec_place    sig_fig  dec_place  dec_place
precision     1       0          8         1          1

@input_from_database
database Empress


@where tan9106
t_station  station_no !match '118|143'

@where tan9212
t_station station_no !match '155' and gear_perf match '1|2'

@where tan9401
t_station gear_perf match '1|2'

@where tan9501
t_station station_no !match '7|45|66|76|106' and categories match 'RD'

@where tan9601
t_station station_no !match '4|23|43|60'

@where tan9701
t_station station_no !match '29|93'

@where tan9801
t_station gear_perf match '1|2' and categories match 'RD'
t_stratum stratum !match '0021|0022'

@where tan9901
t_station gear_perf match '1|2' and categories match 'RD'
t_stratum stratum !match '0021'
```

```
@where tan0001
t_station gear_perf match '1|2' and categories match 'P1|P2'
t_stratum stratum !match '0021'

@where tan0101
t_station gear_perf match '1|2' and categories match 'P1|P2'

@where tan0201
t_station gear_perf match '1|2' and categories match 'P1|P2'
t_stratum stratum !match '0022'

@where tan0301
t_station gear_perf match '1|2' and categories match 'P1|P2'

@where tan0401
t_station gear_perf match '1|2' and categories match 'P1|P2'

@where tan0501
t_station gear_perf match '1|2' and categories match 'P1|P2'

@where tan0601
t_station gear_perf match '1|2' and categories match 'P1'

@where tan0701
t_station gear_perf match '1|2' and categories match 'P1|P2'
t_stratum stratum !match '0022'

@where tan0801
t_station gear_perf match '1|2' and categories match 'P1|P2'
t_stratum stratum !match '0022'

@where tan0901
t_station gear_perf match '1|2' and categories match 'P1|P2'

@where tan1001
t_station gear_perf match '1|2' and categories match 'P1|P2|RD'
t_stratum stratum !match
'HAKE|021A|021B|0022|0023|0024|0025|0026|0027|0028|0029'

#tan9106 0001 0002 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013
0014 0015 0016 0017 0018 0019 0020 0021 0022 0023 0024
#tan9212 0001 0002 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013
0014 0015 0016 0017 0018 0019 0020 0021 0022 0023 0024 0025
#tan9401 0001 0002 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013
0014 0015 0016 0017 0018 0019 0020 0021 0022 0023 0024 0025
#tan9501 0001 0002 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013
0014 0015 0016 0017 0018 0019 0020 0021 0022 0023 0024 0025
#tan9601 0001 0002 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013
0014 0015 0016 0017 0018 0019 0020
#tan9701 0001 0002 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013
0014 0015 0016 0017 0018 0019 0020
#tan9801 0001 0002 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013
0014 0015 0016 0017 0018 0019 0020 0021
#tan9901 0001 0002 0003 0004 0005 0006 0007 0008 0009 0010 0011 0012 0013
0014 0015 0016 0017 0018 0019 0020 0021
#tan0001 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020 0021
#tan0101 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020
#tan0201 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020 0022
```

```
#tan0301 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020
#tan0401 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020
#tan0501 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020
#tan0601 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020
#tan0701 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020 0022
#tan0801 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020 0022
#tan0901 0001 002A 002B 0003 0004 0005 0006 0007 008A 008B 0009 010A 010B
011A 011B 011C 011D 0012 0013 0014 0015 0016 0017 0018 0019 0020


# tan9106
@change_strata tan9106
from 0002 0003 0005 0008 0009  0017 0021 0022 0023 0024
to   002A 002B 0004 008A 008B  0016 0003 0005 0009 0017

@change_stratum_area tan9106
strata     0004     0016
new_areas  10704    11540

# tan9212
@change_strata tan9212
from 0002 0003 0005 0008 0009  0017 0021 0022 0023 0024
to   002A 002B 0004 008A 008B  0016 0003 0005 0009 0017

@change_stratum_area tan9212
strata     0004     0016
new_areas  11318    11558

# tan9401
@change_strata tan9401
from 0002 0003 0005 0008 0009  0017 0021 0022 0023 0024
to   002A 002B 0004 008A 008B  0016 0003 0005 0009 0017

@change_stratum_area tan9401
strata     0004     0016
new_areas   11319   11521


# tan9501
@change_strata tan9501
from 0002 0003 0005 0008 0009  0017 0021 0022 0023 0024
to   002A 002B 0004 008A 008B  0016 0003 0005 0009 0017

@change_stratum_area tan9501
strata     0004     0016
new_areas  11304    11522



{
BAR NULL 0.0091 2.88 NULL
BOE NULL 0.04054 2.809 NULL
HAK NULL 0.002221 3.267 NULL
HOK NULL 0.004612 2.884 NULL
LDO NULL 0.03133 2.887 NULL
```

```
LIN NULL 0.001007 3.36 NULL
ORH NULL 0.0963 2.68 NULL
SBW NULL 0.003 3.2 NULL
SOR NULL 0.054 2.78 NULL
SSO NULL 0.03506 2.862 NULL
STA NULL 0.015479 3.02791 NULL
SWA NULL 0.006535 3.299 NULL
TAR NULL 0.028 2.879 NULL
WWA NULL 0.029 2.971 NULL
EPT NULL 0.022134 2.91932 NULL
SSK NULL 0.03285 2.87855 NULL
RCO NULL 0.013104 2.91313 NULL
SPE NULL 0.02618 2.921 NULL
LSO NULL 0.00799 3.12785 NULL
GSH NULL 0.001411 3.37333 NULL
RBM NULL 0.011172 3.12709 NULL
CYP NULL 0.00141 3.2661 NULL
ETB NULL 0.00196 3.2376 NULL
RBT NULL 0.004947 3.25917 NULL
SSI NULL 0.00305 3.24085 NULL
SND NULL 0.00129 3.2389 NULL
}

@lw_coeff  BAR
a 0.0091
b 2.88

@lw_coeff BOE
a 0.04054
b 2.809

@lw_coeff HAK
a 0.002221
b 3.267

@lw_coeff HOK
a 0.004612
b 2.884

@lw_coeff LDO
a 0.03133
b 2.887

@lw_coeff LIN
a 0.001007
b 3.36


@lw_coeff ORH
a 0.0963
b 2.68


@lw_coeff SBW
a 0.003
b 3.2


@lw_coeff SOR
a 0.054
b 2.78
```

```
@lw_coeff SSO
a 0.03506
b 2.862


@lw_coeff STA
a 0.015479
b 3.02791


@lw_coeff SWA
a 0.006535
b 3.299


@lw_coeff TAR
a 0.028
b 2.879


@lw_coeff WWA
a 0.029
b 2.971


@lw_coeff EPT
a 0.022134
b 2.91932


@lw_coeff SSK
a 0.03285
b 2.87855

@lw_coeff RCO
a 0.013104
b 2.91313


@lw_coeff SPE
a 0.02618
b 2.921


@lw_coeff LSO
a 0.00799
b 3.12785


@lw_coeff GSH
a 0.001411
b 3.37333

@lw_coeff RBM
a 0.011172
b 3.12709


@lw_coeff CYP
```

```
a 0.00141
b 3.2661


@lw_coeff ETB
a 0.00196
b 3.2376


@lw_coeff RBT
a 0.004947
b 3.25917


@lw_coeff SSI
a 0.00305
b 3.24085


@lw_coeff SND
a 0.00129
b 3.2389
```

10.