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This report summarises information on important areas for spawning, pupping, and egg-laying, and for juveniles of 32 important deepwater fish species (occurring from 200 to 1500 m depth), 4 pelagic fish species, 45 invertebrate species or species groups, and 5 seaweeds.

Data sources included published and unpublished literature, and Ministry of Fisheries research and commercial scientific observer databases. Some data were also provided from research programmes funded by the Foundation for Research, Science and Technology. The amount and quality of data available varied by species. For some fish species, and many invertebrates, knowledge of juvenile and spawning habitat is based on recorded catches only, with no segregation of individuals by size or maturity. Where data were available, summaries include distribution maps of ripe, running ripe, and spent fish, monthly proportions of gonad maturity stages by area, distribution maps of juveniles and adults, and catch rate plots of juveniles from research trawl survey time series. To enable some assimilation of the data presented, summaries of spawning and juvenile abundance are provided by species and area for deepwater and pelagic fish species.

The overall conclusion from this study is that all areas around New Zealand, from the coast to 1500 m, are important for either spawning or juveniles of one or more fish or invertebrate species. Evaluation of the relative "significance" of different areas is difficult because of varied levels of sampling coverage, species identification, and data collection. However, some areas appear to be "hotspots". For example, juveniles of all 32 deepwater fish species examined have been recorded from the Chatham Rise. The Chatham Rise is also an important habitat for many deepwater invertebrates.

Introduction

The Environmental Principles of the 1996 Fisheries Act require that habitats of particular significance for fisheries management be protected. Areas suitable for juvenile and spawning fish and invertebrates are often spatially limited, but can exert strong influences on final adult population sizes (and hence sustainable yields). Habitat availability and structure is critical for the successful recruitment of many fish stocks (Nack et al. 1993, Gibson 1994, Blaber et al. 1995, Parrish et al. 1997). Alteration of habitat through fishing, or more general environmental modifications (e.g., sedimentation, pollution), may adversely affect the productivity of marine fisheries.

Hurst et al. (in press) summarised information on important areas for spawning, pupping, egg-laying, and juveniles of 35 important New Zealand coastal (occurring in under 200 m depth) fish species. This report expands on the work of Hurst et al. (in press), to describe habitats of importance for all significant New Zealand deepwater (from 200 to 1500 m depth) fish species, pelagic fish species (excluding highly migratory species), and invertebrates.

Deepwater spawning fish are more likely to be vulnerable to mortality caused by target and non-selective fishing methods than to environmental modification. Target fishing on spawning fish, which are often more aggregated and more easily caught than non-spawning fish, may lead to reduced recruitment through disruption of spawning and dispersal of the schools. This is more likely to be a problem if stocks are heavily exploited or are at low stock size. Non-selective fishing methods can also result in high levels of mortality for juveniles or spawning fish of bycatch species. Identification of areas where these fish occur is essential if management and/or mitigation measures are to be effective.

Deepwater sharks and related cartilaginous species have low fecundity and low juvenile natural mortality rates because the young are relatively large at birth or hatching. As a result, elasmobranchs are unable to withstand large increases in mortality, and consequently their populations may be particularly sensitive to loss of nursery grounds. Shark nursery areas are attracting much research attention internationally, with studies often leading to their protection from fishing. Most emphasis has been placed on estuarine and shallow coastal nurseries (e.g., Williams & Schaap 1992, Manire & Hueter 1995, Carrier & Pratt 1998), but attention has been devoted to offshore nurseries (Holts & Bedford 1993).

Fisheries for pelagic species are often recruitment driven, where recruitment success is determined by environmental conditions (e.g., Hutchings et al. 1998). An example is the complex interrelationship between pelagic fisheries in South America and the El Niño-La Niña climate oscillation (Sharp & McLain 1993). Identification of spawning and juvenile areas of New Zealand pelagic fish species is an important first step towards understanding the processes influencing recruitment.

Invertebrate species account for about 30% of the total export value of New Zealand commercial fisheries (Statistics New Zealand 2000), as well as having considerable customary and recreational value. Invertebrates occupy a wide variety of habitats and exhibit a wide variety of strategies to ensure juvenile dispersal, settlement, and reproductive success. Of the edible invertebrate species in the New Zealand Exclusive Economic Zone (EEZ), only a few have nursery or breeding areas that are distinct and separate from the harvested populations, and many begin to breed at a small size within a year or so of settling. Where juvenile settlement occurs in areas which are harvested, successful settlement can be threatened by harvesting operations. Many invertebrates also occur in coastal areas, which are particularly vulnerable to human activities and pollution. The same issues also apply to some commercially important seaweed species, which can themselves be part of the habitat for fish and invertebrates.

Knowledge of habitats of significance for spawning, pupping, egg-laying, and juveniles may be used to alleviate human impacts on these areas. In addition, if juvenile nurseries can be identified, it may be possible to derive recruitment indices from these grounds for inclusion in stock assessment modelling (Ings et al. 1997). In New Zealand, this approach has been successful for snapper, hoki, and southern blue whiting (Francis 1993, Francis et al. 1997, Livingston 1997, Annala et al. 1998, Hanchet 1998a, Ballara et al. 1998). Surveying important juvenile areas may be a cost-effective means of predicting changes in stock size several years in advance.

This project had three objectives.

1. To review the literature and existing data for all significant fish species, including all Quota Management System (QMS) species, encountered from the 200 to 1500 m contours within the New Zealand EEZ to:
a) determine areas of important juvenile fish habitat;
b) determine areas of importance to spawning fish populations; and
c) determine areas of importance for shark populations for pupping or egg laying.

2. To review the literature and existing data for all significant pelagic fish species (excluding highly migratory species) encountered within the New Zealand EEZ to:
a) determine areas of important juvenile fish habitat;
b) determine areas of importance to spawning fish populations; and
c) determine areas of importance for shark populations for pupping or egg laying.

3. To review the literature and existing data for all significant marine invertebrate species encountered within the New Zealand EEZ to:
a) determine areas of important juvenile habitat; and
b) determine areas of importance to spawning populations.

For this project, juveniles are defined as sexually immature animals. The main data sources were published and unpublished literature (including university theses and local body reports) and the Ministry of Fisheries research trawl survey (*trawl*), commercial scientific observer trawl (*obs* and *obs_lfs*) and tuna longline (*l_line*) databases, all of which are maintained by NIWA. These databases contain catch records from most parts of the EEZ (see Anderson et al. 1998, Bagley et al. 2000, Hurst et al. in press).

This project was funded by the Ministry of Fisheries as ENV2000/04, but includes results of (i) the previous Ministry of Fisheries project ENV1999/03 (Hurst et al. in press), (ii) a FRST-funded project (FCA903, Marine Fish Communities of New Zealand) which produced an atlas of juvenile distributions for New Zealand fish and squid (Hurst et al. 2000) and (iii) a review of potential species and areas for marine enhancement for the Ministry of the Environment (Booth 2000).

Methods

Deepwater fish

We identified 32 deepwater species that are found regularly in the 200 to 1500 m depth range and for which there are sufficient (over 200) length-frequency measurements on the *trawl* database to permit classification of juveniles (Table 1). Three of these species (ling, hake, silver warehou) were included in the previous ENV1999/03 project (Hurst et al. in press) because their juveniles also inhabit shallower water, but juvenile plots have been repeated here for completeness. Spawning data for ling, hake, and silver warehou were not included in Hurst et al. (in press), as they were known to spawn deeper than 200 m. Eighteen species were included in the atlas of juvenile distributions (Hurst et al. 2000), but have been updated here to include the two and a half most recent year's data. Twenty-one of the species selected from the research database have also been measured by scientific observers (Table 1) and data from the observer biological database (*obs_lfs*) were incorporated into the summaries for these species.

Literature review

Published and unpublished literature was reviewed for information on the distribution and habitat requirements of spawning adult, planktonic egg, and juvenile stages of the 32 species listed above. Data sources included a bibliography of New Zealand fish and fisheries compiled by Mr L. J. Paul, NIWA, computerised bibliographic searches, unpublished university theses, regional council reports, and environmental impact reports.

Areas of important juvenile fish habitat

The main source of information on the distribution of juvenile fishes from 200 to 1500 m depth is the Ministry of Fisheries *trawl* database. This database contains records of over 24 000 research trawl tows made during the last 40 years (Figure 1). Almost 20 000 of the tows were carried out during random bottom trawl surveys. The other source of data was the Ministry of Fisheries scientific observer (*obs_lfs*) database for commercial trawls, which contained over 44 000 trawls.

Data analysis followed that used by Hurst et al. (2000, in press). The first step was to define the first two identifiable juvenile age classes (usually 0+ and 1+) of each species by length. Most fish caught during trawl surveys were not aged. Juvenile age classes were determined from the modes and troughs of length-frequency distributions, taking into account information on the age, growth, spawning period, and theoretical birthday of each species. Separate length-frequency distributions were plotted for each of the main trawl survey time series and the appropriate length cutoffs were determined by eye. These cutoffs were compared across survey series (which were often conducted at different times of year) to determine the degree of seasonal movement of modal peaks. Fast growing species with considerable seasonal movement of peaks required four (quarterly) sets of length cutoffs to adequately track the seasonal movement of age classes; i.e., length-frequency data sets can be combined across three-month periods (Hurst et al. 2000). Slower growing species show less modal movement, and their age classes could be adequately defined by combining data across six-month periods (Hurst et al. 2000). For species where we could not identify juvenile age classes from length modes, we used (a) length-cutoffs based on published or unpublished length at maturity data (see below) or (b) arbitrary length cutoffs that distinguish "small" from "medium to large" fish. For some elasmobranch species, length cutoffs were determined separately for each sex. Data used to determine these lengths and age classes are given in Table 2.

Juveniles were also distinguished using data on length at maturity (Table 2). Length of maturity was defined as the size at which 50% of fish are mature. Maturity data were not available for all species and the length at maturity may vary spatially and between the sexes. In those instances an arbitrary or average length cutoff was used (Table 2), except where the difference between male and female length at maturity was greater than 10 cm. For these species (mainly elasmobranchs), the distribution of immature and mature fish was determined separately for each sex and then the data were combined.

Once length cutoffs had been determined, data on juveniles were extracted from the *trawl* and *obs_lfs* databases. Only data from bottom trawls (headline height less than 15 m from the bottom) were selected. This allowed us to plot the depth distribution of juveniles (see Section 1.1). Depth data were not always available for midwater trawls or longlines. Details on the databases and possible sources of error or uncertainty relevant to the distribution data extracted can be found in Anderson et al. (1998) Bagley et al. (2000), and Hurst et al. (2000). The date for extraction of data for juvenile plots presented in Section 1 was 30 June 2001.

For each species, maps were produced showing the distribution of stations at which each juvenile age (size) class was caught (Section 1.1). Maps were also produced for each of the 32 species showing the locations of stations at which immature fish were caught, as well as the location of adult fish (Section 1.1), so that the areas where juveniles do not occur can also be determined. The grey background on each adult plot in Section 1.1 shows all positions where the species has been caught, thereby indicating where the species occurs but may not have been measured.

Maps in Section 1.1 show the "presence-absence" of juveniles. For research bottom trawl survey series that had used the same vessel and gear, expanding symbol plots of trawl catch rates of juveniles (immature fish) were also produced (Section 1.2). These provide relative abundance maps for subsets of the data. Expanding symbol plots were produced only for species of which at least 200 fish were measured or 20 stations with fish measured per time series. Surveys selected for this part of the report are listed in Table 3, and species are listed in Table 1.

Length cutoffs for expanding symbol plots were the same as those used for the presence/absence distributions (Table 2). Catch rates were determined from the area swept by the trawl, using the doorspread width multiplied by the distance towed. Catch rates were expressed as either tonnes (t) or kilograms (kg) per square kilometre (km^2), with symbol size proportional to trawl catch rate.

There are two sets of plots in Section 1.2. The first set of plots (Section 1.2.1) shows data from three time series: middle depth surveys by *Tangaroa* (closed circles); deepwater surveys by *Tangaroa* (open circles); and deepwater surveys by other vessels using similar trawl gear (solid diamonds). The second set of plots shows four series of inshore surveys by *Kaharoa* (Section 1.2.2). On the *Kaharoa* plots, North and South Island are separate, and within the North Island plot, data from the southeast are represented by a different symbol (open circle) to represent the different trawl used in that area. Surveys around the South Island used the same trawl, although east coast South Island surveys since December 1996 have a used a smaller codend mesh size (28 mm compared to 74 mm previously). These 28 mm mesh stations are indicated by a different symbol (open circle). All symbols are defined in figure captions at the start of each section. Reference plots showing where each species was caught are shown on left-hand pages.

Areas of importance to spawning fish

The two main data sources were the same as for the juvenile distributions: the *trawl* and *obs_lfs* databases. Scientific staff on research surveys and scientific observers aboard commercial fishing vessels have collected data on fish gonad maturity stages for commercially important species. All records with gonad stage information were extracted from the databases, including both bottom and midwater trawls, and longline data.

Scientific observers have used a 5-stage scale for gonads since the start of the observer programme. Research staff have used a variety of staging methods for different species, but these stages were translated into the 5-stage observer scale for comparability (see Table 4). Analyses were restricted to voyages for which the staging scheme could be determined. Only female data were used because ripe males are not an accurate indicator of imminent spawning activity (spermatozoa may be held in the testes for extended periods). Running ripe females are the best indication of spawning in the immediate vicinity, but this stage of some species is relatively rarely caught, perhaps because changes in behaviour of spawning fish make them unavailable to the fishing gear, or because the process of ovulation, hydration and spawning is rapid. Therefore, we also used ripe and spent fish as likely indicators of the presence of spawning fish.

Of the 32 deepwater species listed in Table 1, 19 teleost species and two skates have records where female gonads have been staged. Shark female reproductive data were not usually recorded on these databases.

The locations of ripe and running ripe (combined) and spent females were plotted on distribution maps (Section 2). The grey background scale on the distribution figures shows where gonad stage information has been collected, allowing identification of areas that have not been sampled to date. The date for extraction of data for spawning plots presented in Section 2 was 30 June 2001.

The proportion spawning (and number of samples) by main fishery areas were also summarised by month. The areas were related to, but not always the same as, Fisheries Management Areas (FMA). Boundaries were chosen that separated known spawning areas and stocks, while grouping FMAs where the distribution of fish appeared to be continuous (see Section 2). Proportion spawning was calculated from fish greater than the length of maturity only (see Table 2), otherwise immature fish are included with resting mature fish (as stage 1) in the 5-stage gonad staging scale (see Table 4).

Areas of importance to sharks for pupping and egg-laying

Sharks and other cartilaginous fishes reproduce either by depositing leathery egg cases on the seabed, or by giving birth to live young (often known as pups). Pupping and egg laying areas can be identified directly, by the location of deposited eggs, and indirectly, from the presence of pregnant females carrying full-term embryos, or egg cases ready for extrusion and 0+ pups.

Existing data sources on the location of shark pupping and egg laying areas are meagre. Indirect evidence can be obtained from the presence of young juveniles in the *trawl* and *obs_lfs* databases (see plots in Section 1). The *trawl* database did contain gonad stage data for small numbers of rough skate and smooth skate, and these are summarised in Section 2. Only stations from research voyages with reliable identification and staging of skates were plotted.

Pelagic fish

Highly migratory species were specifically excluded from this objective. Most of the large pelagic species that are taken by tuna longline, purse seine and troll vessels in New Zealand waters, including tunas, broadbill swordfish, marlins, blue shark, porbeagle shark, and mako shark, are highly migratory. Furthermore, juvenile and adult distributions of these species have already been analysed by NIWA under a FRST programme (Hurst et al. 2000). The only other significant large pelagic species are Ray's bream and moonfish. Ray's bream are also caught by trawlers and are covered under deepwater species (see above). The scale of movements of moonfish is unknown, but we have assumed that it is non-migratory.

Medium-sized pelagic species (kahawai, kingfish, jack mackerels, trevally, blue mackerel) were all covered by MFish project ENV1999/03 in 1999–2000 (Hurst et al. in press). Of the small pelagic species, pilchards have recently been the subject of a detailed study (Paul et al. 2001). This report summarised the available information on spawning, and juvenile habitat was reviewed in a general way. However there is considerable, previously unanalysed, length-frequency data on the Ministry of Fisheries research trawl database that can be used to identify areas of juvenile habitat for pilchards. Sprats (*Sprattus antipodum* and *S. muelleri*) and anchovies have not been analysed previously and were included here.

There are no significant pelagic sharks that are not highly migratory, so no work was carried out under Objective 2c.

In summary, this objective was limited to: (a) analysing length-frequency data for moonfish from the tuna longline observer database, and reviewing literature on moonfish spawning and juvenile habitat; (b) analysing length-frequency data for pilchards from the research trawl database; and (c) reviewing literature and analysing research trawl database length-frequency data for sprats and anchovies.

Areas of important juvenile fish habitat

Length-frequency data were extracted from the MFish tuna longline observer database *l_line* for moonfish, and from the MFish research trawl database *trawl* for pilchards, sprats, and anchovies (see Table 1). Data analysis followed that used for deepwater species as described above, and length cutoffs are given in Table 2. There was insufficient information available to identify year-class cutoff lengths for any of these species, hence maps were produced for immature and adult fish only. These maps showed the positions of longline sets or trawl tows in which immature fish or adults were caught (Section 3.1). For moonfish, expanding symbol plots, where symbol size was proportional to longline catch rate, were created to show relative abundance (Section 3.2). For the three small pelagic species, escapement from the trawl meshes used in trawl surveys is probably high and variable, and the numbers caught in each tow probably did not reflect abundance.

Areas of importance to spawning fish

Gonad stage data were not available in MFish or NIWA databases for any of the four pelagic species covered under this sub-objective. Published and unpublished literature were reviewed for information on the distribution of spawning, and of planktonic eggs and larvae, of moonfish, sprats, and anchovies, and are summarised in the text.

Invertebrates and seaweeds

We identified 45 species or species groups of invertebrate and 5 species of seaweeds important to commercial, customary, or recreational fishers (Table 5). A species by species (or group of species) analysis approach was used for invertebrates. The species involved, their different habitats and autecology to fishes, and the considerable variation in these among the invertebrate species, make this approach a more useful one than the more general methods described for deepwater fish above.

Particular attention was directed towards species in which juvenile habitat or adult breeding areas are at risk through fishing or other activity. Because they occur in similar areas and depth zones as some of the important invertebrates, the principal harvested seaweed species were also considered.

Areas of important juvenile and spawning habitat

The main sources of information were 1) published and unpublished reports and surveys from NIWA, government departments (in particular, Department of Conservation and Ministry for the Environment), museums (mainly Museum of New Zealand Te Papa Tongarewa), and universities; 2) NIWA (and previous NZOI) station records of benthic sampling; 3) Ministry of Fisheries *trawl, obs,* and *obs_lfs* databases; and 4) overseas literature accessed through abstracting programmes.

The format of the distribution maps in Section 5 differed according to the species or species group. For many of the 28 trawl-caught species or species groups examined there was no size information collected but, because of the sedentary nature of many of these invertebrates, "presence-absence" plots may be a good indicator of adult breeding areas. A wide range of reproductive strategies are displayed by invertebrates, from brooding of the young (e.g., some cidarid sea urchins) to forms with a long planktotrophic larval stage (e.g., *Fusitriton* spp), so "presence-absence" will be a variable indicator of juvenile habitat.

For trawl-caught species with size frequency data (scampi, paddle crabs, prawn-killers), data analysis followed that used for fish species (see above and Hurst et al. 2000, in press). Juveniles were distinguished using data on length at maturity (Table 6). Data on juveniles were extracted from the *trawl* and *obs_lfs* databases. Data from all trawls (bottom and midwater) were selected, but most species examined here would be vulnerable only to bottom trawls. The date for extraction of data for invertebrate plots presented Section 5 was 30 August 2001.

For each species, maps were produced showing the distribution of stations at which it was caught. Maps were also produced for scampi, paddle crabs, and prawn-killers showing the locations of stations at which immature fish were caught, as well as the location of adult fish, so that the areas where juveniles did not occur could also be determined. The grey background on each adult/juvenile plot in Section 5 shows all positions where the species has been caught, indicating where the species occurs but may not have been measured. A reference figure is also provided in Section 5 giving the positions of all trawls (research and observer) which recorded a catch of any invertebrate, excluding squid and octopus species, a total of 17 751 trawls.

Reproductive data were available only for scampi. Scientific staff on research surveys and scientific observers aboard commercial fishing vessels have regularly collected data on female scampi gonad maturity stages, determined from both external egg characteristics (research and observer) and internal ovary condition (research only). All records with gonad stage information were extracted from the databases (*trawl* and *obs_lfs*), including both bottom and midwater trawls, and longline data. As for deepwater fish species (see above), we used ripe and spent female scampi as likely indicators of spawning. The location of ripe and spent female scampi (combined) were plotted on a distribution map in Section 5. The grey background scale on this figure shows where gonad stage information has been collected.

Results

The literature review and text summarising data on deepwater fish, pelagic fish, invertebrates, and seaweeds are given below. Plots containing the data summaries referred to are in Sections 1–2 (deepwater fish), 3 (pelagic fish), and 5 (invertebrates and seaweeds). Section 4 provides a quick visual guide to the most important areas for spawning and juvenile fish, and the most important months for spawning. It encompasses information from the literature review and the new data presented here, as well as highlighting gaps in our knowledge. The split of areas into sub-areas within FMA allows for identification of areas which might be important for more detailed sampling of habitat, or appropriate for sampling to index recruitment of selected species.

Deepwater fish

Species are described in alphabetical order of the scientific name.

Allocyttus niger (black oreo)

Literature review

Black oreo are found from Cook Strait south, in depths of 600–1200 m (McMillan 1996), and generally form schools above or near pinnacles and canyons (Paul 2000). Black oreos are long lived and slow growing (Doonan et al. 1995, McMillan et al. 1997). Length at maturity is 34 cm in females, reached at about 40 years of age (Doonan et al. 1995, McMillan et al. 1997).

Spawning areas
The Chatham Rise is the only confirmed spawning area for black oreo. Ripe, running ripe and spent black oreo are found on the south Chatham Rise in October–November (McMillan & Fincham 1988, Hart & McMillan 1998). Fish in ripe and running ripe condition are found in depth range 600–1000 m, while developing fish are found in depths up to 1500 m (Hart & McMillan 1998). Reports of spawning in other areas have not been investigated in detail. Black oreo with developing gonads were reported from the Puysegur Bank and Macquarie areas of Southland in August–September (Clark & Tracey 1994b), and some ripe fish were observed in the same area in September–October (Clark et al. 1996).

Juvenile distribution
Juvenile oreos are pelagic but rarely seen. They probably spend about 6 years in the pelagic phase (G. James & P. McMillan, NIWA, unpublished data) and are seldom caught by trawling (McMillan 1996). Juvenile black oreo, ranging in size from 41 to 178 mm, have been caught in depths of 150–1100 m on the Chatham Rise and Campbell Plateau, mostly on the south Chatham Rise. Juveniles settle on the bottom when they are 20–25 cm TL (McMillan 1996). Some black oreos under 34 cm are found in all areas where mature fish are found, including the north and south Chatham Rise (McMillan & Hart 1994a, 1994b, 1994c, Tracey & Fenaughty 1997, Hart & McMillan 1998, Langley 2001), Puysegur Bank and Macquarie Ridge (Clark & Tracey 1992, 1994b, Clark & Thomas 1994, Clark et al. 1996), Pukaki Rise and east coast South Island (Clark & Thomas 1994).

Data summaries

Spawning areas
Gonad state has been recorded over much of the area where black oreo have been caught. Most spawning and spent fish occurred along the southern Chatham Rise. Observers also recorded spawning and spent fish south of Puysegur, and spawning fish to the northeast of the Pukaki Rise. There were few records of spawning fish off the southeast coast of the South Island or on the northern Chatham Rise. Most black oreo in spawning condition were observed between September and February, with a peak on the Chatham Rise in November, when about 45% of fish were ripe, running ripe, or spent.

Juvenile distribution
Immature black oreo have a similar distribution to adults. Immature fish occur at 600–1200 m depth on the Chatham Rise, off the southeast coast of the South Island, to the north and northeast of the Southern Plateau, and south of Puysegur. There were also a few observations of juveniles north of New Zealand. Most records of immature black oreo were from the southern Chatham Rise, but immature fish were also observed on the northern Chatham Rise, where they occurred more frequently than adults.

Juvenile abundance
The peak catch rate of immature black oreo (190 039 kg km^{-2}) was taken to the south of Puysegur during a deepwater survey from a commercial vessel. High catches were also taken on *Tangaroa* surveys along the southern Chatham Rise, and northeast of the Pukaki Rise on the Southern Plateau.

Argentina elongata (silverside)

Literature review

Silverside are usually found in deep waters beyond the shelf edge, from 200 m to at least 600 m depth, but may occur in shallower waters around the South Island (Paul 2000). Average size varies with region and depth: 10–20 cm in the North Island, and 20–25 cm from the Campbell Plateau in 400–600 m depth (Paul 2000).

Spawning areas
Eggs of silverside are rarely found (Robertson 1975a).

Juvenile distribution
Size and age at maturity is not known. A specimen measuring 75.2 mm was collected at Cape Campbell (Russell 1996), but with no maturity data it is not known if this fish was a juvenile.

Data summaries

Spawning areas
Insufficient data.

Juvenile distribution
The length of maturity is uncertain and was based on length frequency modes. Juvenile silverside (and even adults) are unlikely to be fully selected by trawl gear with typical codend mesh sizes (60–100 mm). Small silverside (under 19 cm) were recorded mainly off the northeast coast of the North Island, west coast South Island, and on the Chatham Rise and Southern Plateau. There were a few records from Southland and off the northwest tip of the North Island. Small silverside tended to occur at shallower depths than larger fish, with peaks at 200 and 400 m.

Juvenile abundance
Small silverside were recorded only from 33 *Tangaroa* middle depth tows, mainly on the Chatham Rise and off the west coast South Island. Catch rates were very low (under 3 kg km^{-2}), with the peak catch rate recorded on the west coast South Island.

Beryx splendens (alfonsino)

Literature review

Alfonsino are found around the North Island and southern South Island and Chatham Rise, usually over or near deep reefs or rough bottom, in depths of 200–800 m (Paul 2000). Stock structure is unknown. Horn (1988a) suggested that alfonsino in New Zealand waters could be part of a widely distributed South Pacific stock. Alfonsino show strong diurnal migration: they are on the bottom during the day and form large schools at dusk in mid-water (Horn 1988a). The target commercial fishery for alfonsino is off the lower east coast of the North Island, particularly from Tuaheni Bank to the Palliser Bank, where alfonsino are generally found on banks and seamounts (Horn & Massey 1989). Alfonsino are a moderately slow growing species. Males reach about 31, 39, and 42 cm at 5, 10, and 15 years respectively; females reach about 32, 41, and 46 cm at the same ages (Horn & Massey 1989, Massey & Horn 1990).

Spawning areas

Age and size at maturity are not yet confirmed in New Zealand waters, but size at maturity is probably about 30 cm (Horn & Massey 1989, Annala et al. 2001). Spawning grounds remain unknown (Annala et al. 2001). Few fish with developing gonads were found at any time of the year on the lower east coast of the North Island, and no running ripe fish were found (Horn & Massey 1989). Fish from Palliser Bank showed a peak gonadosomatic index (GSI) in June, which could indicate that they spawn in July-August (Horn & Massey 1989). The reduction in abundance of alfonsino on the Palliser Bank in July-August suggests that they probably spawn away from the main commercial grounds (Horn & Massey 1989). Horn & Massey (1989) suggested that they start to mature in winter (hence the peak GSI in winter), but leave the ground in spring to spawn in summer in a reproductive area not yet known. Fish caught on the northeast coast of the North Island were immature or resting (Clark & King 1989).

In New Caledonia, alfonsino reach 50% maturity at 33 cm for females and 34 cm for males (Lehodey et al. 1997). In Japanese waters, alfonsino first spawn at about 34 cm (FL) at age 4 years (Horn & Massey 1989). Spawning in Japan occurs from summer to early autumn, eggs are free floating, and larvae are widely distributed by surface currents, until they adopt a demersal existence, believed to be at about 1 year old (Horn & Massey 1989).

Juvenile distribution

Young alfonsino were caught on the lower east coast of the North Island in several locations (Palliser Bank, Tuaheni High, Paoanui Ridge and Motukura Bank), and those caught on the Palliser Bank are generally small (Horn & Massey 1989, Massey & Horn 1990). A few small alfonsino, 20–30 cm, were caught trawling north of Manukau Harbour on the west coast of the North Island, and the northeast North Island as well as the lower east coast of the North Island (Clark & King 1989). Age 4 fish recruit onto the Palliser Bank from February until July, and recruit to the fishery at about age 5. Small alfonsino are under-represented in commercial landings owing to mesh selection and discarding at sea (Massey & Horn 1990).

In New Caledonia, Lehodey et al. (1997), investigating alfonsino on seamounts, differentiated "vegetative" zones, in which juvenile alfonsino grow, from "reproductive zones" (fishing grounds) which are inhabited by mature individuals. They found that the smallest alfonsino (13 cm) were caught on seamounts with shallow summits, and that depth of capture increased with increasing body size (Lehodey et al. 1997). Juvenile alfonsino, 54–96 mm long, were collected in water of 50–210 m depth in the Indian Ocean, and adults were caught at depths of 260–630 m (Ivanin 1987). It appears that juvenile alfonsino can be transported long distances by upwelling and currents (Ivanin 1987, Lehodey et al. 1997), and that eddy systems between seamounts are likely to play an important role in colonisation (Lehodey et al. 1997).

Data summaries

Spawning areas

Gonad states were recorded only for 119 tows catching alfonsino. There are very few observations of alfonsino in spawning condition, with only three records of ripe or running ripe fish, and seven records of spent fish. These spawning fish were mostly taken from FMA 2 (east coast North Island) from September to December, with other records from the eastern Chatham Rise in October, December, and January, and the Lord Howe Rise in August.

Juvenile distribution

Immature (1+ and 2+) alfonsino occur mainly in 200–500 m depth north of 45° S. Immature fish are found off the east coast North Island, west coast South Island, on the northern Chatham Rise, and Challenger Plateau. Immature alfonsino tend to occur in the same general areas as adults, but at shallower depths.

Juvenile abundance

Juvenile alfonsino were caught in middle depth and deepwater surveys on *Tangaroa*. Peak catch rates (up to 2 360 kg km^{-2}) were taken on the Chatham Rise, with other large catches on the west coast of the South Island and on the Ritchie Hill.

Brama brama and *B. australis* (Ray's bream)

Literature review

Ray's bream have a wide distribution, being found in the North Atlantic Ocean and throughout the subtropical to subantarctic waters of the southern hemisphere (Mead & Haedrich 1965). *Brama* species (probably *B. brama* and *B. australis* combined) are distributed across the whole South Pacific between New Zealand and Chile, but are most abundant west of 110° W (Yatsu 1995). Ray's bream average about 40–50 cm fork length, reach about 60 cm, and are pelagic or mesopelagic, occurring near the surface or in midwater to depths of several hundred metres (Ayling & Cox 1982, Moreland 1983). Paulin (1981) noted that Ray's bream were locally abundant in New Zealand, and that they ranged between the Bay of Plenty and Banks Peninsula and Hokitika. Analyses of 10 years of scientific observer data collected aboard tuna longliners show that Ray's bream occur throughout the New Zealand EEZ (from 30 to 50° S), but that their abundance is greatest in the southern part of their range (Francis et al. 1999, 2000, Bagley et al. 2000).

Spawning areas

Nothing is known about spawning of Ray's bream in New Zealand. In the North Atlantic, They spawn over a protracted period between spring and autumn. Spawning may occur at different times of year in different latitudes, with a preference for temperatures over 19.5 °C (Mead 1972). Juveniles less than 25 mm long are found in surface waters at temperatures of 21–24 °C (Mead 1972). They appear to descend into deeper water as they grow. In the North Pacific, Pacific pomfret spawn over a lengthy period in warm subtropical waters, and small juveniles exclusively occur there (Shimazaki 1989, Pearcey et al. 1993, Savinykh 1994).

Juvenile distribution

By analogy with Ray's bream in the North Atlantic, and Pacific pomfret, it seems likely that New Zealand Ray's bream have high growth and natural mortality rates, and low to moderate longevity. The fishery for Ray's bream off northwest Africa mainly exploits two successive age groups, and progression of length-frequency modes suggests a fast growth rate of about 13 cm per year for fish of 27–30 cm fork length (Rodriguez 1980). Fast initial growth is also likely for Portuguese fish, followed by a considerable reduction in growth rate to a maximum age of 12 years (Lobo & Erzini 2000). Pacific pomfret also grow rapidly, reaching about 30 cm in their first year, and maturing during their second year (Shimazaki 1989, Pearcey et al. 1993, Savinykh & Vlasova 1994, Bigelow et al. 1995).

Length-frequency distributions for Ray's bream observed aboard tuna longliners around southern New Zealand (mainly west coast South Island) consisted of a single prominent mode at 45–55 cm fork length, with most fish 40–60 cm long (Francis et al. 2000). Females mature at about 43 cm (unpublished observer data from trawl-caught fish), suggesting that most fish caught by tuna longlines are mature. Ray's bream caught by research bottom and midwater trawls were smaller than those taken on longlines (mainly 35–45 cm) (Hurst et al. 2000), and were probably mostly immature.

Data summaries

Spawning areas

Gonad states for Ray's bream were recorded in only 37 tows: ripe fish were observed in Southland (3 tows), off the west coast South Island (1 tow) and on the western Chatham Rise (1 tow). Only seven ripe individuals were recorded from these tows, in February (four fish), April (one fish) and September (two fish).

Juvenile distribution

Juvenile Ray's bream have been recorded only south of 40° S. Immature fish (groups i and ii) occur off Wairarapa, west coast South Island, Southland, and on the Chatham Rise. Most immature Ray's bream are taken from 100–700 m water depth, but there is also a small peak at 1100 m depth. Ray's bream from deep water may have been caught in bottom trawls during deployment and retrieval. Juvenile Ray's bream have a similar distribution to adults, although adults tend to be more widespread, especially over the Southern Plateau.

Juvenile abundance

Juvenile Ray's bream have been caught in middle depth and deepwater trawl surveys on *Tangaroa.* Catch rates were generally low (less than 50 kg km^{-2}), but were relatively consistent across the Chatham Rise. The only other area with catch rates comparable to the Chatham Rise was the Stewart-Snares shelf.

Centroscymnus crepidater (longnose velvet dogfish)

Literature review

Longnose velvet dogfish occur all around the New Zealand coast, and are common on the Chatham Rise (Wetherbee 2000). They are found on or near the bottom of continental and insular slopes at depths of 270–1300 m, most commonly in depths of 780–1100 m. (Compagno 1984, Last & Stevens 1994). The maximum length is about 105 cm. Males mature at about 60 cm and females at about 80 cm (Last & Stevens 1994).

Pupping areas

Longnose velvet dogfish carry four to eight pups per litter and give birth to live young that are about 30–35 cm in length (Last & Stevens 1994). King & Clark (1987) reported a smaller birth length of 28–30 cm. Females appear to breed throughout the year (Last & Stevens 1994). There is no information available on pupping areas.

Juvenile distribution

No information available.

Data summaries

Pupping areas
Insufficient data.

Juvenile distribution
Longnose velvet dogfish were widespread around New Zealand between 700 and 1200 m, but were measured in less than 4% of the 4816 research tows in which they were recorded in the catch. Immature longnose velvet dogfish have been observed in the same areas as adults, namely on the Chatham Rise, the Challenger Plateau, off the northwest of the North Island, and Wairarapa. We suspect immature longnose velvet dogfish are also present in other areas where there are no length data.

Juvenile abundance
Immature longnose velvet dogfish were recorded in only one middle depth and 17 deepwater tows on *Tangaroa*, and in 4 deepwater research tows by charter vessels. All these tows were on the Chatham Rise, except one tow off the northwest coast of the North Island. Catch rates were less than 200 kg km^{-2}.

Centroscymnus owstoni (Owston's dogfish)

Literature review

Owston's dogfish are distributed throughout New Zealand on the upper continental slope at depths of 500–1400 m, but are most common in depths of 730–900 m (Last & Stevens 1994). They occur on or near the bottom (Compagno 1984). They are common on the west coast of the South Island and Challenger Plateau (King & Clark 1987), and the north Chatham Rise (Wetherbee 2000). Clark & King (1989) reported their occurrence in trawl surveys off the northern North Island (from the Challenger Plateau off the west coast to south of Cape Kidnappers off the east coast), and Roberts (1987) reported their occurrence at Three Kings. They attain a maximum length of 120 cm, males mature at about 70 cm and females at 100 cm (Last & Stevens 1994).

Pupping areas
Owston's dogfish give birth to live young that are about 30 cm long (Last & Stevens 1994). Females contain up to 34 eggs (Last & Stevens 1994), with an average of 17 (King & Clark 1987). Pupping has not been observed in New Zealand, and the exact location of pupping areas is unknown.

Yano & Tanaka (1988) reported that in Japan the number of embryos ranged from 16 to 28 and that the number of embryos carried increased with the size of the female. Owston's dogfish does not appear to have a well defined breeding season, females with mature or fertilised ova were found in several months of the year. The gestation period is not clear, but for squaloid sharks usually lasts 1–2 years.

Yano & Tanaka (1988) reported depth segregation related to breeding in two species of *Centroscymnus* dogfish, including *C. owstoni*, in Suruga Bay, Japan. Females with mature ova and pregnant females move into shallower waters, but pregnant females with full term embryos are not caught in shallow waters. It appears that they move into nursery areas which are probably in deeper waters.

Juvenile distribution
No information available. Length frequency data not often recorded for dogfish.

Data summaries

Pupping areas
Insufficient data.

Juvenile distribution
As for longnose velvet dogfish, Owston's dogfish is relatively widespread round New Zealand at 800–1200 m depth, and has been recorded in the catch of 3192 research trawls. However, Owston's dogfish are seldom measured, and the distribution of immature fish is based on only 93 tows, which cover only part of the overall range. Immature Owston's dogfish have been recorded on the Chatham Rise, the Challenger Plateau, and off Northland.

Juvenile abundance
Insufficient data.

Cyttus traversi (lookdown dory)

Literature review

Distributed around New Zealand, in 100–900 m water depth. Lookdown dory are most common in 400–700 m, particularly on the Chatham Rise (Paul 2000). Average size is 25–40 cm, and females grow larger than males (Clark & King 1989, Paul 2000, O'Driscoll and Bagley 2001). Maximum length is 65 cm (Stewart 1995).

Spawning areas
Females mature at about 30–35 cm (Clark & King 1989). Ripe and spent fish were found on the east coast North Island (Clark & King 1989). Most spawning appears to take place in autumn–winter, but some spawning may occur all year (Clark & King 1989).

Juvenile dstribution
Juvenile lookdown dory are found near the surface in inshore waters. At about 12 cm in length, they begin to take on the adult shape and move into deeper water (Ayling & Cox 1982). Lookdown dory of less than 30 cm were caught on both east and west coasts of the upper North Island (Clark & King 1989), on the Chatham Rise (Livingston et al. 1991), and in the Sub-Antarctic (O'Driscoll & Bagley 2001).

Data summaries

Spawning areas
Gonad states of lookdown dory have been recorded from 142 tows. Ripe or running ripe fish were recorded in 19 tows and spent fish in 83 tows. Fish in spawning condition have been observed around New Zealand from Northland, east coast North Island, west coast South Island, Chatham Rise, Southern Plateau, and Puysegur. Seasonal sampling of coverage was poor. The best coverage was in northern New Zealand (FMAs 1, 2, 9), when gonad states were recorded in nine months. Spawning in this area appears to occur in winter, with ripe fish recorded in May and June, and more than 80% of fish in July to September spent. A high proportion (over 50%) of fish sampled in July and August on the west coast of the South Island (FMA 7) were also spent. Timing of spawning is less certain on the Chatham Rise and on the Southern Plateau where ripe or spent fish were present in almost all months sampled.

Juvenile distribution
Juvenile (group i and ii) lookdown dory were recorded from 300–600 m depth. This was a narrower depth range than for adults, which occurred to 800 m. Juvenile lookdown dory occurred on the east coast North Island, west coast South Island, Chatham Rise, and the Southern Plateau. Few juveniles were observed on the Challenger Plateau, at Puysegur, on the Stewart-Snares shelf, or on the Pukaki Rise, where adults were relatively abundant. The length at maturity of lookdown dory (33 cm) was considerably larger than the maximum length of group ii juveniles (20 cm). The spatial and vertical distribution of all immature fish combined was very similar to the adult distribution, suggesting that fish may move into adult areas at between 20 and 33 cm.

Juvenile abundance
Immature lookdown dory were recorded in three types of survey time series: *Tangaroa* middle depth, other vessels deepwater, and *Kaharoa* inshore. They were most commonly observed in *Tangaroa* middle depth tows, occurring in 1356 tows. Catch rates of immature lookdown dory in *Tangaroa* middle depth tows were moderate (peak catch rate 180 kg km^{-2}), with highest catch rates on the Chatham Rise and west coast South Island. No large catches were taken on the Southern Plateau or at Puysegur, even though immature fish were commonly recorded there. In deepwater surveys, highest catch rates of immature lookdown dory where taken in the Bay of Plenty and off the west coast of the North Island, but these catch rates (maximum 65 kg km^{-2}) were lower than middle depth catch rates on the Chatham Rise and west coast South Island. Inshore catch rates from *Kaharoa* surveys were also relatively low (maximum 46 kg km^{-2}), with peak catches off Wairarapa, west coast South Island, and the eastern South Island shelf between Canterbury and Otago.

Deania calcea (shovelnose dogfish)

Literature review

Shovelnose dogfish are distributed all around the New Zealand coast, and are most abundant in the north (King & Clark 1987). They are a deepwater demersal species of the continental and insular slopes and outer shelves, are found in depths of 70–1450 m, but are most common in depths of 400–900 m (Last & Stevens 1994). They attain at least 113 cm, and both sexes mature at about 70 cm (Last & Stevens 1994).

Pupping areas
Shovelnose dogfish are ovoviviparous, with litters of 6–12 pups (Compagno 1984, Last & Stevens 1994), which are born at 29–34 cm length (King & Clark 1987). Clark & King (1989) reported that full-term female fish were common in autumn and winter in their North Island trawl surveys (from the Challenger Plateau off the west coast to south of Cape Kidnappers off the east coast, at bottom depths of 400–1200 m), although they suspected that reproductive events might occur at any time of the year. Most late-term females were caught in Hawke Bay, which is likely to be an important reproductive area for the species (Clark & King 1989).

Juvenile distribution
Clark & King (1989) reported the capture of many juvenile shovelnose spiny dogfish in trawl surveys around the North Island, from the Challenger Plateau off the west coast to south of Cape Kidnappers off the east coast, at bottom depths of 400–1200 m. Most small juveniles in these surveys were caught in Hawke Bay (Clark & King 1989).

Data summaries

Pupping areas
Insufficient data.

Juvenile distribution

Shovelnose dogfish are widespread, occurring in 5826 research tows around New Zealand. However, as with other deepwater elasmobranch species, shovelnose dogfish are seldom measured on research trips (only 423 tows) and there are no length data from observers. Consequently, our knowledge of the distribution of juveniles is uncertain. Immature shovelnose dogfish were observed in most areas where the species was measured, including the west and east coasts of the North Island, Chatham Rise, Challanger Plateau, west coast South Island, and Puysegur. Small (group i) juveniles were most frequently recorded north of 45° S, from the north and west coasts of the North Island, and from the northern Chatham Rise. Juvenile shovelnose dogfish occurred at 500–1100 m depth.

Juvenile abundance

Immature shovelnose dogfish were recorded from middle depth and deepwater trawls on *Tangaroa*, and from deepwater tows by other vessels. Highest catch rates (maximum 543 kg km^{-2}) were taken on *Wanaka* surveys off the northwest coast of the North Island. Relatively large catches (maximum 327 kg km^{-2}) of immature fish were also made consistently along the northern Chatham Rise by *Tangaroa* middle depth surveys.

Dipturus innominatus (smooth skate)

Literature review

Smooth skate are relatively uncommon on the North Island continental shelf, usually occurring in deeper water than rough skate (Garrick & Paul 1974). The mean depth for smooth skate is 412 m (Francis et al. 2001). Smooth skates grow to at least 158 cm and 60 kg, and females grow larger than males (Francis 1997).

Mating, egg laying, and hatching areas

Smooth skate reproduce by laying yolky eggs, enclosed in leathery cases, on the seabed and the young hatch at about 10–15 cm pelvic length (Francis 1997). Mating, egg laying, and hatching areas have not been reported.

Juvenile distribution

Male smooth skate reach maturity at about 93 cm (8 years) and females mature at about 112 cm (13 years) (Francis et al. 2001). Smooth skate of less than 60 cm have been recorded in trawl catches from the east coast of the North Island, where small fish were predominant, the east coast of the South Island and the Stewart-Snares shelf (Francis 1997), the west coast of the South Island (Stevenson 1998), and in the Canterbury Bight and Pegasus Bay (Stevenson & Hurst 1998, Stevenson & Beentjes 2001).

Data summaries

Mating, egg laying, and hatching areas

Maturity of smooth skate was recorded in 137 research tows. There were 17 records of female skate with mature, ovarian eggs and 20 records of females with ovulated eggs or egg cases. Smooth skate in egg-laying condition were observed mainly off the South Island, with one record from Tasman Bay. No female smooth skate with mature ovarian or ovulated eggs, or egg cases were recorded from the Chatham Rise. The temporal coverage of cruises with skate gonad staging was insufficient to determine timing of spawning.

Juvenile distribution

Immature smooth skate have been observed in 475 research trawls over much of the New Zealand shelf, including the Chatham Rise, in 100–600 m depth. Juvenile smooth skate may be more widespread than adults. Immature smooth skate have been observed in the north (including Hauraki Gulf) and west of the North Island where there are no records of adults. There are no records of immature or adult smooth skate from the Challenger Plateau, and only a few records from the Southern Plateau. The depth distribution of both juveniles and adults is bimodal, with peaks at 100 m and 400 m. This may reflect the areas of coverage of inshore and middle depth trawl surveys.

Juvenile abundance
Immature smooth skate have been recorded in 151 middle depth tows on *Tangaroa* and 205 inshore tows on *Kaharoa*. Peak catch rates were in *Kaharoa* surveys in the Hauraki Gulf (569 kg km^{-2}) and south of Banks Peninsula (290 kg km^{-2}) in depths shallower than 200 m. There were also consistently high catch rates in *Kaharoa* and *Tangaroa* surveys on the west coast South Island, and in *Tangaroa* surveys on the Chatham Rise.

Dipturus nasutus (rough skate)

Literature review

Rough skate are common on the North Island continental shelf, in depths greater than 50 m, or shallower in areas with a mud bottom (Garrick & Paul 1974). The depth range for both species is 10–1450 m, with a mean depth of 370 m for rough skate (Francis et al. 2001). Rough skates grow to at least 79 cm and 11 kg, and females grow larger than males (Francis 1997).

Mating, egg laying, and hatching areas
Like smooth skate, rough skate reproduce by internal fertilisation, then lay yolky eggs, enclosed in leathery cases, on the seabed. Females appear to produce two egg cases at a time, but the number of eggs laid annually is unknown. The young hatch at about 10–15 cm pelvic length (Francis 1997). Little is known about the timing of mating, egg laying, and hatching. Aquarium studies reveal that a skate can lay as many as 30 capsules in 6 weeks, and that the young take 4 to 4.5 months to hatch (Graham 1956).

Rough skates lay eggs at least in spring-summer (Francis 1997). Eggs cases ready for extrusion were found in female rough skate on the east coast of the South Island during December-January (Francis 1997). Graham (1939) found egg cases in rough skate from Otago in October, January, and March, suggesting that some spawning may also take place during autumn in this area.

Graham has collected skate eggs in cases up to 6 inches (15.2 cm) long in the Otago region (Graham 1956). Waite (1909) reported the collection of skate (probably mostly *D. nasutus*) eggs at a number of stations in the South Island, and at the Chatham Islands.

Juvenile distribution
Male rough skate reach maturity at about 52 cm (4 years) and females mature at about 59 cm (6 years) (Francis et al. 2001). Rough skate under 40 cm appear to be confined to waters shallower than 75 m on the east coast of the South Island. On a trawl survey of the Stewart-Snares shelf, few small fish were found and they were confined to depths less than 150 m (Francis 1997). Small rough skate were reported from trawl surveys in Tasman Bay and Golden Bay in depths of 20–70 m (Stevenson 1998), and in the Canterbury Bight and Pegasus Bay (Stevenson & Hurst 1998, Stevenson & Beentjes 2001) and small rough skate of 10–13 cm were recorded from the Otago region throughout the year during 1982–83 (Francis 1997).

Data summaries

Mating, egg laying, and hatching areas
Reproductive states of rough skate were recorded in 292 tows from the east and west coasts of the South Island, and in Tasman and Golden Bays. Female smooth skate with mature ovarian or ovulated eggs, or egg cases were observed in all areas where maturities were recorded, with the highest density of skate in egg-laying condition on the east coast South Island south of Banks Peninsula. As for smooth skate, the temporal coverage of cruises with skate gonad staging was insufficient to determine timing of spawning.

Juvenile distribution
Immature rough skate were recorded at depths of less than 200 m all round the coast of mainland New Zealand, occurring most frequently around Banks Peninsula. There was only one observation of an immature rough skate from the Chatham Rise. The distribution of immature fish was similar to the adult distribution.

Juvenile abundance
Because of their shallow depth range, immature rough skate were most frequently observed in *Kaharoa* inshore surveys, occurring in 327 tows. There were also 30 records of immature rough skate in middle depth tows by *Tangaroa*, mostly in Southland, but catch rates were low (under 32 kg km^{-2}). In *Kaharoa* surveys, the maximum catch rate (407 kg km^{-2}) was in a single tow off the Wairarapa coast. Consistently high catch rates of 50–200 kg km^{-2} were taken around Banks Peninsula, off the west coast North Island, and the west coast South Island.

Emmelichthys nitidus (redbait)

Literature review

Redbait are widely distributed around New Zealand, occurring in midwater schools over the outer shelf, from Three Kings Rise to the Snares Shelf, and the Chatham Islands (Paulin 1999). They are trawled in depths of 100–400 m (Ayling & Cox 1982). Related species occur elsewhere, including the South Pacific, on seamounts (Paulin 1999).

Spawning areas
Very little is known of the biology of redbait in New Zealand and no published information is available on spawning areas. Spawning aggregations occur on seamounts in the Indian Ocean from August to October (Roshchin 1986). Spawning females were almost absent from the trawl catches (Roshchin 1986), which suggest that, as for other fish inhabiting seamounts, they probably go to a different, probably deeper, area to spawn.

Juvenile distribution
No information available.

Data summaries

Spawning areas
Gonad states of redbait were recorded in only nine research tows. Spawning redbait were observed at two stations, one off the west coast South Island and one on Mernoo Bank (western Chatham Rise). Seven ripe and two spent females were also observed at the station on the Mernoo Bank in January, and one ripe female was observed at the station off the west coast in August.

Juvenile distribution
Redbait were measured in only 96 of 673 (14%) of research trawls in which they were caught. The distribution of juveniles is also uncertain because juvenile redbait are unlikely to be fully selected by trawl gear with typical codend mesh sizes (60–100 mm). Small redbait (under 26 cm) were caught around the north of the North Island, on the Chatham Rise, and south of Stewart Island. Small redbait were usually found in water shallower than 250 m. This depth distribution was more restricted than that of the adults, which were caught at bottom depths up to 600 m. However, juvenile redbait were more widely distributed spatially than adults, especially in the North Island. Adult redbait were not recorded north of 40° S, but were observed on the west coast South Island, where juveniles were rare.

Juvenile abundance
Small redbait were recorded in 18 middle depth tows by *Tangaroa.* There was one very large (943 kg km^{-2}) catch off the Otago coast. Catch rates in other areas, including the Chatham Rise, south of Stewart Island, and the west coast South Island, were much smaller.

Epigonus telescopus (black cardinalfish)

Literature review

Black cardinalfish, also known as deepsea cardinalfish, occur throughout the New Zealand EEZ, over hills and rough ground, about 150 m off the bottom, in depths of 300–1100 m, with a preferred depth range of 600–900 m (Field et al. 1997). The largest commercial catches were in FMA2, east coast North Island (Field et al. 1997, Field & Clark 2001). Black cardinalfish were the most abundant species on the Ritchie Banks in February 1986 (Clark & King 1989). It is not known if there is more than one stock in New Zealand (Field et al. 1997). The average size landed is about 50–60 cm (Field et al. 1997). Black cardinalfish are slow growing, with a maximum age over 100 years, and an estimated age of full recruitment of 45 years (Tracey et al. 2000).

Spawning areas
Little is known about the reproductive biology of black cardinalfish. Fish mature at about 40–50 cm, and spawning may occur in early winter (Field et al. 1997). Fish sampled on the east coast North Island were mostly in an immature or resting reproductive state. A few ripe fish were found in June and spent fish were recorded in October-November (Tracey et al. 2000).

Juvenile distribution
A few juveniles have been caught on the west coast South Island and the northeast Chatham Rise, in depths from 450 to 620 m (Tracey et al. 2000).

Data summaries

Spawning areas
Gonad states for black cardinalfish were available from 169 research and commercial tows. Almost all spawning fish were observed off the North Island, with only one observation of a single spent female on the Chatham Rise. Spawning appears to occur in the autumn. Most data were from the Bay of Plenty (FMA 1) where ripe females were recorded in November, March, and April, with a high proportion (79%) of spent fish in July. On the east coast North Island between East Cape and Wairarapa (FMA 2), ripe and running ripe fish were observed from February to May, with 45–75% of fish spent in July and August. In the Tasman Sea, on the northwest Challenger Plateau and Lord Howe Rise (FMAs 5,7,8,9 and ET), black cardinalfish were observed in spawning condition from February to July, peaking in April when about 60% of females were ripe or running ripe.

Juvenile distribution
Immature black cardinalfish were recorded from 500 to 1000 m depth off the east coast of the North Island, the northern Chatham Rise, Puysegur, northwest Challenger Plateau, and Lord Howe Rise. The distribution of juveniles was similar to the adult distribution, although adult cardinalfish were observed deeper (600–1200 m).

Juvenile abundance
Immature black cardinalfish were recorded in 27 *Tangaroa* middle depth stations, 23 *Tangaroa* deepwater stations, and 20 deepwater research stations sampled by other vessels. There were two very large catches (up to 2365 kg km^{-2}) of immature black cardinalfish taken at Puysegur by charter vessels and one moderate catch (216 kg km^{-2}) by *Tangaroa* further south on the Stewart-Snares shelf. Lower catch rates were recorded in all three survey series on the northern and eastern Chatham Rise, and by chartered deepwater vessels north of the Bay of Plenty.

Etmopterus baxteri (Baxter's dogfish)

Literature review

Baxter's dogfish (sometimes referred to as *E. granulosus*) is found around most of the coast of New Zealand. It is common off east central New Zealand and the south Chatham Rise, where it is the most abundant of all dogfish (King & Clark 1987, Wetherbee 2000). Baxter's dogfish is found on or near the bottom (Campagno 1984) in depths of 220–1430 m (Last & Stevens 1994), with the highest catch rates between 800–1200 m (Wetherbee 1996). Females attain 75 cm and males 62 cm (Last & Stevens 1994). Females begin to mature at 62 cm total length, and males at 52 cm (Wetherbee 1996).

Pupping areas
Baxter's dogfish are ovoviviparous with litters of 6–15 pups (Wetherbee 1996) and young are born at about 18 cm (Last & Stevens 1994). There is little information available on pupping areas. Wetherbee (1996) found no pregnant females on the Chatham Rise and suggested they moved to other areas or depths before pupping. There was no evidence of a seasonal reproductive cycle (Wetherbee 1996).

Baxter's dogfish, and other deepwater squaloid sharks, have slow rates of growth, late maturity, prolonged gestation, and few young compared with shallow water sharks, and they are vulnerable to overfishing (Wetherbee 1996).

Juvenile distribution
No information available.

Data summaries

Pupping areas
Insufficient data.

Juvenile distribution
Baxter's dogfish were caught at 6560 research trawl stations, but were measured at only 251 stations (4%). There were no length measurements from observer data. Tows with length measurements covered only a small subset of the overall distribution, so the distribution of juveniles is uncertain. Immature Baxter's dogfish were recorded in the same areas as adults, with most records from the Chatham Rise at depths between 700 and 1300 m.

Juvenile abundance
Immature Baxter's dogfish were recorded in deepwater research tows by *Tangaroa* (62 tows) and other vessels (9 tows). There were two very large catches on the northern Chatham Rise, one of 42 t km^{-2} by *Tangaroa*, and one of 182 t km^{-2} by a charter deepwater vessel. Other, much smaller, catches were taken around the margin of the Chatham Rise.

Genypterus blacodes (ling)

Literature review

Ling have been recorded in research and commercial trawls, mainly at 200–800 m depth, all around New Zealand, on the Challenger Plateau, on the Chatham Rise, and in the Sub-Antarctic. They also occur across the shelf, particularly in southern areas (Anderson et al. 1998).

Spawning areas
Spawning is known to occur off the west coast South Island, and Puysegur Bank (Patchell & McKoy 1985, Colman 1988a), the east coast South Island and the Chatham Rise (Horn 1993a), and in Cook Strait and on the Campbell Plateau (Horn & Ballara 1999). Ling in spawning condition have been reported in spring and early summer (Annala et al. 1999). Ling in ripe condition have been noted in the Otago region in September (Graham 1939) and a few larvae have been recorded from inner shelf waters in December (Parsons 1999). Prespawning aggregations of ling have been recorded off Northland, but it is not known whether these fish remain in the area to spawn (Roberts 1987).

Juvenile distribution
Little is known about the distribution of juveniles until they are about 40 cm in total length when they begin to appear in trawl samples over most of the adult range (Annala et. al. 1999). Horn (1993b) reported 2 year olds (mean length 34.9 cm) on the Chatham Rise and Southern Plateau. Adult ling are widely dispersed over the New Zealand region, especially south of 40° S, in 200–700 m depth (Annala et al. 1999). Most ling reach maturity at about ages 6 (30%) and 7 (75%) (Annala et al. 1999).

Data summaries

Spawning areas
Gonad states have been recorded from much of the New Zealand EEZ, with 8347 observer or research stations with gonad stage information. Ling in spawning condition have been observed off the west coast South Island, Puysegur, Southland and the Southern Plateau, the Bounties, the Chatham Rise, Cook Strait, and the southeast coast of the North Island. There is also good temporal sampling coverage, with gonad stage data from most areas for seven or more months. The timing of spawning varies between areas. On the west coast South Island (FMAs 7 & 8) and Cook Strait (FMA 2) most ripe and running ripe female ling were recorded from July to September. On the Southern Plateau and the Bounties, spawning appears to be later, with ripe and running ripe fish observed from September to December on the Southern Plateau, and September to February on the Bounties. Timing of spawning on the Chatham Rise may be intermediate, with ripe and running ripe fish peaking in September and October.

Juvenile distribution
There are some records of 0+ juveniles in shallow inshore areas, but most occur from 200 to 500 m depth. Main areas include the Bay of Plenty and central east coasts of the North and South Islands. A few 0+ ling have also been recorded from the west coast South Island, Chatham Rise, Southland, and the Auckland Islands. Juveniles up to 2 years old have a similar distribution but occur more frequently on the west coast South Island, the Chatham Rise, and in the Sub-Antarctic. Immature fish are found

extensively throughout the EEZ from 200 to 800 m depth, including a few around the northern North Island and the Challenger Plateau. Distribution around the North Island may be under-represented due to the lack of trawling in the 200–800 m depth range. Adults have a similar distribution to the immature fish but tend to be less common in inshore shelf areas, except for the Stewart-Snares shelf where they are more commonly caught than juveniles.

Juvenile abundance
Immature ling have been caught mainly in *Tangaroa* middle depth surveys (1676 tows) and in *Kaharoa* inshore surveys (979 tows). There have been only a few small catches in deepwater surveys. A high proportion (88%) of *Kaharoa* catches with ling contained juveniles. Catch rates were relatively patchy. The largest North Island catch (122 kg km^{-2}) was east of Cook Strait, and the largest South Island catch rates (up to 1.5 t km^{-2}) were on the shelf in Canterbury Bight. Moderate catches of immature ling in *Tangaroa* middle depth surveys were widespread on the Chatham Rise, west coast South Island, and Southern Plateau although one large catch (7 t km^{-2}) on the southwest Chatham Rise dominated the distribution.

Hoplostethus atlanticus (orange roughy)

Literature review

Orange roughy occur in deepwater (750–1200 m) around New Zealand, and are most common at depths of 800–1000 m on the Chatham Rise, along the Gisborne to Kaikoura coastline, off south Westland, and parts of the Challenger Plateau (Paul 2000). They are found aggregated over a variety of bottom types, including slope areas, edges of canyons, drop-offs and the top and sides of seamounts or pinnacles (Tracey & Fenaughty 1997). Orange roughy are very long lived, with ages over 80 years (Horn et al. 1998). They are extremely slow growing ($K = 0.06$), and growth is slower after fish reach maturity (Mace et al. 1990, Doonan 1994). Age and length at maturity vary between areas, ranging from 23 years and 29 cm on the Challenger Plateau to 29 years and 30–31 cm on the Chatham Rise (Horn et al. 1998).

Spawning areas
Spawning occurs in late June–early July on the Ritchie Banks and the Cook Canyon, early–mid July on the Challenger Plateau and Lord Howe Rise, mid–late July on the Chatham Rise (Clark 1990), and mid–late July on the western side of the Puysegur Bank (Clark & Tracey 1992, 1994b). These are all considered to be separate spawning populations (Clark 1990). Spawning occurs over about 20 days (Mace et al. 1990). Due to the many known spawning locations, literature is summarised by area below.

Chatham Rise
The main fishery on the Chatham Rise centres on the north slopes where the fish spawn (Clark 1990). The most important spawning area on the north Chatham Rise is known as the "Spawning Box"(Tracey & Fenaughty 1997). Spawning also occurred in the "Graveyard" area (north central Chatham Rise) and on the northeastern pinnacles (Tracey & Fenaughty 1997). Ripe and spent fish have been recorded on the south Chatham Rise in July (Clark 1990). Orange roughy on the south Chatham Rise appear to be spawning at the same time as those on the north and therefore are probably a separate stock (Robertson & Mace 1988).

Challenger Plateau
Spawning occurs inside and outside the EEZ on the Challenger Plateau and the Lord Howe Rise (Clark 1990, 1998a, Field & Clark 1996). Orange roughy form large spawning aggregations during June to August at depths of 850–900 m on the central flat and the Pinnacles (inside EEZ) and Westpac Bank (outside EEZ) (Clark & Tracey 1994a). Peak spawning occurred in early July inside the EEZ and slightly later in July outside the zone on the Westpac Bank (Clark 1990).

East coast North Island
A major spawning aggregation congregates on the Ritchie Hill (the northern end of the Ritchie Banks) in June-July (Field 1992, Field et al. 1993). Spawning also occurs at Tolaga Hill (Field 1992), and in the East Cape Hills, which consist of 11 seamounts in an area 90 km east of East Cape (Anderson 2000). Spawning has been recorded in the western Bay of Plenty around Mercury Knoll, Colville Knoll, and Ohena Knoll (Clark & Field 1998), Alderman's Knoll and White Island (Anderson 2000).

West coast South Island
The main commercial fishery on the west coast South Island centres on a spawning aggregation in the Cook Canyon (Clark & Tracey 1988).

Southern South Island
Concentrations of spawning orange roughy were found on the western side of the Puysegur Bank, where spawning occurs in mid–late July (Clark & Tracey 1992, 1994b). Spawning also occurs in the Snares Islands region (Clark & Tracey 1992). Clark & Thomas (1994) reported a major spawning hill called "Bob's Gun" west of Snares, and a hill called "D.S.W." in the Auckland Islands area.

Other areas
Clark (1998b) reported spawning on the Louisville Ridge outside the EEZ. Orange roughy are caught throughout northern North Island waters, but no spawning aggregations were found by Clark & King (1989). Anderson (2000, 2001) reported spawning orange roughy from east Northland. No major spawning grounds are known off the Wairarapa or Kaikoura coasts (Field et al. 1993). Planktonic eggs of orange roughy were taken in winter 1979 between the Bounty and Antipodes Islands (D. Robertson, NIWA, pers. comm.).

Juvenile distribution
Orange roughy appear to be multiple spawners (Zeldis 1993). Fertilisation occurs in depths of about 800 m (Grimes & Zeldis 1993). Cultured eggs hatched after 235 hours of development at 10 °C (Zeldis et al. 1995). Orange roughy eggs change their buoyancy characteristics and undergo extensive movement throughout the water column as they develop (Grimes & Zeldis 1993, Zeldis et al. 1995). Young eggs ascend rapidly to the mixed layer which they reach at about 50 hours, and they reside there until about 150 hours, then sink rapidly for about 50 hours before hatching (Zeldis et al. 1995). Eggs are believed to hatch near the bottom (Zeldis et al. 1995). The pelagic larval/post-larval phase may last for at least 7–10 months (Mace et al. 1990).

Pre-recruit fish are caught in most of the orange roughy fisheries (Paul 2000). Larvae were found in the "Spawning Box" on the Chatham Rise, north of the Chatham Islands (Tracey & Fenaughty 1997). The highest proportions of pre-recruit fish (under 32 cm SL) on the Chatham Rise were found on the northwest flat and northeast flat, on either side of the "Spawning Box" (Tracey & Fenaughty 1997). Small juveniles, less than 10 cm SL, were caught at most stations on surveys of the north Chatham Rise, during February, May and September, but no aggregations of juveniles were located (Mace et al. 1990). Pre-recruit orange roughy, from 9 cm, were also regularly caught on the Challenger Plateau (Clark & Tracey 1994a). Off the southern South Island, small orange roughy were found on the Puysegur Bank, and small fish were predominant in the Stewart Island area (Clark & Tracey 1994b). Juveniles were not caught in a survey of the western Bay of Plenty around Mercury Knoll, Colville Knoll, and Ohena Knoll (Clark & Field 1998).

Data summaries

Spawning areas
There is an extensive data set on gonad states of orange roughy, with observations from more than 10 000 commercial and research tows. Ripe and running ripe orange roughy have been recorded, often associated with seamount features, from the north of the North Island, Bay of Plenty, east coast North Island, Chatham Rise, Sub-Antarctic and Southland, west coast South Island, and Challenger Plateau

within the EEZ, and from the northwest Challenger Plateau and Lord Howe Rise in the Tasman Sea. The distribution of spent orange roughy is similar to the distribution of ripe and running ripe fish, but more dispersed, probably because spent fish are also caught as they move away from the main spawning areas.

Spawning usually occurs between June and August, with the highest proportion of running ripe females in July in all areas. However, a small proportion of ripe females have been observed in every month in some areas (e.g. west coast South Island).

Juvenile distribution
Immature orange roughy have a very similar distribution to adults, occurring from 700 to 1500 m depth around New Zealand. Immature orange roughy occur most frequently on the Chatham Rise, Challenger Plateau, Lord Howe Rise, west coast South Island, Southland hills, and east coast North Island.

Juvenile abundance
Immature orange roughy have been caught in over 4000 deepwater research tows made by *Tangaroa* and other vessels. Over 80% of deepwater survey tows catching orange roughy contained immature fish. The highest catch rate (433 t km^{-2}) was by a charter vessel on the Challenger Plateau. Large catches of immature orange roughy were taken consistently by *Tangaroa* and other vessels along the north Chatham Rise. Immature orange roughy were also caught in middle depth surveys on *Tangaroa*, but catch rates were comparatively low (less than 130 kg km^{-2}), with peak catches at Puysegur.

Hydrolagus novaezealandiae (dark ghost shark)

Literature review

Dark ghost shark are the most common member of family Chimaeridae in New Zealand, and are abundant around the South Island (Ayling & Cox 1982, Paul 2000). They occur in depths ranging from 30 to 850 m. They are most common on the south coast of the South Island, Chatham Rise, Stewart-Snares shelf, and Sub-Antarctic. They are not known to occur on the Bounty Platform, and are sparse north of 40° S. Populations in the north are found in shallower water than those in the south (Horn 1997a).

Dark ghost shark reach 100 cm, but little is known of their biology (Paul 2000). Larger sharks are found on the Chatham Rise than in the Sub-Antarctic, and females grow larger than males (Horn 1997a). There is no published information on age or growth rate of any *Hydrolagus* species, or any species of Chimaeridae (Horn 1997a). Horn (1997a) estimated length at birth of 5 cm and maximum age of both species to be about 15–25 years. Stock structure is unknown. Horn (1997a) suggested three fishstocks for management purposes: east coast New Zealand, Stewart-Snares & Campbell Plateau, and west coast New Zealand.

Mating, egg laying, and hatching areas
Fecundity of ghost sharks is low. Females produce two eggs at each spawning interval, and embryos may remain in the egg case for about 9–12 months (Horn 1997a). Ghost sharks may have an extended or year-round spawning season (Horn 1997a). Aggregations are reported to occur (Horn 1997a) but it is not known if this corresponds to mating. Mating, egg laying, and hatching areas have not been identified.

Juvenile distribution
Size at maturity for dark ghost sharks is estimated to be 52–53 cm for males and 62–63 for females (1997a). Sharks smaller than this have been caught in trawls on the Chatham Rise and Stewart-Snares shelf (Horn 1997a), Southland/Sub-Antarctic (Horn 1997a, O'Driscoll & Bagley 2001), the west coast of the South Island (Horn 1997a, Stevenson 1998), and in larger numbers in the inshore waters of the

Canterbury Bight and Pegasus Bay (Horn 1997a). Juvenile ghost shark are regularly caught in trawls in the Canterbury Bight and Pegasus Bay (Beentjes 1998, Stevenson & Hurst 1998, Stevenson & Beentjes 2001). Smaller dark ghost shark, less than 40 cm CL (chimaera length: tip of snout to end of upper caudal fin) are more abundant in waters shallower than 200 m, especially in the Canterbury Bight (Horn 1997a).

Data summaries

Mating, egg laying, and hatching areas
Insufficient data.

Juvenile distribution
Juvenile dark ghost shark occur at 200–500 m depth. Small juveniles less than 30 cm (group i) were recorded most commonly on the east coast South Island off Canterbury, the Chatham Rise around the Mernoo Bank and the Chatham Islands, Southland, west coast South Island, and Bay of Plenty. Larger juveniles 30–40 cm (group ii) had a similar distribution, but were more widespread, particularly on the Chatham Rise, Southland, and west coast South Island. Immature fish combined were concentrated on the east coast South Island, Chatham Rise, Campbell Plateau, Puysegur, and west coast South Island in the same areas as adults. Immature and adult dark ghost shark were seldom recorded deeper than 500 m.

Juvenile abundance
Immature dark ghost shark were recorded in *Tangaroa* middle depth surveys (480 tows) and *Kaharoa* inshore surveys (343 tows). Consistently high catch rates of up to 4 t km^{-2} were taken in inshore surveys of the east coast South Island, south of Banks Peninsula. A large catch of 2.7 t km^{-2} was made on the western Chatham Rise during a *Tangaroa* middle depth survey, but most middle depth catches on the Chatham Rise, the Sub-Antarctic, and the west coast South Island were smaller than those from the east coast South Island inshore surveys.

Hydrolagus sp.B2 (pale ghost shark)

Literature review

Pale ghost shark occur throughout the New Zealand EEZ, in deeper water than the dark ghost shark, ranging from 270 to 1200 m. They are most abundant in depths of 400–1000 m on the Chatham Rise and Southland/Sub-Antarctic, and are uncommon north of 40° S (Horn 1997a). They are a similar size to the dark ghost shark, and little is known of their biology (Paul 2000).

Mating, egg laying, and hatching areas
Fecundity is expected to be low, and spawning may be year round, as for dark ghost shark (Horn 1997a). Mating, egg laying, and hatching areas not known.

Juvenile distribution
Size at maturity for pale ghost sharks is estimated to be 59–60 cm for males and 69–70 for females (Horn 1997a). Sharks smaller than this have been caught in trawls on the Chatham Rise and Southland/Sub-Antarctic (Horn 1997a, O'Driscoll & Bagley 2001).

Data summaries

Mating, egg laying, and hatching areas
Insufficient data.

Juvenile distribution
Juvenile pale ghost shark were caught mainly on the Chatham Rise and Southern Plateau at depths between 500 and 900 m. Some juveniles were also taken at Puysegur, Bounties, east coast North Island, and on the Challenger Plateau. The spatial distributions of the two length classes of juveniles, all immature fish combined, and adults were similar, but adult dark ghost shark were found over a wider depth range (350–1200 m) than juveniles.

Juvenile abundance
Immature fish were recorded in 42% of middle depth and 15% of deepwater *Tangaroa* research trawls in which pale ghost sharks were caught. Catch rates of immature pale ghost shark were usually less than 100 kg km^{-2}, with peak catches in middle depth tows on the southeastern Chatham Rise and the eastern Stewart-Snares shelf.

Hyperoglyphe antarctica (bluenose)

Literature review

Bluenose are widely distributed in waters of the southern hemisphere, and occur around New Zealand and on the Chatham Rise, on the outer shelf and upper slope, usually near rough ground (Paul 2000), although large catches are sometimes trawled over soft bottoms (Horn 1988b). It is a moderately fast growing, fairly short-lived, semi-pelagic species (Horn 1988b, 1988c). Bluenose is a major associated catch of the alfonsino fishery on the east coast North Island, and the two species often school together (Horn 1988c). It is not known if there is more than one stock in New Zealand (Horn 1988c). Tagging studies suggest that adult bluenose are relatively sedentary and do not move far (Horn 1988c).

Spawning areas
The biology of bluenose is poorly understood. It appears that spawning begins in late summer and may extend over several months (Horn & Massey 1989). No running ripe bluenose were reported from surveys of the Palliser Bank (Horn 1988c, Horn & Massey 1989). Peak GSI occurred in November or December, which agrees with anecdotal reports from commercial fishers that they spawn from January to April (Horn 1988c, Horn & Massey 1989). A few running ripe male bluenose were found on the Paoanui Ridge, the Madden Canyon, and the Motukura Bank in early March in 1987 (Horn & Massey 1989). Clark & King (1989) reported catching maturing fish in summer and autumn on the east coast North Island, and ripe males on the northeast coast North Island in autumn. It appears that spawning does not occur in the areas exploited by trawl fisheries (Horn 1988c).

Juvenile distribution
Bluenose are believed to have an early pelagic phase and then become demersal and enter the fishery at about 47 cm when they are 1–3 years old, but the distribution of the pelagic juveniles is unknown as they are rarely caught (Horn 1988b, 1988c, Horn & Massey 1989). Recently, epipelagic juvenile bluenose were recorded in New Zealand for the first time. Two specimens were collected beneath flotsam near Nga Motu/Sugar Loaf Islands, west coast North Island, and at least 20 were found inside a piece of trawl net drifting east of Cape Kidnappers. These juveniles ranged in size from 65 to 87 mm standard length (Duffy et al. 2000). Duffy et al. (2000) suggested that juveniles spawned off southeast Australia could be carried with rafts of algae by the Tasman Current to New Zealand.

Bluenose mature at about 60 cm and 3–5 years old (Horn 1988c). Growth is faster in females than in males, and varies between fishing grounds (Horn 1988b). Most (two-thirds) of the fish at Palliser Bank are immature (Horn 1988c). On the lower east coast of the North Island small fish are prevalent on the Tuaheni, Lachlan, and Motukura Banks, and in the Madden Canyon, and fish less than 60 cm were regularly found on the Palliser Bank (Horn & Massey 1989). Small bluenose (less than 60 cm) were caught trawling off the northeast North Island as well as the lower east coast of the North Island (Clark & King 1989). Small bluenose were caught on the east coast of the North Island in spring, summer, and autumn, and the autumn catch was predominantly small fish (Blackwell 1999).

Data summaries

Spawning areas
Gonad states for bluenose were available from 2046 stations, mainly commercial tows or longline sets, throughout New Zealand. Spawning bluenose were recorded from relatively few stations. There were only 49 observations of ripe or running ripe females and 156 observations of spent females. Bluenose in spawning condition (ripe, running ripe, or spent) were caught on the Lord Howe Rise, Challenger Plateau, west coast South Island, Puysegur, Chatham Rise, east coast North Island, northern North Island, and the Kermadecs. Sampling occurred throughout the year in all areas, but because there were so few fish in spawning condition, the timing of spawning was uncertain. Spawning may occur over several months. For example, at the Kermadecs (FMA 10) running ripe female bluenose have been reported in April, May, August, and December.

Juvenile distribution
Age 2+ bluenose have been observed most frequently on the east coast North Island between Hawke Bay and Wairarapa, with most other records from the Chatham Rise. Age 3+ bluenose were more widespread, also occurring in the Bay of Plenty, the west coast South Island, Challenger Plateau, Puysegur, and the eastern South Island shelf. Immature bluenose combined had a similar distribution to 3+ fish. Juvenile bluenose occurred between 200 and 500 m depth with a pronounced mode at 300 m. Adult bluenose occupied a wider depth range from 200 to 900 m, with a broader mode between 300 and 650 m.

Juvenile abundance
Immature bluenose were recorded in inshore *Kaharoa* surveys (11 tows), middle depth *Tangaroa* surveys (51 tows), and in deepwater surveys by other vessels (14 tows). The highest catch rates (up to 560 kg km^{-2}) were off the Wairarapa coast by *Kaharoa*. Other relatively large catches of immature bluenose (over 100 kg km^{-2}) were made by *Tangaroa* on the Chatham Rise and west coast South Island, and by deepwater charter vessels off Gisborne and in the Bay of Plenty.

Lepidoperca aurantia (orange perch)

Literature review

Lepidoperca aurantia has previously been recorded as *Anthias pulchellus* and *Lepidoperca pulchella* (Roberts 1989). It is likely to be confused with other members of the genus, especially *Lepidoperca pulchella*, *L.* inornata, and *L. tasmanica*, which also are found in New Zealand (Roberts 1989).

Orange perch are widespread around New Zealand, from North Cape to Stewart Island, and on the Chatham Rise, but appear to be absent from cooler waters of the Campbell Plateau and Bounty Platform (Roberts 1989). Catches of more than 200 kg of orange perch were recorded in Southland around the Stewart-Snares shelf (Fenaughty & O.Sullivan 1978), and near the Chatham Islands (Hurst & Bagley 1987). Orange perch are found most commonly over rough rocky ground in 200–400 m (Roberts 1989). Average size 20–30 cm, and may reach 35 cm (Paul 2000).

Spawning areas
Little is known about the reproduction of orange perch. Roberts (1989) noted that females with ripe ovaries have been observed during March. Larvae of orange perch were recorded from the Kaikoura Peninsula (Dolphin 1997).

Juvenile distribution
No published information.

Data summaries

Spawning areas
Insufficient data.

Juvenile distribution
The distribution of juvenile orange perch is uncertain because they were measured in only 75 of the 471 research tows in which they were caught, and tows with length measurements covered only part of the overall distribution. The length at maturity was also arbitrary, based on length frequency modes. Most small (under 21 cm) orange perch were recorded on the Chatham Rise, with a few other observations in the Bay of Plenty, west coast North Island, west coast South Island, and Stewart-Snares shelf. Most small orange perch were caught at depths between 200 and 400 m.

Juvenile abundance
Small orange perch were recorded in 15 middle depths tows by *Tangaroa.* Catch rates were low. The highest catch rate was 13 kg km^{-2} taken on the Stewart-Snares shelf. All other, smaller, catches of juveniles were on the Chatham Rise.

Lepidopus caudatus (frostfish)

Literature review

Frostfish are a widespread species of temperate waters. In New Zealand, frostfish are usually found over the outer shelf and upper slope, but are somewhat patchily distributed (Paul 2000). They are most common between 36° and 44° S, and found in depths of 50–600 m, and bottom temperatures of 10–16 °C (Bagley et al. 1988). Greatest abundance is off the west coast South Island in temperatures of 11.8–12.8 °C, and they also occur on the Chatham Rise where 8.5 °C is thought to be the lower limit of their tolerance (Stewart 1996). They may occur over offshore seamounts, as they are known to elsewhere (Nakamura & Parin 1993, Paul 2000), and they sometimes stray into coastal waters (Paul 2000). Frostfish reach a maximum length of 165 cm FL (Bagley et al. 1988). Age at maturity is not known in New Zealand waters. In the northwest Mediterranean, males mature at 97 cm and females at 111 cm total length (Demestre et al. 1993).

Spawning areas
Frostfish spawning, as indicated by the presence of planktonic eggs, occurs on the east coast North Island, from the Bay of Islands to Mahia, where eggs were found in autumn and summer (Robertson 1980a). Eggs were also present in Fiordland, in Dusky and Milford Sounds in March (Robertson 1980a), and off Otago (Robertson 1973). Frostfish larvae have been recorded from the Hauraki Gulf (Kingsford 1986), and Northland east coast (Crossland 1982). Spawning takes place in mid to outer shelf waters 50–200 m deep, in the afternoon, with surface temperatures of 17.5–22.0 °C (Robertson 1980a). Spawning occurs off the west coast South Island in March (Bagley et al. 1988).

Juvenile distribution
Juvenile frostfish have been recorded in the Bay of Plenty, Hauraki Gulf, off Northland, the west coast North Island, and the west coast South Island (Bagley et al. 1988). Robertson (1980a) recorded pre-juveniles 24–46 km offshore from Castlepoint in autumn and summer. Small fragile juveniles, 20–50 cm are found tangled in nets of coastal trawlers (Paul 2000) including the inshore waters of west coast South Island, from May to September, where 15 cm fish were recorded in June (Bagley et al. 1988).

Data summaries

Spawning areas
Gonad states were recorded in only 269 tows catching frostfish, covering only part of the known distribution. Most tows with gonad stage information were from the west coast South Island, with little data from other areas. Spawning is probably in autumn to winter. Ripe frostfish were recorded on the west coast South Island from March to September, with the highest proportion of ripe fish (about 15%) in April and June. Spent fish were most common in April.

Juvenile distribution
Frostfish were measured in less than 20% of research tows in which they were recorded in the catch. As for gonad state information, most length data were from the west coast South Island, but frostfish were also measured around the North Island, and on the Chatham Rise. Immature frostfish were recorded from the west coast South Island, northwest coast North Island, outer Hauraki Gulf, Bay of Plenty, and Chatham Rise. Small juveniles (group i) were also observed in Tasman and Golden Bays. The depth distribution of juveniles was similar to adults, with most occurring between 100 and 500 m.

Juvenile abundance
Immature frostfish were recorded in 53 inshore tows by *Kaharoa* and 8 middle depth tows by *Tangaroa.* The peak catch rate (191 kg km^{-2}) was during an inshore survey of the Bay of Plenty. Other relatively large catches (up to 41 kg km^{-2}) were taken from *Kaharoa* and *Tangaroa* on the west coast South Island, with one slightly smaller catch (about 30 kg km^{-2}) on the Chatham Rise just west of the Chatham Islands.

Macruronus novaezelandiae (hoki)

Literature review

Hoki occur all around New Zealand, but are most common off the South Island, and on the Chatham Rise and Campbell Plateau (Paul 2000). They occupy a wide depth range, but are generally most abundant in 300–600 m depth (Paul 2000). Average size is 60–100 cm, reaching 130 cm (Paul 2000).

Growth rate is quite rapid, and females grow faster and larger than males (Horn & Sullivan 1996). Maximum age is from 20 to 25 years (Annala et al. 2001). There are differences in growth rates between areas, fish on the west coast South Island growing faster than those in Cook Strait (Horn & Sullivan 1996). Males on the spawning grounds at age 4 are 65 cm on the west coast of the South Island and 63 cm in Cook Strait (Horn & Sullivan 1996). Mature females at age 5 are 75 cm on the west coast South Island and 70 cm in Cook Strait (Horn & Sullivan 1996).

There are thought to be at least two separate hoki stocks: a western stock which is resident in the southern area (Stewart-Snares shelf and the Sub-Antarctic) and spawns on the west coast South Island; and an eastern stock which is resident on the Chatham Rise and spawns in Cook Strait (Ballara & Hurst 1997). Evidence for the two stocks is provided by morphometric and ageing data (Livingston et al. 1992, Livingston & Schofield 1996a), and growth rates (Horn & Sullivan 1996). Smith et al. (1996) found no significant genetic heterogeneity in samples from Cook Strait and the west coast South Island.

Spawning areas
The west coast South Island is the major spawning ground for western hoki (Sullivan & Livingston 1988). Large aggregations of spawning hoki are found in 300–700 m depth around the Hokitika Canyon and further north (Sullivan & Livingston 1988, Ballara & Hurst 1997). Spawning in Hokitika Canyon peaks in late July–early August, in 400–600 m depth (Langley 1993). Hoki are multiple batch

spawners and female hoki may spawn three to five batches of eggs (Langley 1993). Estimates of spawning duration ranges from 14 to 27 days (Langley 1993). Plankton surveys from Westland showed that hoki eggs were most abundant along the shelf edge and slope, especially around the Hokitika and Cook Canyons and the shelf region off Westport (Zeldis et al. 1998). Larvae were abundant where eggs were abundant, but larger, older larvae occurred shoreward of the eggs and newly hatched larvae, suggesting onshore advection (Zeldis et al. 1998). Spawning hoki were not found south of the Hokitika Canyon or in Cook Canyon by Livingston & Coombs (1988), but egg densities in plankton samples in the Cook Canyon area suggested spawning there in more recent years (Zeldis et al. 1998).

Hoki eggs and larvae were first reported from Cook Strait by Murdoch & Chapman (1989), leading to the discovery of the eastern spawning grounds (Livingston 1990). The most important spawning area is Cook Strait Canyon, with smaller amounts of spawning occurring in the Nicholson Canyon and the Terawhiti Sill (Ballara & Hurst 1997).

Some hoki spawning also occurs on the Puysegur Bank in Southland (Ballara & Hurst 1997). It appears that hoki spawn later at Puysegur than on the west coast South Island, as running ripe fish are caught from mid August to early September (Ballara & Sullivan 1994). Ballara & Sullivan (1994) suggested that Puysegur is not a major spawning ground, and possibly only hoki which do not have time to reach the west coast South Island spawn late in the season at Puysegur. Ripe hoki have also been recorded on the eastern edge of the Stewart-Snares shelf in June, September, and October, but no significant spawning has been recorded in this area (Ballara & Hurst 1997).

Small quantities of spawning hoki have also been found on the east coast South Island in Pegasus Canyon and Conway Trough (Livingston & Berben 1987, Livingston 1990). Few ripe hoki are observed on the Chatham Rise or the east coast North Island (Ballara & Hurst 1997).

Juvenile distribution
The Chatham Rise is the main nursery area for hoki in the EEZ. Livingston et al. (1992) reported that 90% of juvenile hoki (less than 65 cm TL) are found on the Chatham Rise.

Hoki eggs are released in mid-water during the night with a peak spawning time of 2 a.m. (Zeldis 1993). Eggs are positively buoyant (Hurst et al. 1988), and eggs and larvae are carried in surface currents to all areas in New Zealand (Patchell 1982, Livingston 1990). Juveniles less than 1 year old occur close to the coasts of the North and South Islands (Hurst et al.1988, Stevenson & Hurst 1998, Stevenson & Hanchet 2000, Stevenson & Beentjes 2001). Most juvenile hoki move to the Chatham Rise nursery grounds by the time they are 2 years old (Livingston & Schofield 1996b). On the Chatham Rise, the smallest fish are found at 200 m, and larger fish inhabit progressively deeper water (Ballara & Hurst 1997). A proportion of older hoki leave the Chatham Rise, presumably to recruit to the Southern Plateau (Livingston & Schofield 1996b). Trawl data from the Sub-Antarctic and Puysegur regions, and from the spawning grounds, show that there are some juveniles (from about 35 cm), but most hoki in these areas are adults (Ballara & Hurst 1997, Ballara & Livingston 2001, O'Driscoll & Bagley 2001).

Data summaries

Spawning areas
Gonad states are available from more than 14 000 research and commercial tows, covering the known distribution of hoki. Most ripe and running ripe female hoki were observed on the known west coast South Island and Cook Strait spawning grounds, with a third, smaller, concentration of spawning hoki at Puysegur. A few hoki in spawning condition have also been recorded on the northwestern Southern Plateau, the western Chatham Rise, and on the east coast North Island. Spent hoki were more widespread than ripe and running ripe fish, especially on the Southern Plateau and Chatham Rise.

Spawning occurs in winter in Cook Strait and the west coast South Island with most ripe and running ripe females observed between June and September. Coverage in Cook Strait is poor at other times of the year, but a high proportion (over 50%) of running ripe females was also recorded from a small (65 fish) sample in May. Spawning may be later at Puysegur, with running ripe females recorded in August and September only. A few running ripe females were also reported from the Chatham Rise in August. Elsewhere, there are few records of ripe or running ripe hoki.

Juvenile distribution
Age 0+ hoki occur in coastal areas, mostly at depths from 50 to 300 m. Small, 0+ hoki were recorded most frequently around spawning areas on west coast South Island, Cook Strait, and Puysegur, with other concentrations in Tasman and Golden Bays, western Chatham Rise, and east coast North Island. Older, 1+ hoki are more widespread, with a wider depth range from 100 to 700 m. 1+ hoki occur in the same areas as 0+ fish, but also occur over the Southern Plateau, central and eastern Chatham Rise, Challenger Plateau, and northern North Island. All immature hoki combined have a similar distribution to adults, with concentrations off the west coast South Island, Puysegur, Southern Plateau, Chatham Rise, Cook Strait, and east coast North Island. Immature hoki mostly occupy depths between 200 and 800 m, while adults may be found to 1000 m and deeper.

Juvenile abundance
Immature hoki have been caught frequently during *Tangaroa* middle depth surveys (1840 tows) and *Kaharoa* inshore surveys (392 tows), and in a smaller number of deepwater tows by *Tangaroa* (182 tows) and other vessels (135 tows). Highest catch rates (up to 11 t km^{-2}) were in middle depth surveys on the Chatham Rise and at Puysegur, with lower catch rates on the Southern Plateau, west coast South Island, and east coast North Island. Catch rates of immature hoki up to 4 t km^{-2} have been taken during *Kaharoa* surveys off the west coast South Island and on the east coast South Island at the western edge of the Chatham Rise. Catch rates in deepwater surveys were generally much lower, but 711 kg km^{-2} of immature hoki were caught by a deepwater charter vessel in the Bay of Plenty.

Merluccius australis (hake)

Literature review

Hake have been recorded in research and commercial trawls, mainly in under 250–1200 m depth around the South Island, on the Challenger Plateau and Chatham Rise, and in the Sub-Antarctic. They also have been caught along the southeast coast of the North Island and in the few deep tows around the northern North Island (Anderson et al. 1998).

Spawning areas
Colman (1998) gave evidence for at least three distinct hake spawning grounds. On the west coast South Island, spawning takes place from June onwards, peaking in September. The main centre of activity appears to be a small patch just to the north of the Hokitika Canyon in 600–700 m depth. To the northwest (about 70 n. mile) of the Chatham Islands, spawning appears to take place in September and October (Colman 1998), as it does in the region between the Auckland and Snares Islands. The status of Puysegur Bank as a spawning ground is uncertain as running ripe females are found here only occasionally (Colman 1998). Hake have been observed to aggregate before spawning off the west coast of the South Island and also on the Chatham Rise (Patchell 1981, 1987).

Juvenile distribution
The distribution of juveniles is similar to that of spawning adults. Juveniles occur off the west coast of the South Island, the Chatham Rise, and the Campbell Plateau (Colman 1988b). Immature fish, 25–40 cm long, are widespread in water shallower than 100 m around the South Island (Patchell 1981). There is a west coast South Island hake nursery ground between Cook Canyon and Bruce Bay. Other known nursery areas are Pegasus Bay on the east coast of the South Island, and the east side of Campbell Island (Patchell 1981). Ayling & Cox (1982) reported that hake of 30 cm in length are

found commonly in Tasman Bay in shallow water. Female hake mature at 50–60 cm when they are 5–6 years old (Patchell 1981), but size at maturity varies with area, and west coast South Island fish appear to reach maturity at a smaller size than those of the Chatham Rise and the Southern Plateau. Males reach maturity about a year before females (Colman 1998).

Data summaries

Spawning areas

Gonad states of hake were recorded in 7913 research and commercial tows. Ripe, running ripe, and spent hake were observed in four distinct areas: west coast South Island, Puysegur, Southern Plateau (especially around the Stewart-Snares shelf), and Chatham Rise. No hake in spawning condition were observed on the east coast North Island, or on Challenger Plateau where gonad stage data were also available. Despite the good spatial and temporal coverage of the data, the timing of spawning is uncertain in at least three of the four main areas. On the Chatham Rise and Sub-Antarctic (Southern Plateau and Puysegur), ripe female hake have been observed in all months of the year. There may be two spawning episodes in the Sub-Antarctic, with a relatively high proportion of ripe and running ripe female hake in August to November, and another peak in February–March. The highest proportion of ripe females is in September on the western Chatham Rise, and August–September on the eastern Chatham Rise. Spawning on the west coast South Island appears to occur in winter, with ripe and running ripe females recorded from June to October, peaking (at 34%) in September. However, there are no data on hake gonad stages from the west coast South Island between November and March.

Juvenile distribution

Young (0+) juveniles occur inshore, in less than 200 m depth, mainly off the west coast South Island and in Tasman and Pegasus Bays. Juveniles up to 2 years old (1+) occur considerably deeper (to 1000 m) and have been found around Mernoo Bank, the Chatham Islands, and on the Challenger Plateau, but have been rarely caught south of 45° S. Juveniles (1+) have also been found in midwater tows on the west coast of the South Island (see Hurst et al. 2000). Immature fish combined are found in all the areas where adults occur, extending deeper and south into the Sub-Antarctic, as well as north along the southeast coast of the North Island. In contrast to the 0+ juveniles, adults most commonly occur deeper than 350 m.

Juvenile abundance

Immature hake have been caught in 296 tows on *Kaharoa* trawl surveys off the east and west coasts of the South Island and in Tasman Bay. Immature fish occurred in a high proportion (95%) of tows that caught hake, from shallow water out to the shelf edge. Catch rates were highest off the west coast South Island, reaching 6 t km^{-2}, with one large catch (over 1 t km^{-2}) also recorded in Pegasus Bay. Immature hake have also been recorded in *Tangaroa* middle depth (829 tows) and deepwater (223 tows) trawl surveys, and in 19 tows by other deepwater vessels. Catch rates were highest (up to 617 kg km^{-2}) at Puysegur, with relatively high catches also taken on the western Chatham Rise around the Mernoo Bank and off the west coast South Island.

Micromesistius australis (southern blue whiting)

Literature review

Southern blue whiting are found in subantarctic waters. The species is distributed widely over the Campbell Plateau and around the Bounty Islands, and somewhat more sporadically around the Auckland Islands (Hanchet 1998b, Paul 2000). Southern blue whiting school near the bottom in 450–650 m depth, but spend much of the time in midwater as young fish, at night, and during the spawning season (Paul 2000). Male southern blue whiting mature at age 3 and females at age 4 (Colman 1988c). Growth is reasonably fast for the first five years, then slows over the next five, and virtually ceases after age 10 (Hanchet & Uozumi 1996). Southern blue whiting grow to 20 cm FL in their first year (Hanchet & Uozumi 1996). Maximum ages recorded were 24 years for males and 25 years for females, and maximum lengths 54 and 59 cm for males and females respectively (Hanchet & Uozumi 1996).

Southern blue whiting are assessed as four stocks: Campbell Island Rise, Bounty Platform, Pukaki Rise, and the Auckland Islands Shelf (Annala et al 2001). Morphometric and biological differences have been found between fish from these four areas, and it appears that fish return to spawn on the grounds to which they first recruit (Hanchet 1998b).

Spawning areas
Spawning takes place in spring, from August to October in large spawning aggregations (Colman 1988c). Two batches of eggs are spawned by each female and this can be seen as two spawning peaks 10–15 days apart (Hanchet 1998b). There are four distinct spawning areas corresponding to the four stocks: the Bounty Platform, Pukaki Rise, Auckland Islands Shelf, and Campbell Island Rise (Hanchet 1998b, 1999). Spawning occurs first on the Bounty Platform, followed by the Pukaki Rise, the Auckland Islands Shelf, and lastly on the Campbell Island Rise. Spawning on the Bounty Platform occurs 3–4 weeks earlier than on the Campbell Island Rise (Hanchet 1998b, 1999).

Juvenile distribution
Little is known of the biology of small southern blue whiting as the very small fish are not caught in trawls. The smallest fish caught by trawl were 10–17 cm, caught in April and June (Hanchet & Uozumi 1996). Southern blue whiting of 80–90 mm, and age 4–5 months, were preyed on by black-browed albatrosses in the Campbell Plateau (Cherel et al. 1999). Black-browed albatrosses make only shallow dives of less than 5 m, suggesting that juvenile southern blue whiting are pelagic and occur in dense schools in the upper few metres in the Campbell Plateau during the summer months (Cherel et al. 1999). The amount of mixing of the early life stages between areas is not well understood (Hanchet 1999). The Bounty Platform is separated bathymetrically, and possibly hydrologically, from the rest of the Campbell Plateau, which may restrict mixing between the two regions (Hanchet 1999).

Pre-recruit fish, 1–2 years old are found over all of the spawning grounds (Bounty Platform, Pukaki Rise, Auckland Islands Shelf, and Campbell Island Rise), and in the southern ocean (Hanchet 1997, 1998, 1999, 2000, O'Driscoll & Bagley 2001). McMillan (1986) reported that there is size stratification with depth, with larger fish more abundant in deeper water.

Data summaries

Spawning areas
Gonad states of southern blue whiting have been recorded in 2760 commercial and research tows. Observations of ripe and running ripe southern blue whiting were concentrated at known spawning grounds at the Bounties, Campbell Island, Pukaki, and the Auckland Islands. Spent fish were also observed in these areas, but were more dispersed, especially around Pukaki. Peak spawning in all areas occurs in September, when over 50% of females are recorded in spawning condition (ripe, running ripe, or spent). Spawning appears to begin earlier at the Bounties, with ripe and running ripe females observed in August, and may extend into October on the Campbell Island Rise. Spent southern blue whiting are observed in all areas through until December.

Juvenile distribution
Small (0+) southern blue whiting are observed mainly around the four spawning areas, with a few records from the east coast of the South Island. Older (1+) juveniles are more dispersed, occurring over much of the Southern Plateau and the Bounty Platform, with observations extending up the east coast South Island, and onto the Chatham Rise. There have even been two records of 1+ southern blue whiting on the west coast South Island from commercial tows, although these may be reporting errors.

Immature fish combined have a similar distribution to 1+ juveniles and adults. Juvenile and adult southern blue whiting occur at similar depth ranges, from 200 to 600 m.

Juvenile abundance
Immature southern blue whiting have been recorded only in middle depth surveys on *Tangaroa*, where they occurred in 333 of 454 stations (73%) in which southern blue whiting were caught. Highest catch rates (up to 989 kg km^{-2}) were on the Campbell Island Rise and at Pukaki.

Mora moro (ribaldo)

Literature review

Ribaldo are widespread, but not abundant, around New Zealand, including the Chatham Rise, the Challenger Plateau, and the Campbell Plateau (McMillan & Hart 1998). Ribaldo are bentho-pelagic, from the outer continental shelf and slope (Cohen et al. 1990), found in 200–1200 m depth, and most common in 500–1000 m (McMillan & Hart 1998). Average size is 40–60 cm, with a maximum length over 90 cm (Paul 2000). Females grow larger than males (Clark & King 1989, McMillan & Hart 1998). Length at maturity is unknown (McMillan & Hart 1998).

Spawning areas
Little is known of the reproductive biology of ribaldo. There is no evidence that they migrate or aggregate at particular sites to spawn (McMillan & Hart 1998). Small groups of maturing fish were observed in the orange roughy "spawning box" on the northern Chatham Rise, suggesting that they spawn there in winter (McMillan & Hart 1998).

Juvenile distribution
Small ribaldo were caught during plankton sampling, in the upper 200 m of water over the slope occupied by the adults, at the southwest end of the Chatham Rise (McMillan & Hart 1998). Small ribaldo were also caught around most of the upper North Island: the smallest mode of 30–40 cm appeared on both the east and west coasts, with some fish 20–30 cm (Clark & King 1989). Some small fish were also caught in the Sub-Antarctic area (O'Driscoll & Bagley 2001).

Data summaries

Spawning areas
Gonad states of ribaldo were recorded from 405 stations (trawl or commercial tows, or commercial longline). These stations covered much of the southern part of the range of ribaldo, but there were few gonad stage data from around the North Island or on the Challenger Plateau. Ripe or running ripe females were recorded on the west coast South Island and Chatham Rise, with a single observation from Puysegur, and another from the Southern Plateau. Spent ribaldo occurred more frequently than ripe or running ripe fish, and were found over the Southern Plateau, and at Puysegur, as well as on the west coast South Island and Chatham Rise. Spawning appears to occur in winter, with observations of ripe and running ripe females from June to September on the Chatham Rise, and from July to August on the west coast South Island.

Juvenile distribution
Juvenile ribaldo were widespread, occurring around the north and east of the North Island, Chatham Rise, Southen Plateau, Puysegur, west coast South Island, and Challenger Plateau. Immature and adult ribaldo had similar distributions, although small (group i) juveniles tended to be restricted to depths less than 800 m, while larger juveniles and adults were observed to 1000 m.

Juvenile abundance
Immature ribaldo were reported during deepwater and middle depth trawl surveys by *Tangaroa* and in deepwater surveys by other vessels. The peak catch rates of 210 kg km^{-2} was taken by a charter vessel on the Challenger Plateau. Highest *Tangaroa* catch rates were generally on the northeast Chatham Rise, with smaller catches of juveniles at Puysegur and on the west coast South Island. One catch of 44 kg km^{-2} was taken in a deepwater *Tangaroa* survey off East Cape.

Neocyttus rhomboidalis (spiky oreo)

Literature review

Spiky oreo are found from Otago north, at shallower depths than other oreos, at 300–800 m (McMillan 1996). They are seldom abundant, and are caught mostly as minor bycatch while fishing for orange roughy on the east coast of the North Island, Challenger Plateau, and Lord Howe Rise (McMillan 1996). Average size is 25–35 cm (Paul 2000), maturing at about 30 cm (Clark & King 1989), and attaining 45 cm TL (McMillan 1996).

Spawning areas
Maturing fish were found throughout the year on the northwest coast of the North Island, and east coast North Island, from East Cape south (Clark & King 1989). Ripe females were recorded in spring, and spent females in spring and summer, suggesting spawning in spring–summer (Clark & King 1989).

Juvenile distribution
Spiky oreo juveniles are very rare, and only two specimens are known to date (G. James & P. McMillan, NIWA, unpublished data). These were 75 and 80 mm TL, caught fishing in depths of 670–900 m, at the eastern tip of the Chatham Rise, and the north Challenger Plateau respectively. Spiky oreo smaller than 30 cm were found throughout the year on the northwest coast of the North Island, and east coast North Island from East Cape south (Clark & King 1989).

Data summaries

Spawning areas
There were relatively few tows (77) in which gonad states of spiky oreo were recorded and these were scattered over a wide area. A total of 26 observations of ripe or running ripe females and 8 observations of spent females were reported: from the Challenger Plateau, Chatham Rise, east coast North Island, and east coast South Island. Timing of spawning is uncertain because of the sparse data, but ripe spiky oreo were observed from July to December. Running ripe females were observed only in October.

Juvenile distribution
Immature spiky oreo were observed mainly on the Chatham Rise, east coast North Island, and western Challenger Plateau, with a few records from northern New Zealand, Puysegur, and the Southern Plateau. The distribution of immature spiky oreo was similar to the adult distribution. Adult spiky oreo were more common than juveniles at depths greater than 1000 m.

Juvenile abundance
Immature spiky oreo were reported in 99 midwater and 27 deepwater tows from *Tangaroa*, and 51 deepwater tows by other vessels. Peak *Tangaroa* catches were all taken on the western Chatham Rise, and were up to 864 kg km^{-2} in middle depth tows. Other relatively large catches of immature spiky oreo were taken by *Tangaroa* on the east coast North Island and at Puysegur, and by a charter vessel on the Challenger Plateau.

Plagiogeneion rubiginosum (rubyfish)

Literature review

Rubyfish are widely distributed, but not common, on the upper continental shelf around New Zealand (Ayling & Cox 1982, Paul 2000), and are most abundant between 200 and 400 m (Paul 1997). Rubyfish have been caught from the Southern Kermadec Ridge to Otago Peninsula and the Chatham Islands (Paulin 1999). They are not present around the southern South Island or on the Campbell Plateau (Paul 1997). Rubyfish are targeted or caught as bycatch in the alfonsino fishery on the east coast North Island, where they are associated with seamounts and dropoffs, and in the outer Bay of Plenty, off Northland, the outer north Taranaki Bight, and Westland (Paul 1997).

It appears that early growth of rubyfish is very rapid, and that the species is very long lived, with a maximum known age 88 years (Paul et al. 2000). Mel'nikov & Ivanin (1995) carried out an age and growth study, in which they provided estimates of ages for fish up to maximums of 9 years for males and 10 years for females, but it appears that the species was not *Plagiogeneion rubiginosum*, (probably *P. fiolenti*) and ages were underestimated (Paul 1997).

Spawning areas
There is no information on reproduction or spawning areas. Paul (1997) surmised ".. rubyfish are presumably free-spawners in offshore waters, probably in their preferred habitat above seamounts and submarine ridges."

Juvenile distribution
Age and size at maturity is not known. Small fish (14–20 cm), presumed to be juveniles, were caught west of Kawhia Harbour in 134 m in February-March (Paul 1997). Paul et al. (2000) speculated that young fish inhabit different areas from older fish. According to anecdotal information from a commercial fisher, small rubyfish are caught in midwater schools above seamounts on the east coast North Island (QMA2) in 140–160 m depth (P. McMillan, NIWA, pers.comm.).

Data summaries

Spawning areas
Gonad states of rubyfish were available from only 17 research and commercial tows, so spawning areas and timing are extremely uncertain. There were three tows with ripe or running ripe fish (one each on the western Chatham Rise, Wairarapa coast, and northeastern North Island) and four observations of spent rubyfish (two from the west coast North Island, and one from west coast South Island and northeast coast North Island). Ripe and running ripe females were observed in November, January, and February. Spent fish were reported in November, April, and September.

Juvenile distribution
There were only 151 research tows which caught rubyfish, and lengths were recorded from about a third of these (47 tows). Observer data are also sparse, so our knowledge of juvenile distribution is based on very few observations. Small rubyfish (under 33 cm) were recorded, mostly at 200 or 400 m depth, in 11 tows on the eastern Chatham Rise, east coast North Island, Bay of Plenty, and west coast North Island. Adult rubyfish occur north of 45° S from the west coast South Island, round the north Island to Cape Palliser, and on the western Chatham Rise. There was also one observation of adult rubyfish from the Challenger Plateau.

Juvenile abundance
Immature rubyfish were caught in very low numbers (less than 3 kg km^{-2}) in three middle depth tows by *Tangaroa* close to the Chatham Islands.

Pseudocyttus maculatus (smooth oreo)

Literature review

Smooth oreo occur from Cook Strait south, although a few have been caught as far north as the Bay of Plenty. They are generally found in large schools in depths of 650–1300 m (McMillan 1996). Smooth oreo are long lived and slow growing (Doonan et al. 1995, 1997, McMillan et al. 1997). Length at maturity is 40 cm in females, reached at about 27 years of age (Doonan et al. 1995, 1997, McMillan et al. 1997).

Spawning areas
Smooth oreo spawn in similar areas to black oreo. Spawning fish are relatively abundant on the western and mid to eastern ends of the south Chatham Rise (McMillan & Fincham 1988, McMillan et al. 1988). Ripe, running ripe and spent fish are found on the Chatham Rise in October–November (Hart & McMillan 1998). Fish in ripe and running ripe condition are found in the depth range 600–1000 m, while developing fish are found in depths up to 1500 m (Hart & McMillan 1998). Smooth oreo in spawning condition were also observed in the Puysegur Bank and Macquarie areas in August–October (Clark & Tracey 1994b, Clark et al. 1996).

Juvenile distribution
Like juvenile black oreo, juvenile smooth oreo are pelagic but rarely seen (G. James & P. McMillan, NIWA, unpublished data). Juvenile smooth oreo, ranging in size from 35–100 mm, have been caught in depths of 670–1070 m on the south Chatham Rise. Smooth oreo smaller than 40 cm are found in all areas where mature fish are found, including the north and south Chatham Rise (McMillan & Hart 1994a, 1994b, 1994c, Tracey & Fenaughty 1997, Hart & McMillan 1998, Langley 2001), Puysegur Bank and Macquarie Ridge (Clark & Thomas 1994, Clark & Tracey 1994b, Clark et al. 1996) the Auckland Islands area (Clark et al. 1996), the Pukaki Rise, east coast South Island, and round the Snares (Clark & Thomas 1994).

Data summaries

Spawning areas
Gonad states for smooth area were recorded from 2518 research and commercial tows, which covered much of the overall adult distribution. Most ripe and running ripe smooth oreo were on the southern Chatham Rise; another group of spawning fish came from commercial tows in the Sub-Antarctic. Spent smooth oreo were recorded less frequently, but occurred in the same areas as ripe and running ripe fish. Only a few smooth oreo in spawning condition were observed on the northern Chatham Rise, or elsewhere. More than 20% of female smooth oreo on the Chatham Rise were ripe or running ripe from September to December, with peak spawning probably occurring in November. Spawning may be later in the Sub-Antarctic. Running ripe smooth oreo were observed in the Sub-Antarctic from November to February, peaking in December at Puysegur (FMA 5), and in January further south (FMA 6).

Juvenile distribution
Immature smooth oreo had a similar distribution to adults, occurring from 700 to 1500 m depth. There were few records of smooth oreos north of 40° S or from the west coast. Both juveniles and adults occurred off the east coast North Island from the Mahia Peninsula south, around the margin of the Chatham Rise, along the Otago-Southland shelf, round the Southern Plateau and Bounty Platform, and south of Puysegur.

Juvenile abundance
Immature smooth oreo were reported in 2379 deepwater research tows by *Tangaroa* and other vessels, and 153 middle depth tows by *Tangaroa*. Overall, immature smooth oreo were observed in 65% of all tows in which this species was caught. Very high catch rates of 100–1500 t km^{-2} were taken by

Tangaroa and charter vessels on the southeastern Chatham Rise. Other relatively large catches (more than 20 t km^{-2}) were taken in deepwater tows on the south and east Chatham Rise, and off the Otago shelf. Catch rates in the Sub-Antarctic by chartered deepwater vessels and in *Tangaroa* middle depth tows were lower, but some catches were still over 1 t km^{-2}.

Seriolella caerulea (white warehou)

Literature review

White warehou are distributed around New Zealand, particularly on the Chatham Rise and Campbell Plateau (Bagley & Hurst 1997, Paul 2000). They are caught mainly on the edge of the continental shelf and upper slope (Bagley & Hurst 1997) at depths of 200–800 m (Paul 2000). Average size is 45–55 cm, reaching over 60 cm (Paul 2000). There are thought to be three stocks: Chatham Rise, Campbell Plateau, and west coast South Island (Bagley & Hurst 1997, Horn 1999). Age at maturity is 3–4 years, which corresponds to a length of 38–47 cm (Bagley & Hurst 1997). Growth is rapid until first spawning, then is much slower (Horn 1999). Females grow faster than males, and the maximum known age is 21 years (Horn 1999).

Spawning areas

Spawning occurs in late winter–early spring in three areas: around the Mernoo Bank, on the west coast South Island, and off Southland (Bagley & Hurst 1997). Spawning lasts for about a month in the Mernoo Bank area, peaking in August–September (Bagley & Hurst 1997). In Southland, mature and spent fish have been recorded on the Puysegur Bank, and maturing fish have been recorded from the Stewart-Snares shelf in summer. Eggs have been collected in plankton tows from the Campbell Plateau in September and from the west coast South Island in August (Bagley & Hurst 1997). Eggs of white warehou were also recorded from Otago (Parsons 1999), and larvae from the Kaikoura Peninsula (Dolphin 1997).

Juvenile distribution

Juvenile white warehou are believed to be pelagic (Bagley & Hurst 1997). Small fish, 6–11 cm FL, were caught in trawls on the south Chatham Rise (Bagley & Hurst 1997). Very small fish have also been recorded in stomach contents of fish caught on the western side of the Chatham Islands in December (Bagley & Hurst 1997). White warehou of 25–40 cm FL tend to be found in water of 200–400 m depth, shallower than the adults, particularly on the Chatham Rise (Bagley & Hurst 1997). Pre-recruit fish, in a 25–35 cm length mode, were recorded on the Chatham Rise and Campbell Plateau (Bagley & Hurst 1997, Horn 1999). A specimen of 19.6 cm was recorded from Cook Strait (McDowall 1980).

Data summaries

Spawning areas

White warehou in spawning condition were observed relatively infrequently, with ripe or running ripe females occurring in only 47 of 775 tows for which gonad stage data were available. Most ripe, running ripe, and spent white warehou were observed in three areas: west coast South Island, Sub-Antarctic north of the Auckland Islands, and western Chatham Rise. There were also a few observations of spawning females at Puysegur, off Hawke Bay, and further east on the Chatham Rise. Spawning may occur in winter or spring. On the Chatham Rise, ripe females were recorded in May and August–September, with spent fish present from July to January. On the west coast South Island ripe and running ripe white warehou occurred from July to September, but there are no data for eight months of the year. Timing of spawning in the Sub-Antarctic is uncertain: ripe or running ripe females were recorded in February, March, June, August, and September, and spent fish were most prevalent in September and October.

Juvenile distribution
Immature white warehou were most common at depths from 200 to 600 m on the Chatham Rise, Southern Plateau (especially along the eastern edge of the Stewart-Snares shelf), and west coast South Island. Interestingly, no 2+ juveniles were recorded from west coast South Island, although 1+ juveniles and adults were taken in this area. A few immature fish were also reported from the Bounty Platform, Puysegur, and the Wairarapa coast. Adults were more widespread than immature fish, extending further north up the east coast of the North Island to Coromandel, and occasionally on the Challenger Plateau. Adults also occupied a wider depth range (250–750 m) than juveniles.

Juvenile abundance
Immature white warehou were reported in 69 inshore tows by *Kaharoa* and 502 middle depth tows by *Tangaroa*. *Tangaroa* catches were dominated by one tow on the western Chatham Rise, which caught 4.9 t km^{-2} of juvenile white warehou. Other catches were much smaller, but catches greater than 50 kg km^{-2} were taken by *Tangaroa* on the Chatham Rise and Southern Plateau, and by *Kaharoa* off the east coast of the South Island.

Seriolella punctata (silver warehou)

Literature review

Silver warehou have been caught in research and commercial trawls, mainly around New Zealand and across the Chatham Rise. They have been recorded occasionally on the Challenger Plateau and in the Sub-Antarctic. They occur mainly in 100–600 m depth (Anderson et al. 1998).

Spawning areas
Spawning silver warehou have been recorded from the west coast of the South Island in winter, Mernoo Bank in winter and spring, and at the Chatham Islands in spring and summer, and there is some evidence of possible spawning on the Stewart-Snares shelf in early spring (Livingston 1988). They also spawn on the east coast of the North Island (Annala et. al. 1999). Eggs have been recorded off Kaikoura in autumn (Robertson 1975a) and off Otago from spring to autumn (Parsons 1999). Eggs hatch after about 6 days (146 hours at 10–13 °C) and emergent yolk-sac larvae are about 3 mm long (Grimes & Robertson 1981).

Juvenile distribution
Juveniles have been reported to occur throughout the year in South Island shelf areas, in particular on the Pegasus Bay shelf and Canterbury Bight (Garilov 1979). They inhabit shallow water (less than 200 m depth) and remain apart from sexually mature fish (Annala et. al. 1999). Garilov & Markina (1970) described the progression of juveniles into deeper water with increasing size and in relation to the distribution of their prey. Very young fish (12–14 cm long) feed on plankton, juveniles (14.0–15.5 mm) feed on amphipods and chaetognaths in coastal waters. At 24–31 cm they move into the deeper part of the shelf, feeding on zooplankton, especially salps. Fish over 30 cm long feed on macroplanktonic organisms of the slope region of the shelf and as they become larger they enter the sexually mature part of the population. Silver warehou become sexually mature at 4–6 years, at about 47 cm (Horn & Sutton 1995, 1996).

Data summaries

Spawning areas
There were nearly 4000 commercial and research tows in which gonad states of silver warehou were recorded, providing good spatial and temporal information. Spawning appears to occur in three main areas: northwestern Chatham Rise around Mernoo Bank, west coast South Island, and southern New

Zealand around Puysegur, Auckland Islands, and the Stewart-Snares shelf. A few ripe and spent females were also observed off the north and east coasts of the North Island and on the eastern Chatham Rise. Timing of spawning varies between the three main spawning areas. On the Chatham Rise, most ripe and running ripe silver warehou were reported between August and November. Spawning in the southern region may be earlier, with ripe silver warehou present from May to September. Ripe and/or running ripe silver warehou were observed from June to October on the west coast South Island, the only months for which there were data.

Juvenile distribution
Young (0+) juveniles occur in waters less than 300 m deep all around mainland New Zealand and on the Chatham Rise. Juveniles up to 2 years old (1+) occur further south along the Stewart-Snares shelf than 0+ fish, but are seldom observed north of 40° S. Older juveniles are also more common in deeper water (200–450 m). Adult silver warehou are mostly caught from 200–600 m depth, rarely occurring over the continental shelf. Important adult areas are the Chatham Rise, western Stewart-Snares shelf, Puysegur, west coast South Island, and Wairarapa. Adult silver warehou are also reported occasionally from the Southern Plateau, the Challenger Plateau, and the northeast coast of the North Island.

Juvenile abundance
Immature silver warehou have been caught frequently in *Kaharoa* inshore surveys (878 tows) and *Tangaroa* middle depth surveys (637 tows), and rarely in deepwater surveys by other vessels (3 tows). In *Kaharoa* trawl surveys, catch rates were low around the North Island, up to only 37 kg km^{-2} in the Bay of Plenty. Larger catches (up to 548 kg km^{-2}) were taken around the South Island outer shelf, in Canterbury south of Banks Peninsula, and in Tasman Bay. In *Tangaroa* middle depth surveys, juveniles occurred at the shallower depths sampled (200–400 m) across the Chatham Rise. Catch rates were relatively uniform except for three large catches (over 2 t km^{-2}). The peak catch rate (5.1 t km^{-2}) of immature silver warehou in *Tangaroa* surveys was taken off the mid- to outer-shelf south of Otago, and relatively large catches were also taken further south along the western edge of the Stewart-Snares shelf.

Squalus mitsukurii (northern spiny dogfish)

Literature review

Northern spiny dogfish occur on or near the bottom on the continental and insular shelves and upper slopes (Compagno 1984) at 180–600 m depth (Last & Stevens 1994). They attain a maximum total length of 110 cm; females mature at 72 cm and males from 65 cm (Compagno 1984). Smaller lengths at maturity (51–55 cm total length for males, and 52–60 cm total length in females) have been reported in the southwest Atlantic (Lucifora et al. 1999).

Pupping areas
Size at birth about 22 cm (Last & Stevens 1994). There is little known about their biology. A related species is reported to give birth to four to nine young after a gestation of 1–2 years (Last & Stevens 1994). Litter size ranged from 2–15 in Japan (Taniuchi et al. 1993)

Juvenile distribution
No information available.

Data summaries

Pupping areas
Insufficient data.

Juvenile distribution
Northern spiny dogfish were measured in only 220 of the 1235 (18%) research tows in which they were caught. No northern spiny dogfish were measured from the Taranaki Bight or from the Challenger Plateau, so it is not known whether catches from these areas included juveniles. Immature northern spiny dogfish were recorded from all areas where this species was measured, including northern North Island (east and west coasts), west coast South Island, and eastern Chatham Rise. Both juveniles and adults were taken from 100–500 m depth, but immature northern spiny dogfish were most commonly observed shallower than 200 m.

Juvenile abundance
Immature northern spiny dogfish were recorded in 19 inshore *Kaharoa* surveys and 22 middle depth *Tangaroa* surveys. Catch rates were low, with the largest catch (72 kg km^{-2}) from a *Kaharoa* survey off the northwest North Island. Relatively high catch rates (up to 50 kg km^{-2}) were also recorded on *Kaharoa* and *Tangaroa* surveys off the west coast South Island. Smaller catches were taken from *Tangaroa* on the eastern Chatham Rise.

Trachyrinchus longirostris (white rattail)

Literature review

White rattail are found around New Zealand in depths of 600–1200 m (Paul 2000). They are an important component of most catches from deeper than 800 m in the upper North Island (Clark & King 1989). White rattail is one of the larger rattail species, with an average length is 50–60 cm, reaching at least 80 cm (Paul 2000). Females appear to grow larger than males (Clark & King 1989).

Spawning areas
No published information.

Juvenile distribution
White rattail as small as 24 cm were caught around the northern North Island (Clark & King 1989).

Data summaries

Spawning areas
Insufficient data.

Juvenile distribution
White rattails were often caught in research surveys (3840 tows), but were seldom measured (only 82 tows), and the only area in which length frequency data were available was the Chatham Rise. The Chatham Rise is only a small part of the overall distribution of white rattails, which were also caught on the east coast North Island, west coast South Island, Puysegur, and Challenger Plateau. Immature white rattails have been recorded from the northern Chatham Rise, but beyond this the juvenile distribution is unknown. On the Chatham Rise, immature white rattails were caught mostly between 800 and 1100 m.

Juvenile abundance
Information on juvenile abundance is from eight deepwater tows (five by *Tangaroa*, and three by other vessels), all on the northern Chatham Rise. Catch rates were mostly low (less than 20 kg km^{-2}), with one larger catch of 230 kg km^{-2} from *Tangaroa* north of the Chatham Islands.

Zenopsis nebulosus (mirror dory)

Literature review

Mirror dory occur in depths over 200 m around the North Island (Paul 2000). They appear to be confined to open sand or mud areas on the outer continental shelf (Ayling & Cox 1982). Average size is 25–35 cm (Paul 2000), reaching 70 cm (Stewart 1995). On the seamounts of the Nasca Ridge, southeastern Pacific, most fish reach maturity at 25–26 cm at about 3–4 years of age (Parin et al. 1988). They live to at least 13 years, and females are larger than males (Parin et al. 1988).

Spawning areas

Very little is known of the biology of mirror dory. Eggs have been recorded in Otago waters in spring to summer (Robertson 1975a). Mirror dory appear to spawn on the Nasca Ridge in winter and spring and spawning lasts at least 3 months (Parin et al. 1988).

Juvenile distribution

There is no published information on juvenile mirror dory in New Zealand. Parin at al. (1988) reported that juveniles are rarely caught and are probably pelagic. A few juveniles, from 4 cm, were caught above the seamounts of the Nasca Ridge (Parin et al. 1988).

Data summaries

Spawning areas

Insufficient data.

Juvenile distribution

Mirror dory were measured in over half (359) of the 613 research tows in which they were caught. Small mirror dory (under 35 cm) were recorded from all of the east coast North Island, from Cape Reinga to Cape Palliser, and occasionally from west coast South Island. Small mirror dory were not observed on the east coast South Island or the Chatham Rise, even though adults were sometimes caught in these areas. Both adults and juveniles were taken from 100 to 450 m depth.

Juvenile abundance

Small mirror dory were recorded in 91 inshore tows by *Kaharoa*, all on the east coast North Island. Peak catch rates (up to 448 kg km^{-2}) were in the Bay of Plenty, with other relatively large catches (more than 30 kg km^{-2}) from East Cape and Wairarapa.

Pelagic Fish

Species are described in alphabetical order of the scientific name.

Engraulis australis (anchovy)

Literature review

Anchovies are found in surface water around the North Island and north and west South Island (Paul 2000). They are most commonly found in schools, especially during summer, and sometimes in mixed schools with other species (Paul 2000). Average size is 8–12 cm, reaching about 15 cm (Paul 2000). Webb (1972a) reported that length at first maturity was 10 cm for fish from Tasman Bay.

Spawning areas
Anchovies spawn from spring through to autumn, with a peak in summer when the water is warmest (Ayling & Cox 1982). They gather in dense spawning schools in inshore bays and estuaries where the seawater is diluted, especially in the Bay of Plenty, Tasman Bay, and the southern fiords (Ayling & Cox 1982). Anchovies spawn in sheltered bays and sounds around practically all of New Zealand's coastline, except for the southeast South Island. In some parts of New Zealand, anchovy may spawn all year round (Baker 1975).

Robertson (1975a) reports that eggs are common to extremely abundant in neritic waters, except the southeast coast of the South Island. High numbers of anchovy eggs were collected in Milford Sound (Robertson 1975b). Dense spawning concentrations have been detected in the Bay of Plenty, Tasman Bay, and southern fiords (Anon 1977). Ripe and running ripe fish were found in Tasman Bay in December-January (Webb 1972a).

Spawning occurs in the Inner Hauraki Gulf in November and December (Crossland 1981). Eggs were common throughout the whole Hauraki Gulf and Firth of Thames area (Crossland 1981) and in the outer Gulf, with highest concentrations off Bream Head and the Hen and Chicken Islands to Little Barrier Island, and in East Northland between Whangaroa Harbour and Doubtless Bay (Crossland 1982). Spawning began when the sea surface temperature was about 16 °C and peaked at 19–20 °C (Crossland 1981).

Juvenile distribution
Larvae of anchovy were recorded in the Hauraki Gulf (Crossland 1981, 1982, Thompson 1983, Kingsford 1986, Tricklebank 1988), Northland east coast (Crossland 1982, Tricklebank et al. 1992), and Wellington harbour (Elder 1966, Frentzos 1980). Healey (1980) reported that immature anchovy were common in summer in the Pauatahanui Inlet near Wellington. Webb (1972a) found small anchovy, from 8 cm, in Tasman Bay.

Data summaries

Spawning areas
Insufficient data.

Juvenile distribution
Length data on anchovy were available only from research trawls around northern North Island from the Bay of Plenty to Taranaki. Anchovy were also caught in other areas, especially Golden and Tasman Bays, and west coast South Island, but were not measured. There were 18 observations of small (under 8 cm) anchovy, mostly in the Hauraki Gulf, with two records from Bay of Plenty, and three records from west coast North Island. It is not known if immature anchovy occur in other areas. The distribution of juveniles is also uncertain because anchovy are unlikely to be fully selected by trawl gear with typical codend mesh sizes (60–100 mm). Small anchovy were caught shallower than 50 m.

Juvenile abundance
Insufficient data.

Lampris guttatus (moonfish)

Literature review

Moonfish have been confused with opah (*L. immaculatus*). Before recognition of moonfish and opah as separate species, *L. guttatus* was sometimes been referred to as "opah" (Parin & Kukuyev 1983).

Moonfish are a pelagic species, found in surface waters to depths of about 500 m (Roberts & Stewart 1998). They occur in most tropical and temperate oceans (Roberts & Stewart 1998, Paul 2000). Average size is 80–120 cm (Paul 2000). They attain 200 cm in length and 270 kg (Roberts & Stewart 1998). Moonfish are the ninth most commonly caught species taken by tuna longlines in New Zealand (Francis et al. 1999, 2000, 2001). They are widely distributed around New Zealand, especially on the east coast North Island and west coast South Island (Francis et al. 1999).

Spawning areas
No published information.

Juvenile distribution
No published information.

Data summaries

Spawning areas
Insufficient data.

Juvenile distribution
Immature moonfish were recorded in 170 longline sets, mostly off the west coast of the South Island, with other records from the eastern Bay of Plenty, northern North Island, and Challenger Plateau. Small moonfish occurred in the same areas as adults, but adult moonfish were much more numerous (recorded in 846 sets) and more widespread. Adults were observed from the east coast South Island, Stewart-Snares shelf, west coast South Island, and around the North Island from Taranaki to Wairarapa.

Juvenile abundance
Longline catch rates of immature moonfish were very low (peak catch rate 4.2 fish per 1000 hooks). Peak catch rates were taken off the west coast South Island, with smaller catches in the eastern Bay of Plenty.

Sardinops neopilchardus (pilchard)

Literature review

Pilchards are widespread in inshore waters of New Zealand, except for southeast New Zealand, but appear to be common only in embayments like Hauraki Gulf and Tasman Bay (Paul 2000). A pelagic species, pilchards are usually found in pure schools, or sometimes schools with sprat and anchovy (Paul 2000). The average size is 10–20 cm, reaching about 25 cm (Paul 2000). Pilchards live about 7 years (Paul et al. 2001), but little is known of age and growth (Paul 2000, Paul et al. 2001). Pilchards become sexually mature at about 11–14 cm, in their third or fourth year (Baker 1972, 1975, Webb 1972a).

Spawning areas
Spawning occurs over the shelf all year round in northern waters, and in late spring and summer in central and southern waters (Ayling & Cox 1982, Paul 2000, Paul et al. 2001). Robertson (1975a) reported that eggs were common to abundant in most neritic waters except the southeast South Island.

In the Marlborough Sounds, pilchards spend winter in warm saline water near the seafloor, and appear in spring in large schools at the surface for spawning (Baker 1975). November to February is the main spawning season for pilchards in the Marlborough Sounds and Tasman Bay, with peak reproductive activity in January (Baker 1972, Webb 1972a). Baker (1972) reported that spawning takes place with rising temperature, occurring between 14.7–20.9 °C, mostly 16.0–16.4 °C, and suggested that in warmer temperatures in the north, spawning would probably occur all year round. Spawning takes place mainly at night and eggs take 56–58 hours to hatch (Baker 1975).

Female pilchards with ripe ovaries were reported in Otago in December to March (Graham 1939). Graham (1956) reported that pilchards have two spawning seasons or the season is prolonged, and that pilchards spawn offshore in deep water.

Crossland (1981) collected pilchard eggs and larvae in the Hauraki Gulf from October to December and deduced that peak spawning would have been in late October to early November, and probably in an area near Little Barrier Island. A dense patch of eggs was collected around the Hen and Chicken Islands in December, confirming the main spawning area is the Outer Hauraki Gulf in this region (Crossland 1982). Larvae were found throughout the Outer Hauraki Gulf and Bream Bay (Crossland 1982). In east Northland, eggs were collected in the Bay of Islands, and larvae were widely distributed in the whole east Northland area (Crossland 1982).

An exceptionally high catch of pilchard eggs was collected in the Bay of Plenty in April 1975, in an inshore area near the Aldermen Islands, and a large catch was also recorded in the Bay of Islands (Robertson 1975b). Other spawning areas include Fiordland and Gisborne-East Cape area (Paul et al. 2001).

Juvenile distribution
Little is known of the distribution of juvenile 0+ and 1+ pilchards in New Zealand (Paul et al. 2001). In southeast Australia, these size groups are seen in shallow inshore areas in the summer months (Paul et al. 2001). Pilchard larvae have been recorded in the Hauraki Gulf (Crossland 1981, 1982, Thompson 1983, Kingsford 1986, Tricklebank 1988, Paul et al. 2001), Firth of Thames (Paul et al. 2001), Northland east coast (Crossland 1982, Tricklebank et al. 1992), Marlborough Sounds (Baker 1972), and Wellington Harbour (Elder 1966, Frentzos 1980). Some small pilchards were also collected at Paraparaumu Beach (Baker 1972).

Pilchard larvae and small fish (about 20 mm) were collected in the Marlborough Sounds and Tasman Bay in summer (Baker 1972, Webb 1972a). Larvae of 2.2–2.6 mm float on the surface, and growth is very rapid in their first year, when they attain 55–60 mm (Baker 1972).

Data summaries

Spawning areas
Insufficient data.

Juvenile distribution
Immature pilchards were recorded in 41 research trawls at depths shallower than 50 m. Most records were from northern New Zealand, especially the Hauraki Gulf, with one observation in Tasman Bay. The distribution of juvenile pilchards was similar to the distribution of adults. As for other small pelagic species, the distribution of pilchards is uncertain because fish are too small to be fully selected by research trawl gear.

Juvenile abundance
Insufficient data.

Sprattus antipodum and *S. muelleri* (sprat)

Literature review

Formerly known as one species, the New Zealand sprat, *Sprattus antipodum*, with two body forms, deep and slender. The two forms were shown to have genetic differences (Smith & Robertson 1981), and are now recognised as two species, the slender *S. antipodium*, or New Zealand blueback sprat, and the more common, deep-bodied *S. muelleri*, New Zealand sprat (Whitehead et al. 1985). Earlier reports of "*S. antipodium*" would refer to the two species combined (Whitehead et al. 1985).

Sprats are common around the South Island, and are scattered around the North Island at least as far north as Auckland (Paul 2000). Both species are especially abundant on the east coast South Island, south of Banks Peninsula (Ayling & Cox 1982). *S. antipodium* is recorded specifically in Hawke Bay, Cook Strait area (Paraparaumu, Wellington, Tasman Bay), east coast South Island off Akaroa and Canterbury Bight, and the west coast South Island off Runanga and Cape Foulwind (Whitehead et al. 1985). *S. muelleri* is more widely distributed, occurring on the east coast North Island from Whangarei to Hawke Bay, southwest North Island, Cook Strait, Tasman Bay, Marlborough Sounds, east coast South Island from the Waimakariri River to Otago, and west coast South Island from Westport to Okarito (Whitehead et al. 1985).

Spawning areas
Sprats are sexually mature at 8 cm long, and spawn in sheltered bays and inlets (Baker 1975). They congregate to spawn along the southeast coast of the South Island during the winter months, and their peak spawning occurs when the waters are coldest in August and September (Anon 1977, Robertson 1980b, Ayling & Cox 1982). Colman (1979) found their principal spawning grounds to be the Canterbury Bight and off the Otago coast. Eggs were also found on the west coast South Island, between Cape Foulwind and Bruce Bay, and Tasman Bay and Pegasus Bay (Colman 1979).

Eggs of *Sprattus antipodum* were common to very abundant in neritic waters of the east coast South Island, Tasman Bay, and Marlborough Sounds in winter and spring (Robertson 1975a). They spawn in Otago in winter–spring, from May to November (Robertson 1980b). Eggs were collected from Blueskin Bay and the Otago coast, but were absent beyond the middle of the continental shelf (Robertson 1980b, Parsons 1999). Robertson (1973) reported eggs and larvae off the East Cape, Fiordland, and Otago regions. Graham (1939) collected one ripe fish and several spent fish in Otago in May. Graham (1956) reported that sprat spawn in the open sea, and that the eggs are buoyant and drift with wind and current. Sprat also spawn in the Canterbury Bight (Ayling & Cox 1982).

Crossland (1981) reported small quantities of sprat eggs (*S. antipodium*) in the Inner Hauraki Gulf, with the largest concentration off Waiheke Island in October, and noted that sprat spawn in the Marlborough Sounds from July to January.

Reference to *S. antipodium* above probably refers to both species combined.

Juvenile distribution
Larvae of sprats have been recorded in the Hauraki Gulf (Kingsford 1986), Wellington Harbour (Frentzos 1980), and off the Kaikoura Peninsula (Dolphin 1997, Hickford & Schiel 1999), Otago (Parsons 1999, Robertson 1973), East Cape (Robertson 1973), and Fiordland (Robertson 1973)

Data summaries

Spawning areas
Insufficient data.

Juvenile distribution
Sprat are frequently taken in research tows, but are seldom measured. Sprat have been caught off the east and west coasts of the South Island, Tasman and Golden Bays, Hawke Bay, Gisborne, Hauraki Gulf, and west coast North Island. However, length data were available from only 15 tows, mostly in the Hauraki Gulf. Consequently the distribution of juveniles is poorly known. There were seven observations of immature sprat in the Hauraki Gulf and one observation off the west coast North Island. Juvenile and adult sprat were usually caught at depths less than 50 m.

Juvenile abundance
Insufficient data.

Invertebrates and seaweeds

The invertebrate species we have included are those living in shallow to moderate depths that are commercially, recreationally, or traditionally important, and also those that were well represented (at at least 20 stations) in the trawl and observer databases. The seaweeds dealt with are among the most prominent of algae, some such as *Macrocystis pyrifera* being important definers of New Zealand's marine provinces and environments. Species are ordered alphabetically, usually by genus but occasionally by family. The common names used are generally from the Ministry of Fisheries list of codes and names database, maintained by NIWA.

Identification of some of the trawled invertebrates, particularly those less commonly encountered, can be tricky, so obviously incorrect records were removed after discussion with specialists at Museum of New Zealand Te Papa Tongarewa (MNZ) and NIWA. Where similar-looking species might have been confused, we have combined them under the generic name.

Acanthephyra spp.

Literature review

Acanthephyra pelagica and *A. quadrispinosa* are easily confused prawns (Webber et al. 1990). Both live at depths of 400 m to at least 2000 m and have been recorded in all but the most southern parts of the EEZ, the latter more commonly in the north and the former more to the south. Nothing has been reported on the breeding or juvenile areas for these species in New Zealand waters.

Data summaries

The databases show these prawns to have been most commonly taken on the southern side of the Chatham Rise at depths of 750–1100 m, but there was also a spike of occurrence at 1250 m. There is no information on the breeding or juvenile areas.

Aristaeomorpha foliacea (royal red prawn)

Literature review

This large prawn lives over mud bottoms at depths of 250–1300 m in waters north of Cook Strait and has been reported most often from the Bay of Plenty (Webber et al. 1990). There is no information on its breeding or juvenile areas in New Zealand waters.

Data summaries

The databases show that this prawn has been most commonly encountered in the Bay of Plenty at depths of 350–1100 m, but it was also occasionally taken as far south as the southern slope of the Chatham Rise. There is no information on the breeding or juvenile areas.

Aristaeopsis edwardsiana and *Aristeus* sp. (scarlet prawn)

Literature review

Aristaeopsis edwardsiana (formerly *Plesiopenaeus edwardsianus*) and *Aristeus* sp. are included together because they are very easily confused (Webber et al. 1990). The former is the largest natant decapod in New Zealand waters.

Both species live over mud bottom in waters 200–1800 m deep. They have been most commonly reported off both coasts of northern North Island and on the slope of the Challenger Plateau (Webber et al. 1990).

Nothing is known of the juvenile ecology or breeding biology of these prawns in New Zealand waters.

Data summaries

These extend the distribution of these prawns by showing that they are also reasonably common near the 1000 m contour of the Chatham Rise and the Solander Trench.

Atrina pectinata zelandica (horse mussel)

Literature review

A conspicuous bivalve living mainly on muddy-sand bottom in the lowest intertidal and subtidal shallows (Grace 1972) to 25 m or more, in the North, South, and Stewart Islands (Powell 1979). The *Atrina* community in Whangateau Harbour is almost entirely subtidal, in medium to fine muddy, but fairly stable, sand with moderate current velocities and no wave action (Grace 1972). Similar communities have been described in Ohiwa Harbour (Paul 1966), Auckland Harbour (Grace 1972), Hauraki Gulf (McKnight 1969), and Marlborough Sounds (Estcourt 1967).

Spawning populations
Spawning takes place throughout much of the year (Booth 1983), but there is no information on the size or age at which breeding begins.

Juvenile habitat
A pelagic larva is free swimming for several days or weeks (Booth 1979), but nothing is known of its primary settlement locations which may not be within the adult beds (see, for example, pipi). There is no evidence for migrations once shells have embedded, so the juvenile habitat is also the adult habitat.

Austrovenus stutchburyi (cockle)

Literature review

The cockle (formerly known as *Chione stutchburyi*) is a shallow-burrowing suspension feeder of the bivalve family Veneridae. It is found in fine mud to coarse sand on protected beaches and enclosed shores all around North and South Islands, and at Stewart Island and Chatham Islands, from the lowest high water neap mark to the lowest part of the shore (Morton & Miller 1968, Powell 1979, Cryer 1997, Annala et al. 2001, and numerous other authors). Larcombe (1971) suggested that the upper limit is where submergence is only 3.5 hours per day.

Cockles are often very abundant. For example, the average intertidal density in Pauatahanui Inlet is 577 m^{-2}. (Richardson et al. 1979), accounting for probably three-quarters of the total weight of the living biomass – apart from birds and fish (Healy 1980). In many harbours cockles are the defining species in the most common and widespread invertebrate community (e.g., Grace 1972).

There can be quite extensive movements by juveniles (Martin 1984), but individuals greater than 25 mm shell length (SL), although capable of crawling along the surface a few metres, remain largely sessile (Morton & Miller 1968). Beds of adults may change position slightly from time to time as water channels and gutters alter course (Paul 1966).

Spawning populations
Breeding biology is moderately well known and all populations studied have contained spawners. Sexes are separate but co-occur. Maturity appears to be primarily a function of size rather than age, occurring at about 18 mm SL (compared with the minimum exploited size of about 30 mm SL in commercial and non-commercial fisheries) (Larcombe 1971, Cryer 1997). Because there is a positive correlation between shell size and period of immersion in a number of localities, from Whangateau to Otago Harbours (Lacombe 1971), the greatest proportion of breeders live on lower parts of the shore. There is also often a gradient in size in enclosed waters, cockles often being small at the harbour entrance, large in the basin, and progressively decreasing in size up the estuary (Grace 1966). This decrease in size up estuaries can be explained through the reduced salinity: cockles from a less saline regime showed delayed weight gain and lower maximal body tissue weight that may also indicate reduced reproductive potential (Marsden & Pilkington 1995).

To summarise, the areas that appear most important to spawning populations are those near low tide level, within harbour basins.

Juvenile habitat
The settlement process and juvenile habitat are not well known because most studies have looked only at adults. After a planktonic larval stage lasting about 3 weeks, pediveligers settle at 160–200 μm. In general, settlement takes place throughout cockle beds, but particularly on already well-established ones (Blackwell 1984). Recruitment levels are significantly lower in areas where all live cockles have been removed, probably due to poor settlement rather than low survival (Larcombe 1971) or some conditioning factor (Martin 1984). It is likely that the increased shell debris of the high density beds provides a stable sediment surface free from reworking and so indirectly contributes to a higher level of recruitment success (Blackwell 1984). The ability of juveniles to move presumably means that cockles can migrate out of over-dense beds.

At Howick, smaller (probably 2 year old) animals were predominant higher on the beach, with larger (5–6 year old) animals lower down the beach, suggesting settlement higher on the beach in the coarser sand (Morton & Miller 1968), but we are not aware of any corroboration of this observation.

Camplyonotus rathbunae (sabre prawn)

Literature review

This prawn lives on the bottom at depths of 270–650 m in all parts of our EEZ with the exception of near the Kermadecs (Webber et al. 1990). There is no information on its breeding or juvenile areas in our waters.

Data summaries

The databases show this prawn to be most commonly encountered in the Bay of Plenty at depths of 400–600 m. There is no information on the breeding or juvenile areas.

Chlamys delicatula (southern queen scallop)

Literature review

This is a small pectinid found on the mid to outer continental shelf of the southeast coast of the South Island and around the Sub-Antarctic islands (Michael & Cranfield 1999). Little is known of its biology. There has been a commercial fishery off Otago in recent years.

Spawning populations
Sexes are separate but co-occur. There are spawning events in spring to autumn. The estimated 40–50 day larval life suggests that the scallops in the Otago population may recruit from natal populations up to 300 km up current, on the Snares Shelf. Males reach maturity at about 30 mm shell height, females at about 40 mm, at ages of 4 and 5 years respectively.

Juvenile habitat
Settlement processes are poorly known. Juveniles are found bysally attached to fragments of bryozoa and other biogenic debris including the shells of other queen scallops and *Tiostrea* (Michael & Cranfield 1999). This suggests that this scallop is like *Pecten novaezelandiae* (see below) in requiring intricate surfaces for primary settlement.

Data summaries

Spawning and juvenile populations
These cannot be distinguished because the trawl and observer shellfish were not measured or sexed. Queen scallops have been taken from near Mernoo Gap, particularly off Otago, and on the Snares Shelf.

Cidaridae (cidarid urchins)

Literature review

This family is represented by several, mostly rare, species in New Zealand waters including *Goniocidaris umbraculum, G. parasol, G. magi, G. peltata, Austrocidaris pawsoni, Ogmocidaris benhami, Histocidaris elegans, Histocidaris* sp., *Stereocidaris sceptrificoides, Stylocidaris brevicollis, Notocidaris pawsoni, Ctenocidaris aotearoa,* and *Poriocidaris* sp. The most common are likely to be *G. parasol, G. umbraculum,* as well as *A. pawsoni* and *O. benhami.* These species are collected most frequently from the Chatham Rise and Campbell Plateau. Little is known about the biology of cidarids, but some are known to brood their young under the protection of their large radioles (spines). *G. parasol*, *G. umbraculum*, and *O. benhami* are among those thought to brood their young (Mortensen 1921, Fell 1958).

Data summaries

The databases show cidarids are most commonly recorded on the Chatham Rise in all depths between 100 m and 1100 m. Breeding and juvenile areas are likely to be similar to where specimens are caught, especially for those species that brood their young. Pelagic, non-feeding, larval development is also more common in cidarids than in most other echinoderm groups, a feature which also restricts their ability to disperse (Emlet 1995).

Crassostrea gigas (pacific oyster)

Literature review

This oyster was introduced accidentally around the late 1960s (Dinamani 1971) and by the latter half of the 1970s had spread to most harbours and estuaries in Northland (Dinamani 1987). It has been reported at least as far south as the Marlborough Sounds (Jenkins & Meredyth-Young 1979).

Spawning populations
Breeding biology is moderately well known. Sexes are separate but co-occur. Spawners are at least 7–8 months old (Dinamani 1987). It is not clear that the southernmost oysters are spawning populations because breeding is strongly limited by temperature: Mann (1979) found that gametogenesis in *C. gigas* was dependent on both absolute temperature, ranging from 15 °C to 18 °C, and the period of exposure, and he postulated a minimum temperature of 18–20 °C as necessary to induce spawning.

Juvenile habitat
The settlement process in New Zealand, although undoubtedly well known by oyster farmers because this oyster is now the mainstay of the northern rock oyster aquaculture industry, has not been reported in the literature. Clearly, settlement takes place among and on the adult beds.

Durvillea antarctica (bull kelp)

Literature review

Bull kelp is found on all exposed rocky coasts of South Island, from the most exposed promontories but also up into inlets (Morton & Miller 1968). It is essentially a southern cold-water species, but occurs sporadically up the east coast into the Bay of Plenty and is plentiful around Three Kings Islands (Adams 1994). It is also found at the Chathams, Snares, Auckland, Campbell, Bounty, and Antipodes Islands (Morton & Miller 1968, Adams 1994), but although cast ashore at the Kermadecs, it is not known to grow there.

Reproductive populations
These appear to be widespread throughout the range of the species. Male and female gametes are shed during winter months (Adams 1994).

Juvenile habitat
Juvenile plants quickly colonise bare rock surfaces, which may be within or separate from established beds (Adams 1994).

Echinothuriidae (tam-o-shanter urchins)

Literature review

Several species are known from the New Zealand region, including *Phormosoma rigidum, P. bursarium, Araeosoma thetidis, A. coriaceum,* and *Asthenosoma gracile.* Echinothuriids are found mainly in the deep sea and are slow moving deposit feeders that aggregate strongly (Tyler & Gage 1984).

Data summaries

The databases show that echinothuriids are widespread over the Chatham Rise and Campbell Plateau and are also found along the east coast of North Island and the west coast of the South Island. Few specimens have been recorded north of East Cape. They have been found in many depths greater than about 300 m. Studies of reproduction in this group are few, but unlike most other regular echinoids (except cidarids), many echinothuriids produce large eggs and have direct development (no feeding larval stage), implying that settlement is likely to be near adult populations.

Evechinus chloroticus (kina)

Literature review

This urchin is found along all the coasts of mainland New Zealand and the inshore islands, and at Chatham and Snares Islands (Andrew 1988 and references therein). They live on shallow rocky reefs, cobbled areas, and, to a lesser extent, on sand-mud substrates. Their abundance generally increases with increasing exposure to wave action except at the most exposed locations where densities are reduced. In northern New Zealand, few live deeper than 12 m (Choat & Schiel 1982), but further south and elsewhere they are in places deeper than 15 m. Kina also live intertidally (Dix 1970). They are rarely evenly distributed over extensive areas, but usually occur in isolated clumps or aggregations, often at high density. Highest densities are often recorded from coralline flats, rather than from beneath macroalgal canopies (e.g., Dix 1970, McShane & Naylor 1991, Davidson & Chadderton 1994).

Spawning populations

Breeding biology is moderately well known. Sexes are separate but co-occur. Kina at Arapawa Island mature at a smaller size (less than 50 mm test diameter) than at Dusky Sound (about 90 mm) (McShane & Anderson 1997). Kina respond to low resource availability by increasing the size of the food gathering apparatus, maturing at a smaller size, and growing to a smaller size than individuals from food-rich habitats. They can therefore persist in dense aggregations in habitats of low food availability (McShane & Anderson 1997).

Spawning takes place during summer but varies in precise timing among locations (Andrew (1988), Lamare (1998) and references therein). Populations can increase fertilisation success by forming spawning aggregations and spawning synchronously (Lamare 1998).

Juvenile habitat

Settlement, which takes place after a 30–60 day larval period (Andrew 1988 and references therein), and the juvenile habitat have been little studied. Andrew & Choat (1985) found small juvenile kina in holdfasts and at the bases of sponges. A cryptic habitat, with juveniles being found both intertidally and subtidally in crevices and depressions in rocks, under rocks (particularly those resting on pebbles) and often covered with shell fragments and other debris, was also reported by Dix (1970). Kina 3–10 mm in diameter were sometimes present in large numbers among the shell debris in the *Gari* and *Atrina* communities in Whangateau Harbour (subtidal, coarse to very coarse sand, high to very high current velocities, no wave action) (Grace 1972). Most small juveniles have been found in shallow waters, but it remains unknown whether kina also recruit to greater (greater than 12 m) depths (Andrew & Choat 1985). There is no apparent relationship between the presence of adults and the survival of larvae (Andrew 1988).

Fusitriton magellanicus

Literature review

The genus is known from all temperate regions of the southern hemisphere. Around New Zealand, *Fusitriton* are known mostly from the Chatham Rise, and off the south and southeast of the South Island where they are a key community species (Powell 1950). This is one of the most common and widely distributed gastropods in the 150–1000 m depth (Beu 1978, S. O'Shea, NIWA, pers. comm.). It is a generally infaunal carnivore that lives half buried in soft substrates but also occurs in rocky seamount environments. It is usually one of the most abundant gastropods from or next to hydrothermal vents.

Data summaries

The databases show this mollusc has been recorded from trawls only on the Chatham Rise, mostly in the east around the Mernoo Bank, in depths of 400–600 m. This is surprising given its known wide distribution. There is no information on the breeding or juvenile areas, but they may have a long larval phase with settlement over a wide range, as do the northern hemisphere species of *Fusitriton* (Beu 1978).

Gracilaria spp.

Literature review

Gracilaria are red seaweeds with a long history of use as a source of the gelling phycocolloid, agar, and have many other uses (Pickering 1989). Adams (1994) listed three widespread species for mainland New Zealand. They are most common in the intertidal and subtidal zones of sheltered coasts, harbours, and estuaries, but also live on exposed coasts, sometimes subtidally. *Gracilaria* can form vast meadows on mudflats, such as in Manukau Harbour, and is tolerant of silt and sand.

Reproductive populations and juvenile habitat
These seaweeds are dioecious but little is known of their reproduction. The agar weed is the cystocarp, on which the spermatangia are produced. The tetrasporangia develop in the cortex, scattered over the fronds (Adams 1994). New young plants co-occur with the older ones.

Gracilechinus multidentatus

Literature review

This is a moderately large and distinctive regular echinoid often caught in trawls in large numbers from depths of 600–1200 m, particularly on the south Chatham Rise. The roe is said to be edible (D. McKnight, NIWA, pers. comm.). It is occasionally found as far north as Three Kings Ridge and Norfolk Ridge (McKnight 1993).

Data summaries

The databases show that most of the records of this species are from the south Chatham Rise with a few records from the north Chatham Rise, a scattering of occurrences off the North Island east coast as far as North Cape, and one record near Stewart Island. Most records are from 600 to 1200 m. There is no information on the breeding and juvenile areas.

Haliotis iris (paua)

Literature review

Paua are herbivorous gastropods that inhabit shallow waters (generally less than 6 m) and can form large aggregations on coastal reefs (Annala et al. 2001). They are discontinuously distributed along North, South, Stewart, Chatham, and Snares Islands (Powell 1979, Sainsbury 1982), but are most abundant in the cooler waters from Cook Strait south (Schiel & Breen 1991). Few paua are harvested commercially north of East Cape, but they are still common there. Movement is over a sufficiency small spatial scale that the species can be considered sedentary. Growth and survival are significantly greater in deep (6–8 m) compared with shallow (1–2 m) habitats (McShane & Naylor 1995a). Dislodgment or smothering could account for the low survival and growth in the shallows.

Spawning populations
Sexes are separate but co-occur and they are broadcast spawners. Fertilisation success in abalone appears to be dependent on the distances separating individuals (Babcock & Keesing 1999), and recruits to the seafloor are probably derived from nearby adults because larval dispersal is thought to be localised (McShane *et al.* 1988). Therefore, at very low abalone destiny, natural recovery may not take place.

Paua in the north mature more rapidly and at a smaller size (50–60 mm SL) than in the south (50–80 mm SL). There are probably also more spawning events spread over a more extended breeding season in the north (late summer to early spring, with major spawning events in July and October) compared with the south (late summer to autumn) (Poore 1973, Sainsbury 1982, Hooker & Creese 1995a, Wilson & Schiel 1995). Much variability in individual and population spawning activity has been reported (Wilson & Schiel 1995).

Even within localities there can be considerable variability in reproductive output. Paua on headlands reached maturity at a smaller size than those in bays, possibly because of different growth rates (McShane & Naylor 1995b).

Juvenile habitat
Laboratory studies have shown that paua larvae settle after 1–2 weeks and reach 3–4 mm shell length in 1–2 months (Hooker & Creese 1995a). Recruitment varies greatly between regions, habitat-related factors being an important source of variation in post-settlement survival.

Extremely wave-exposed coasts have very low recruitment: those of intermediate wave exposure appear to have strongest recruitment. Some water and boulder movement appears to be important to survival, perhaps in keeping juvenile habitat relatively free of fouling and sediment. If wave action is excessive, presumably the boulder habitat is moved so often that survival is low; there may also be poor larval retention in such places. Juveniles are found under nearshore boulders which are not heavily fouled by encrusting organisms (McShane 1993, Roberts et al. 1999). They occur on boulders with coralline algae, tube worms, and bryozoans, but are seldom found on rocks heavily encrusted with sponges or tunicates. The surface of the coralline algae is often coated with a biofilm composed largely of bacteria, diatoms, and extracellular polysaccharides, which probably provide both the settlement cues and food for recruiting paua.

Post-settlement paua use the crustose coralline habitat for about 8 weeks before seeking cryptic habitat, generally under boulders (McShane & Naylor 1995a). Rates of recruitment measured as the density of early post-settlement individuals were similar between shallow and deep habitats, suggesting that the paucity of juvenile paua in deep habitat was due to low post-settlement survival (McShane & Naylor 1995a).

Paua become emergent at shell lengths corresponding to the onset of maturity. Recruitment indices (the mean number of juveniles sampled in dive surveys) indicate a higher abundance of juveniles off D'Urville Island and in Cook Strait than in wave exposed habitats of west coast Stewart Island, Fiordland, and southern Otago (McShane 1993, McShane et al. 1993, 1994).

Haliporoides sibogae (jack-knife prawn)

Literature review

This prawn lives over soft mud at 100–1500 m from the Chatham Rise north (Webber et al. 1990). Most have been taken along the east coast of Northland into the Bay of Plenty, and on Chatham Rise. NIWA's collections have mainly come from 400–500 m, and also around 1000 m (S. O'Shea, pers. comm.). Nothing has been reported on its juvenile or breeding areas.

Data summaries

These indicate high abundance not only in the Bay of Plenty, but also along the Wairarapa coast. The very southern observer records, near the Auckland Islands, cannot be discounted and extend the known distribution of this prawn well south. Nothing can be derived from the data summaries about the juvenile or breeding areas.

Holothuriidae (sea cucumbers)

Literature review

This group has numerous, poorly known species in New Zealand waters. Species include *Pseudostichopus mollis, Ocnus sacculus, O. farquhari, O. brevidentis, Bathyplotes natans, Heterothyone alba, H. ocnoides, Neothyonidium dearmatum, Amphicyclus thomsoni, Chirodota nigra, C. gigas, Taeniogyrus dunedinensis, Paracaudina chilensis, P. longidentis, Echinocucumis hispada, Molpadia antarctica, M. musculus, Bathyplotes natans, Laetmogone violacea, Enypniastes eximia*, as well as others undescribed (McKnight & Probert 1997). These are generally slow-moving bottom dwellers or burrowers and are suspension or deposit feeders. Many cold water forms are brooders, e.g., *O. sacculus* and most species are dioecious.

The common sea cucumber *Stichopus mollis* is addressed later.

Data summaries

The databases show holothurians are widespread in New Zealand waters, occur over a wide range of depths, and are encountered in most areas where echinoderms have been recorded. There is no information on the breeding and juvenile areas of any of these holothurians.

Ibacus alticrenatus (prawn-killer)

Literature review

The prawn killer is widespread in New Zealand waters at depths to 500 m (Dell 1955), from the Kermadec Islands to the Campbell Plateau on trawled grounds. Sexes are separate but co-occur. Examination of material held at MNZ showed that females reach maturity at a carapace length (CL) of about 25 mm. The phyllosoma larval stage (Atkinson & Boustead 1982) lasts many weeks and so there is opportunity for wide dispersal, but most specimens, particularly the later stages, have been taken over the continental shelf (NIWA, unpublished data), and all nistos (postlarvae) have been taken within the area of the adults. Thus, although the settled stage is capable of walking large distances, there is no evidence for the breeding or juvenile areas being discrete.

Data summaries

These show how extensively this species is distributed, being most frequently taken in northern waters from Bay of Plenty to Chatham Rise and on the southern part of Challenger Plateau at 200–400 m. The deepwater occurrences reported (900–1200 m) may indicate a yet to be described deepwater scyllarid lobster. Few *I. alticrenatus* were measured, and of those, few were smaller than 25 mm CL. The first map shows the location of lobsters less than 25 mm CL (presumably juveniles) against the background of all station occurrences, the second those 25 mm CL or greater (presumably adults), with strong spatial overlap indicated.

Jacquinotia edwardsii (giant spider crab)

Literature review

These spider crabs live in the southeast and south of New Zealand from near Mernoo Gap to Campbell Island, but appear to attain highest densities southeast of the Snares and around the Auckland Islands. Ryff & Voller (1976) recorded them in decreasing quantities at Pukaki Rise, Auckland Islands, Campbell Islands, Bounty Islands, Stewart Island, Stewart Island shelf, Puysegur Bank, and off Otago Heads, an observation consistent with earlier resource surveys (Ritchie 1970, 1973, Webb 1972b). At Auckland Islands they appear most abundant between 20 m and 40 m, but on Pukaki Rise between 140 m and 160 m, although they have been recorded to 550 m (McClay 1988).

Spawning populations

Breeding biology is moderately well known. Sexes are separate but co-occur, with evidence for a terminal, puberty moult. It appears that, at least near shore, large males move into and out of deep water seasonally. Pair formation and swarming takes place in shallow water (less than 10 m) or just out of the water in September–November, when females are in late berry. Egg laying probably takes place in September to February and larval release in September to November. In summer, females and pre-puberty males occur mainly in shallow water while large males are deeper (Chilton 1911, Thomson 1913, Ritchie 1970, 1973, Webb 1972b, Ryff & Voller 1976).

Juvenile habitat

There is less information on the location of juveniles. Juveniles were found commonly at Auckland Islands close inshore, where shoreline rock met the deeper mud and sand flats (Ritchie 1973). Seaweed present here was apparently both food and shelter for the young crabs.

Data summaries

Spawning populations and juvenile habitat
These cannot be distinguished because the trawl and observer crabs were not measured or sexed. Crabs were taken from near Mernoo Gap to the Campbell Plateau, but particularly on outer parts of Snares Shelf, Pukaki Rise, and south Auckland Islands Shelf.

Jasus edwardsii (red rock lobster)

Literature review

Red rock lobsters are found from the Three Kings Islands in the north to Auckland Islands in the south, at Chatham Islands in the east (Kensler 1967), and on surrounding banks. Although they remain near their settlement site for the first year or so, once they reach 3 years of age they can be considered migratory, and long-distance movements have been recorded.

Spawning populations
Breeding biology has been well studied. The sexes are separate but co-occur. Sexual maturity in females is reached at 60–120 mm CL (Annala et al. 1980), 3–10 years after settlement, depending on locality. Males appear to mature at about the same size as females in the same area. Mating takes place in autumn, and eggs hatch in spring into the short-lived naupliosoma stage. The high abundance, small size, and young age at maturity, and the many years (about 10) to reach legal size mean that the spawning potential is much higher along the east coast of the North Island south of East Cape than elsewhere.

Juvenile habitat
Settlement has been well studied, but less is known of the juvenile habitat. *J. edwardsii* settle when shore-moving pueruli cease extensive forward swimming and take up residence on the substrate (Phillips & Booth 1994). Puerulus settlement takes place mainly at depths less than 20 m, but not uniformly over time or between regions (Booth 1994). Most settlement is in winter and highest levels are recorded along the east coast of the North Island south of East Cape. Postlarval recruitment levels can fluctuate widely from year to year. The puerulus moults into the benthic juvenile about 9 days after settlement in summer and 20 days in winter; the rate of progress to the moult depending on temperature (Booth & Stewart 1993).

Most puerulus and first-instar juvenile *J. edwardsii* reported have been on firm substrates in roughly round holes 10–20 mm in diameter and 20–30 mm deep, or in crevices under stones, and where light levels are low (Booth & Forman 1995). New recruits to the seafloor may move soon after settlement to habitats that lead to higher survival. Such post-settlement migration takes place in at least some *J. edwardsii*: pueruli settle, begin to pigment, but may then move to a new site (Hayakawa et al. 1990, Booth & Stewart 1993).

Both pueruli and first-instar juveniles seek shelter over and above conspecifics or other marine life (Booth 2001). They prefer conditioned refuges over those unconditioned, horizontal apertures over vertical ones, and rough surfaces over smooth. Although some structurally complex seaweed and bryozoan species seemingly provide suitable refuge, they are less often used by the young lobsters than are hard-walled shelters. Both pueruli and first-instar juveniles are capable of almost completely burying themselves in sand, but they are intolerant of deep silt.

One year old juveniles are solitary, highly cryptic and seldom encountered, and are most commonly found at depths of 5–15 m (Booth et al. 2001). Two and three year olds, which are now communal, are found in a similar depth range and are associated with reef crevices and caves. There is some evidence for lobsters about 3+ leaving inshore areas and being found with the adult stocks.

Leptomithrax and *Teratomaia* spp.

Literature review

This is a diverse complex of crab species with three, *L. longipes*, *L. garricki*, and *Teratomaia richardsoni*, probably accounting for almost all records referred to *L. australis* (S. O'Shea, NIWA, pers. comm.). These crabs are found from Cook Strait to Stewart Island, at Chatham, Snares, Bounty, Auckland, and Campbell Islands, and on Pukaki Rise, from the intertidal to 100 m (Ryff & Voller 1976, McClay 1988). Moults and several large live specimens have been found at Auckland Island and one live crab at Campbell Island (Ritchie 1970, 1973). Nothing is known of the breeding or juvenile areas.

Data summaries

These show a geographic distribution consistent with the above, with most crabs being taken around Snares Islands and Auckland Island shelves. However, there is a much wider depth distribution, with crabs being taken down to 900 m. Nothing can be said about the spawning or juvenile areas.

Lipkius holthuisi (omega prawn)

Literature review

This prawn occurs in waters 600–1000 m and has been most commonly reported from the Challenger Plateau (Webber et al. 1990). Nothing is known of the breeding or juvenile areas.

Data summaries

This prawn is found mostly off the southeast of the North Island, on Challenger Plateau, near the 1000 m contour of Chatham Rise, and intermittently over Campbell Plateau, at 600–1000 m. There is no information on the juvenile or breeding habitat.

Lithodes spp (stone crabs)

Literature review

Three species are very similar and easily confused: *Lithodes murrayi*, *L. longispinus*, and (possibly) *L. turritus* (Rick Webber, Museum of New Zealand Te Papa Tongarewa, pers. comm.). They live at depths of 120–900 m from the Wairarapa to the Solander Islands and on the west coast of Stewart Island (McClay 1988). Crabs are egg-bearing in summer and autumn. Nothing is known of breeding and juvenile areas in New Zealand.

Data summaries

These show a distribution consistent with the literature review, except that they extend the distributions, north to East Cape (and possibly even further) and south to the southern parts of the Campbell Plateau. There is no information on breeding and juvenile areas.

Macrocystis pyrifera (bladder kelp)

Literature review

This conspicuous brown alga is found attached to rock in most southern harbours that are suitably deep and have a fast tidal flow (Morton & Miller 1968). Perhaps the best patches are at the mouth of Wellington Harbour, the Marlborough Sounds, and the harbours of Otago and Banks Peninsula. It spreads up the east coast to about Castlepoint and Kapiti Island on the west, and also occurs at the Campbell, Aucklands, Bounty, and Antipodes Islands (Morton & Miller 1968, Adams 1994). Its northern distribution is related to the highest summer sea-surface temperatures, the seaweed not persisting in areas where the maximum water temperatures exceed 18–19 °C for several days (Hay 1990).

Reproductive populations and juvenile habitat
The large plants are sporophytes; the gametophyte is microscopic, filamentous, and dioecious. Both occur together on rock surfaces. Although usually growing in extensive, offshore beds, small plants are also found in quite shallow pools and channels (Adams 1994).

Mediaster sladeni (Sladen's star)

Literature review

This is a large, variably shaped, orange asteroid (family Goniasteridae); it is sometimes almost pentagonal when young, but bears long slender arms in adults. It is known from the Chatham Rise and Cook Strait (Fell 1958) and inhabits depths of 200–600 m. It may be confused with the less common *M. arcuatus*.

Data summaries

The databases show only a few records, mostly from Chatham Rise and around Auckland Islands from 300 to 500 m. There is no information on the breeding or juvenile areas.

Metanephrops challengeri (scampi)

Literature review

Scampi are widely distributed around the coast, principally in depths of 200–500 m on the continental slope (Annala et al. 2001). They may spend a considerable portion of their time in their burrows. Their distribution appears to be determined by the occurrence of fine, sticky sediments (Wear 1976). Stocks in QMA 6 appear to be genetically distinct from those in other areas (Smith 1999).

Spawning populations
Breeding biology is quite well known; sexes are separate but co-occur, and all populations studied have contained spawners. Females reach maturity at about 40 mm orbital carapace length (OCL) in Bay of Plenty and on the Chatham Rise, 36 mm OCL off Wairarapa, and 56 mm OCL around Auckland Islands. Scampi spawn mainly in spring and early summer, larval development probably taking about 3 days (Wear 1976).

Juvenile habitat
Very little is known about settlement and the juvenile habitat. Because the larval development period is so short, and currents at the depths of the adult populations usually weak, the adult and juvenile habitat are probably one and the same.

Data summaries

Spawning populations
The databases reveal female spawning scampi (eggs embryonic or ovaries spent) in Bay of Plenty, off Wairarapa, on the western Chatham Rise, and south of Auckland Islands, coinciding with the main scampi fisheries and with the distribution of adult scampi.

Juvenile habitat
Juvenile scampi were found in all places where scampi were measured. On Chatham Rise, juvenile scampi were restricted more to the western end near Mernoo Bank but adults were more widespread over the Rise. This is thought to represent sampling biases rather than actual spatial differentiation of juveniles.

Mytilus galloprovincialis (blue mussel)

Literature review

This mussel lives on firm surfaces, often in dense carpets, from open coasts to upper reaches of inlets where it is limited by the salinity. It is found continuously from the Wellington area south, with a number of more local records further north, at Auckland and Campbell Islands, and at Chatham Islands (Morton & Miller 1968, Hurn 1971, Powell 1979). Densest adult populations are where the shore is isolated from sublittoral or particulate bottom, is free from accumulating silt, has poorly developed fauna except for filamentous algae on which young mussels settle, and often where there is turbulent water.

At Wellington, it is common to abundant in the sheltered and semi-exposed waters of the harbour, continues its distribution into the exposed waters of the eastern side of the harbour, but on the western side the distribution ends just inside the semi-exposed waters. It is not found even in sheltered areas on the open coast on the western side.

Spawning populations
Breeding patterns are well known. Sexes are separate but co-occur. Blue mussels spawn much of the year, but mostly in spring (Ralph & Hurley 1952, Booth 1977, Kennedy 1977, Meredith-Young & Jenkins 1978, 1980, Jenkins 1979).

Juvenile habitat
There is a larval period of several weeks. Settlement has not been as well studied as in *Perna*, but it seems to be similar in that spat require irregular substrate on which to settle – and this is often provided by filamentous algae. It is likely that there may be post-settlement movement to adult beds, as in *Perna*.

Nectocarcinus antarcticus and *N. bennetti*

Literature review

These two crabs are easily confused. *N. antarcticus* is found from the far north of New Zealand to Stewart Island, at Chatham, Bounty, Auckland, and possibly Campbell Islands, and on Pukaki Rise (Ryff & Voller 1976, McClay 1988). Large numbers occur at Auckland Islands, especially in deeper offshore waters where there are few spider crabs (Ritchie 1973, Ryff & Voller 1976). They live on sand, gravel, mud, and shell bottoms, down to 550 m. *N. bennetti* is found in southern South Island and the same offshore islands as *N. antarcticus*, but is rarely taken in the same samples.

Spawning populations
Sexes are separate but co-occur. *N. antarcticus* reaches maturity at about 9 mm carapace width (CW) north of Cook Strait, much smaller than further south; *N. bennetti* mature at 12–20 mm CW (Main 1974). *N. antarcticus* is egg-bearing at any time except winter; *N. bennetti* have been found egg-bearing only in May (McClay 1988).

Juvenile habitat
A pelagic stage means that larvae can disperse large distances, but there is no evidence for settlement areas being removed from breeding areas. Laboratory observations suggest that settlers may take refuge under items such as shell fragments and do not burrow into the sand (McClay 1988).

Data summaries

These show a southern occurrence for the species, but there is no information on spawning populations or the juvenile habitat. The crabs taken well inshore in South Canterbury Bight are a reliable record.

Neolithodes brodiei

Literature review

This stone crab has been reported off the Wairarapa coast, south of Solander Island, and on Campbell Plateau, at 800–1100 m on fine grey mud (McClay 1988).

Spawning populations
Sexes are separate but co-occur. Eggs are large and fecundity is probably low (McClay 1988).

Juvenile habitat
The large egg size suggests abbreviated larval development (McClay 1988), so the adult grounds are also likely to be the juvenile areas.

Data summaries

These greatly extend the distribution of this crab, north to East Cape, east along Chatham Rise, and south to the Campbell Plateau. Highest catches have been off the southeast coast of North Island, along the edges of Chatham Rise and southern part of Challenger Plateau, and sporadically over the edges of Campbell Plateau.

There is no information in this on the occurrence of juveniles or breeders.

Ovalipes catharus (paddle crab)

Literature review

Paddle crabs are found off sandy beaches and in harbours and estuaries throughout mainland New Zealand and at the Chatham Islands (McClay 1988, Stevens 1999 and references therein). Their distribution is probably limited by the availability of substrates suitable for burying. They are abundant from the intertidal to 10 m, but have also been taken much deeper. Abundance seems to have increased significantly since the 1970s, possibly the result of a decline in abundance of predators. Tagging has shown that paddle crabs are highly migratory, with movements being related to breeding and moulting.

Spawning populations
Breeding biology is moderately well known and all populations studied have contained spawners. Sexes are separate but co-occur, although sex ratios are highly variable between and within populations. Size at maturity varies geographically, those from Tasman Bay maturing smaller (50 mm CW) than in Pegasus Bay (65 mm CW) (Armstrong 1988, Stevens 1999). Males and females aggregate and mate in sheltered inshore waters during winter, and it is thought that the females then migrate offshore to deeper waters, generally during September to March. Spawning can be synchronous.

Juvenile habitat
Very little is known about settlement or the juvenile habitat. After a larval period of about 2 months, thought to be in deeper, offshore waters, megalopa migrate inshore to settle during January to May, presumably on fine substrates in which they can take refuge.

Data summaries

The databases show paddle crabs were caught in trawls in shallow waters (less than 100 m) mainly on the central east coast of South Island, in Tasman and Golden Bays at the top of South Island, around Chatham Islands, and in Bay of Plenty. Occasional captures have been recorded on all coasts of mainland New Zealand.

Few paddle crabs were measured, all in Bay of Plenty, but both adults and juveniles were always present.

Paphies australis (pipi)

Literature review

Pipi are a bivalve found throughout North, South, Stewart, Chatham, and Auckland Islands (Powell 1979). They are restricted to channels and sandbanks at the mouths of harbours and on wide harbour sand flats, occurring in the top few centimetres of coarse sediments (Paul 1966, Akroyd & Kilner 1980, Hooker 1997). They are abundant both intertidally and in shallow subtidal areas (Hooker & Creese 1995b). Salinity is probably the key factor to inward extension into harbours (Grace 1966). However, they may particularly flourish where freshwater seeps through the middle beach (Morton & Miller 1968).

The pipi (formerly known as *Amphidesma australe*) community in Whangateau Harbour was characterised by Grace (1972) as being low intertidal and shallow subtidal, of clean medium to fine sand usually with high surface shell content, with moderate to high current velocities but very little wave action, and having salinities reduced after heavy rain. Largest adults were found closest to the harbour entrance.

Spawning populations
Spawning biology is well known and all populations studied have contained spawners. Sexes are separate but co-occur. Sexual maturity is usually assessed as a function of shell length, but it may be a function of age, length, or a combination of age and length (Hooker & Creese 1995b). It is likely, however, that length can be used safely as a convenient indicator of sexual maturity (Eversole 1989). Pipi mature at about 40 mm shell length and spawn mainly in spring to summer, with synchrony in timing at least over hundreds of metres (Booth 1983, Hooker & Creese 1995b).

Juvenile habitat
The settlement and juvenile habitats are not well known because most studies have looked only at the larger juveniles and adults. Pediveligers settle at about 270 μm SL in sand (Grace 1972, Hooker 1997). Beyond 2–3 mm, pipi may produce a single byssal thread to help anchor them to shell fragments and sand grains in unstable sandy or shelly substrates. In such a situation at the entrance to Whangateau Harbour, byssal threads were common in 3–15 mm shells, but in more stable areas, juveniles do not produce a byssal thread. The juvenile (3–15 mm pipi) habitat in Whangateau Harbour is characterised by being lower intertidal and shallow subtidal, having clean coarse to medium sand with high surface shell content, high to very high current velocities, but usually little wave action, and salinities that reduce after heavy rain (Grace 1972). This specialised community of juvenile pipi probably exists in similar areas in most sandy harbours and estuaries where adult pipi are abundant, with large numbers of juveniles likely to occur just seaward of the dense adult beds. These and other observations suggest that the larvae settle closer to the harbour entrance than the location of the adult beds, and later move into the harbour to restock those beds.

Juveniles (less than 15 mm shell length) (and adults) can drift mid-water, buoyed by the secretion of long mucus threads which extend out of the siphons, probably as a way of leaving areas of very high density (Grace 1972, Hooker 1995). They can even attach themselves by shutting their valves onto debris such as branches and being moved along with the branch in the tidal current.

At Howick, pipi high on the beach were mainly juveniles, suggesting that movement down the beach may take place in or after the first year (Wood in Morton & Miller 1968).

Paphies donacina (southern tuatua)

Literature review

Paphies donacina occurs around the South Island, the north coast of Stewart Island, and around the lower part of North Island. Both the northern and the southern tuatua live on Wellington west coast beaches, with the former in shallower waters (less than 1 m chart datum). Local populations of southern tuatua are resurgent and often very large; Dawson (1954) recorded over 400 million *P. donacina* in the littoral area of a 13 km section of beach in Pegasus Bay.

Southern tuatua are optimally distributed from low tide level to about 3 m (Cranfield et al. 1994, Haddon et al. 1996). Present populations of adults in southern Pegasus Bay are restricted to low tide and below, but during the 1950s they were entirely intertidal (Dawson 1954), the changes probably brought about by cyclic changes in beach morphology (Marsden 2000). There has been little evidence for long-shore migration of adults (Dawson 1954).

For surf clams, physical rather than biological factors are often the main factors controlling distribution, with wave height and particle size being most important, although adults are found from fine sand to stony beaches in Pegasus Bay (Marsden 2000). There is considerable variation by site in shell size, which may be indexed to variability in recruitment. The seaward extent of distribution may be influenced by the presence of silt offshore and the landward distribution by the ability of the shellfish to resist fluctuations in temperatures high on the beach (Marsden 2000).

Spawning populations
Breeding biology is well known. Sexes are separate but co-occur. Southern tuatua appear to mature at about 35 mm SL (Dawson 1954, Marsden 2000), at about 3 years of age in Pegasus Bay (Dawson 1954). Spawning takes place over summer (Dawson 1954, Marsden 1999), but there is considerable interannual variation with less than 50% of the population being reproductive during the 1994–95 season, this probably being temperature linked. The reproductive strategy is exploitive, closely determined by the environmental seawater temperature.

Juvenile habitat
Little is known about settlement or the juvenile habitat. Recently settled juveniles were reasonably evenly distributed along the southern Pegasus Bay shore, while larger (greater than 2 cm SL) individuals were highly aggregated (Marsden 2000). Small juveniles were often in highest density near high water mark – which may be the level at which metamorphosing larvae first settle, with evidence for considerable temporal and spatial variability in success of spatfall (and subsequent juvenile survival). Further north, juveniles have been observed both intertidally and in the shallow subtidal. It appears that recruits mainly settle and grow in waters shallower than 1 m chart datum.

Paphies subtriangulata (northern tuatua)

Literature review

Northern tuatua are the most inshore of New Zealand's surf clam species (Hooker & Creese 1995b) occurring in depths of up to 4 m (Cranfield et al. 1994). They are found mainly around the North Island and along the north coast of the South Island, avoiding silty areas. On practically all exposed sandy beaches off northern New Zealand, tuatua are common from below mid tide to a few metres depth, but usually with a very patchy distribution. They may be present on the same beaches as toheroa, but the two species seldom co-occur (Morton & Miller 1968).

P. subtriangulata appears to consist of three (possibly four) geographical groups: north, central, Stewart Island, and Chatham Islands from genetic data at four polymorphic loci (Smith et al. 1989). The reduced genetic pool in the Chatham Islands group may mean that this isolated population is more vulnerable to exploitation (Smith et al. 1989).

In Whangateau Harbour, tuatua are in the lowest intertidal and shallow subtidal areas, in areas of fine sand, very low surface shell content, usually very well sorted unstable sediment, low current velocities, usually considerable wave action, and high salinities (Grace 1972). Like the toheroa, this shellfish may be transported along beaches by water movements (Morton & Miller 1968).

Spawning populations
Breeding biology is well known. Sexes are separate but co-occur. Northern tuatua spawn in spring to autumn (Greenway 1981, Grant 1994, Hooker & Creese 1995b) or late summer and autumn (Grant & Creese 1995). Grant (1994) was able to link the observed spawning at Whangateau Harbour mouth with small-scale temperature fluctuations produced from the effect of the warm spring sunny days and the relatively low water temperature. Tuatua are also known to spawn with sharp changes in water temperature (Redfearn 1987).

Juvenile habitat
Settlement and juvenile ecology are not well known. The pediveligers settle from 230 το 260 μm (Redfearn 1987). Juveniles mainly occur towards the high tide mark and migrate to lower levels only

when they reach about 25 mm (Haddon et al. 1996). Tuatua 3–6 mm may also have byssal threads to attach to the substrate (Rapson 1952, Grace 1972). The juvenile habitat, like that of the toheroa, may be adversely affected by vehicles on beaches, the 'puddling effect' (Stace 1991), floating tuatua out of the sand, and the crushing of juveniles.

Paphies ventricosa (toheroa)

Literature review

Toheroa are endemic to mainland New Zealand and are found predominantly on Ninety Mile, Dargaville, and Muriwai Beaches in Northland, some Wellington west coast beaches, and Oreti and Te Waewae Beaches in Southland (Millar & Olsen 1995, Morrison & Parkinson 2001). They live primarily between mean high and mean low water levels on exposed fine sand beaches. The Northland populations tend to be aggregated into distinct beds (Greenway 1969), whereas the Southland populations are dispersed over much of the available beach (Street 1971). The habitat favoured is a gently sloping beach fully exposed to heavy surf, with fine sand and sufficient residual moisture to prevent desiccation at low tide (Cassie 1955). Historically, adult beds ranged from discrete populations 55–110 m long, separated by kilometres of empty beach (Muriwai), through to continuous beds stretching for kilometres (Dargaville) (Greenway 1969a). Size trends along beaches have sometimes been noted (increasing size going north), suggesting movement along the beach.

Recruitment is widely fluctuating and irregular (Redfearn 1974) with a general decline in stocks being the dominant trend in abundance. However, the population size of toheroa over 14 mm SL on Ninety Mile Beach in 2000 was the highest ever recorded for this beach (Morrison & Parkinson 2001).

Toheroa change levels on the beach using wave movement, and sometimes, usually at night, whole beds of the shellfish emerge in advance of a wave to be carried up the beach. Anecdotal observations suggest that passive migration of thousands of animals along the beach can occur over short time scales (Redfearn 1974). Movements up and down the shore may also occur, with beds moving 30 m or more during a night. Also, toheroa are capable of moving using their own resources, with their shell upright and half embedded in the sand (Morton & Miller 1968). Greenway (1969a) found most tag recoveries close to release points, but some individuals were recovered several miles away.

The hypothesis that there were significant subtidal populations (Cassie 1955 and others later) has not been upheld (see Redfearn 1974).

Spawning populations

Breeding biology is well known. Sexes are separate but co-occur. Populations of toheroa contain mature individuals throughout the year, but most spawning is associated with rising sea temperatures in late spring to summer (Rapson 1952, Redfearn 1974). All toheroa over 42 mm SL are mature, but some mature as small as 13 mm SL and 75% at 32 mm SL (Rapson 1952, Redfearn 1974, Hooker & Creese 1995b). Toheroa spawn with sharp changes in water temperature (Redfearn 1982).

Rapson's (1952) contention that toheroa do not survive unless there is ample seepage water, to prevent the sand becoming too hard, has received little supporting evidence (Cassie 1955, Stace 1991). In fact, they generally avoid regions near river mouths and streams (Cassie 1955).

Juvenile habitat

Settlement and juvenile ecology are not well known. Natural settlement, and settlement in the laboratory, takes place at about 270 µm (Redfearn 1982). On first settling in the wild, toheroa are distributed randomly over the littoral zone (Brunton 1978). For some weeks after metamorphosis the juveniles are continually settled, washed out, and redeposited by succeeding waves. This process gradually moves the juveniles up the shore until they form a band just below the level of the high water mark where they bury to a depth of 1–2 cm. Settlement at any level on the beach is thought to be completely random and depend on the fetch of the particular wave that carries the spat ashore (Redfearn 1974). As they grow they gradually move down the shore to near mid-tide level, where they are able to maintain their position despite the increased pounding by the surf by burrowing deeper. Highest densities were recorded in the small bays formed along the beach, which were also where the adult beds were (Rapson 1954, Redfearn 1974). Rip currents adjacent to these bays may aggregate larvae in a manner analogous to floating debris (Redfearn 1974).

Small toheroa are at risk of crushing by vehicular traffic (Stace 1991). Hooker & Redfearn (NIWA, unpublished data) found mortalities (crushed shells) of up to 14% in small toheroa (6–23 mm SL, mean 10–12 mm SL) following heavy vehicle use of the beach for a large recreational fishing contest. As well as crushing juveniles with the sheer weight of the vehicle, car tracks disturb toheroa buried deeper in the sand (Stace 1991). As a vehicle passes overhead the sand is slightly liquefied and the shellfish tend to rise towards the surface. By drawing toheroa toward the surface, vehicles may be increasing the animal's vulnerability to overheating and to starvation, while at the same time making it more difficult for them to burrow away from danger (Stace 1991). Vehicle pressure also causes the toheroa to eject a jet or water from the mantle cavity, and this may have an effect on resistance to desiccation.

Paramaretia peloria (heart urchin)

Literature review

This is a large, greyish-fawn species known mainly from southern regions, 300–700 m deep on the Chatham Rise (Fell 1958) and shallower (to 130 m) off Otago and the Stewart-Snares shelf (McKnight 1969). Most were recorded from sandy gravel substrate.

Paramaretia tuberculata is very similar but has fewer spines, is widespread but less common, and is also found further north, from the Three Kings Ridge to the Stewart-Snares Shelf in 30–500 m (Baker & Rowe 1990).

Data summaries

The databases show that most records are from the Chatham Rise, especially around Mernoo Bank and east of 180°, in 300–600 m. There is no information on the breeding and juvenile areas.

Pasiphaea spp.

Literature review

These prawns (probably several species) have been trawled at depths of 800–1200 m, but they probably also live at more shallow depths (Webber et al. 1990). They have been most commonly taken on the Chatham Rise and Challenger Plateau. There is no information on the juvenile or spawning habitat.

Data summaries

These are consistent with the above except no *Pasiphaea* spp. have been reported from the Challenger Plateau. They provide no information on the juvenile or spawning habitat.

Pecten novaezelandiae (common scallop)

Literature review

This scallop is distributed throughout the North, South, Stewart, and Chatham Islands (Powell 1979), in a variety of habitats from shallow semi-estuarine inlets to oceanic conditions at depths to about 90 m (Bull 1976). The southern beds are mainly in 10–25 m on soft mud, and North Island ones are mainly on hard sands at 15–30 m. At the Chathams (and in Spirits Bay), the scallops are deep (40–80 m) and large (Annala & Sullivan 1997). Scallops can relocate by swimming (Cryer 1994) and beds can be mobile and somewhat migratory, but there is no evidence for this taking place on a large scale over any great distances.

Spawning populations
Breeding biology is well known, sexes are separate but co-occur, and all populations studied have contained spawners. Juveniles become mature at about the end of their first year, at about 60 mm SL, and then breed for one or two years before reaching takeable size (Cryer 1994, Annala & Sullivan 1997).

Juvenile habitat
Settlement and the juvenile habitat have been moderately well studied. Settlement, at least of those scallops that survive to larger sizes, takes place within the area of the adults. The larva attaches via a byssus thread to filamentous material or dead shells on or close to the seabed (Annala & Sullivan 1997). After reaching about 5 mm, the byssus is detached and scallop takes up the adult mode of life. Dredging has significantly altered the nature of the seabed in some places (Tunbridge 1968), this disturbance being thought to have contributed to declines in suitable settlement areas, in natural settlement rates, and in spat survival.

Perna canaliculus (green-lipped mussel)

Literature review

Green-lipped mussels are widely distributed throughout much of New Zealand, but are most common in central and northern parts where they frequently form dense beds; they are absent from the Chathams and other offshore islands (Morton & Miller 1968, Powell 1979). They are found from the midlittoral to depths of over 50 m. The physiological inability of small mussels to survive aerial exposure restricts the occurrence of these mussels on the upper shore, whereas the lower limits are thought to be regulated by predation (Jeffs et al. 1999 and references therein). They tend to be lower on the shore than *Mytilus* (Kennedy 1976), being less resilient to high temperatures and to desiccation. They are found on firm surfaces (preferably conditioned; Luckens (1976)) in a wide variety of habitats and are tolerant of a wide range of salinities and temperatures.

There appear to be major genetic differences between mussel populations, particularly between northern and southern stocks (Smith 1988).

Spawning populations
Breeding biology is well known. Sexes are separate but co-occur. In the Firth of Thames, *Perna* were reported to mature after 70 mm SL (Greenway 1969b), but most probably mature at much smaller sizes. Gonadal development takes place at temperatures above 11 °C and is also related to food availability. Most spawning is in spring to autumn, but larvae can be present at all times of the year (many references, summarised by Jeffs et al. (1999)). Fertilisation is dependent on the proximity of adults and the duration of the pelagic period.

Juvenile habitat

Settlement processes in farms are well understood, but less is known of natural settlement. Pediveligers ready to settle are 220–350 μm in length, after a 3–4 week larval phase. The larvae swim only vertically but they can be transported large distances (Hayden 1994). Settlement is most intense from late winter to early summer, but is highly variable spatially and temporally. In nature, the larvae settle over a wide range of depths, preferring fine filamentous substrata, including hydroids, bryozoans, and filamentous and turfing algae – probably more related to the general morphology than the chemical composition (Hickman 1976, 1979, Luckens 1976, Hayden 1994, Buchanan & Babcock 1997). Settlement is completed with the attachment of an excreted byssus thread and subsequent metamorphosis. Primary settlement on to beds of adult mussels is uncommon (Buchanan & Babcock 1997), but can take place on surrounding algae and on the byssi of adults (Morton & Miller 1968); secondary settlement involving a form of byssopelagic migration or mucus drifting is thought to be the means by which most juveniles recruit into mussel beds. The spat detaches from the substrate by severing the byssus threads and the secreted mucus strand then enables them to swim or drift to new areas for attachment. Juvenile mussels may move numerous times like this before recruiting into the adult mussel beds. This drifting ability is lost once spat reach about 6 mm length.

Plutonaster spp. (abyssal star)

Literature review

Most of these will be *Plutonaster knoxi* but there are also another four to six less common species. *Plutonaster* spp. are generally abyssal, occurring mostly in 600–2000 m (Fell 1958). Little is known of the reproductive biology of *Plutonaster* in New Zealand, but the northern hemisphere *P. bifrons* has small eggs, high fecundity, and spawns during summer. They have indirect planktotrophic development, with food for the developing larvae coming from the transfer of seasonal surface production (Tyler & Pain 1982).

Data summaries

The databases show that most records are from Chatham Rise, east of 180°, in 400–700 m. One record is from the east Rise, near Mernoo Bank.

Porphyra columbina (karengo)

Literature review

Karengo is a widespread red seaweed important as food in several rohe. It is found on upper intertidal rock in moderately sheltered to open sites all around New Zealand except for the Bounty and Kermadec Islands (Adams 1994). Very little is known of its biology and life history: it appears that there are several species in *P. columbina*, and some may be epiphytic.

Reproductive populations and juvenile habitat

It appears that most, if not all, populations are reproductive. Reproduction is by gametangia shed into the water. The alternate asexual generation is a shell-boring filament, the conchocelis stage, about which little is known (Adams 1994).

Pseudechinus spp.

Literature review

This urchin genus includes *Pseudechinus huttoni*, known from Three Kings Ridge to Campbell Plateau, but most common around Otago, Southland, Stewart Island, and Fiordland in depths of 10–550 m (McKnight 1969); *P. novaezelandiae* and *P. albocinctus*, which overlap this range; *P. flemingi*, found in 60–700 m on the Chatham Rise and off the southeast coasts of North and South Islands (Fell 1958, McKnight 1967, 1969); *P. variegatus* in the northern North Island, but rare (McKnight 1969); and *Pseudechinus* sp., known rarely from Three Kings Ridge (McKnight 1969).

There are few studies on reproduction in these species. Like most other echinoids they are broadcast spawners, and hybridisation may occur between the sympatric *Pseudechinus huttoni, P. novaezelandiae, and P. albocinctus* (McClary & Barker 1998). Like most echinoderms, *Pseudechinus* are slow moving, and breeding and juvenile areas are likely to those where captures have been made.

Data summaries

The databases show that most trawl records are from the southwest Chatham Rise, with the occasional record from the north Chatham Rise, Pegasus Bay, and Campbell and Bounty Plateaux. Most records are from 800 to 1100 m, except for the Pegasus Bay records which were taken in less than 50 m. Locations with multiple captures imply high urchin density and therefore a greater likelihood that breeding is occurring there.

Pterocladia spp.

Literature review

Pterocladia lucida and *P. capillacea* are widespread agar red seaweeds, being found from the Kermadec Islands south to Kaikoura on the east coast and Fiordland on the west; they are known also from the Chatham Islands (Adams 1994). *P. lucida* lives below low tide on exposed shores while *P. capillacea* is often in more moderate shelter where it lives intertidally and in the upper subtidal, usually shaded in pools and channels where water remains at low tide (Morton & Miller 1968, Adams 1994). These species appear to be much less tolerant of silt than *Gracilaria. P. lucida* in particular is the basis of a small handgathering industry in North Island, mainly along the coasts of Wairarapa, Hawke Bay, and Poverty Bay.

Reproductive populations and juvenile habitat
Fertile sexual and asexual plants are common throughout the plants' ranges (Adams 1994).

Saccostrea commercialis glomerata (rock oyster)

Literature review

The native rock oyster lives intertidally in northern harbours, commonly south to Kawhia Harbour on the west coast and East Cape on the east (Curtin 1971, Powell 1979), but even to Cook Strait (Morton & Miller 1968). The densest natural populations have been recorded from Kaipara Harbour, Bay of Islands, and Hauraki Gulf (Curtin 1971). The adult does best in areas free from shade (Morton & Miller 1968).

Spawning populations
Breeding biology is moderately well known, sexes are separate but co-occur, and all populations studied have contained spawners. It seems that oysters mature within a year of settlement, at a size less than about 20 mm SL.

Juvenile habitat
Settlement has been well studied, taking place on hard surfaces, including among adults. The larvae settle in the intertidal region through a 1 m vertical range about mean low water level. Clean cultch surfaces have higher settlement (Luckens 1976, Dinamani & Lenz 1977), and better growth and survival of spat, than fouled ones. Spat settle more heavily on lower surfaces of collectors than the upper surfaces. Mahurangi Estuary was the only area in which commercial-scale spatfall has been consistently recorded (Dinamani & Lenz 1977), usually between January and April with one or two peak settlements around February. There is evidence for later season settlers settling higher in the intertidal than those settling earlier in the season, and for larvae avoiding settling on lower surfaces already heavily populated with their own species. Spat which settle later in the season generally have a poorer survival rate (Dinamani & Lenz 1977).

Sagmariasus verreauxi (packhorse rock lobster)

Literature review

Sagmariasus verreauxi (formerly *Jasus verreauxi*) are widespread (Booth 1986), but are most abundant in waters off the north and northeast of North Island.

Spawning populations
Breeding biology is quite well known. Sexes are separate but co-occur. Size at onset of breeding of females is at least 160 mm CL (Booth 1986). The only known large population of breeding females is west of North Cape, near Cape Reinga (Booth 1984). Breeding females occur in much smaller numbers to the south, seldom south of Whangarei Heads on the east coast, but occasionally to Foveaux Strait on the west coast. Mature females breed once a year, egg-hatching taking place over summer.

Juvenile habitat
Settlement areas and juvenile habitat are poorly known for New Zealand packhorse, but in New South Wales they settle onto shallow rocky reefs between August and January (Montgomery 1999). Here they spend about three years, becoming increasingly more social, and then at about 80 mm CL they move to deeper reefs, over 20 m. In New Zealand, all of the few packhorse phyllosomas and pueruli collected have been taken off the east coast of North Island. This is where the only accumulations of older juveniles are found, as far south as about Mahia Peninsula (Booth 1986). Almost all juveniles, as they approach sexual maturity, migrate to the main spawning area off Cape Reinga.

Sergestidae (*Sergestes* spp. and *Sergia* spp.)

Literature review

These easily confused prawns live from the surface to 2000 m (Webber et al. 1990). They have been most commonly taken between East Cape and Foveaux Strait. There is no information on their breeding or juvenile habitats.

Data summaries

These records are consistent with the above, but contain no information on the breeding or juvenile habitats.

Stichopus mollis (common sea cucumber)

Literature review

This is our largest and most familiar intertidal and subtidal sea cucumber, reaches about 25 cm in length. It is found under low tidal stones, on the sandy bottoms of coralline pools, and in dredgings of shell gravels (Morton & Miller 1968, Sewell 1990). It is found in shallow waters from the far north to the Snares Islands (Sewell 1992), and can be considered sedentary.

Spawning populations

Breeding biology is moderately well known and the sexes are separate but co-occur. They are adult from about 13 cm length (Sewell 1992) and all populations studied have contained spawners. Spawning is during summer, but there is latitudinal and year-to-year variation in the timing and extent of the season, linked to sea temperature (Sewell 1992).

Juvenile habitat

Young (2–5 cm) have been rarely reported, being found most commonly under boulders in the shallow subtidal zone (5–8 m) (Sewell 1990).

Tiostrea chilensis (dredge oyster)

Literature review

This species is found throughout almost the whole country, including the Chatham Islands, but is most abundant in southern parts, particularly Foveaux Strait and in Tasman and Golden Bays (Cranfield 1979, Jeffs & Creese 1996). Dredge oysters occur from the intertidal to depths of at least 150 m (Jeffs & Creese (1996) and many references therein), and in a variety of habitats from attached to rock to free on the bottom. They are most common in shallow water on substrata of muddy sand or mud in coastal inlets throughout New Zealand (Cranfield 1979) and on coarse substratum in Foveaux Strait and in other places. They tolerate a wide range of salinities and temperatures.

In Foveaux Strait, commercial densities of oysters are found only on bryozoan-dominated patch reefs, where mortality is probably lower, recruitment higher, and growth faster than on other substrates. The patch reefs of Foveaux Strait are formed by the bryozoan *Cinctipora elegans* cemented by encrusting bryozoa, ascidians, sponges, and polychaetes (Cranfield et al. 1999). The molluscan fauna is dominated by the oyster and bysally attached bivalves. Dredging for oysters progressively modified reefs until oysters were the only epifauna remaining. Oyster density has not rebuilt on oyster beds abandoned by fishers. With accelerated modification of oyster habitat, disease mortality has become more important.

Spawning populations

Breeding biology is well known and all populations studied have contained spawners. But the breeding characters (percentages fertilised, size of broods, size at release, size at settlement) vary greatly at both the individual and population level (Jeffs et al. 1997). Water temperature is very important in regulating the annual cycle of reproduction (Jeffs et al. 1996).

The dredge oyster is a protandrous hermaphrodite, maturing first as a male then as a female that matures in second or third year (mainly 42–50 mm shell diameter: Cranfield & Allen 1977, Cranfield 1979, Westerskov 1980). A viable regenerating population therefore requires the presence of both large and small oysters. In Foveaux Strait, only a small proportion of the adults spawn as females each summer, whereas many more will develop male gonads (Cranfield & Allen 1977, Cranfield 1979, Westerskov 1980, Jeffs & Creese 1996 and other references therein).

Juvenile habitat

This is well known. Settlement, at least of those oysters that survive to larger sizes, takes place within the area of the adults. Settlement is mainly December to February in Foveaux Strait (Cranfield 1968a, 1968b, Stead 1971, Cranfield & Allen 1977, Annala & Sullivan 2000) but in the north, there can be brooding all year round but usually with less in winter, and increased larval production around spring and early summer (Hollis 1963, Luckens 1976, Jeffs et al. 1996). Larvae are incubated and generally released as pediveligers (416–514 μm) ready to settle. Most larvae settle immediately upon release and seldom disperse more than a few centimetres from the parent oyster (Cranfield 1979, Annala & Sullivan 2000), but a low percentage of larvae are released at smaller sizes and spend some time in the plankton. Larvae settle most densely only a few centimetres above the bottom, and infrequently cemented to plates 30 cm above the substratum (Cranfield 1979).

Larvae settle primarily on live oysters and oyster shell (Annala & Sullivan 2000). Although settlement predominates on under surfaces of oysters and shell – an adaptation that may prevent larvae from settling on surfaces that might be smothered by silt and other fine particles – most surviving spat are attached to the left (curved and generally uppermost) valve of living oysters (Cranfield 1979, Annala & Sullivan 2000). Luckens (1976) reported greatest settling density near Auckland under rocks in pools and on clean surfaces.

Each localised oyster population is, therefore, largely self-recruiting. However, fishing of dense patches in the past may have reduced oyster density so low that the patches have never recovered.

Vitjazmaia latidactyla (deepsea spider crab)

Literature review

This crab has been recorded from Wanganella Bank, east and west of North Island, Challenger Plateau, Chatham Rise, and Chatham Islands, at depths of 500–1300 m (Webber & Richer de Forges 1995). There is no information on its breeding or juvenile habitat.

Data summaries

The records are generally consistent with the above, except for the few shown from Solander Trough and Campbell Plateau. The records add nothing to knowledge of the breeding or juvenile habitat.

Volutidae

Literature review

This gastropod family mostly includes species of the genus *Alcithoe*. Shallower (under 150 m) species include *A. arabica* and *A. fusus*, and deeper species (greater than 150 m) include *A. larochei, A. fissurata, A. benthicola, A. calva, A. ostenfeldi,* and *A. lutea*, all most frequently found north of the Chatham Rise, and *A. flemingi* and *A. smithi* on the Chatham Rise and Campbell Plateau (S. O'Shea, NIWA, pers. comm.). A further species (*Zygomelon zodion*) has recently been described from the Bounty Plateau in 734–1386 m (Harasewych & Marshall 1995).

Data summaries

The databases show most of the trawl records are from around the Auckland Islands, with one or two from the Chatham Rise, but they are likely to be much more widespread. There is no information on the breeding and juvenile areas.

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Table 1: **Deepwater and pelagic fish species (ordered by common names) for which there are over 200 observations. *Res*, Ministry of Fisheries research trawl database; *Obs*, Ministry of Fisheries scientific observer database.**

Common name	Scientific name	Juvenile distributions		Spawning distributions	
		Res	*Obs*	*Res*	*Obs*
Deepwater					
Alfonsino	*Beryx splendens*	+	+	+	+
Baxter's dogfish	*Etmopterus baxteri*	+			
Black cardinalfish	*Epigonus telescopus*	+	+	+	+
Black oreo	*Allocyttus niger*	+	+	+	+
Bluenose	*Hyperoglyphe antarctica*	+	+	+	+
Dark ghost shark	*Hydrolagus novaezealandiae*	+	+		
Frostfish	*Lepidopus caudatus*	+	+	+	+
Hake	*Merluccius australis*	+	+	+	+
Hoki	*Macruronus novaezelandiae*	+	+	+	+
Ling	*Genypterus blacodes*	+	+	+	+
Longnose velvet dogfish	*Centroscymnus crepidater*	+			
Lookdown dory	*Cyttus traversi*	+	+	+	
Mirror dory	*Zenopsis nebulosus*	+			
Northern s. dogfish	*Squalus mitsukurii*	+	+		
Orange perch	*Lepidoperca aurantia*	+			
Orange roughy	*Hoplostethus atlanticus*	+	+	+	+
Owston's dogfish	*Centroscymnus owstoni*	+			
Pale ghost shark	*Hydrolagus* sp. B2	+	+		
Ray's bream	*Brama brama*	+	+	+	+
Redbait	*Emmelichthys nitidus*	+		+	
Ribaldo	*Mora moro*	+	+	+	+
Rough skate	*Dipturus nasutus*	+		+	
Rubyfish	*Plagiogeneion rubiginosum*	+	+	+	+
Shovelnose dogfish	*Deania calcea*	+			
Silver warehou	*Seriolella punctata*	+	+	+	+
Silverside	*Argentina elongata*	+			
Smooth oreo	*Pseudocyttus maculatus*	+	+	+	+
Smooth skate	*Dipturus innominatus*	+	+	+	
Spiky oreo	*Neocytttus rhomboidalis*	+	+	+	+
Southern blue whiting	*Micromesistius australis*	+	+	+	+
White rattail	*Trachyrinchus longirostris*	+			
White warehou	*Seriolella caerulea*	+	+	+	+
Pelagic					
Anchovy	*Engraulis australis*	+			
Moonfish	*Lampris guttatus*		+		
Pilchard	*Sardinops neopilchardus*	+			
Sprats	*Sprattus antipodum & S. muelleri*	+			

***Table 2*: Lengths (cm) used to separate age classes (by season) and maturity stages of deepwater and pelagic fish, based on database extracts and published age and length at maturity and growth data. Seasonal divisions (up to four periods) were made for species that are fast growing or have multiple or extended spawning seasons (i.e., where 1 period is indicated this represents a 12 month season; 2 periods represent 6 month seasons; 4 periods represent 3 month seasons). Divisions start at the assumed birthday which is the first day of the month indicated. Where growth is very slow or unknown, age groups have not been determined. Length measurement methods are: F, fork; G, snout tip to posterior end of dorsal fin; M, mantle; P, pelvic; S, standard; T, total. The length at maturity is the length at which 50% of fish are mature (averaged across sexes where appropriate), or an approximation of this, as indicated. M, male; F, female; SOP, Scientific Observer Programme; –, not determined. Table based on Hurst et al. (2000) with additional species added.**

Species	Length method	Length at maturity	Birth	Age/group	Maximum length by season 1	2	3	4	Length at maturity source	Growth/age data source
Allocyttus niger	T	34	–	–					Annala et al. 1998	Smaller fish may represent many age classes
Argentina elongata	F	19	–	–					Arbitrary based on length frequency modes in research data[1]	Insufficient data
Beryx splendens	F	34	Aug	1	23				Annala et al. 1998: age 4–5 years	Massey & Horn 1990
				2	26					
Brama brama	F	43	Jan	i	35	41			Estimated from SOP data	Arbitrary, based on length frequency modes
				ii	42	45				
Centroscymnus crepidater	T	M: 62 F: 81	–						King & Clark 1987	Insufficient data
Centroscymnus owstoni	T	M: 71 F: 98	–						King & Clark 1987	Insufficient data
Cyttus traversi	T	33	Oct	i	13	13			Clark & King 1989: 30–35 cm	Arbitrary, based on length frequency modes
				ii	18	20				
Deania calcea	T	M: 78 F: 100	–	i	40				Clark & King 1989	Arbitrary, based on length frequency modes
				ii	70					
Dipturus innominatus	P	M: 93 F: 112	–	–					Francis et al. 2001	Insufficient data
Dipturus nasutus	P	M: 52 F: 59	–	–					Francis et al. 2001	Insufficient data
Emmelichthys nitidus	F	26	–	–					Arbitrary based on length frequency modes in research data[1]	Insufficient data
Engraulis australis	F	8	–	–					Estimated from research data	Insufficient data
Epigonus telescopus	F	46	–	–					Field et al. 1997	Smaller fish may represent many age classes

Table 2 — continued

Species	Length method	Length at maturity	Birth	Age/ group	Maximum length by season				Length at maturity source	Growth/age data source
					1	2	3	4		
Etmopterus baxteri	T	M: 56 F: 64	–						King & Clark 1987	Insufficient data
Genypterus blacodes	T	68	Oct	0	26	28			Annala et al. 1998: 30% at age 6, 75% at age 7	Horn 1993b
				1	38	40				
Hoplostethus atlanticus	S	30	–	–					Horn et al. 1998	Smaller fish may represent many age classes
Hydrolagus novaezealandiae	G	M: 52	–	i	30				Horn 1997a	Arbitrary, groups may represent several year classes
		F: 61		ii	40					
Hydrolagus sp. B2	G	M: 59	–	i	35				Horn 1997a	Arbitrary, groups may represent several year classes
		F: 69		ii	45					
Hyperoglyphe antarctica	F	62	Feb	2	46	51			Annala et al. 1998	Horn 1988b (recruit to the bottom at 47 cm, age 2)
				3	56	59				
Lampris guttatus	F	68	–	–					Arbitrary based on length frequency modes in SOP data	Insufficient data
Lepidoperca aurantia	F	21	–	–					Arbitrary based on length frequency modes in research data	Insufficient data
Lepidopus caudatus	F	80	Mar	i	50	60			Estimated from research data	Arbitrary, based on length frequency modes
				ii	80	93				
Macruronus novaezelandiae	T	66	Aug	0	27	31			Annala et al. 1998	Horn & Sullivan 1996
				1	45	55				
Merluccius australis	T	76	Oct	0	22	25	18	25	Annala et al. 1998	Horn 1997b
				1	40	45	45	44		
Micromesistius australis	F	38	Aug	0	19	24			Annala et al. 1998	Hanchet & Uozumi 1996
				1	26	30				
Mora moro	T	45	Aug	i	23	28	25	27	Research and SOP data	Arbitrary, based on length frequency modes
				ii	31	35	31	34		
Neocyttus rhomboidalis	T	30	–	–					Research and SOP data	Smaller fish may represent many age classes
Plagiogeneion rubiginosum	F	33	–	–					Arbitrary based on length frequency modes in research data	Insufficient data
Pseudocyttus maculatus	T	40	–	–					Annala et al. 1998	Smaller fish may represent many age classes

Table 2 — continued

Species	Length Method	Length at maturity	Birth	Age/ group	Maximum length by season				Length at maturity source	Growth/age data source
					1	2	3	4		
Sardinops neopilchardus	F	12	–	–					Baker 1972	Insufficient data
Seriolella caerulea	F	40	Aug	1	23	29			Gavrilov 1979	Gavrilov 1979
				2	33	38				
Seriolella punctata	F	47	Oct	0	20	24	25	28	Horn & Sutton 1996	Horn & Sutton 1996
				1	30	33	35	36		
Squalus mitsukurii	T	68	–	–					Arbitrary based on length frequency modes in research data	Insufficient data
Sprattus antipodum & S. muelleri	F	7	–	–					Estimated from research data	Insufficient data
Trachyrinchus longirostris	T	40	–	–					Arbitrary based on length frequency modes in research data	Insufficient data
Zenopsis nebulosus	T	35	Jan	i	33	35	40	40	Arbitrary based on length frequency modes in research data	Arbitrary, based on length frequency modes

[1] Length frequency data uncertain because of different codend mesh sizes (see Table 3), which may not equally select juvenile and adults.

Table 3: **Research trawl survey vessels, gear, and years used to determine the abundance of juveniles. Years represent the start and end of the time series and are not necessarily annual. NI, North Island; SI, South Island. *San Waitaki (a)* and *(b)* are different vessels.**

Area	Depth range (m)	Vessel	Gear type	Codend (mm)	Survey years
Tangaroa middle depth					
Southland	30–600	*Tangaroa*	Hoki	60	1993–96
Chatham Rise	200–800	*Tangaroa*	Hoki	60	1991–2001
Sub-Antarctic	300–1000	*Tangaroa*	Hoki	60	1992–2000
West coast SI	300–800	*Tangaroa*	Hoki	60	1999–2000
Tangaroa deepwater					
West coast SI	850–1250	*Tangaroa*	6-panel	100	1991
Chatham Rise	450–1700	*Tangaroa*	6-panel	100	1991–99
East coast NI & SI	600–1500	*Tangaroa*	6-panel	100	1992–94
Sub-Antarctic	600–1400	*Tangaroa*	6-panel	100	1992–94
East coast NI	700–1350	*Tangaroa*	6-panel	100	1993
East Cape	600–1350	*Tangaroa*	6-panel	100	1995–97
Other deepwater					
NE Chatham Rise	700–1250	*Otago Buccaneer*	Alfredo	100	1984–87
Kaikoura, Wairarapa & Richie	700–1250	*Otago Galliard*	Alfredo	100	1986
NE Chatham Rise	750–1250	*Cordella*	6-panel	100	1988–90
Kaikoura, Wairarapa & Richie	400–1500	*Cordella*	6-panel	100	1990
Kaikoura, Wairarapa & Richie	600–1500	*Will Watch*	6-panel	100	1989
Challenger	600–1300	*Will Watch*	6-panel	100	1990
Northern NI	400–1200	*Wanaka*	4-panel	100	1985–86
Challenger	750–1200	*Arrow*	6-panel	100	1983–86
West coast SI	700–1250	*Arrow*	6-panel	100	1986
Chatham Rise	600–1200	*Arrow*	6-panel	100	1986
Kaikoura, Wairarapa & Richie	700–1300	*Arrow*	6-panel	100	1987
Challenger	750–1200	*Amaltal Explorer*	6-panel	100	1987–88
Chatham Rise	200–1200	*Amaltal Explorer*	6-panel	100	1987–89
Sub-Antarctic & Bounty	200–1000	*Amaltal Explorer*	6-panel	100	1989–90
NW Chatham Rise & Graveyard	700–1300	*Amaltal Explorer*	6-panel	100	1999
Southland & Sub-Antarctic hills	700–1200	*Giljanes*	6-panel	100	1992
Southland & Sub-Antarctic hills	700–1200	*San Waitaki (a)*	6-panel	100	1993
Chatham Rise	700–1150	*San Waitaki (a)*	6-panel	100	1995
Chatham Rise	650–1150	*San Waitaki (b)*	6-panel	100	2000
Bay of Plenty	750–1000	*Seamount Enterprise*	6-panel	100	1995–2000
Kaharoa inshore					
NI: west coast	10–200	*Kaharoa*	Snapper	40	1986–99
NI: Hauraki Gulf	10–150	*Kaharoa*	Snapper	40	1984–97
NI: Bay of Plenty	10–250	*Kaharoa*	Snapper	40	1983–99
NI: southeast coast	20–400	*Kaharoa*	East NI	80	1993–96
SI: west coast	20–400	*Kaharoa*	SI	74	1992–2000
SI: Tasman & Golden Bays	20–70	*Kaharoa*	SI	74	1992–2000
SI: east coast	30–400	*Kaharoa*	SI	74	1991–96
SI: east coast	10–400	*Kaharoa*	SI	28	1996–99

***Table 4*: Method for converting various female stages scales used by NIWA to the 5-stage scale used by scientific observers. Skate stages were research only and not converted.**

Scientific observers:

1	Immature/resting	
2	Maturing (vitellogenic)	
3	Ripe (hydrated eggs)	
4	Running ripe	
5	Spent	
Auckland:		Observer equivalent
1	Immature	1
2	Resting (regressed)	1
3	Maturing (vitellogenic)	2
4	Ripe (hydrated eggs)	3
5	Running ripe	4
6	Spent	5
Middle Depth:		
1	Immature	1
2	Resting (regressed)	1
3	Maturing (vitellogenic)	2
4	Ripe (hydrated eggs)	3
5	Running ripe	4
6	Partially spent (batches)	3
7	Spent	5
Deepwater:		
1	Immature/resting	1
2	Early maturation	2
3	Mature	2
4	Ripe (hydrated eggs)	3
5	Running ripe	4
6	Spent	5
7	Atretic	5
8	Partially spent	3
Southern blue whiting:		
1	Immature	1
2	Resting (regressed)	1
3	Maturing (vitellogenic)	2
4	Ripe (hydrated eggs)	3
5	Running ripe	4
6	Partially spent (batches)	3
7	Spent	5
8	Reverted	3
Skate:		
1	Immature	
2	Mature, ovarian eggs present	
3	Mature, ovulated eggs or egg cases present	

Table 5: **Invertebrate and seaweed species covered in the report, ordered by scientific names. *Res*, research trawl database; *Obs*, scientific observer database.**

Common name	Scientific name	Data sources		
		Res.	*Obs.*	Other
Invertebrates				
	Acanthephyra spp.	+		
Royal red prawn	*Aristaeomorpha foliacea*	+	+	
	Aristaeopsis edwardsiana and *Aristeus* sp.	+	+	
Horse mussel	*Atrina pectinata zelandica*			+
Cockle	*Austrovenus stutchburyi*			+
Sabre prawn	*Campylonotus rathbunae*	+	+	
Southern queen scallop	*Chlamys delicatula*	+	+	
Cidarid sea urchins	Cidaridae	+		
Pacific oyster	*Crassostrea gigas*			+
Tam-o-shanter urchins	Echinothuriidae	+		
Kina	*Evechinus chloroticus*			+
	Fusitriton magellanicus	+		
	Gracilechinus multidentatus	+		
Paua	*Haliotis iris*			+
Jack-knife prawn	*Haliporoides sibogae*	+	+	
Sea cucumbers	Holothuriidae	+	+	
Prawn killer	*Ibacus alticrenatus*	+	+	
Giant spider crab	*Jacquinotia edwardsii*	+	+	
Red rock lobster	*Jasus edwardsii*			+
Giant masking crab	*Leptomithrax australis*	+	+	
Omega prawn	*Lipkius holthuisi*	+	+	
Stone crabs	*Lithodes* spp.	+	+	
Sladen's star	*Mediaster sladeni*	+	+	
Scampi	*Metanephrops challengeri*	+	+	
Blue mussel	*Mytilus galloprovincialis*			+
	Nectocarcinus antarcticus & *N. bennetti*	+	+	
Stone crab	*Neolithodes brodiei*	+	+	
Paddle crab	*Ovalipes catharus*	+	+	
Pipi	*Paphies australis*			+
Southern tuatua	*Paphies donacina*			+
Northern tuatua	*Paphies subtriangulata*			+
Toheroa	*Paphies ventricosa*			+
Heart urchin	*Paramaretia peloria*	+		
	Pasiphaea spp.	+		
Scallop	*Pecten novaezelandiae*			+
Green-lipped mussel	*Perna canaliculus*			+
Abyssal stars	*Plutonaster* spp.	+		
	Pseudechinus spp.	+	+	
Rock oyster	*Saccostrea commercialis glomerata*			+
Packhorse rock lobster	*Sagmariasus verreauxi*			+
	Sergestidae	+	+	
Sea cucumber	*Stichopus mollis*			+
Dredge oyster	*Tiostrea chilensis*			+
Deepsea spider crab	*Vitjazmaia latidactyla*	+	+	
Volutes	Volutidae	+	+	
Seaweeds				
Bull kelp	*Durvillea antarctica*			+
	Gracilaria spp.			+
Bladder kelp	*Macrocystis pyrifera*			+
Karengo	*Porphyra columbina*			+
	Pterocladia spp.			+

Table 6: **Lengths (mm) used to separate maturity stages of invertebrates. Length measurement methods are: B, carapace length (orbit to carapace notch); W, carapace width; C, carapace length. MNZ, Museum of New Zealand Te Papa Tongarewa.**

Species	Area	Length method	Length at maturity	Length at maturity source
Ibacus alticrenatus	All	C	25	MNZ collections
Metanephrops challengeri	BoP, Chatham Rise	B	40	Annala et al. (2001)
	Wairarapa	B	36	Annala et al. (2001)
	Auckland Islands	B	56	Annala et al. (2001)
Ovalipes catharus	North of 42° S	W	50	Stevens (1999)
	[1]South of 42° S	W	65	Stevens (1999)

[1] No *Ovalipes catharus* were measured south of 42° S.

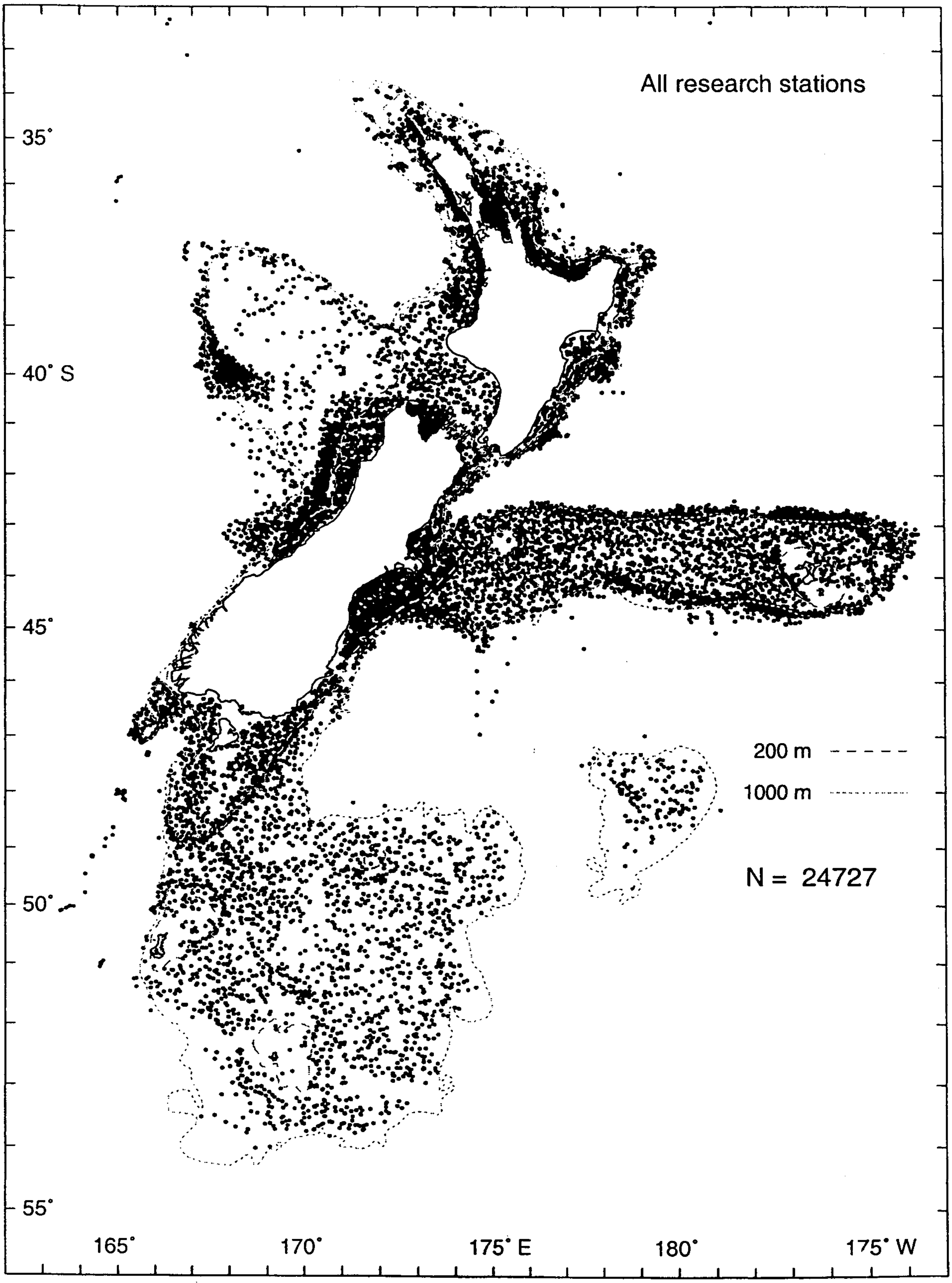


Figure 1: **Positions of all research trawl stations in the *trawl* database, including both midwater and bottom trawls, but excluding foul shots. These data, along with the scientific observer (*obs_lfs*) data, form the base sample-set from which all juvenile and spawning distributions were extracted. The distribution of scientific observer tows (N = 44 440) is not plotted, but the overall distribution of commercial tows was similar to that of research tows.**

1.1 Deepwater fish juvenile distributions

Key to symbols and shading in the distribution plots

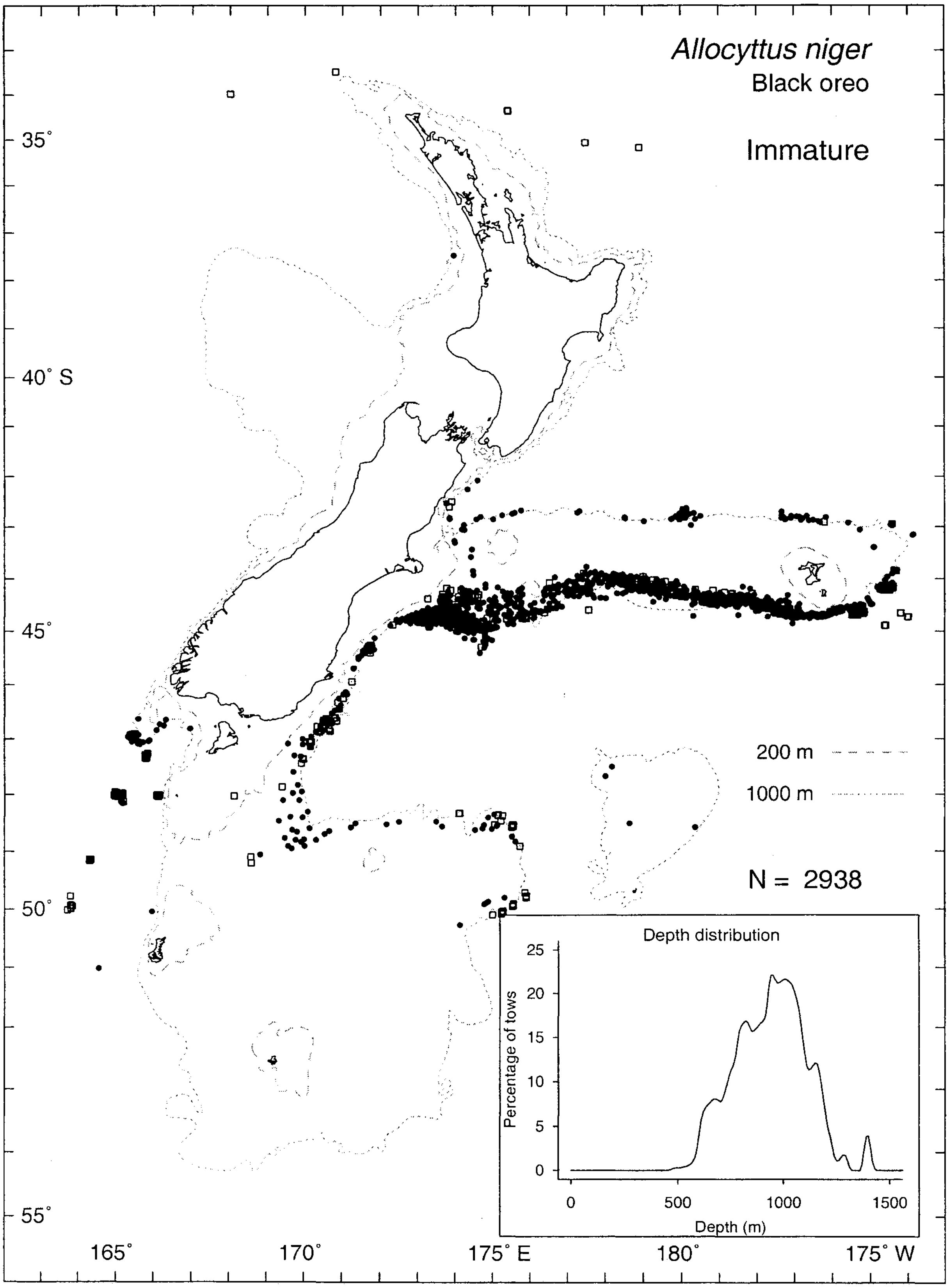
Symbols indicate positions where life history stage occurred.

N, number of stations

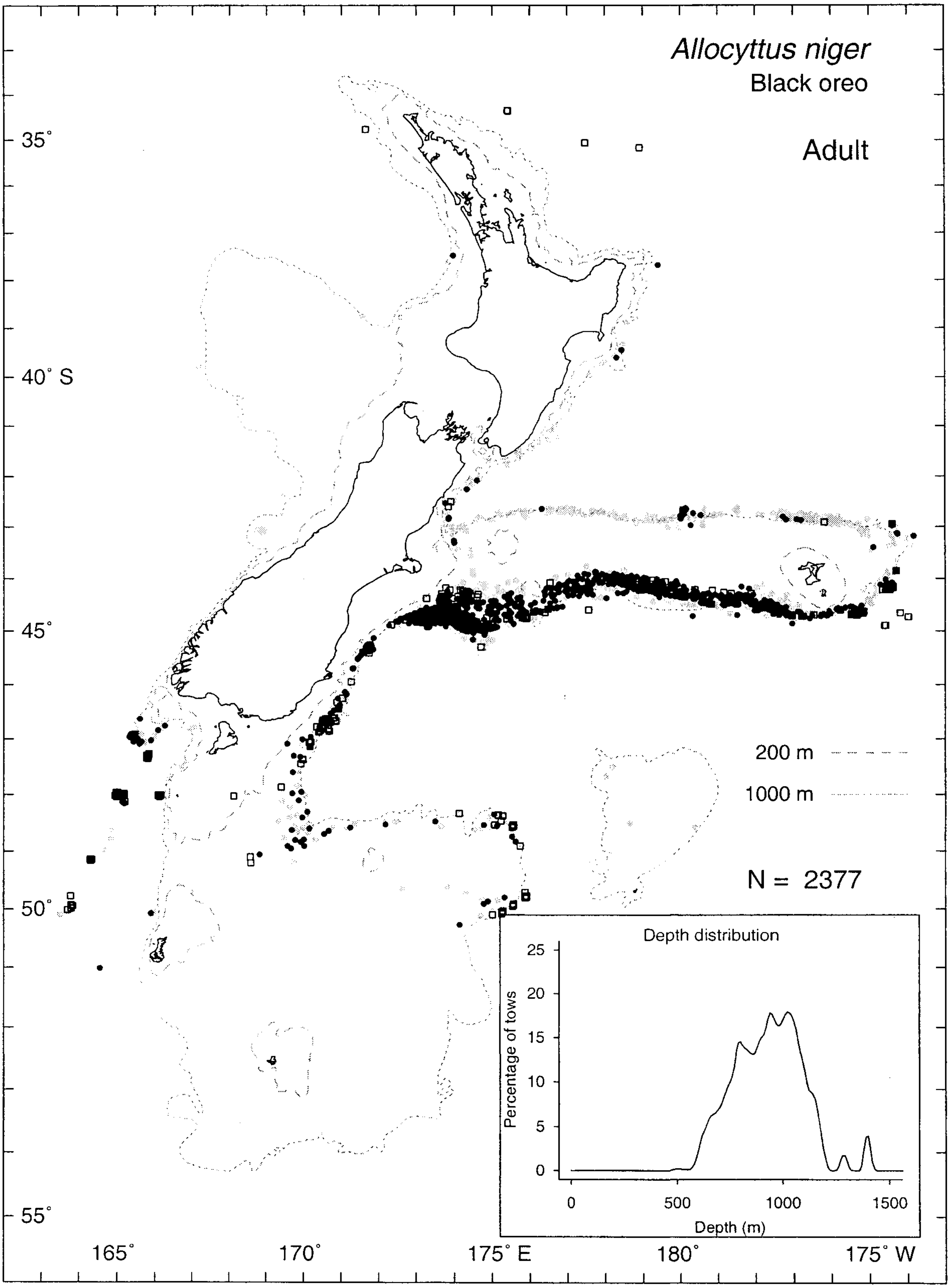
Solid circles, research bottom trawls

Open squares, scientific observer bottom trawls

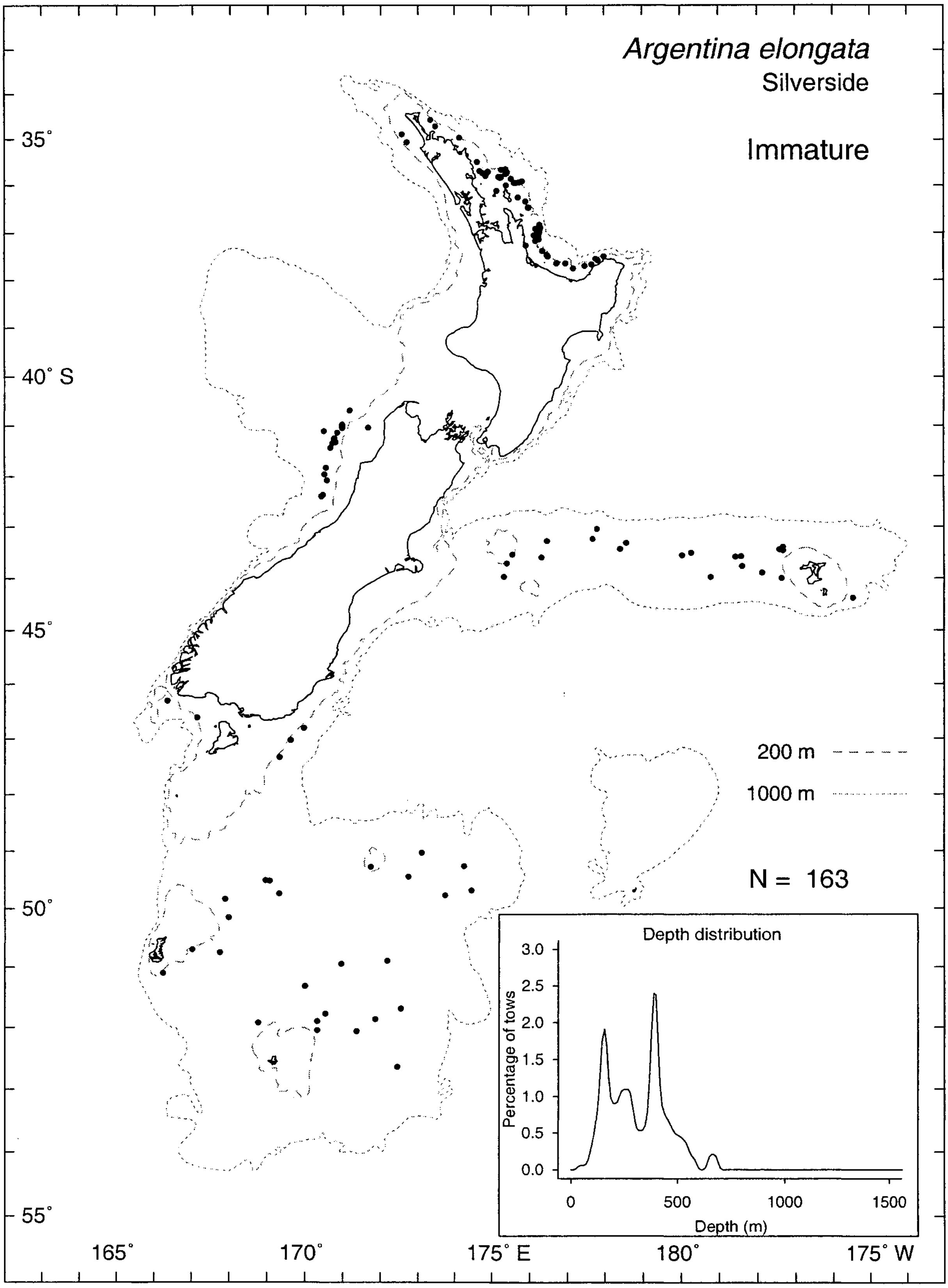
Grey shading in adult plots shows all positions where the species has been recorded in research or commercial bottom trawls.



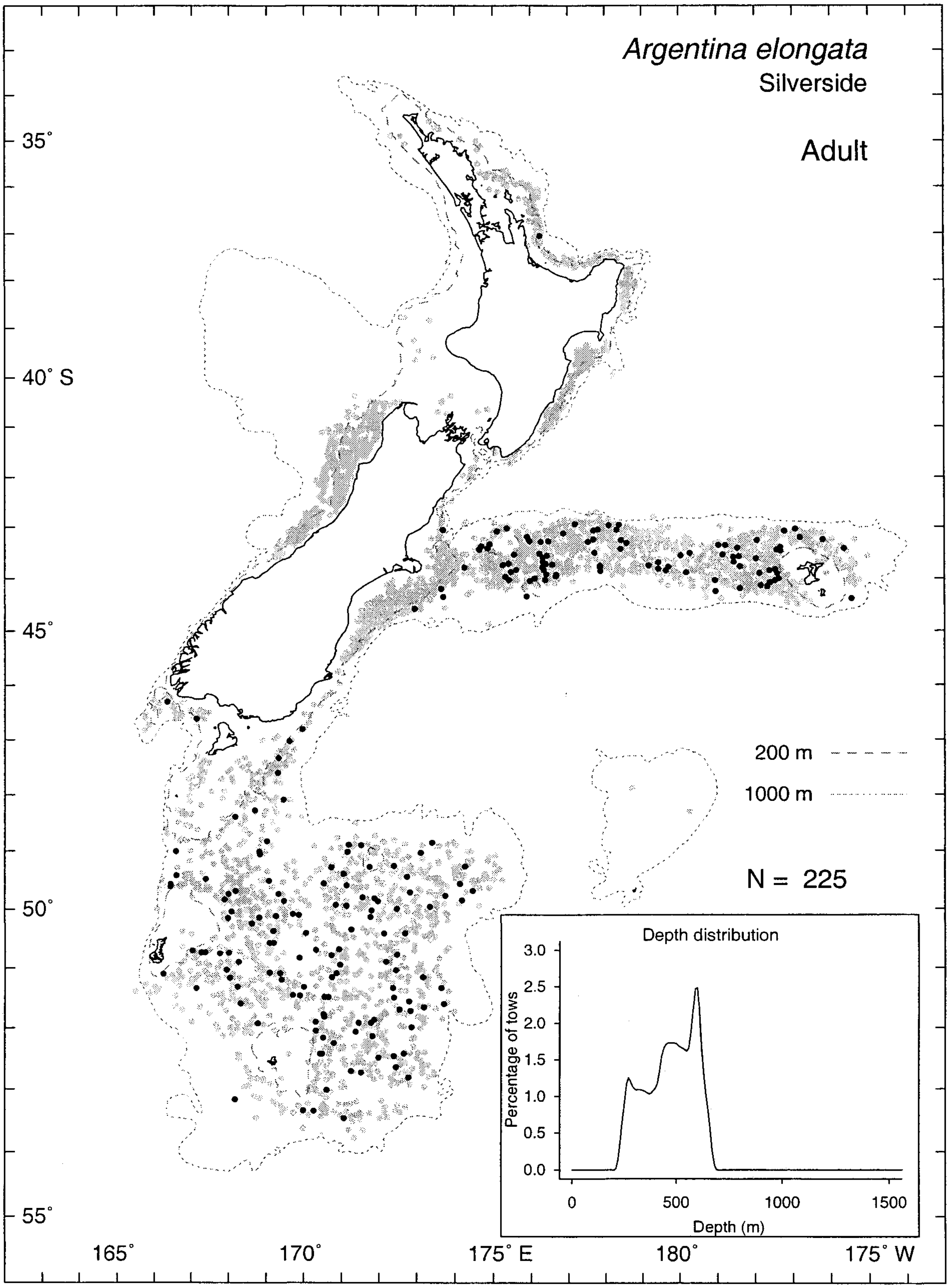
Allocyttus niger
Black oreo
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 2938
Depth distribution
Percentage of tows
Depth (m)
0
5
10
15
20
25
500
1000
1500



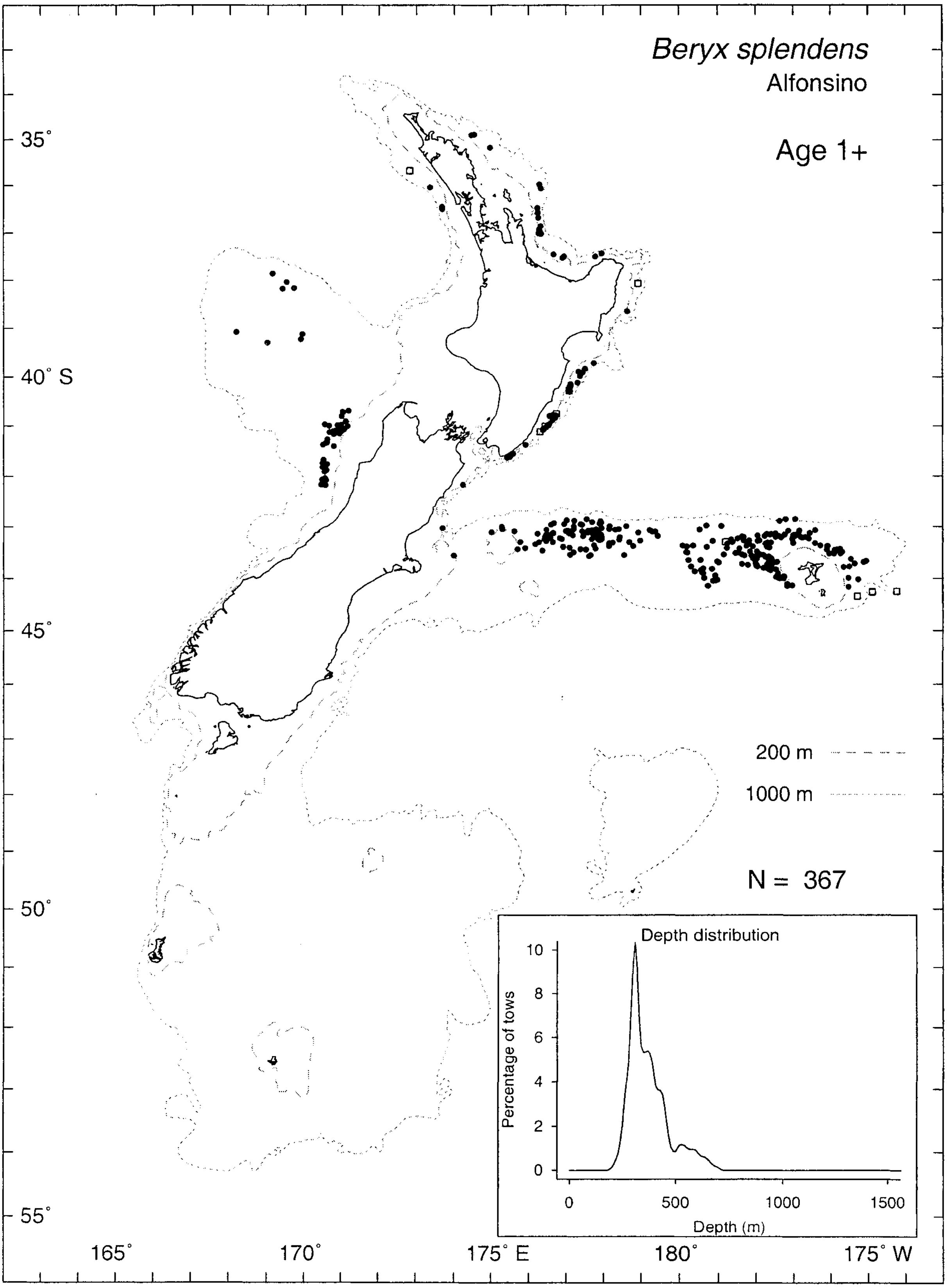
Allocyttus niger
Black oreo
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 2377
Depth distribution
Percentage of tows
Depth (m)
0
5
10
15
20
25
0
500
1000
1500



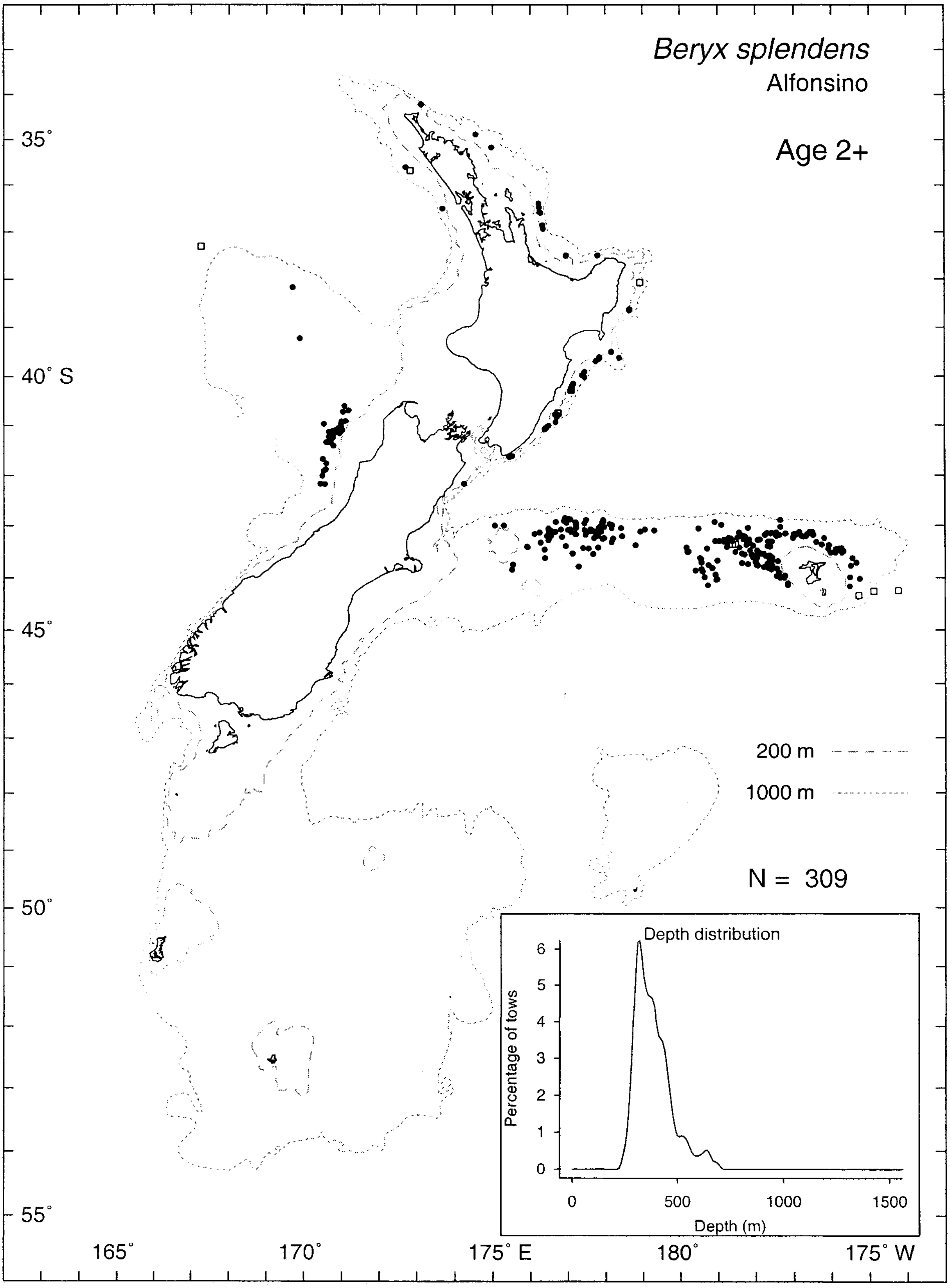
Argentina elongata
Silverside
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 163
Depth distribution
Percentage of tows
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Depth (m)

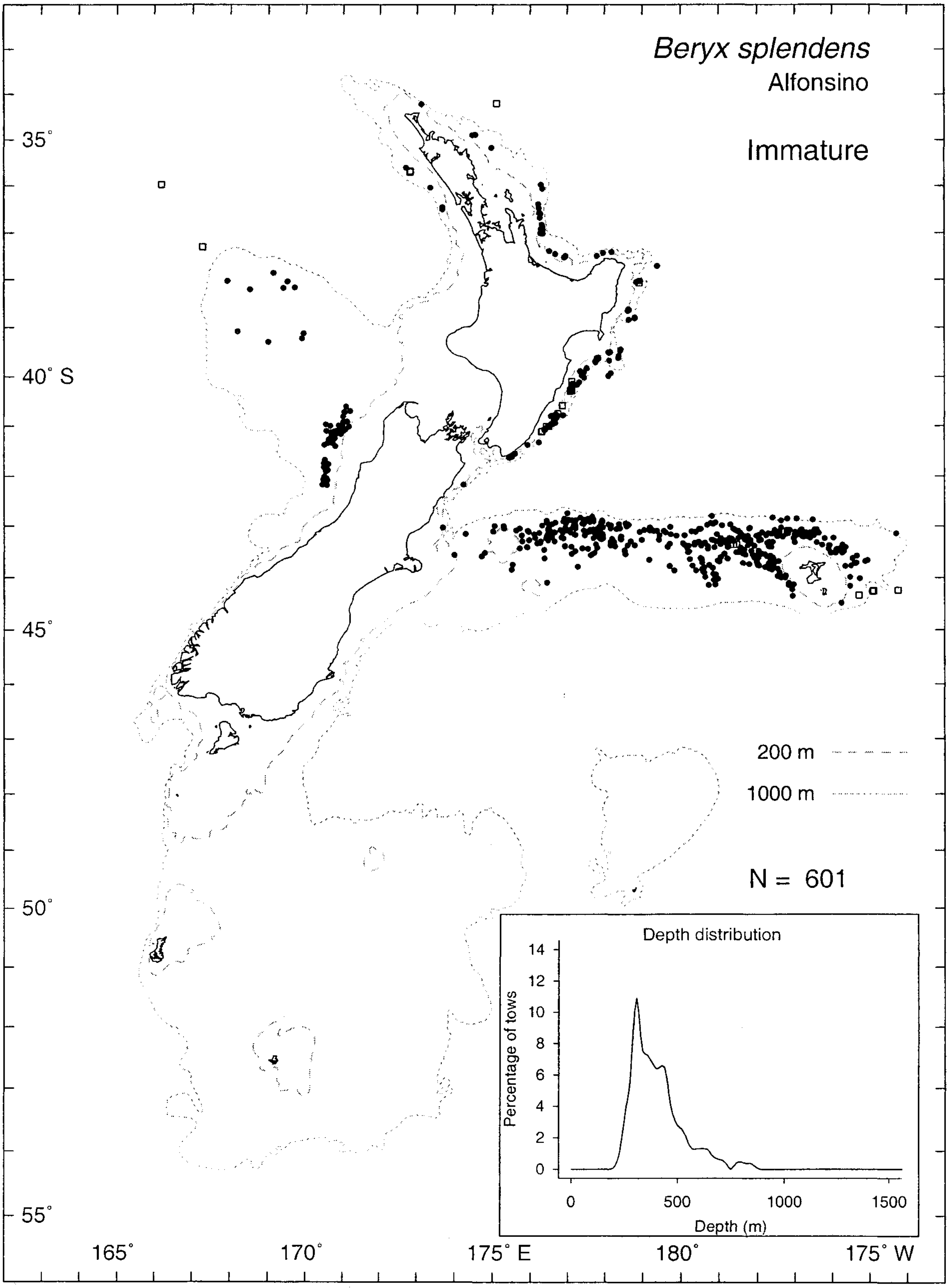


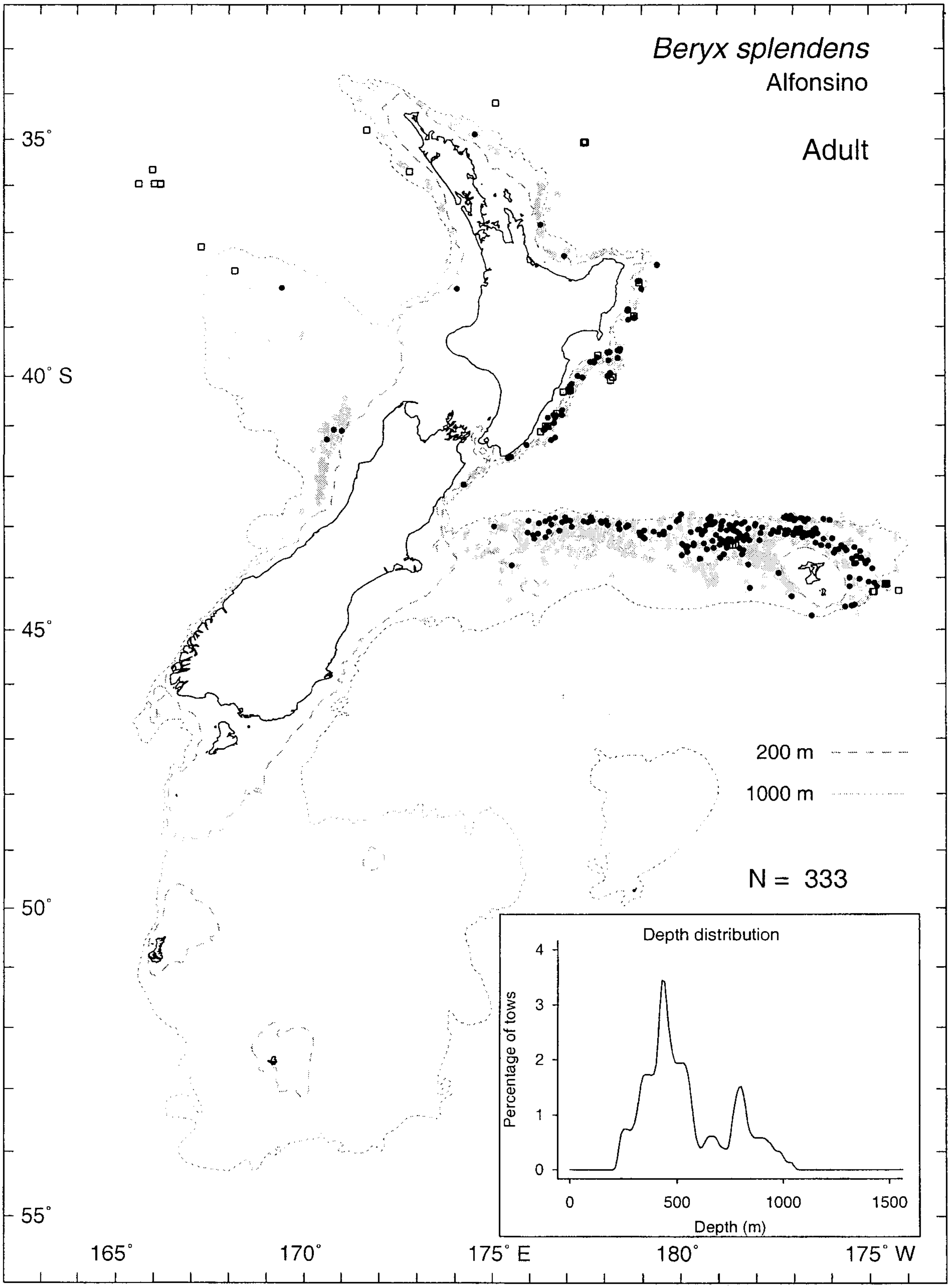
Argentina elongata
Silverside
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 225
Depth distribution
Percentage of tows
Depth (m)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
0
500
1000
1500



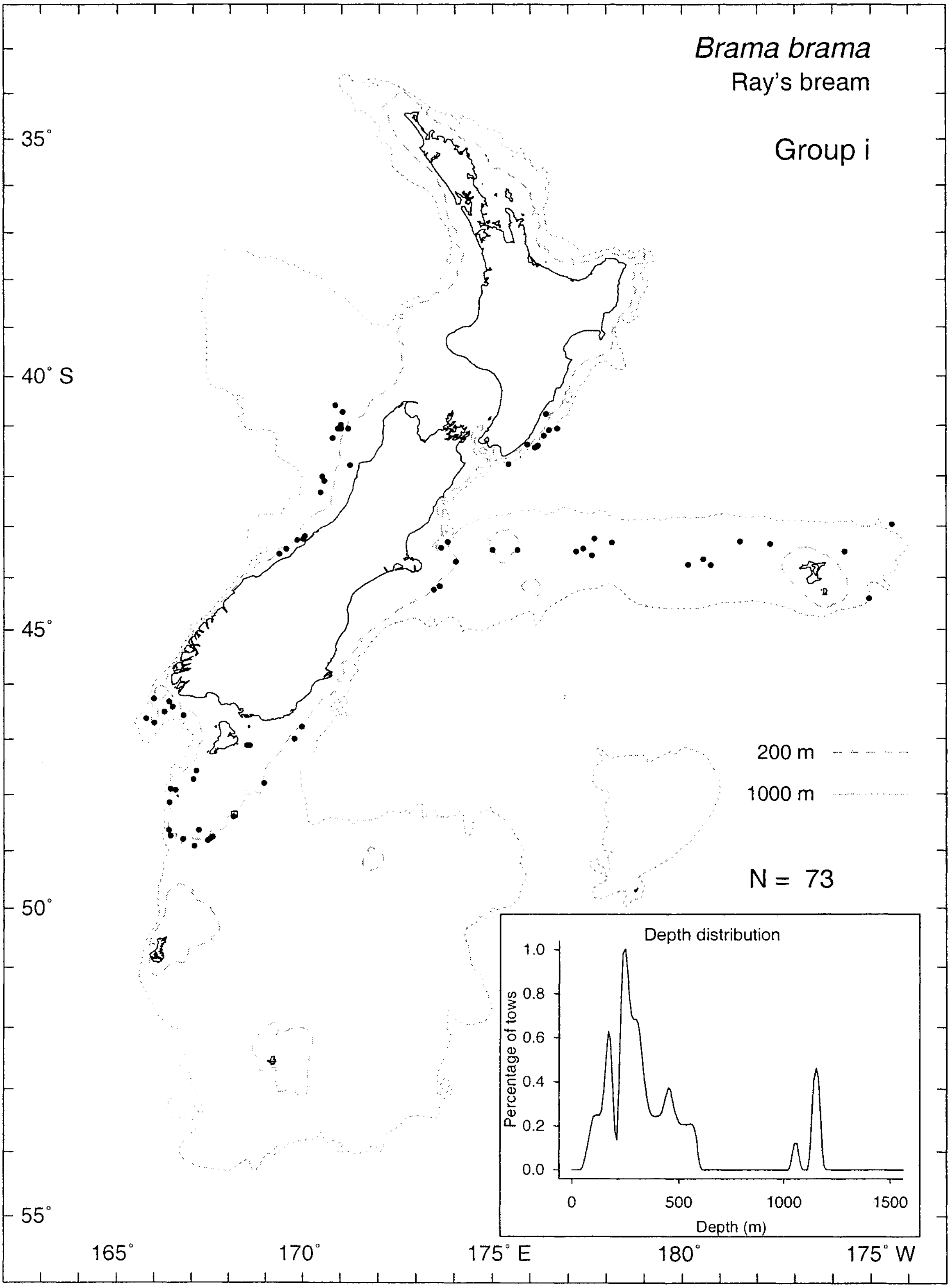
Beryx splendens
Alfonsino
Age 1+
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 367
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
10
0
500
1000
1500

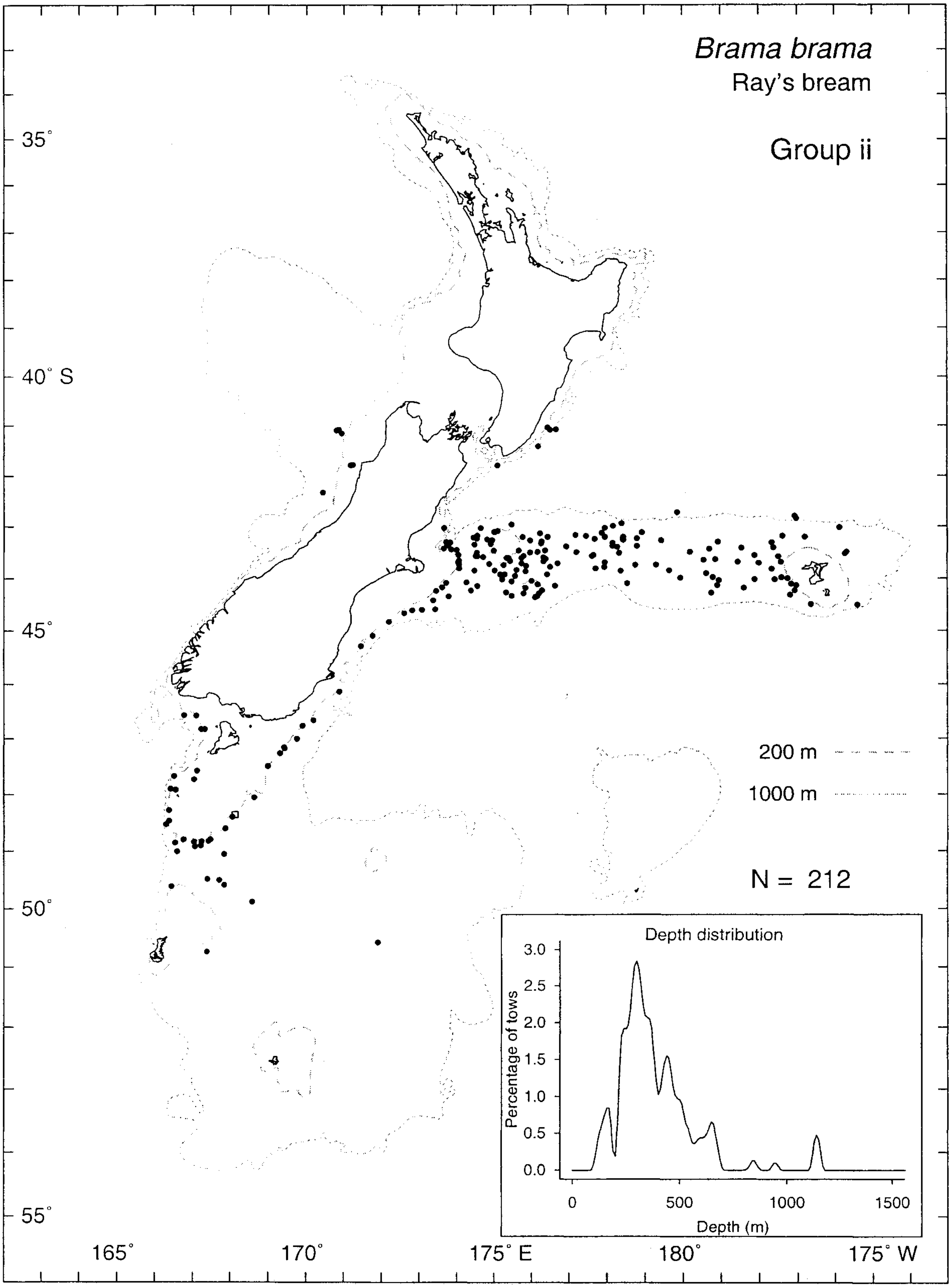

Beryx splendens
Alfonsino
Age 2+
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 309
Depth distribution
Percentage of tows
Depth (m)
0
1
2
3
4
5
6
500
1000
1500

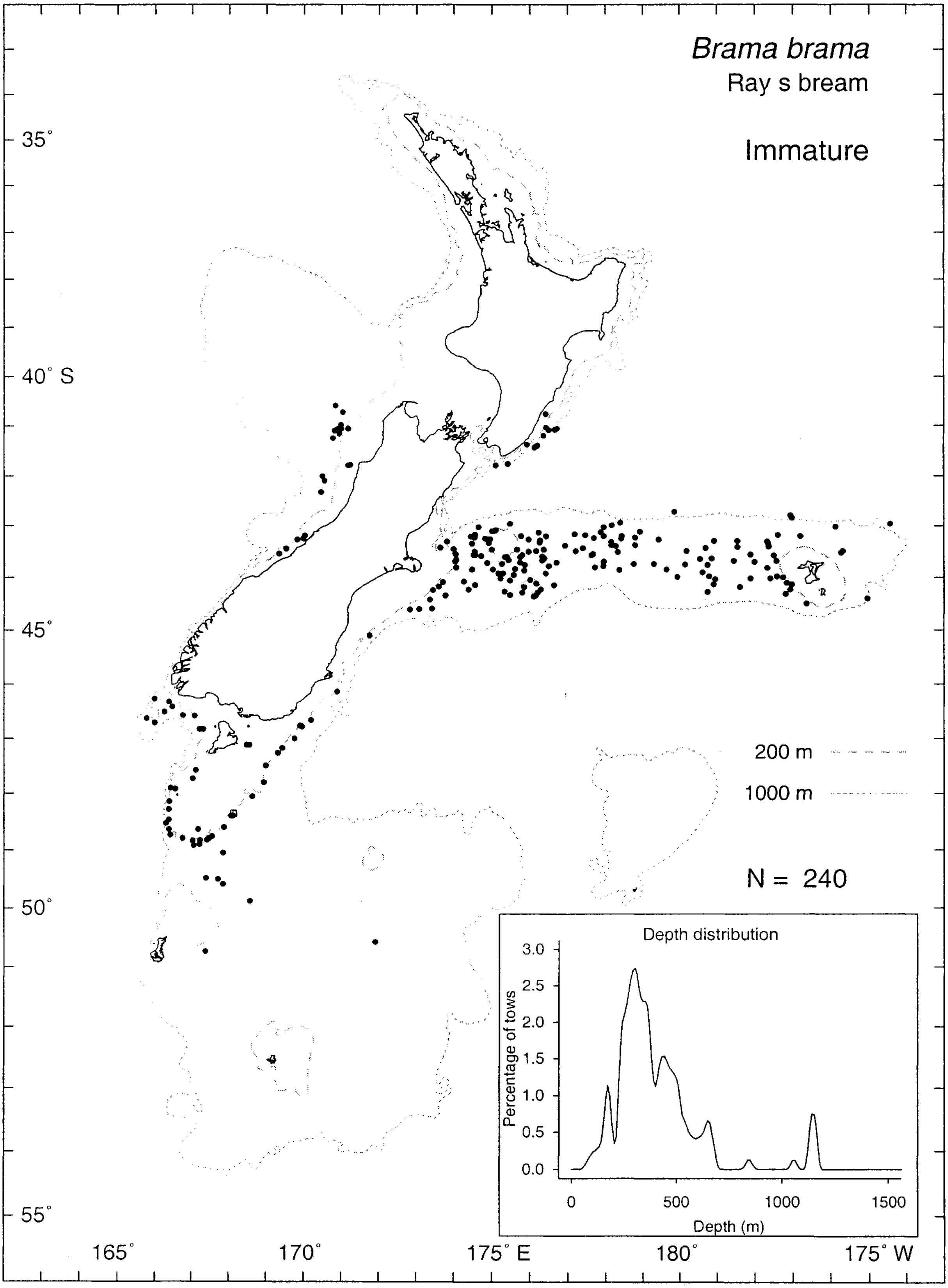

Beryx splendens
Alfonsino
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 601
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
10
12
14
0
500
1000
1500

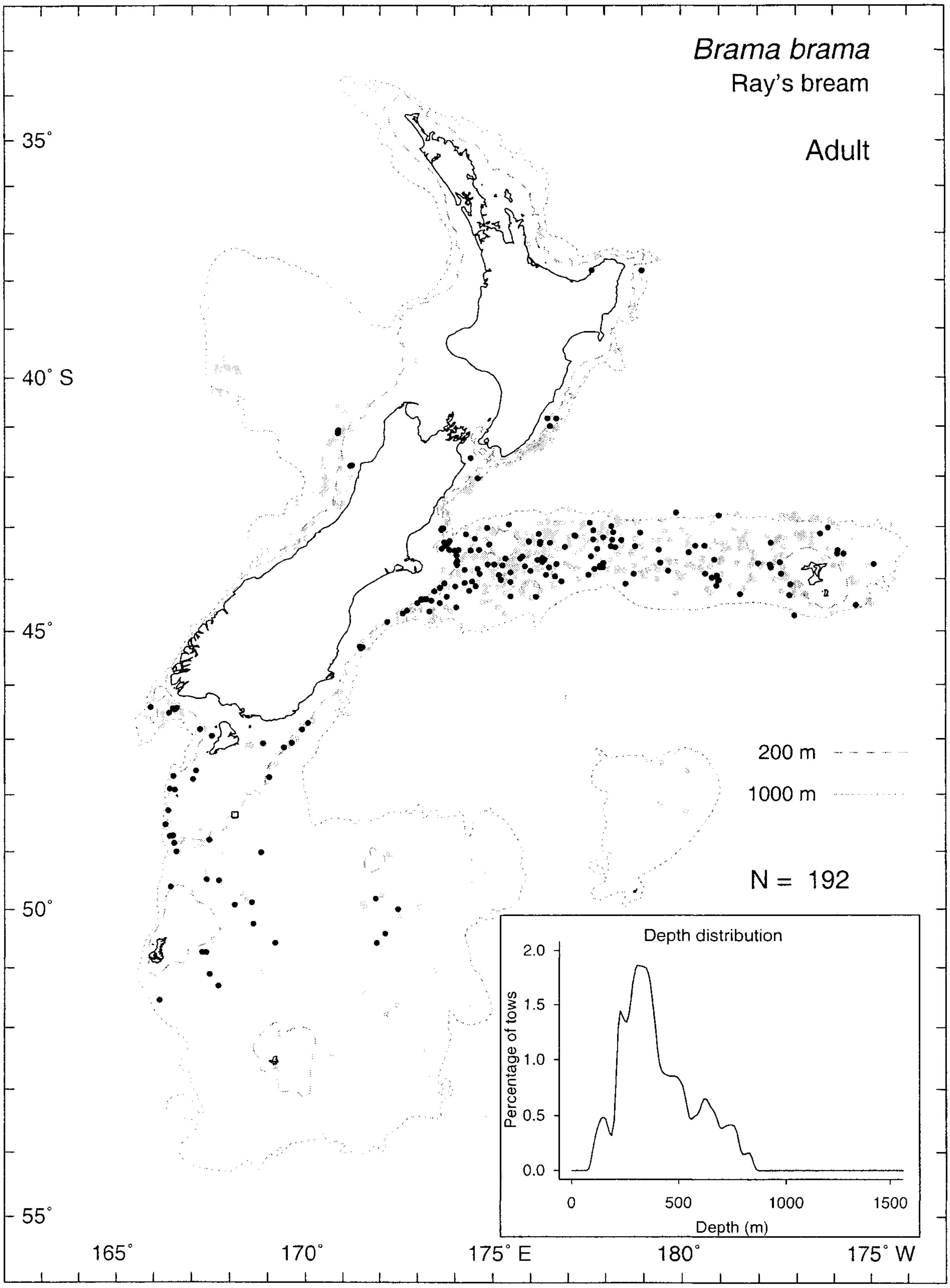


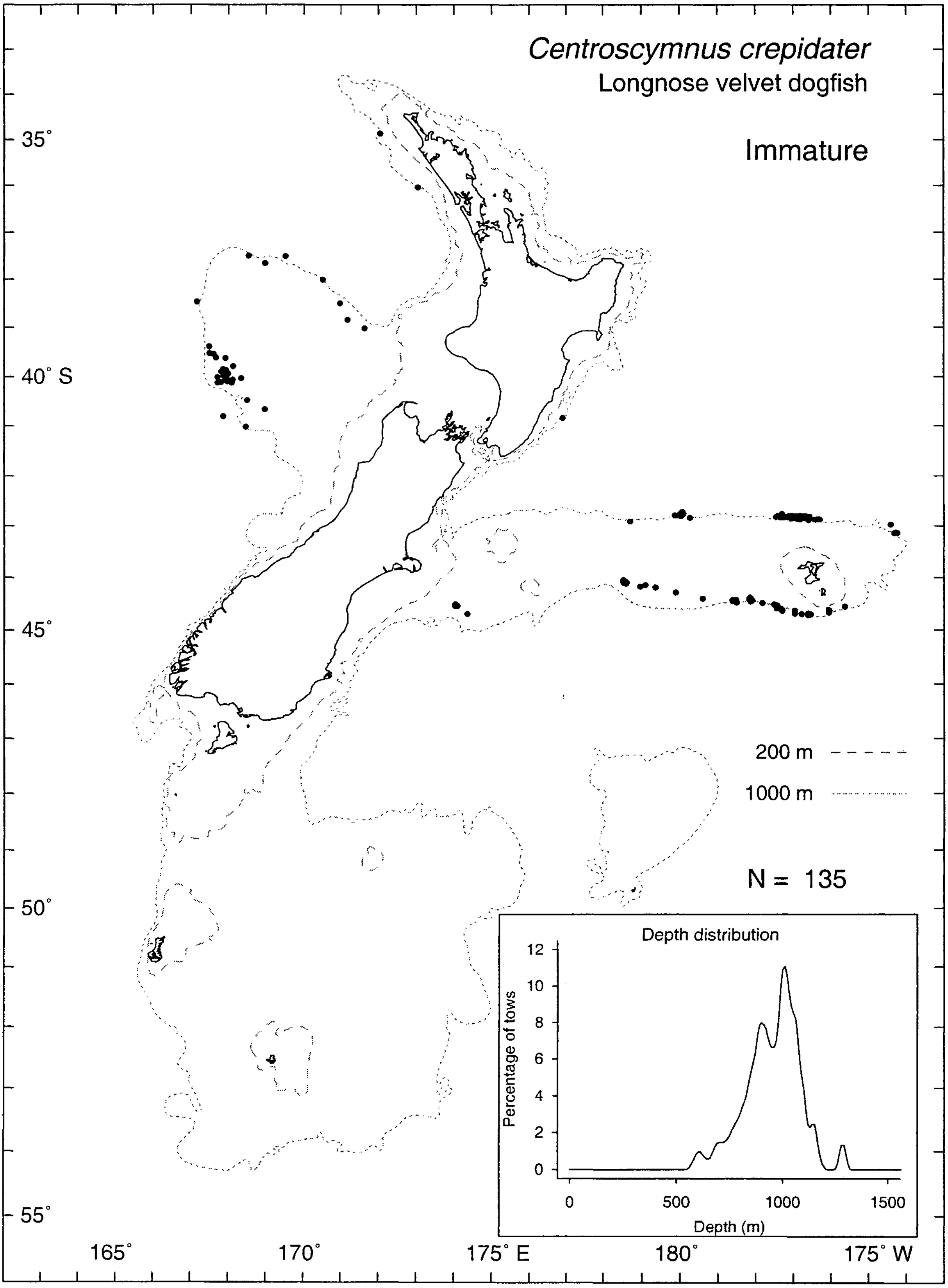
Beryx splendens
Alfonsino
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 333
Depth distribution
Percentage of tows
Depth (m)
0
1
2
3
4
0
500
1000
1500


Brama brama
Ray's bream
Group i
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 73
Depth distribution
Percentage of tows
Depth (m)
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500

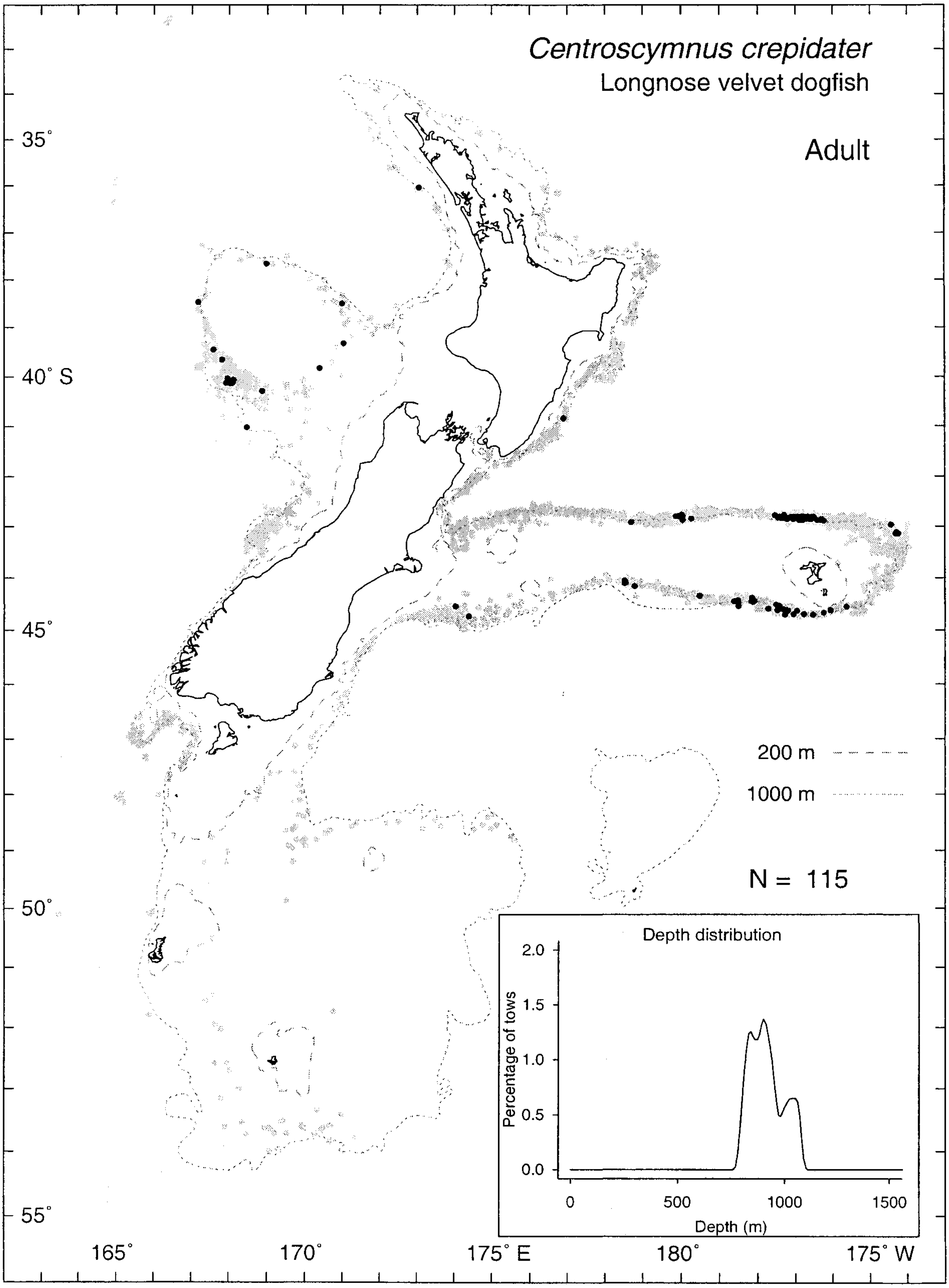

Brama brama
Ray's bream
Group ii
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 212
Depth distribution
Percentage of tows
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Depth (m)


Brama brama
Ray s bream
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 240
Depth distribution
Percentage of tows
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Depth (m)

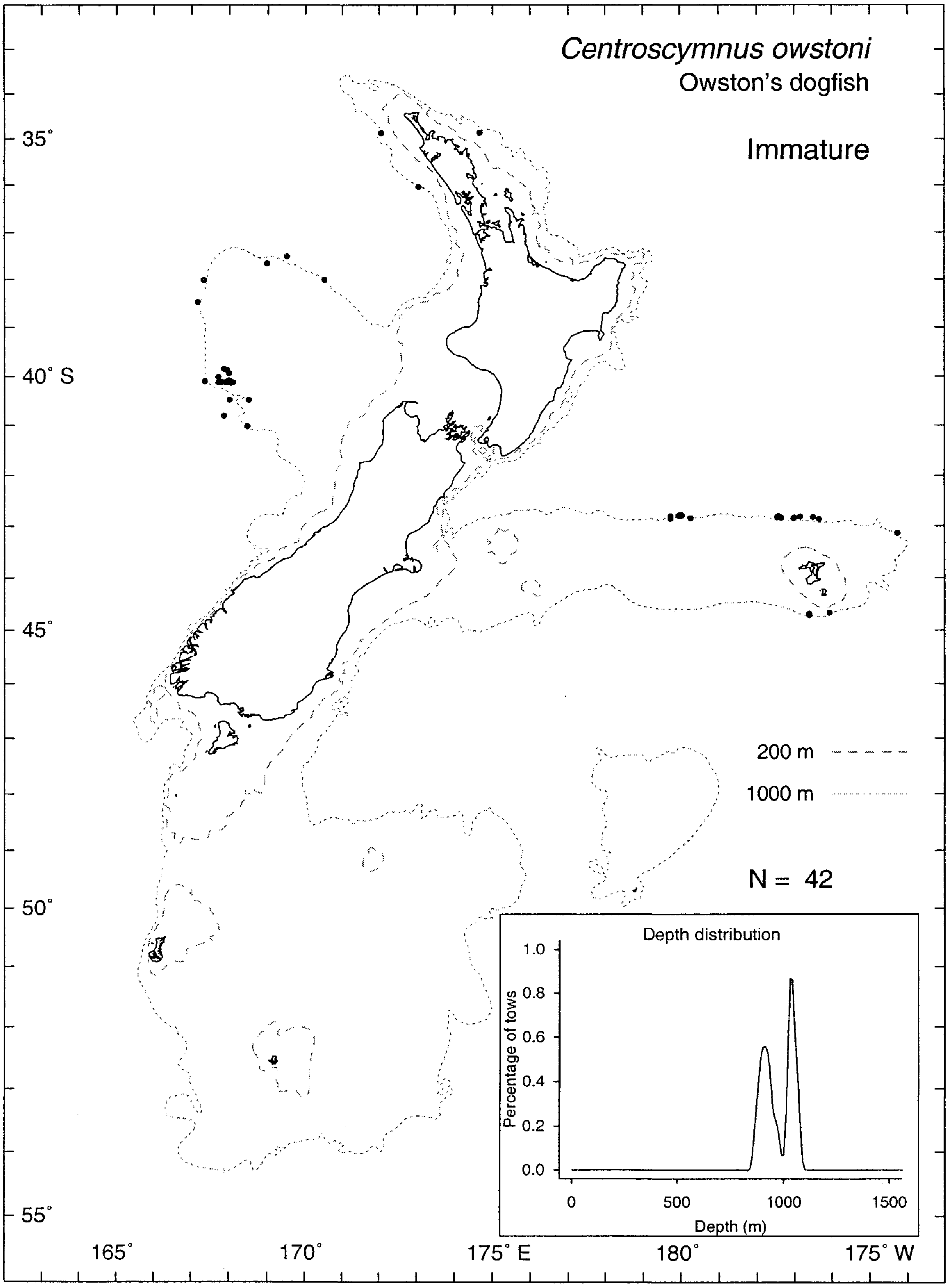

Brama brama
Ray's bream
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 192
Depth distribution
Percentage of tows
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Depth (m)



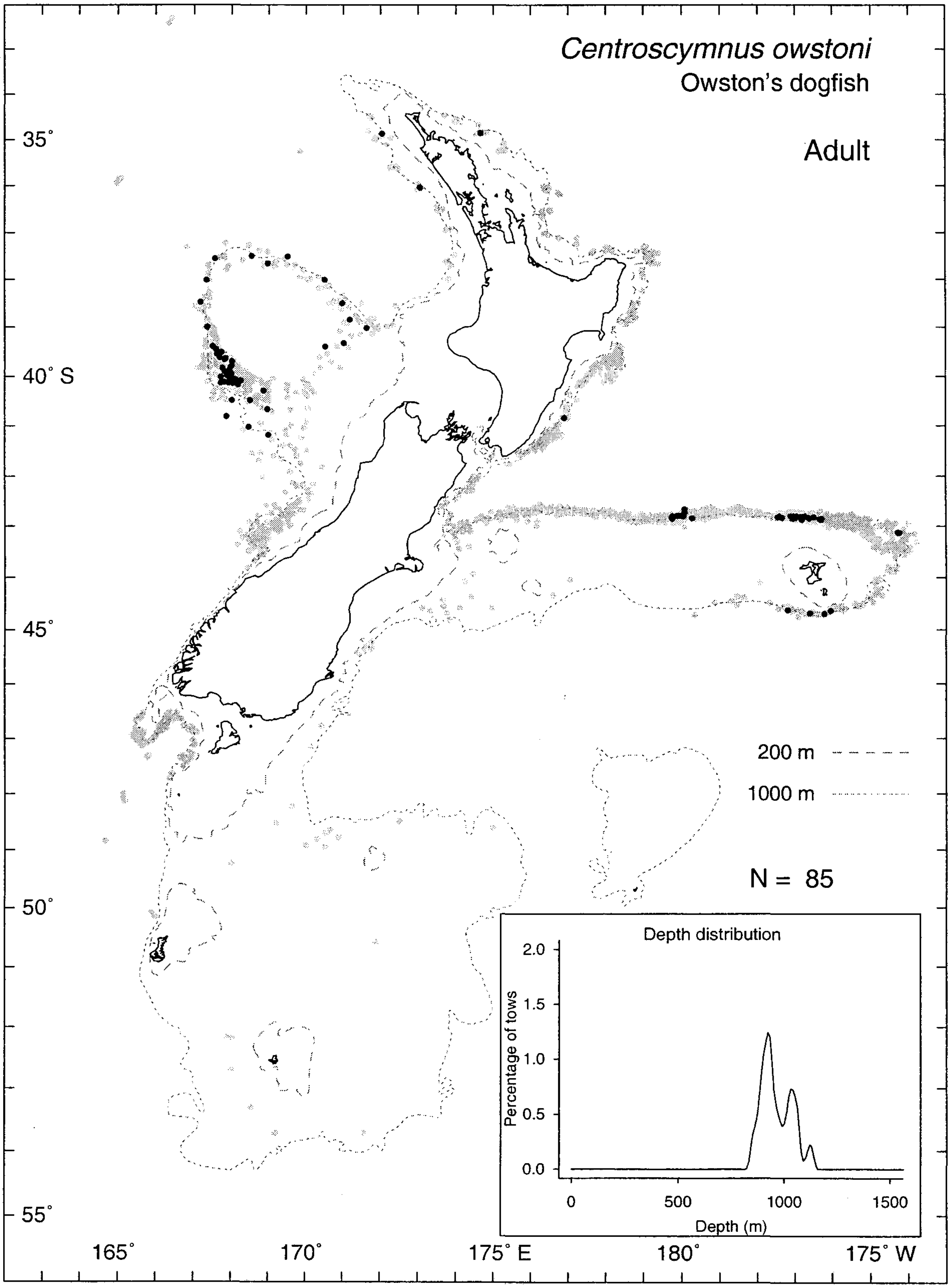
Centroscymnus crepidater
Longnose velvet dogfish
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 135
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
10
12
0
500
1000
1500



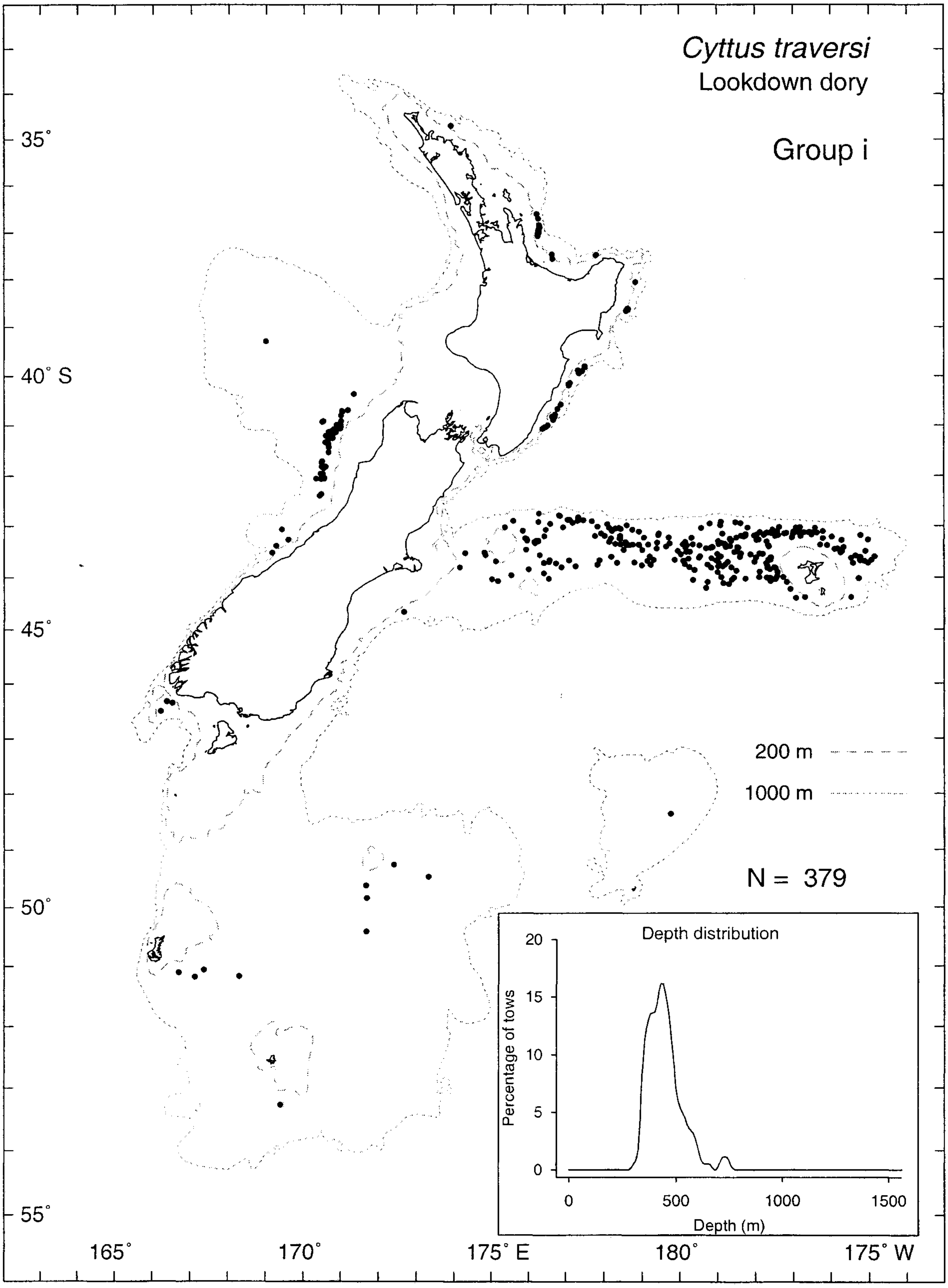
Centroscymnus crepidater
Longnose velvet dogfish
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 115
Depth distribution
Percentage of tows
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Depth (m)



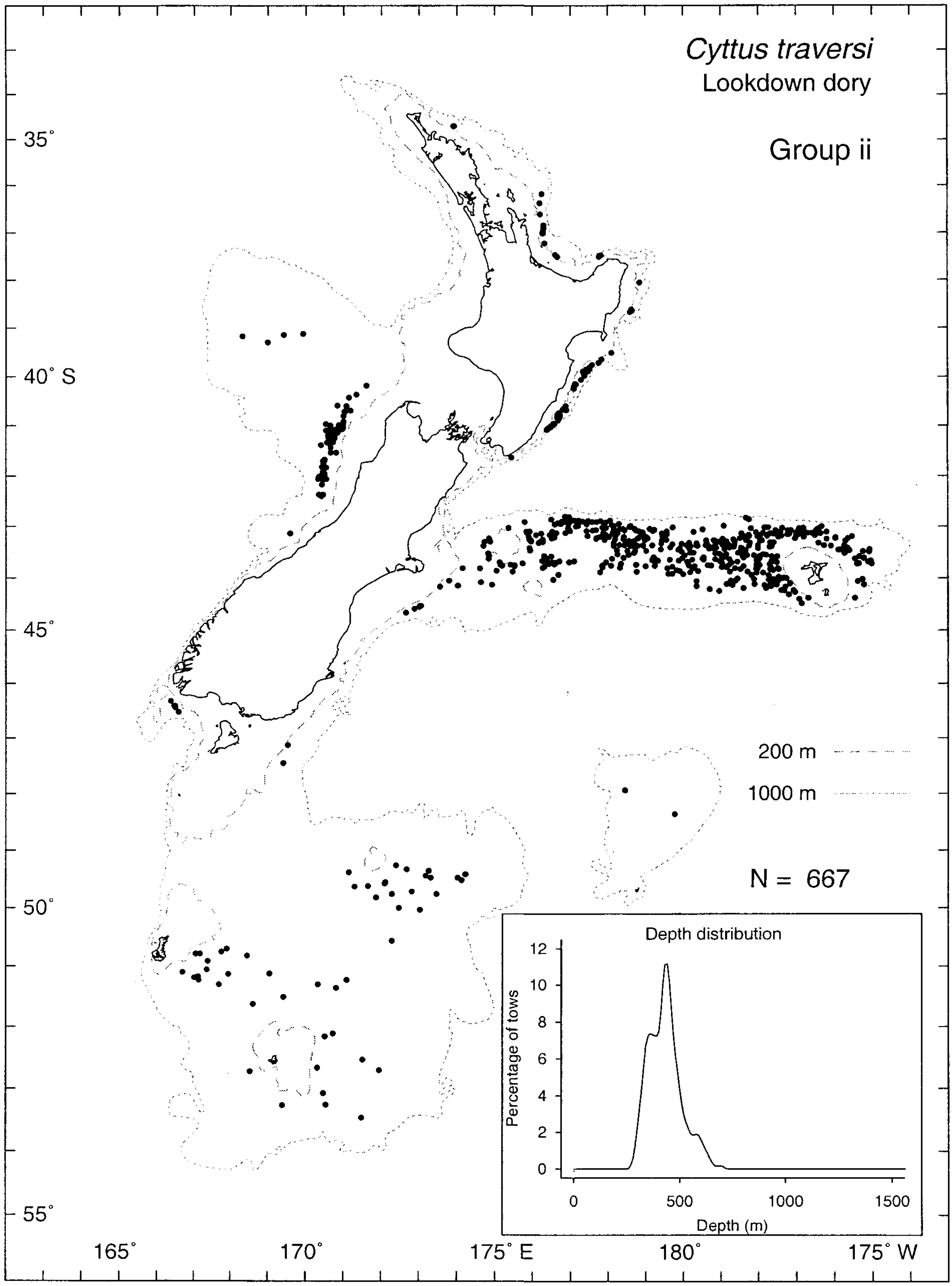
Centroscymnus owstoni
Owston's dogfish
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 42
Depth distribution
Percentage of tows
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
Depth (m)



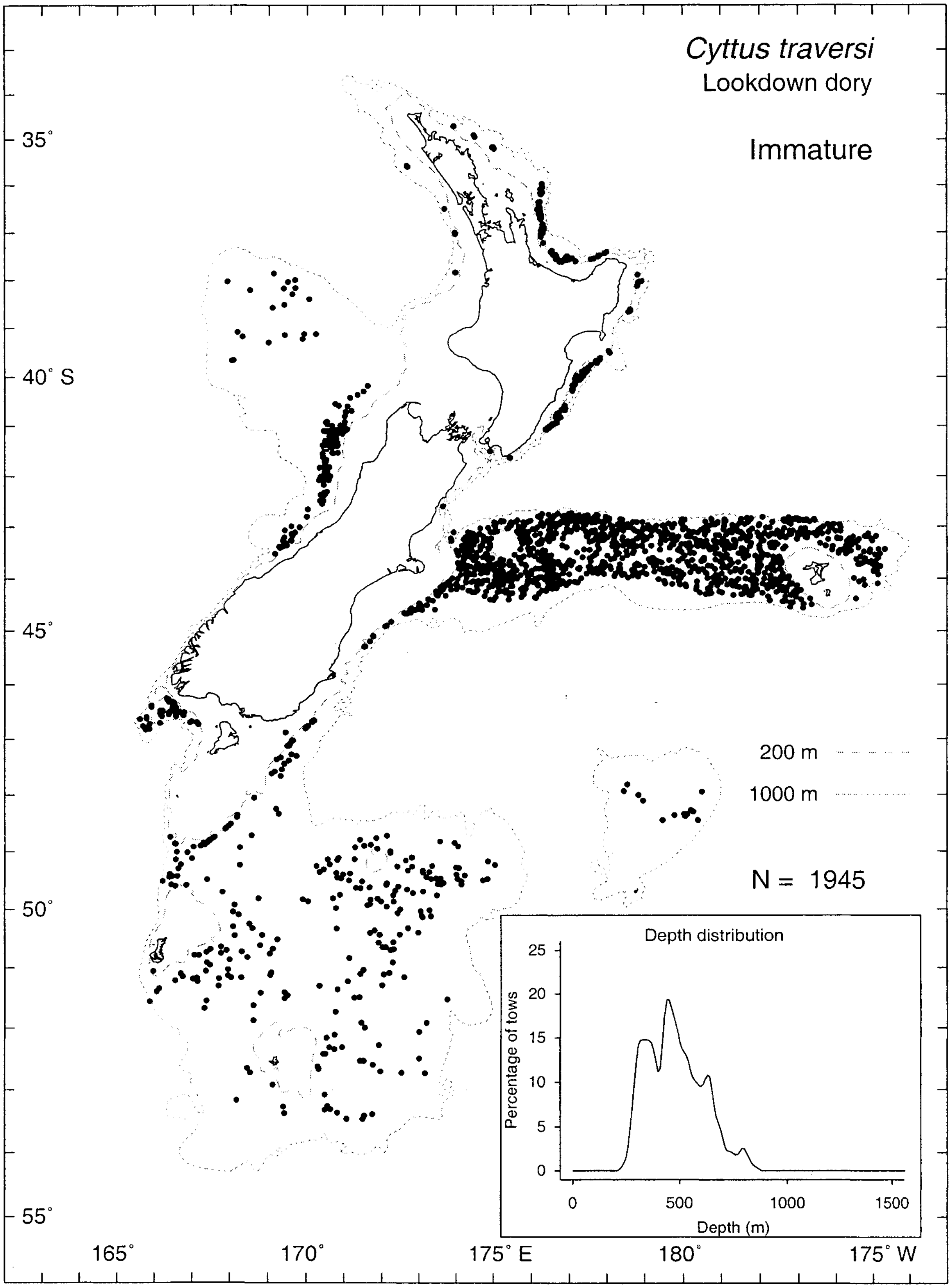
Centroscymnus owstoni
Owston's dogfish
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 85
Depth distribution
Percentage of tows
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Depth (m)



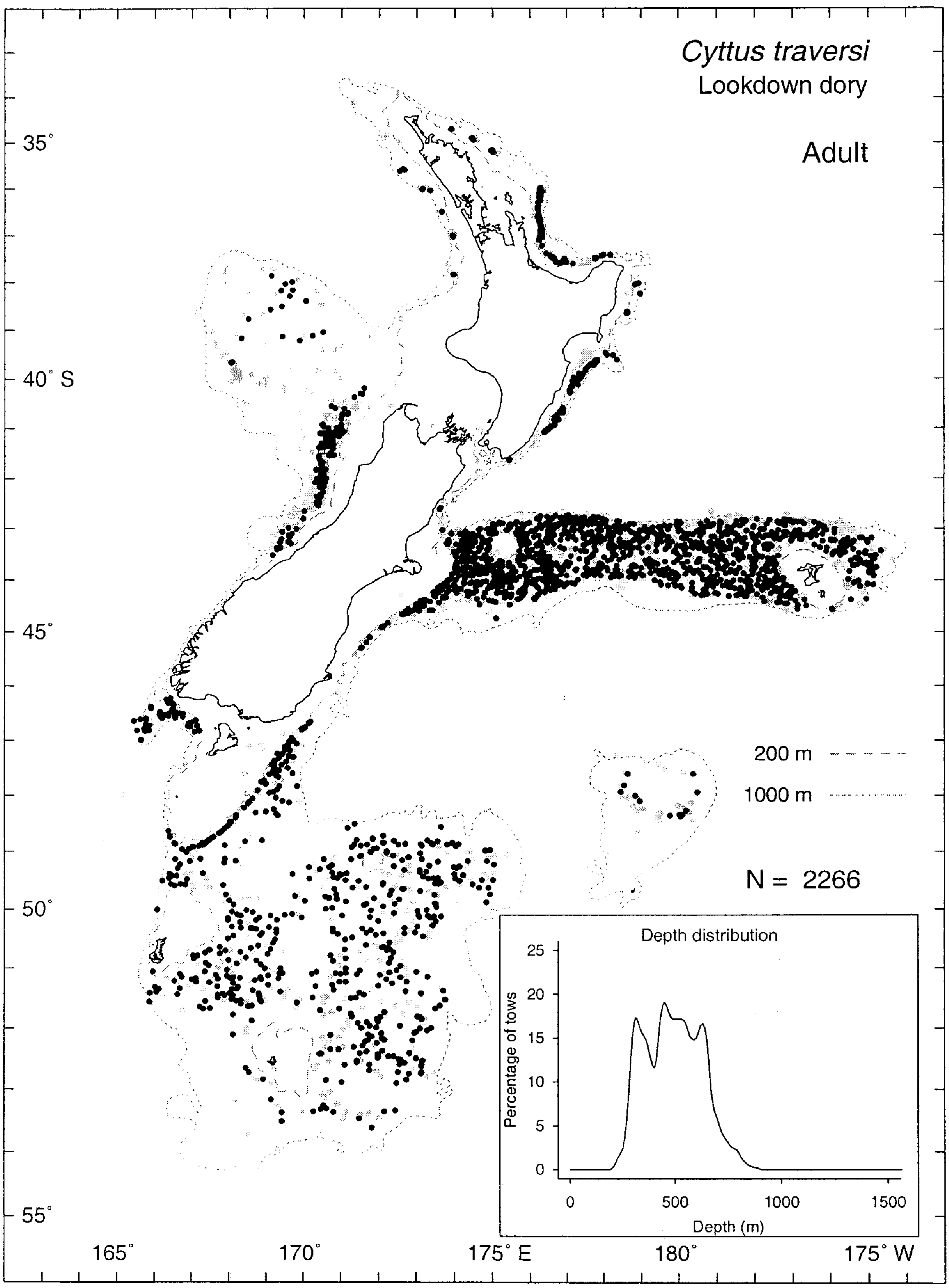
Cyttus traversi
Lookdown dory
Group i
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 379
Depth distribution
Percentage of tows
20
15
10
5
0
0
500
1000
1500
Depth (m)



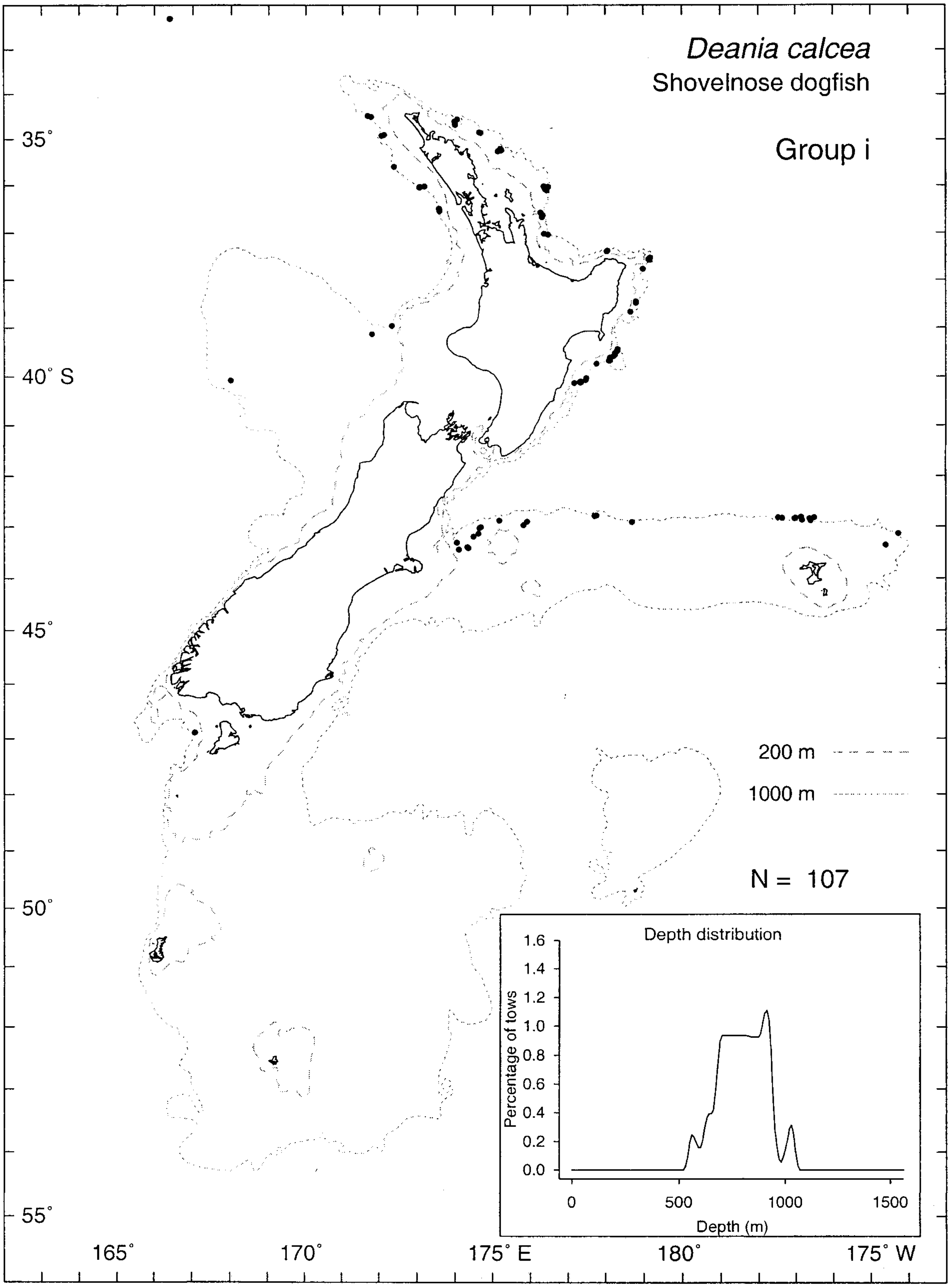
Cyttus traversi
Lookdown dory
Group ii
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 667
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
10
12
500
1000
1500

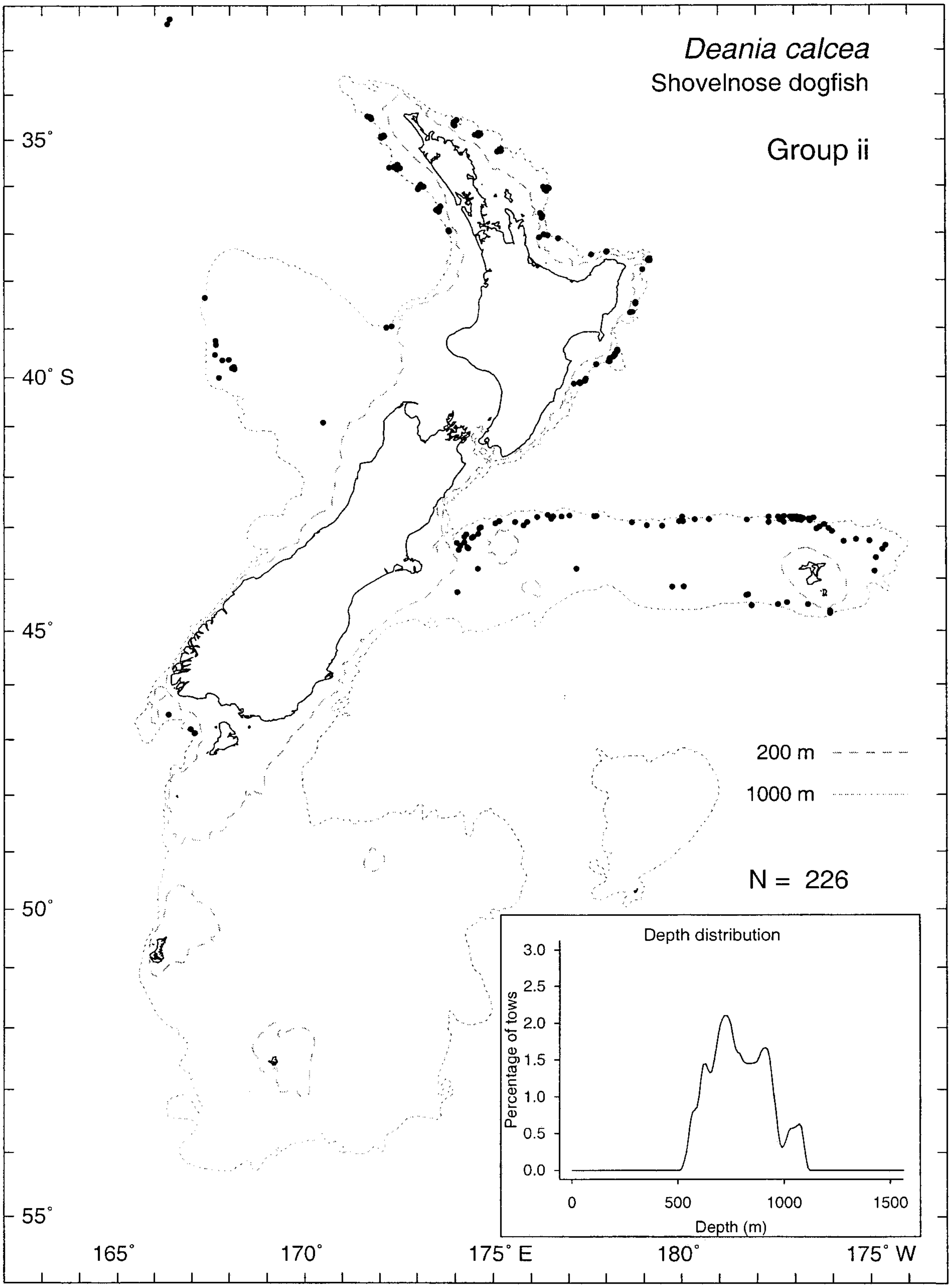


Cyttus traversi
Lookdown dory
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 1945
Depth distribution
Percentage of tows
25
20
15
10
5
0
0
500
1000
1500
Depth (m)

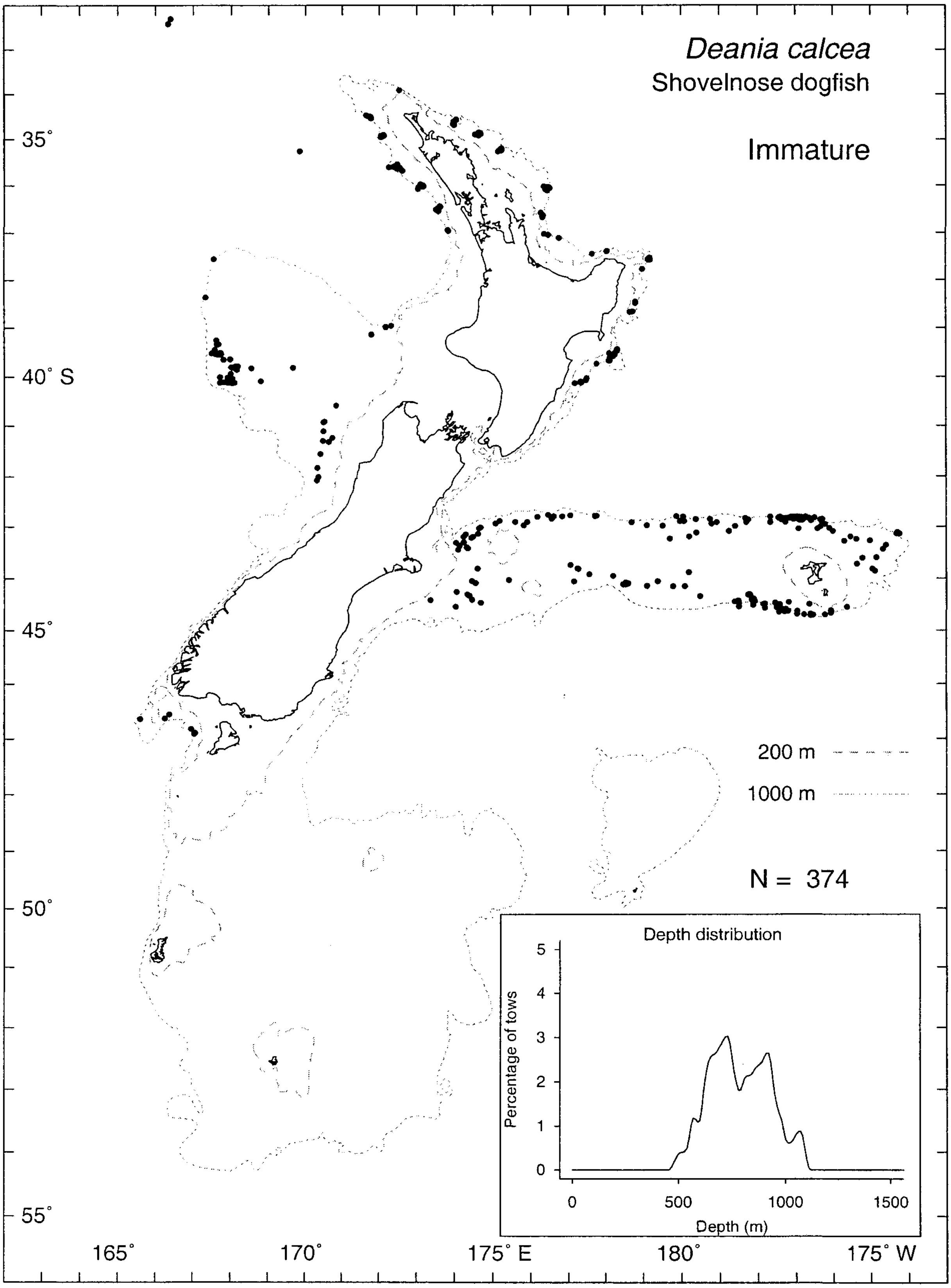


Cyttus traversi
Lookdown dory
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 2266
Depth distribution
Percentage of tows
Depth (m)
0
5
10
15
20
25
0
500
1000
1500

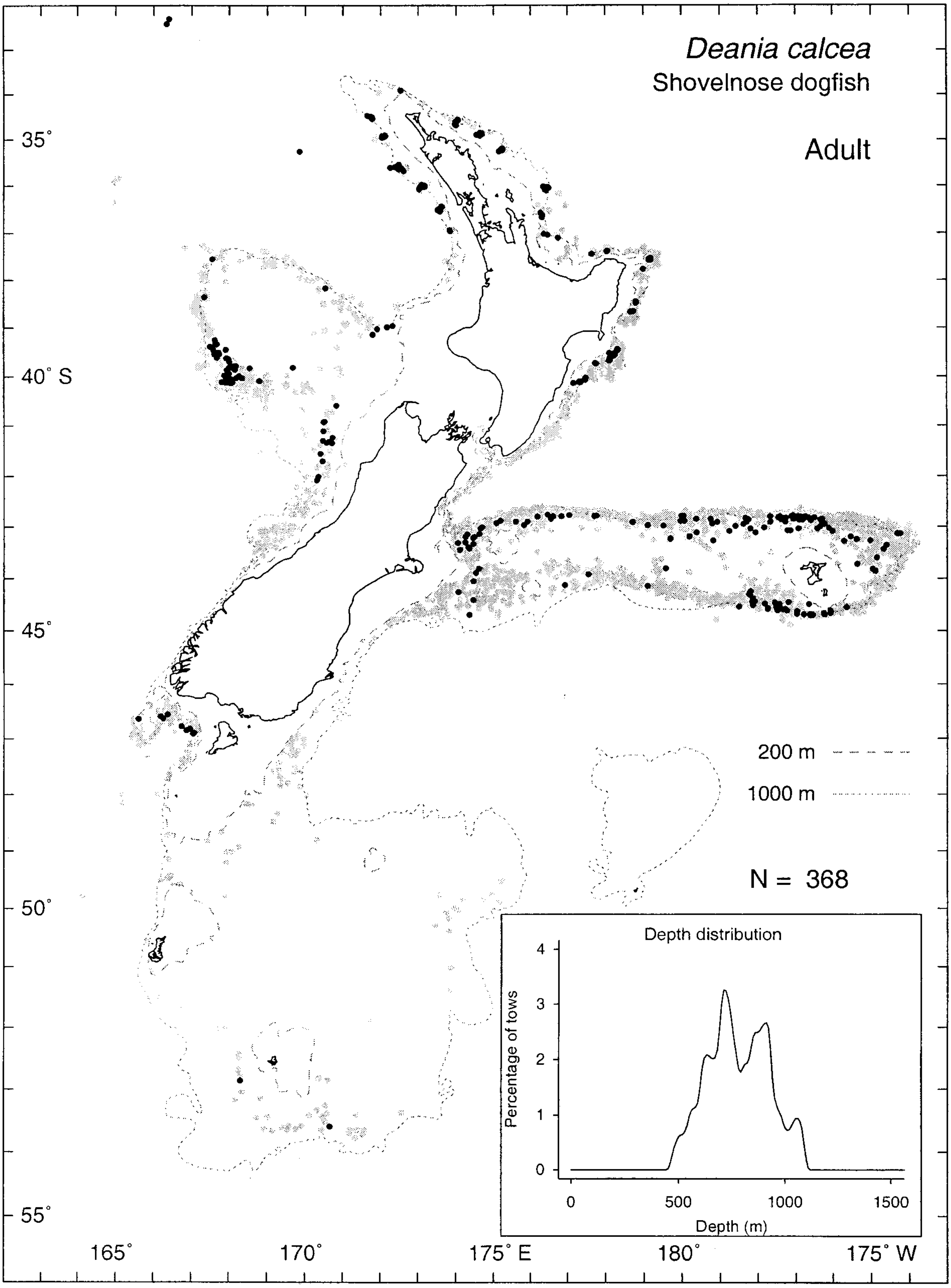

Deania calcea
Shovelnose dogfish
Group i
200 m
1000 m
N = 107
Depth distribution
Percentage of tows
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
Depth (m)
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W



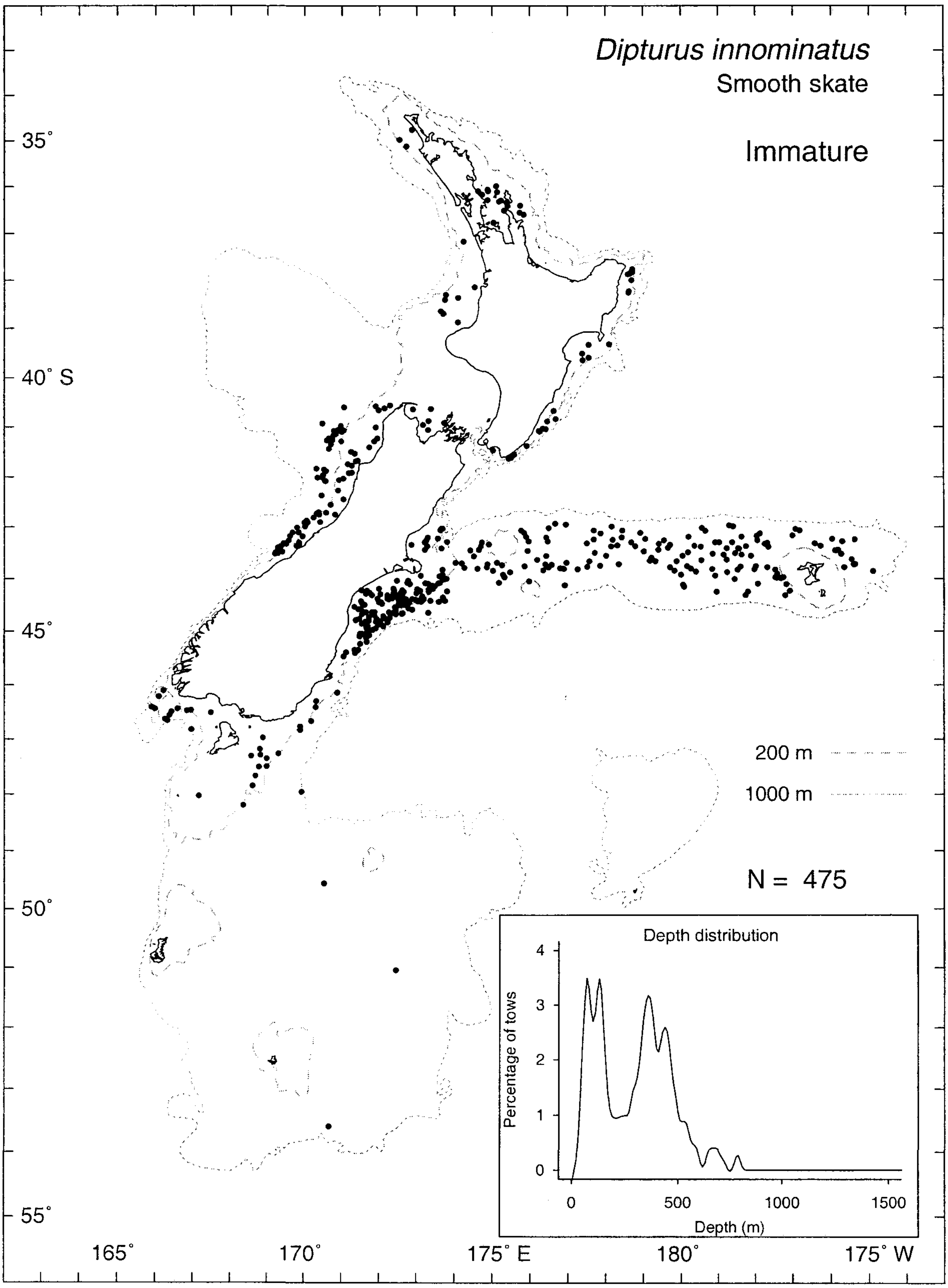
Deania calcea
Shovelnose dogfish
Group ii
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 226
Depth distribution
Percentage of tows
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Depth (m)



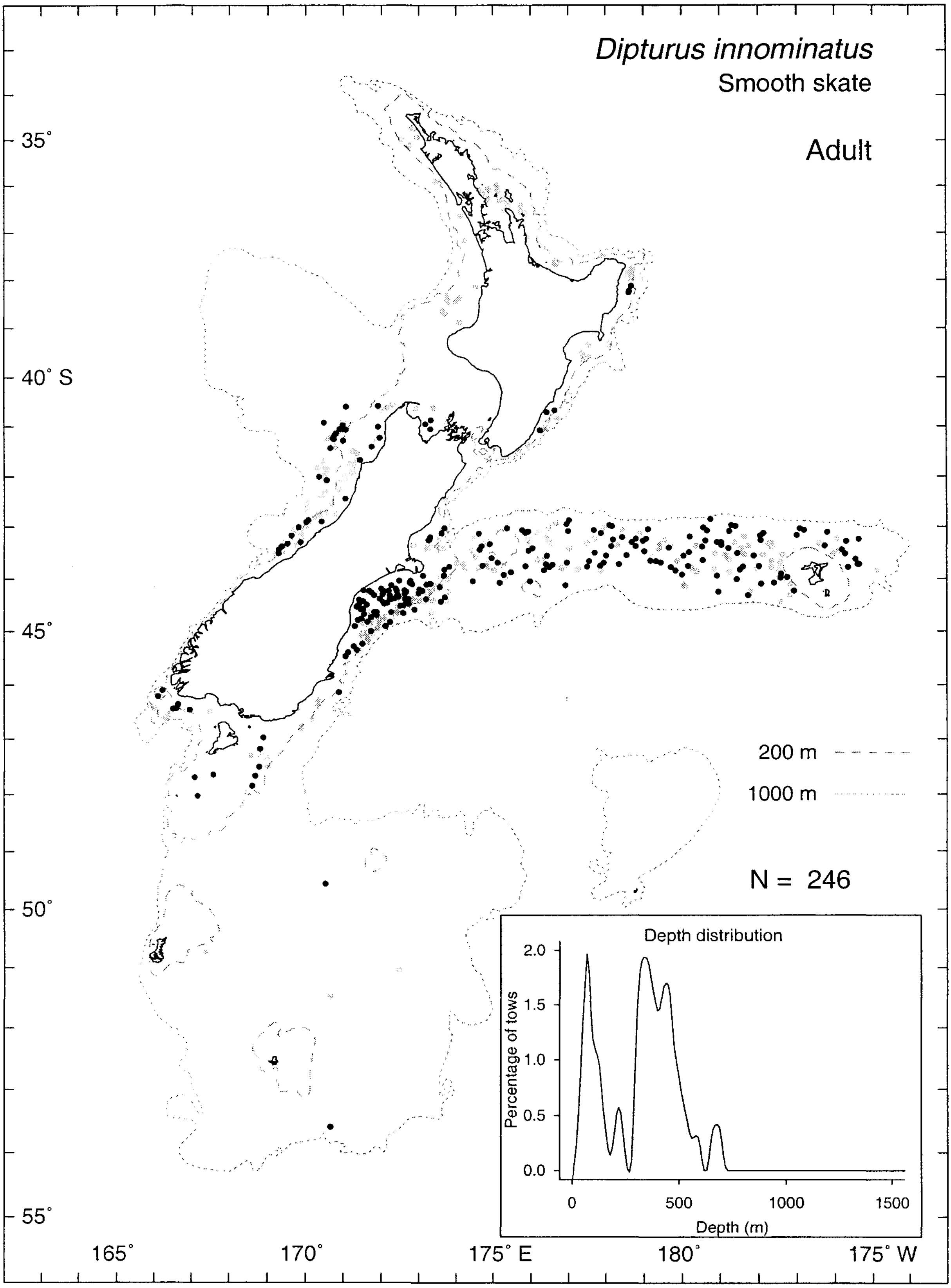
Deania calcea
Shovelnose dogfish
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 374
Depth distribution
Percentage of tows
0
1
2
3
4
5
0
500
1000
1500
Depth (m)



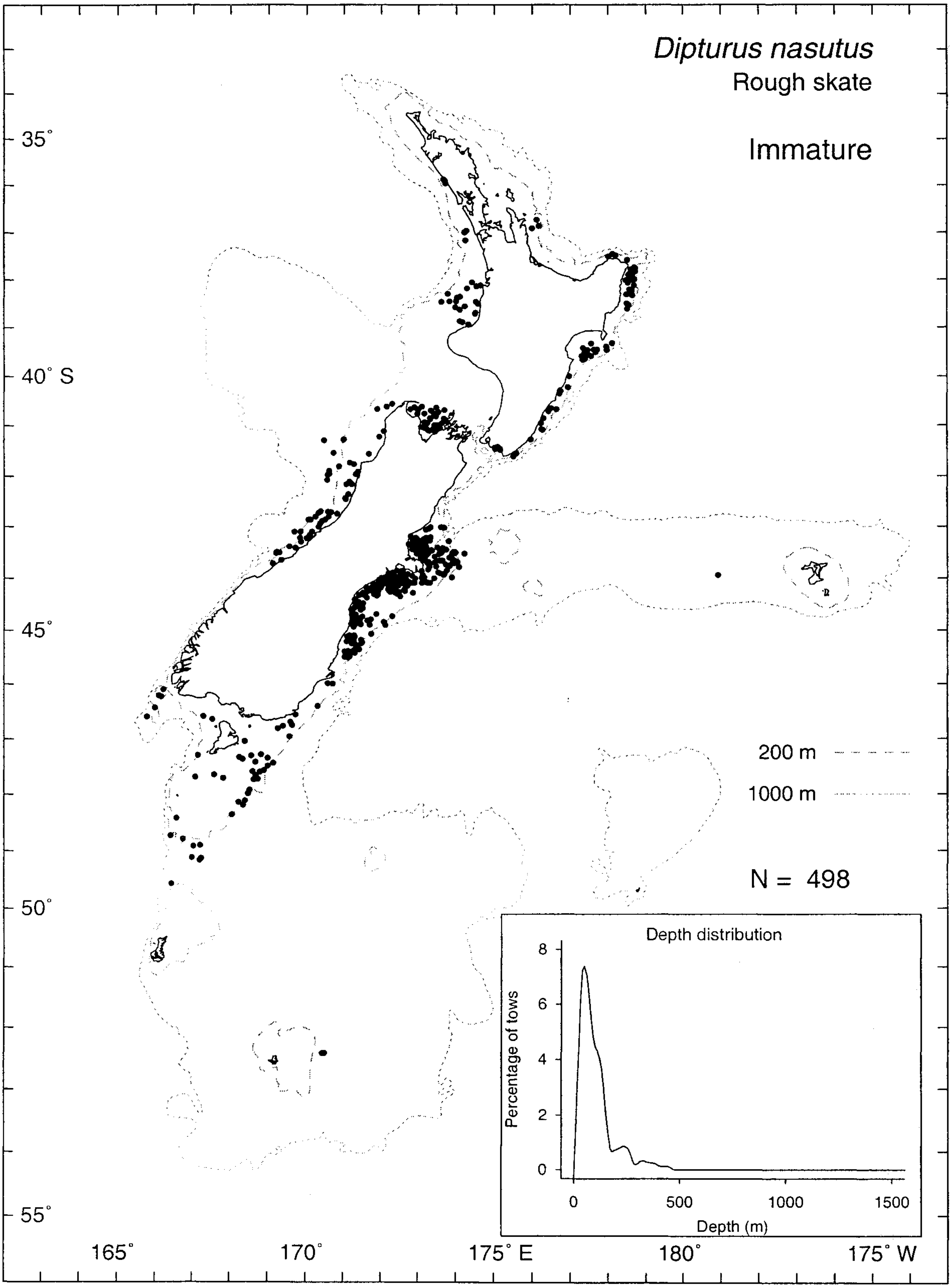
Deania calcea
Shovelnose dogfish
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 368
Depth distribution
Percentage of tows
Depth (m)
0
1
2
3
4
0
500
1000
1500



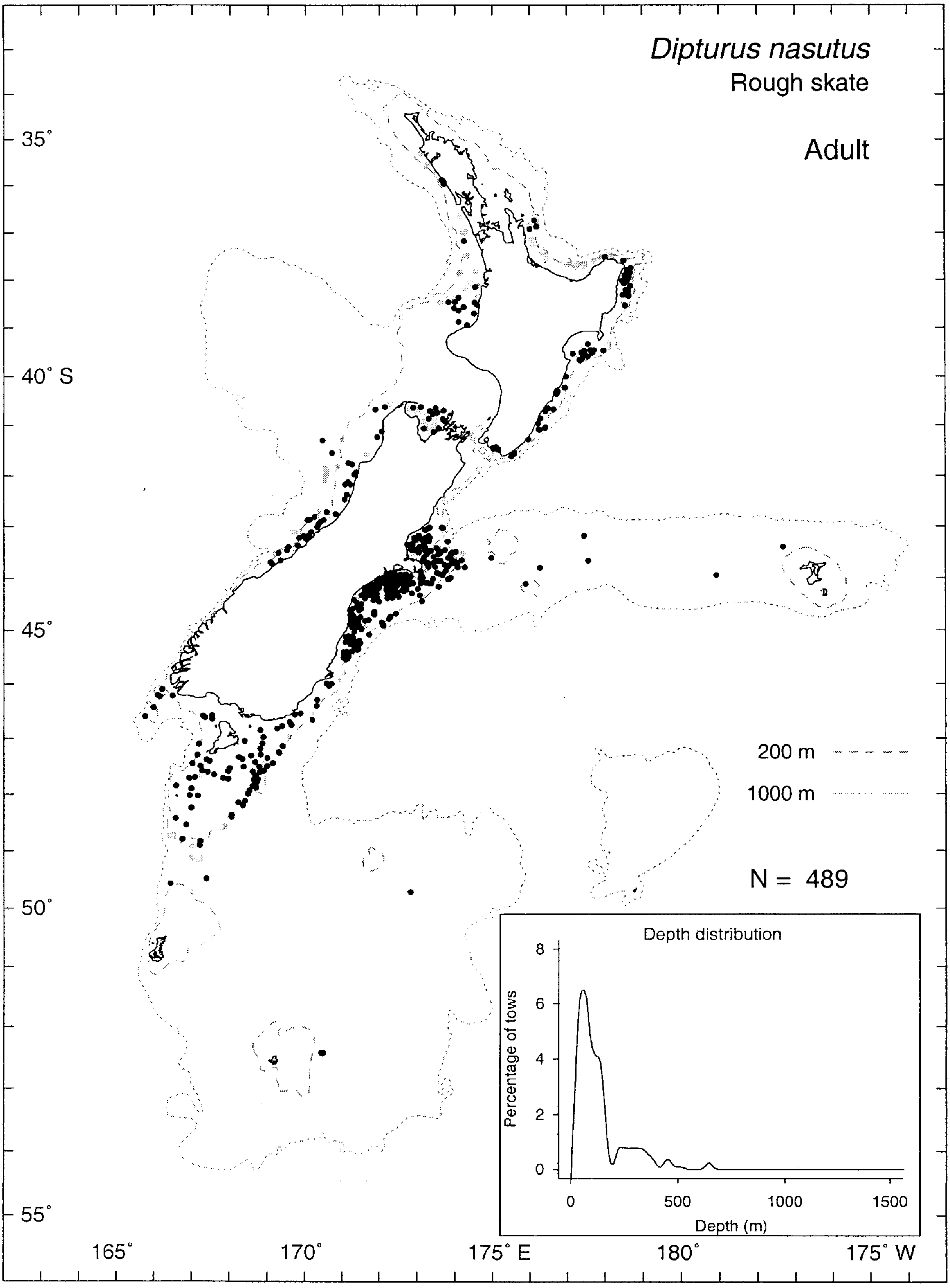
Dipturus innominatus
Smooth skate
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 475
Depth distribution
Percentage of tows
Depth (m)
0
1
2
3
4
0
500
1000
1500



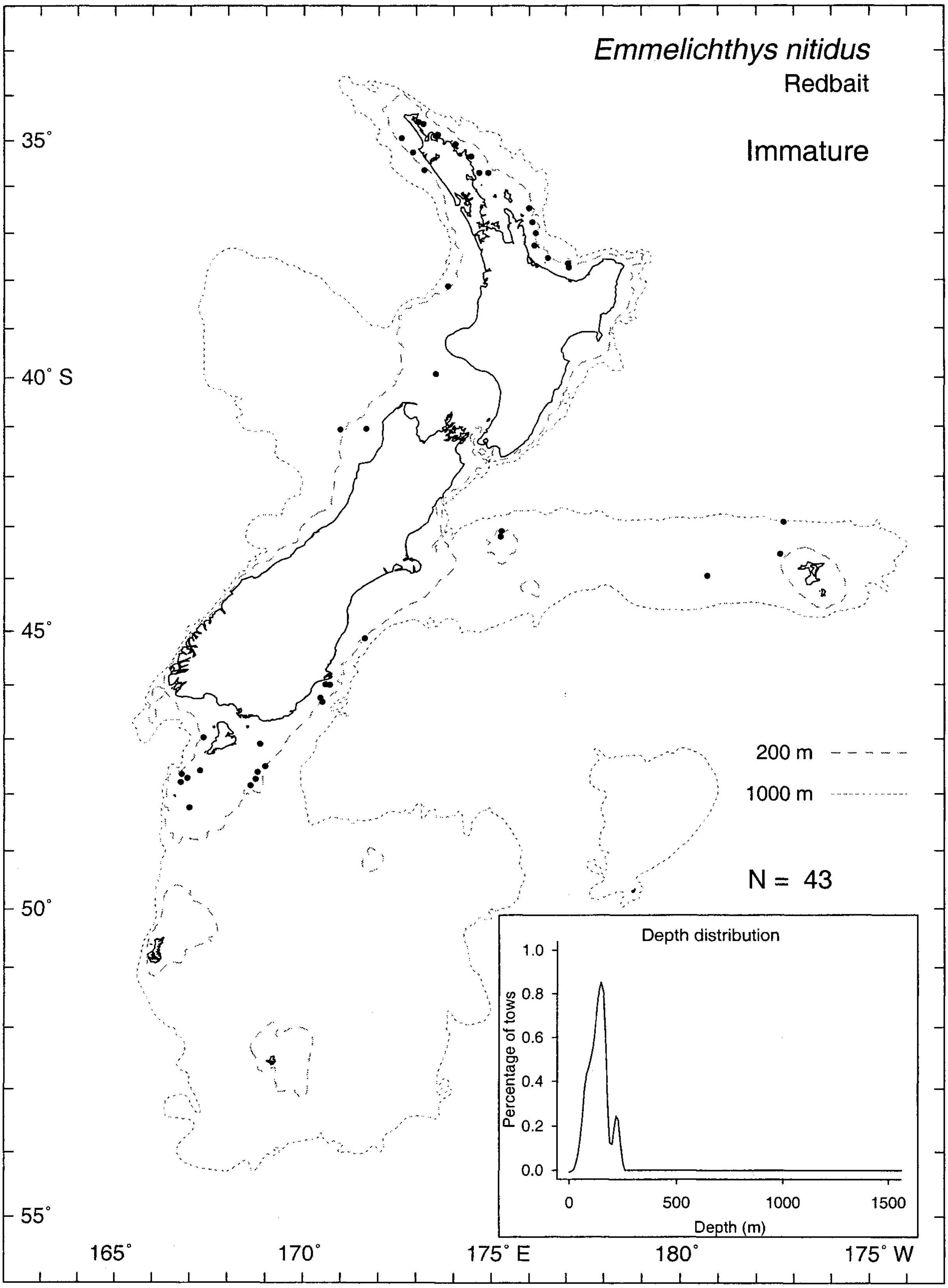
Dipturus innominatus
Smooth skate
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 246
Depth distribution
Percentage of tows
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Depth (m)



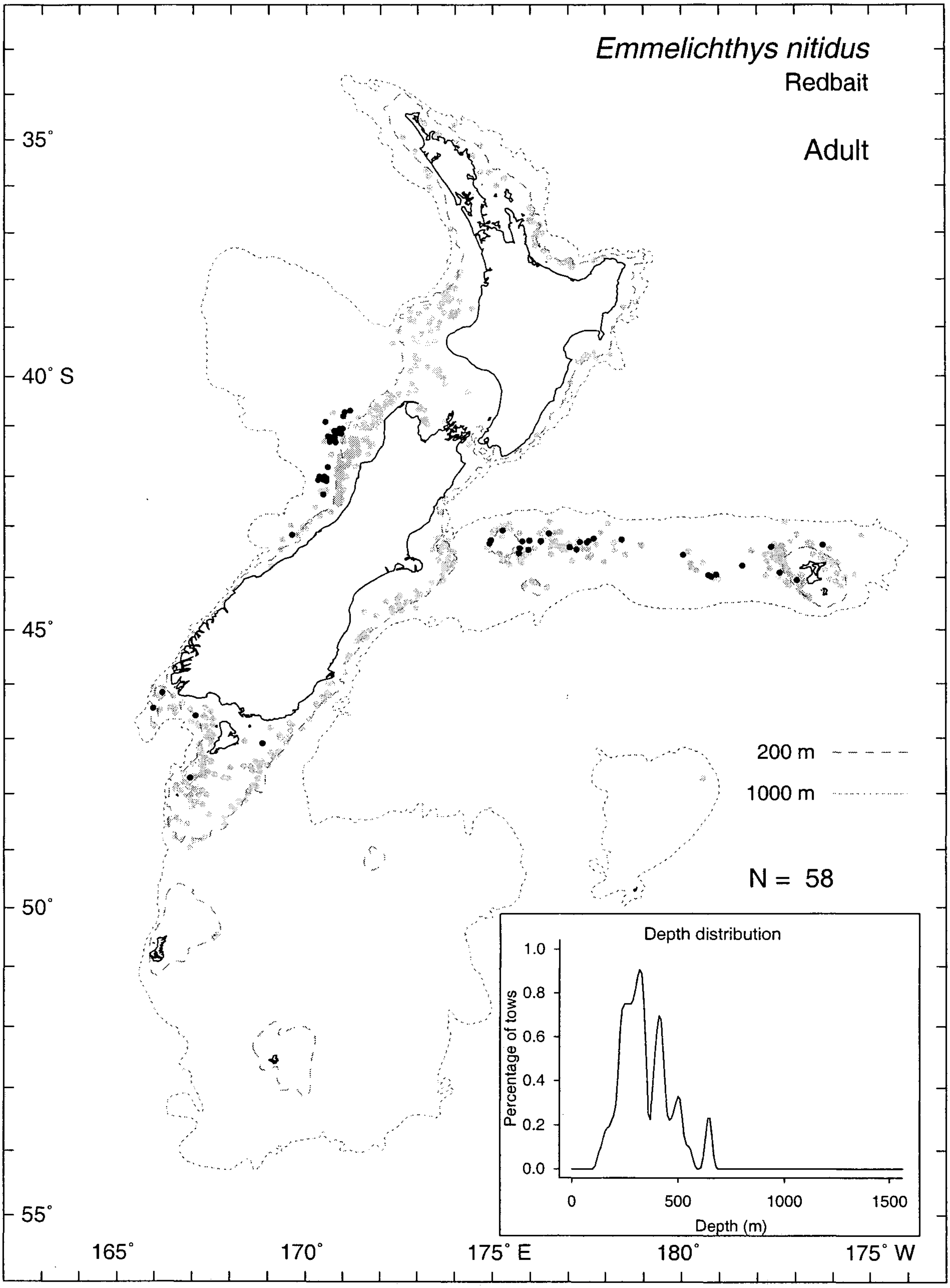
Dipturus nasutus
Rough skate
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 498
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
0
500
1000
1500

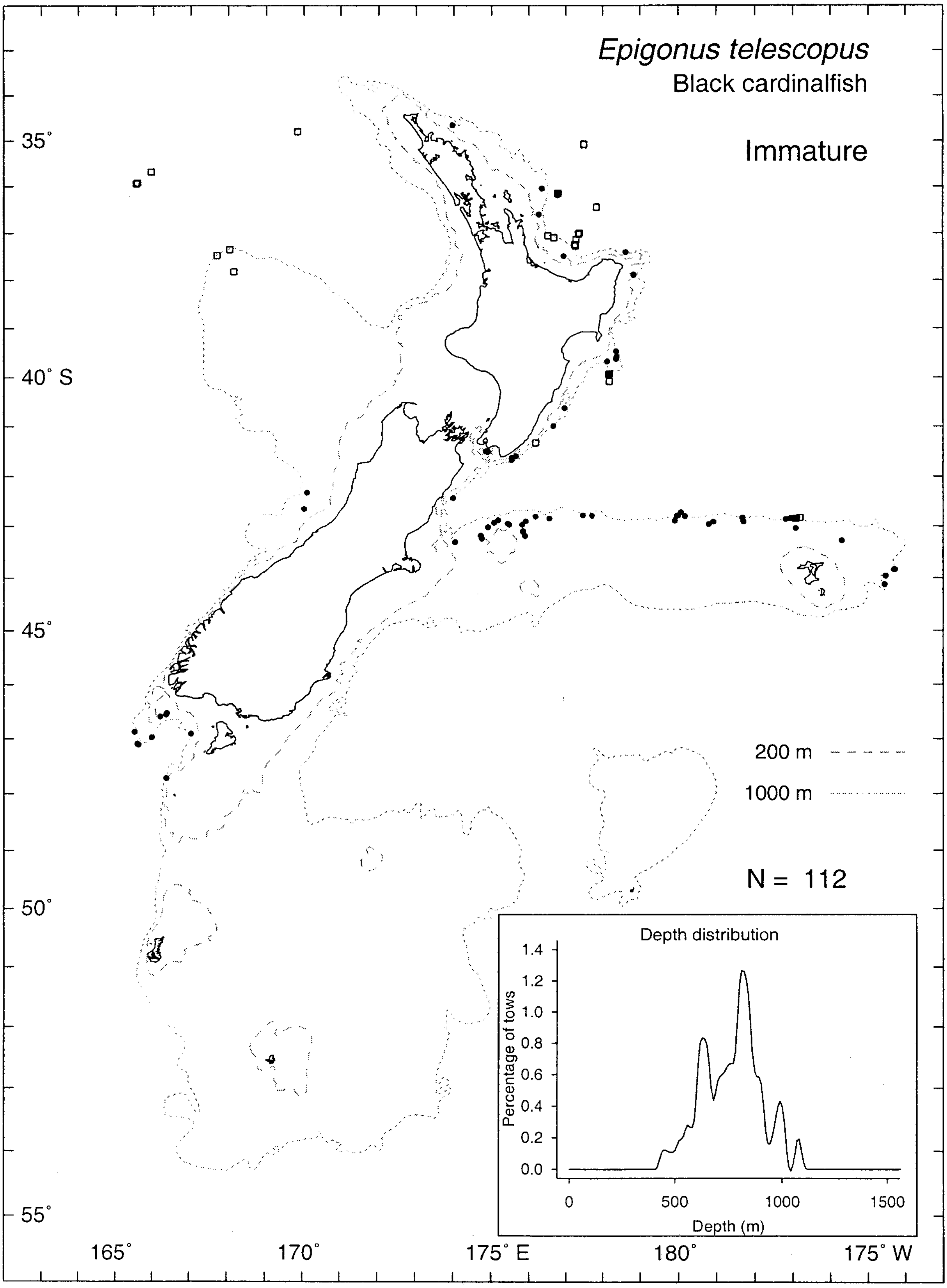


Dipturus nasutus
Rough skate
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 489
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
0
500
1000
1500

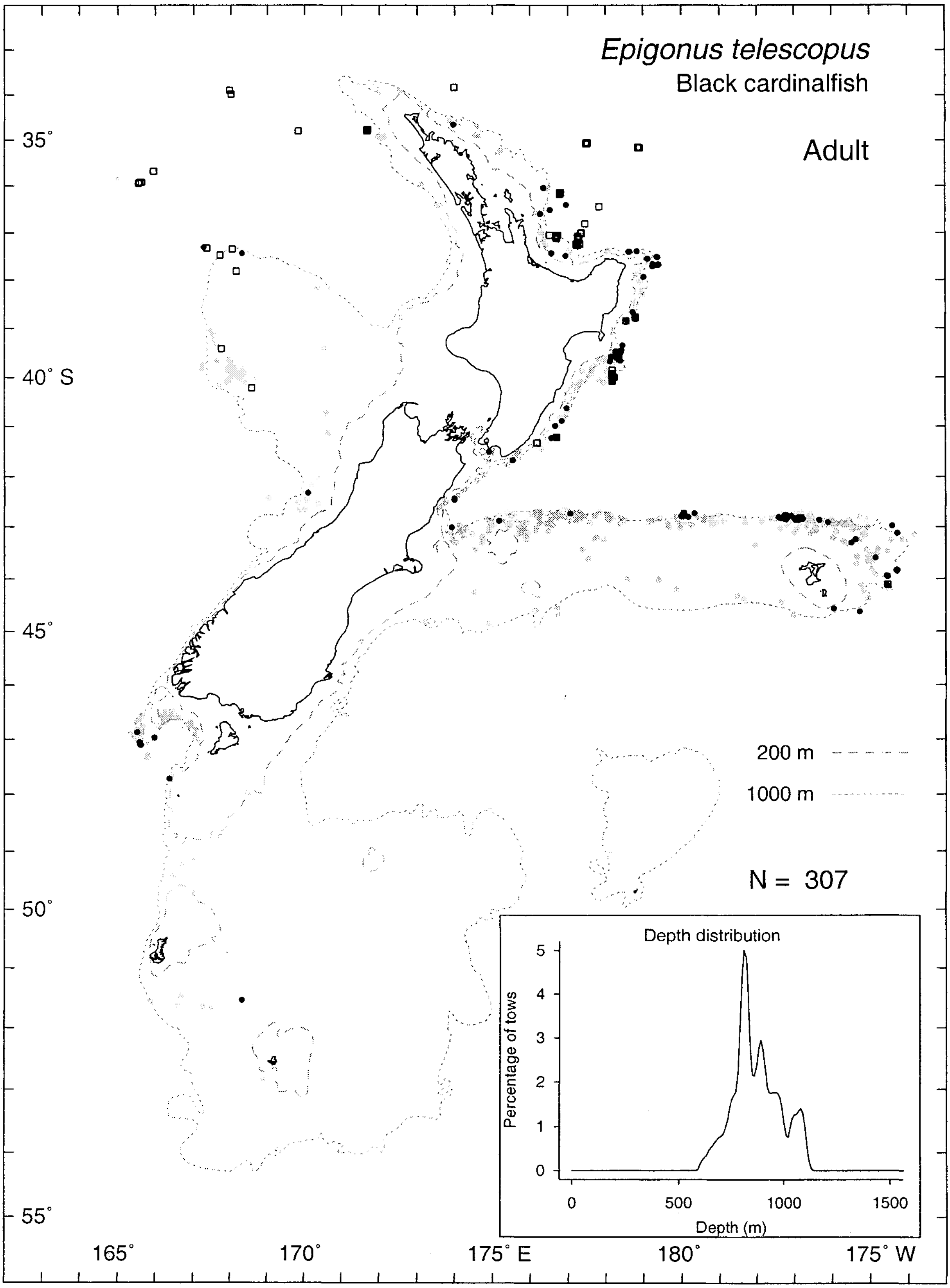


Emmelichthys nitidus
Redbait
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 43
Depth distribution
Percentage of tows
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
Depth (m)

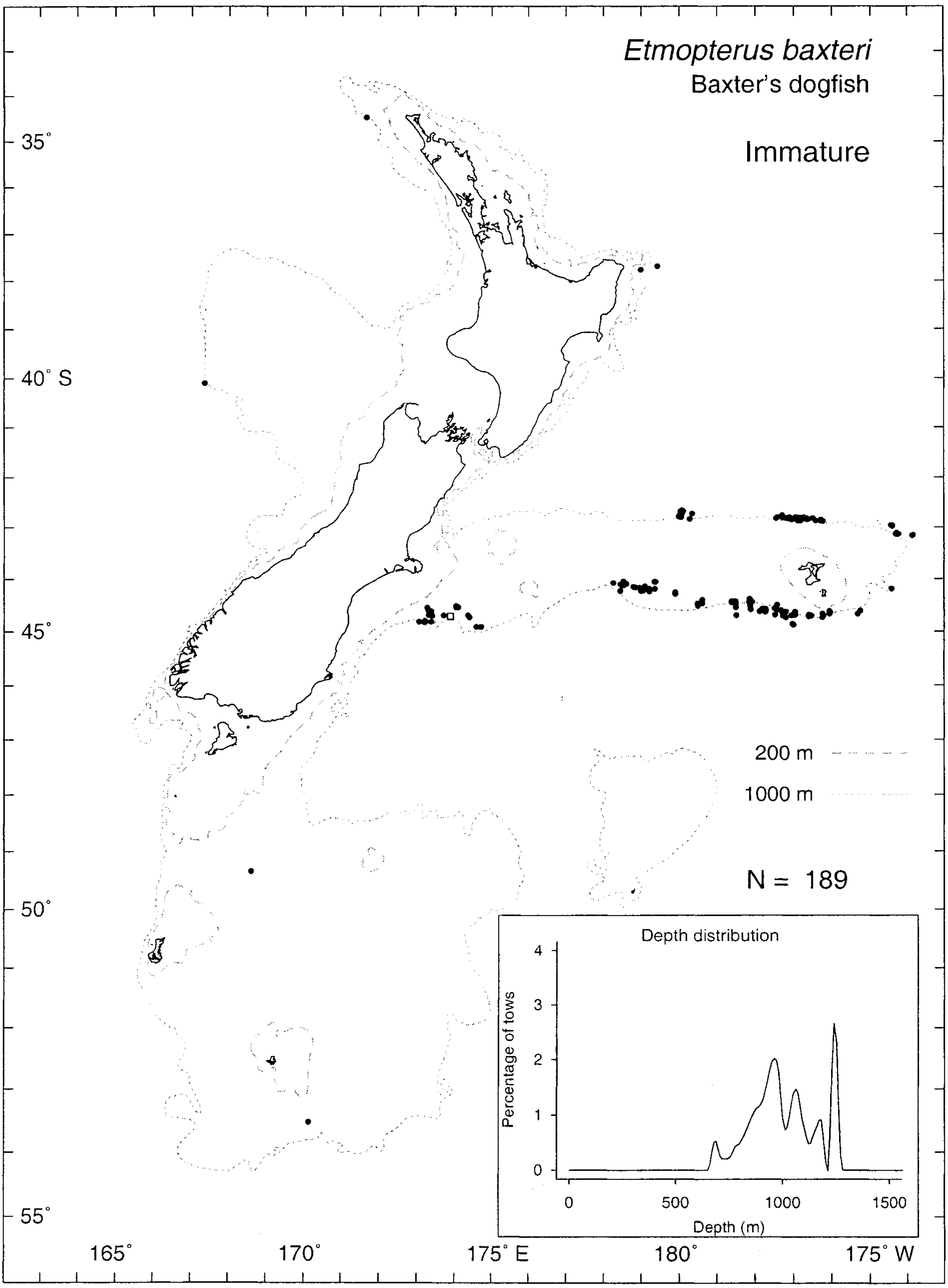

Emmelichthys nitidus
Redbait
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 58
Depth distribution
Percentage of tows
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
Depth (m)

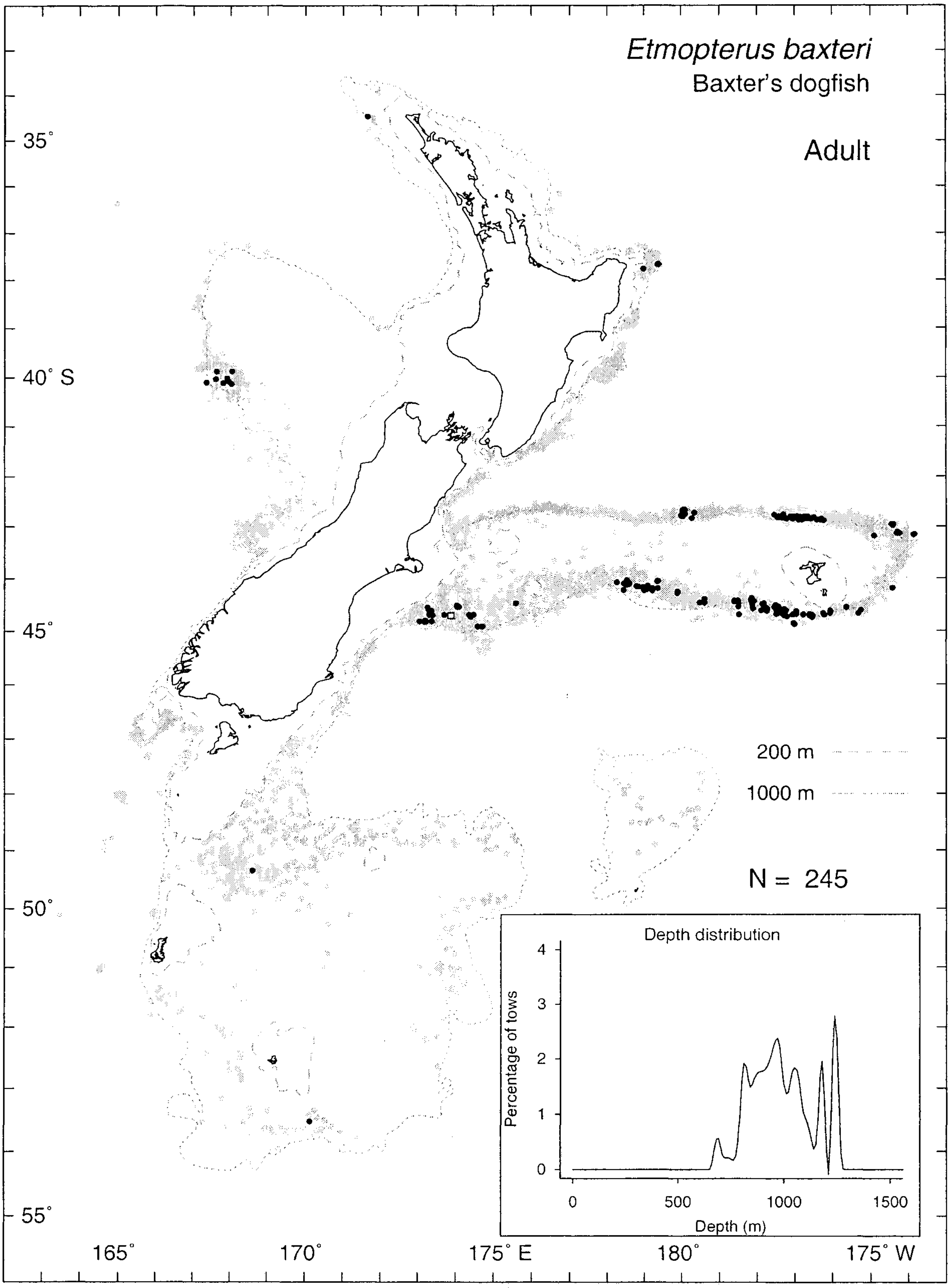


Epigonus telescopus
Black cardinalfish
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 112
Depth distribution
Percentage of tows
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
Depth (m)

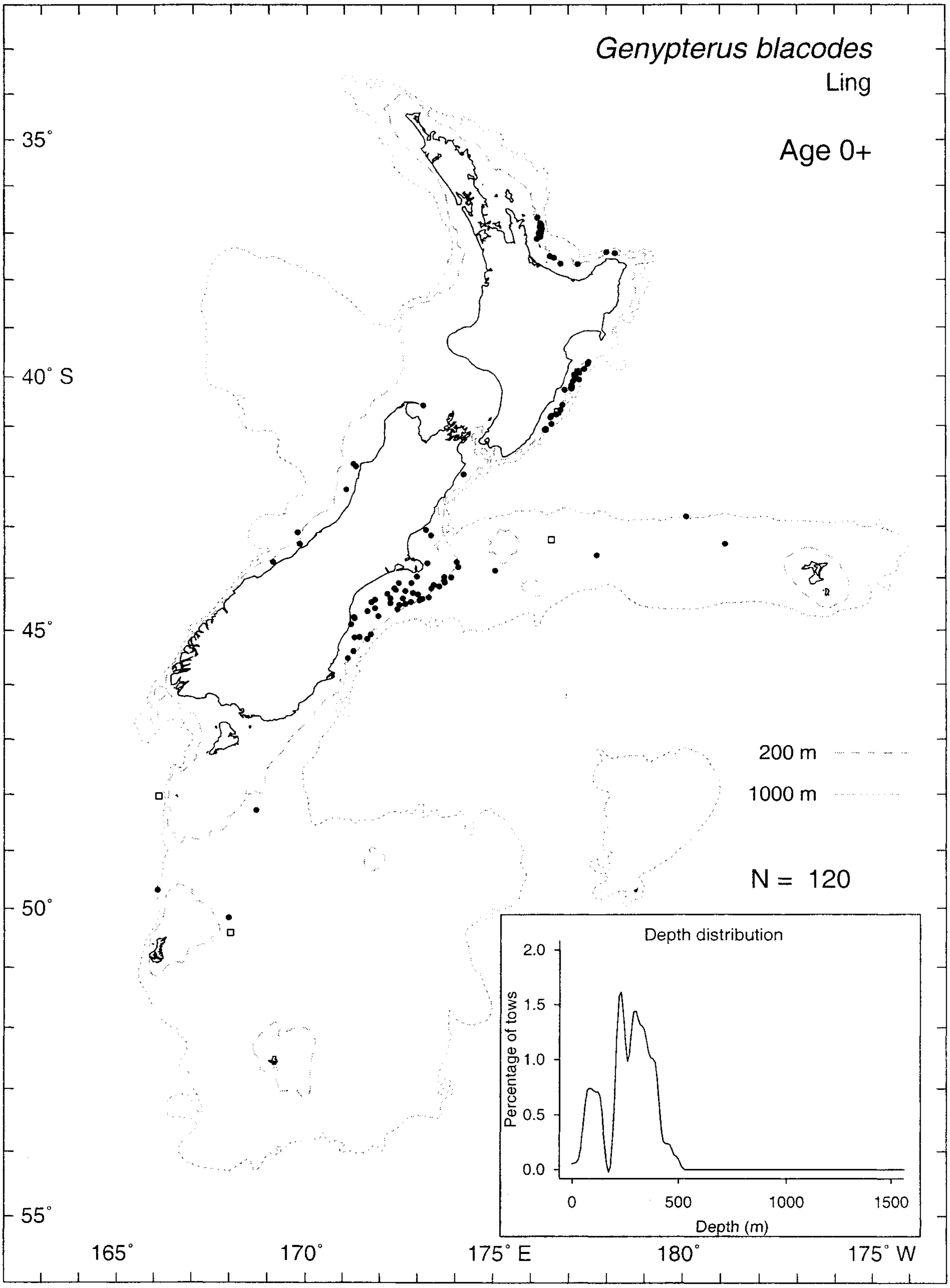


Epigonus telescopus
Black cardinalfish
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 307
Depth distribution
Percentage of tows
Depth (m)
0
500
1000
1500
0
1
2
3
4
5

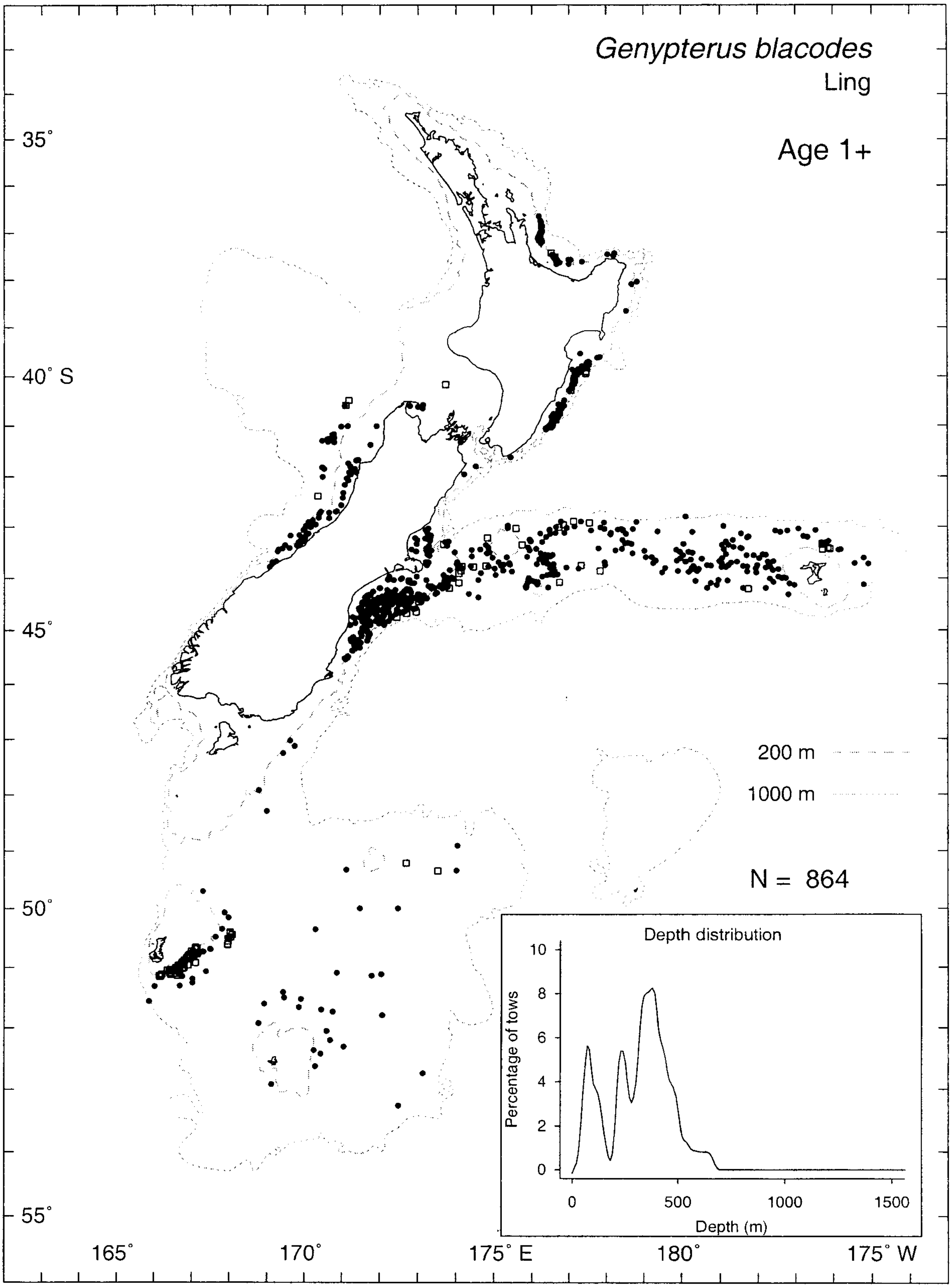

Etmopterus baxteri
Baxter's dogfish
Immature
200 m
1000 m
N = 189
Depth distribution
Percentage of tows
Depth (m)
0
500
1000
1500
0
1
2
3
4
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W



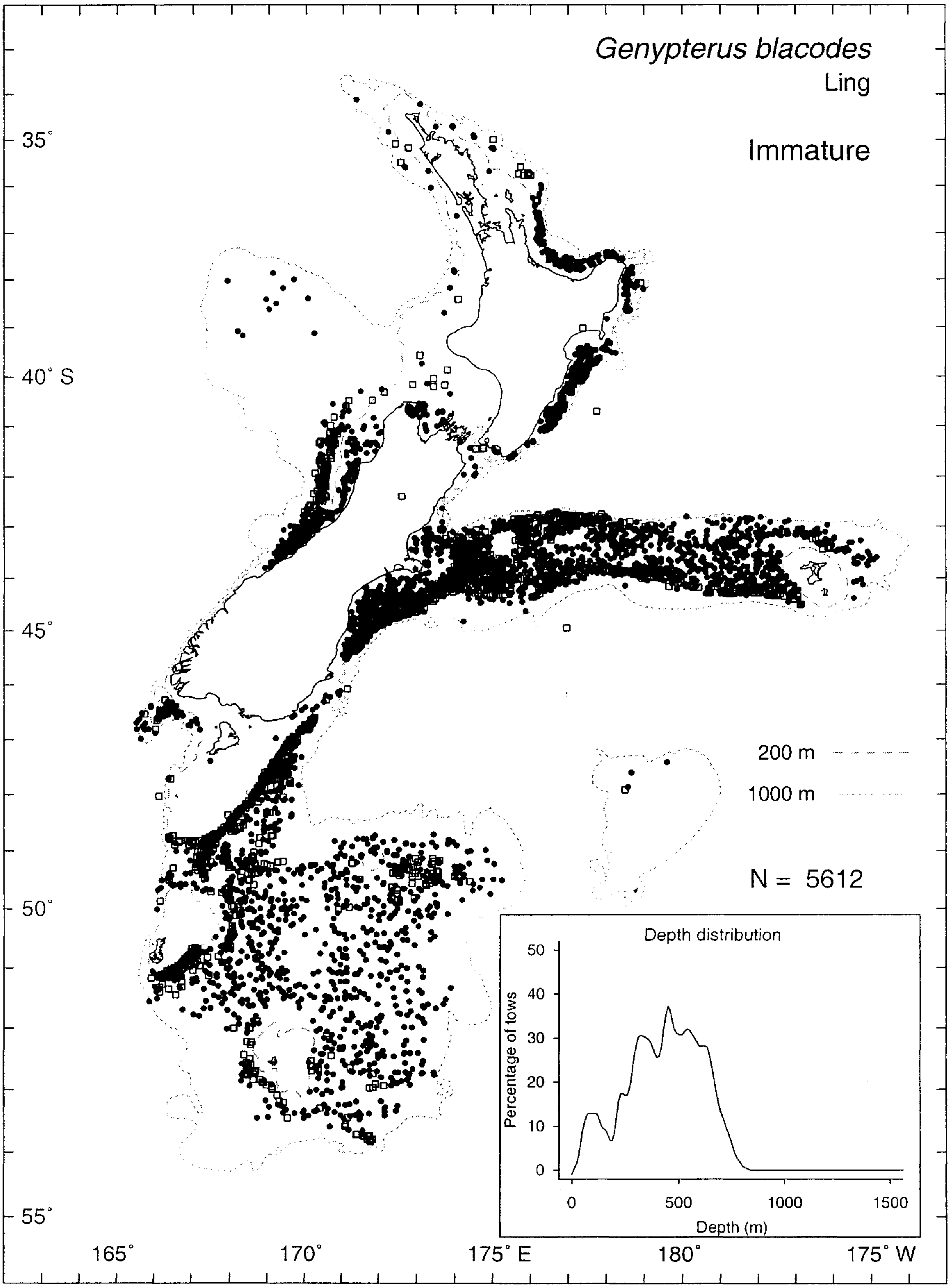
Etmopterus baxteri
Baxter's dogfish
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 245
Depth distribution
Percentage of tows
Depth (m)
0
1
2
3
4
500
1000
1500



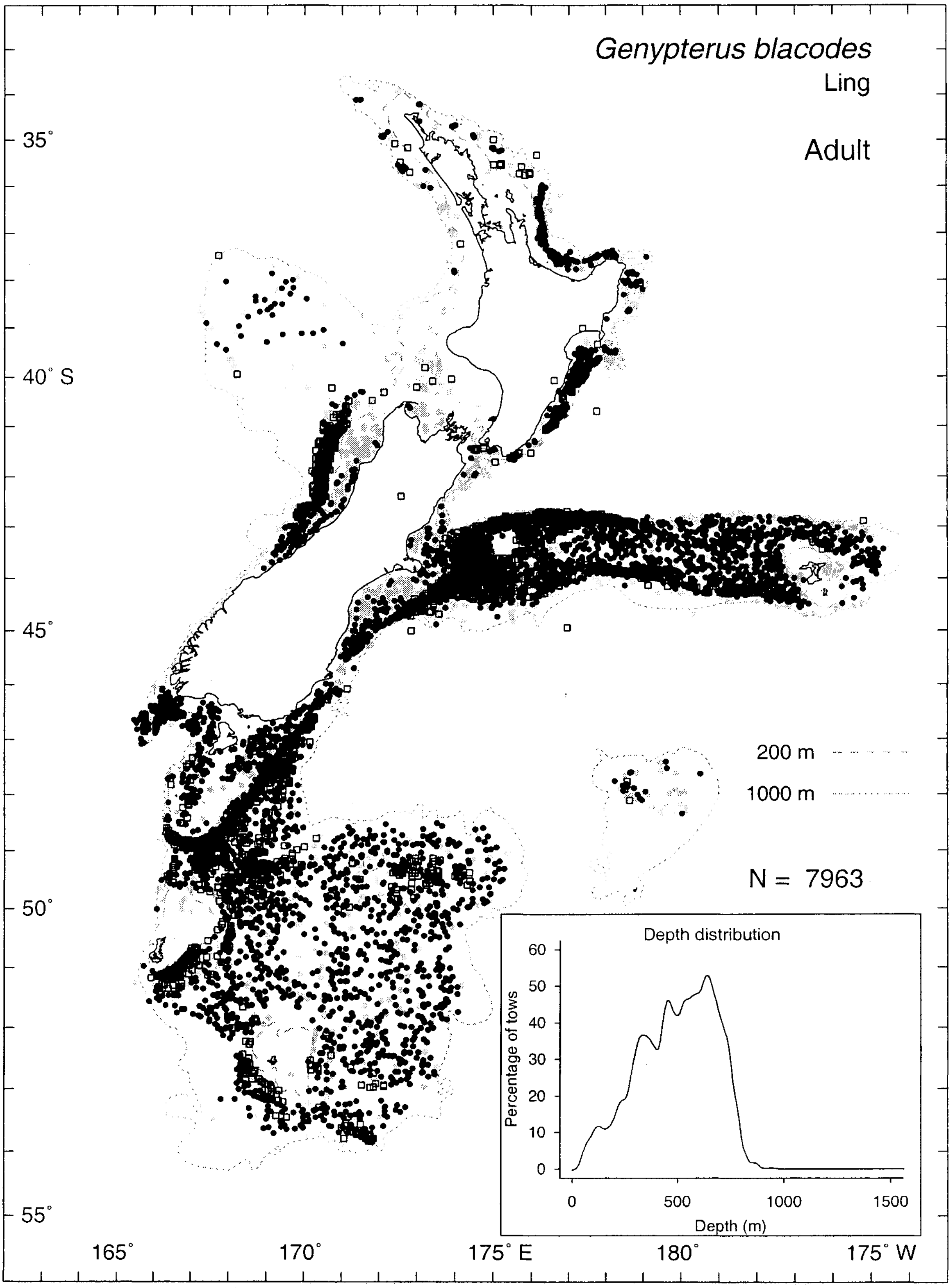
Genypterus blacodes
Ling
Age 0+
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 120
Depth distribution
Percentage of tows
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Depth (m)



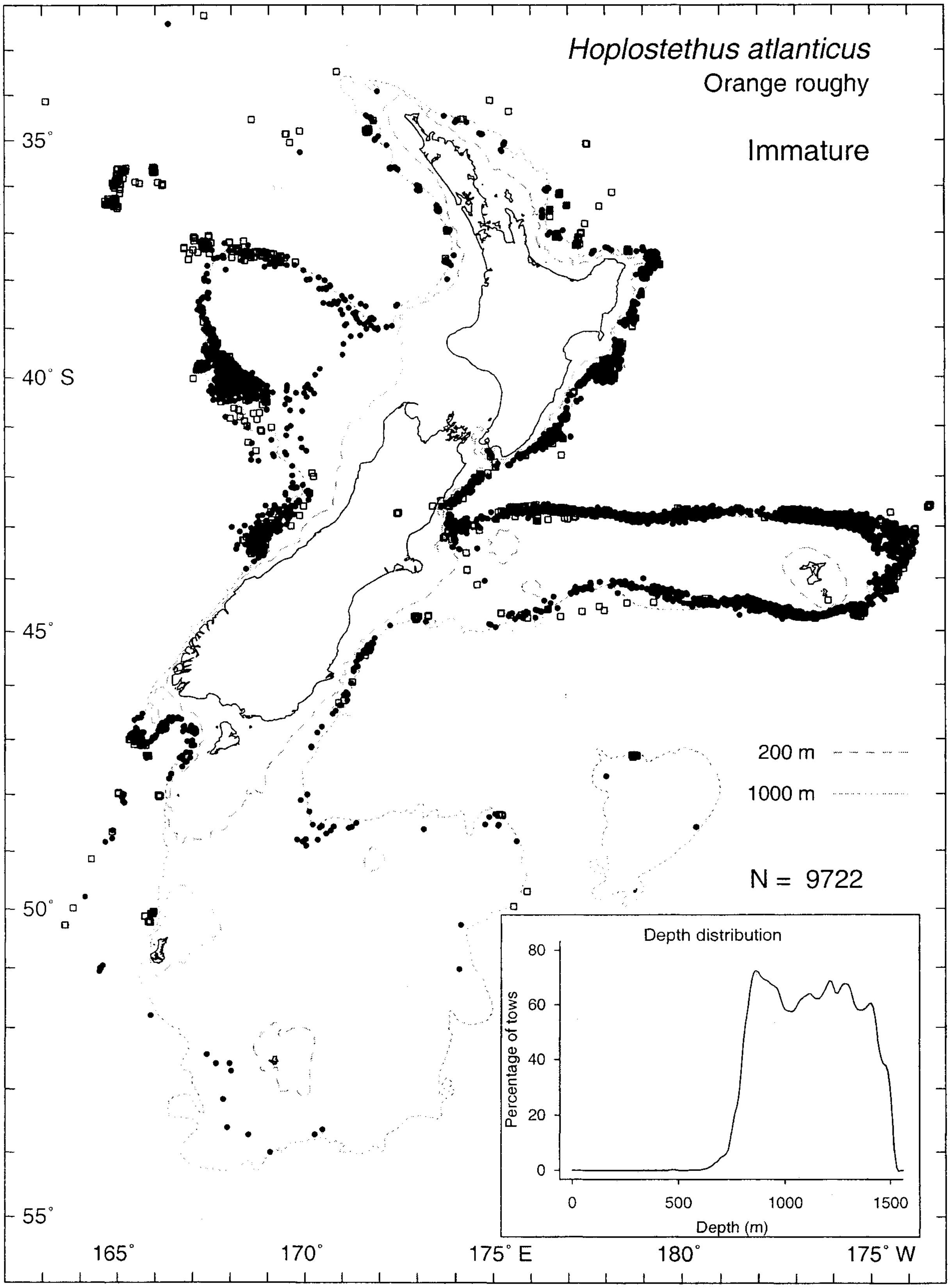
Genypterus blacodes
Ling
Age 1+
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 864
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
10
500
1000
1500



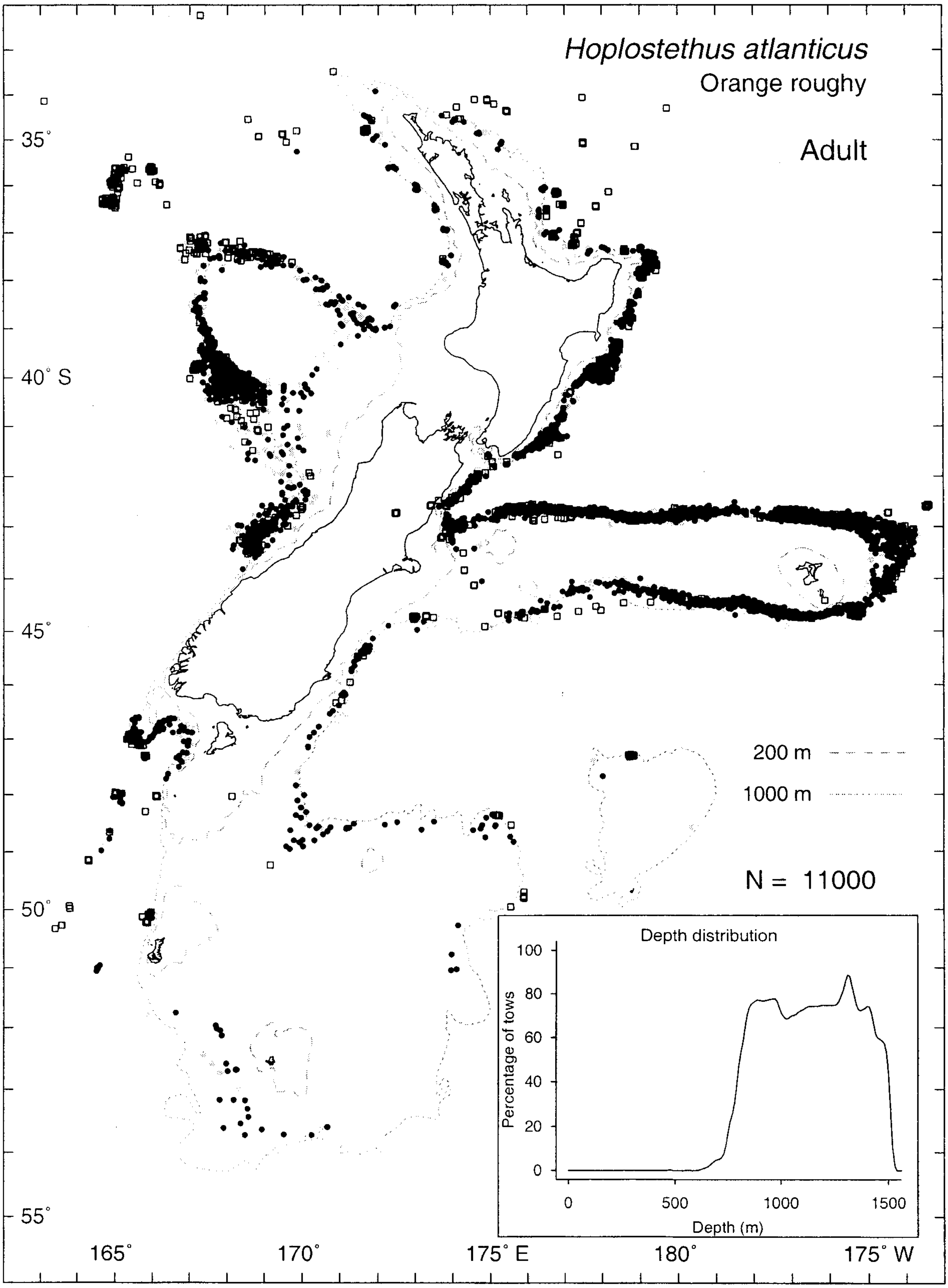
Genypterus blacodes
Ling
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 5612
Depth distribution
Percentage of tows
0
10
20
30
40
50
500
1000
1500
Depth (m)

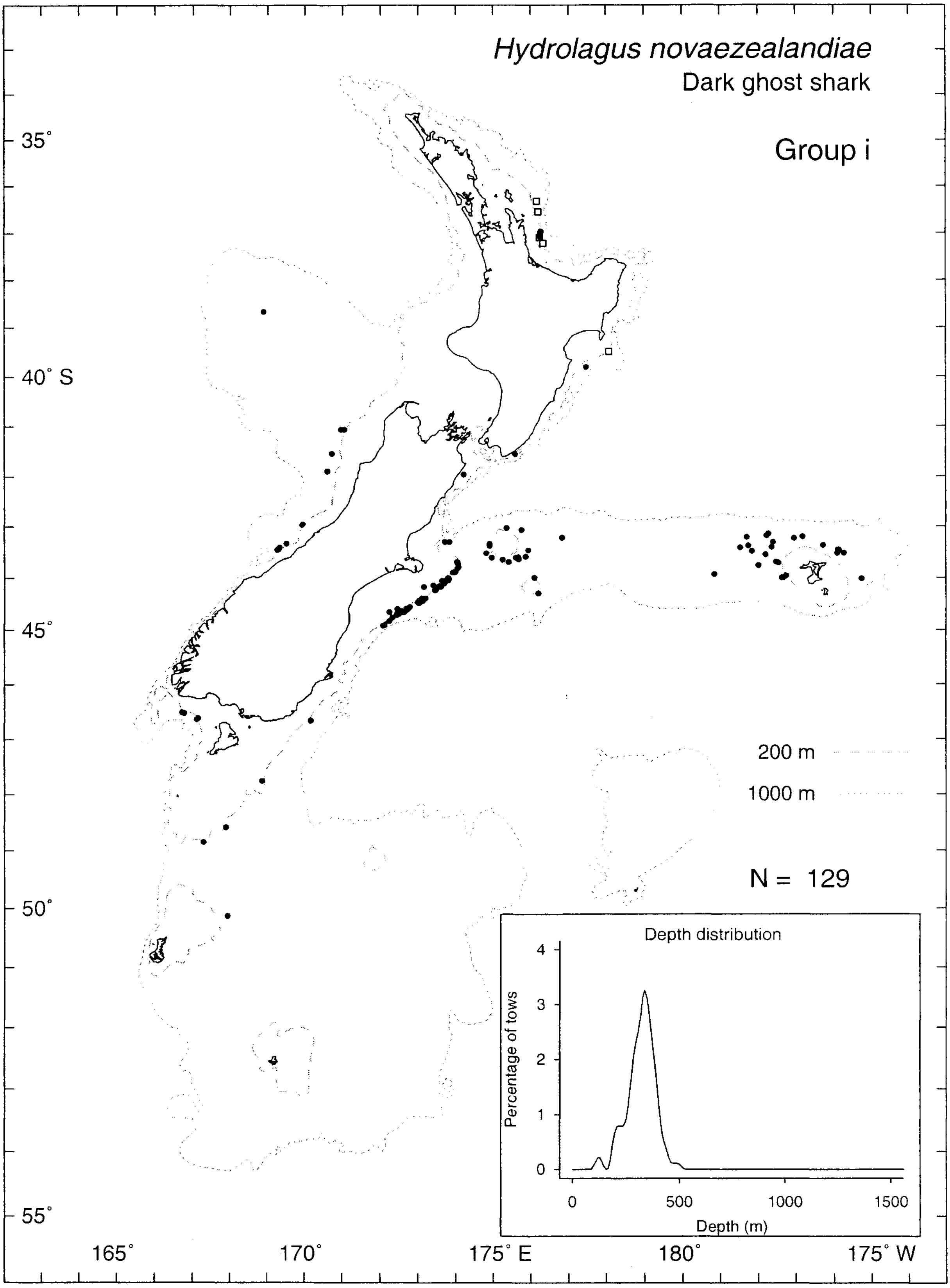


Genypterus blacodes
Ling
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 7963
Depth distribution
Percentage of tows
60
50
40
30
20
10
0
0
500
1000
1500
Depth (m)

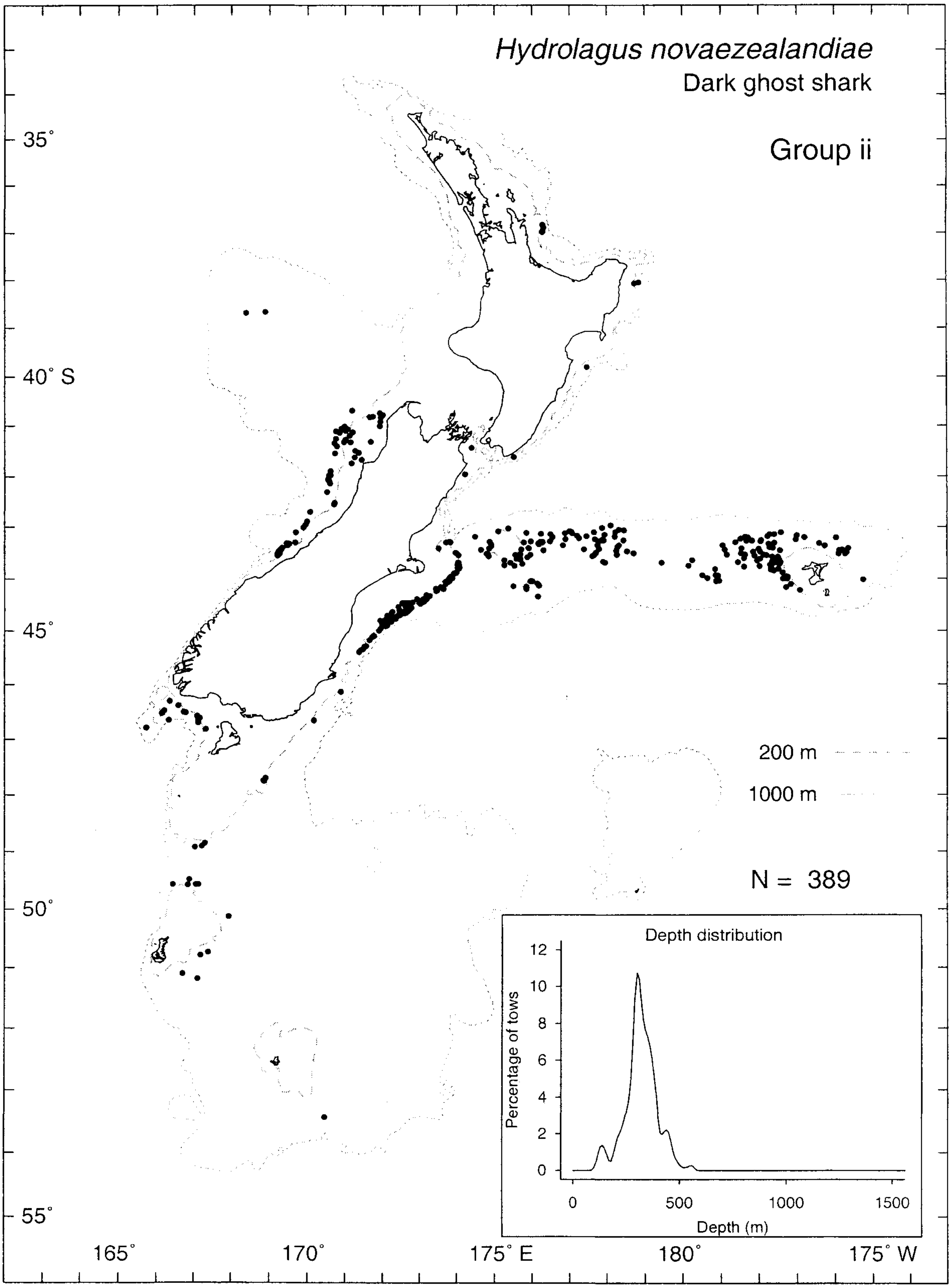


Hoplostethus atlanticus
Orange roughy
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 9722
Depth distribution
Percentage of tows
80
60
40
20
0
0
500
1000
1500
Depth (m)

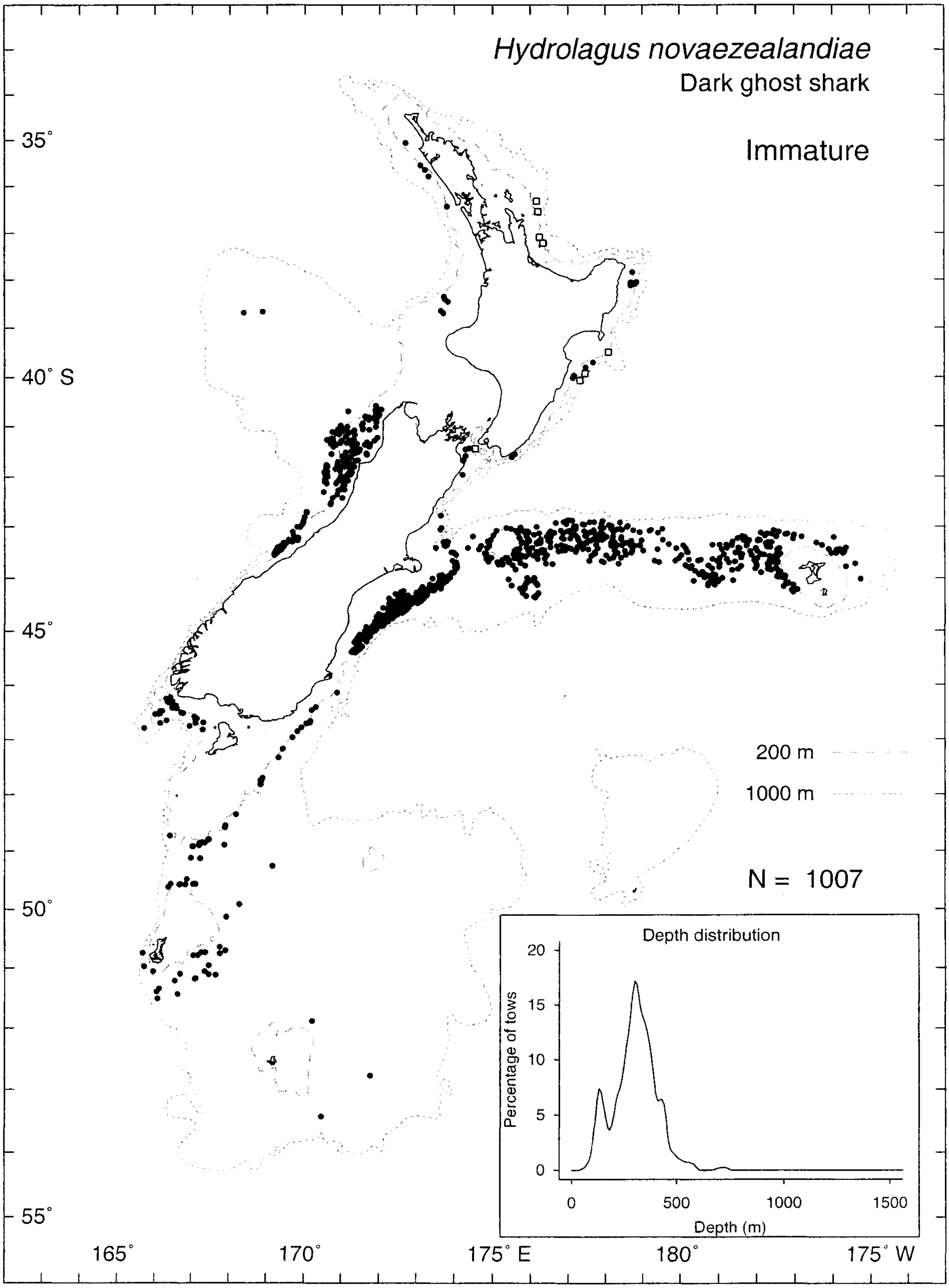

Hoplostethus atlanticus
Orange roughy
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 11000
Depth distribution
Percentage of tows
Depth (m)
0
500
1000
1500
100
80
60
40
20
0

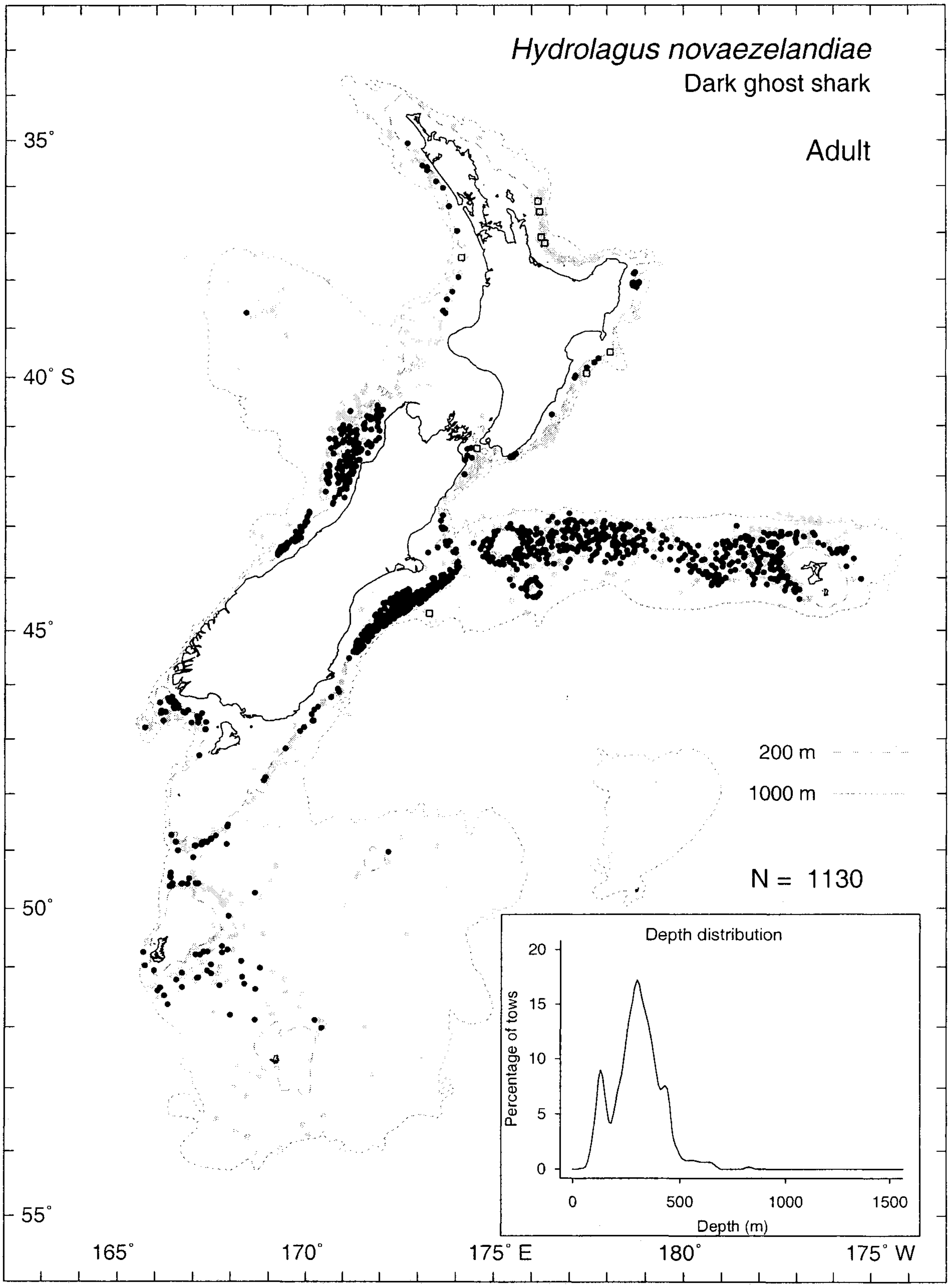


Hydrolagus novaezealandiae
Dark ghost shark
Group i
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 129
Depth distribution
Percentage of tows
0
1
2
3
4
0
500
1000
1500
Depth (m)

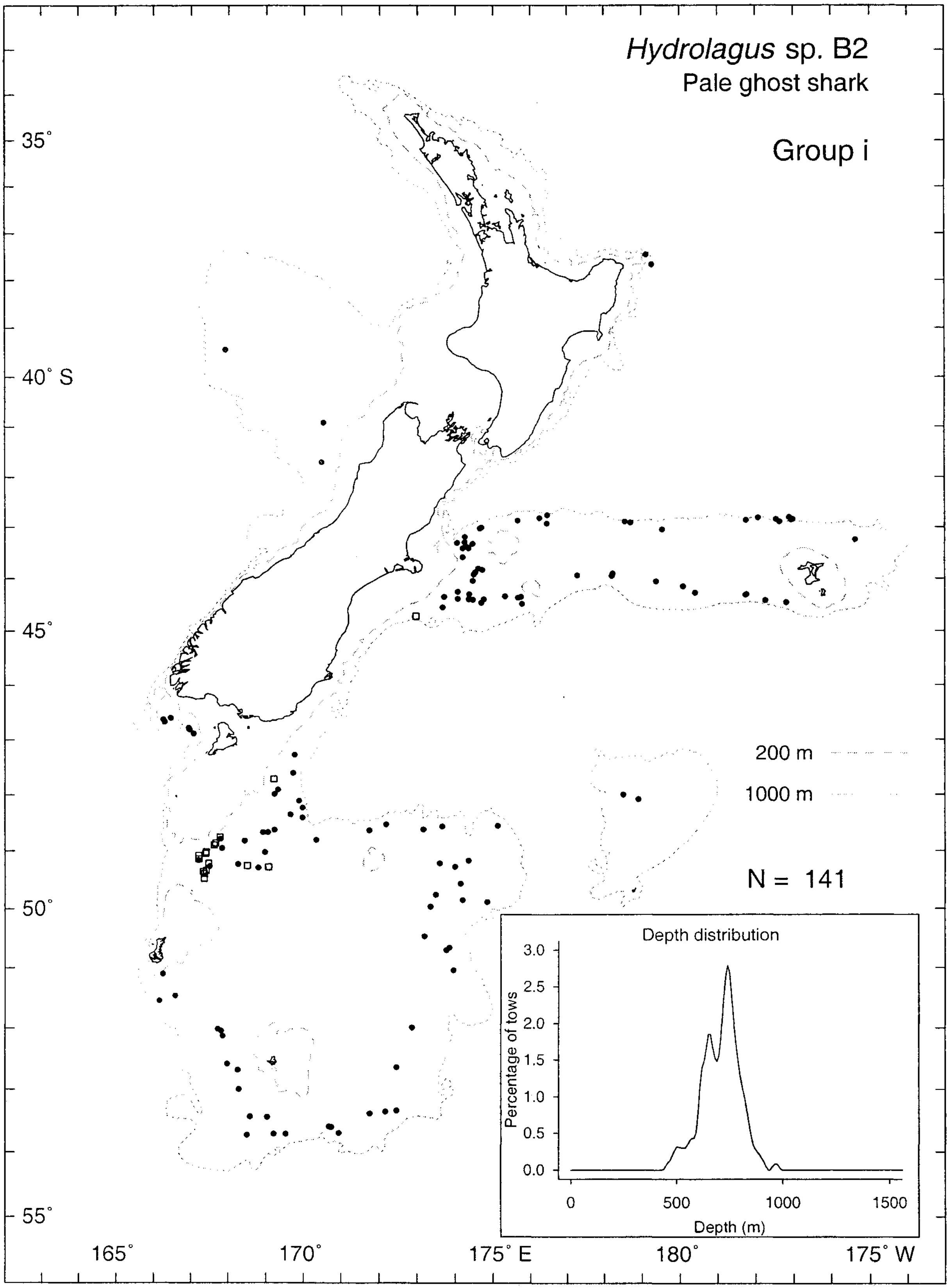


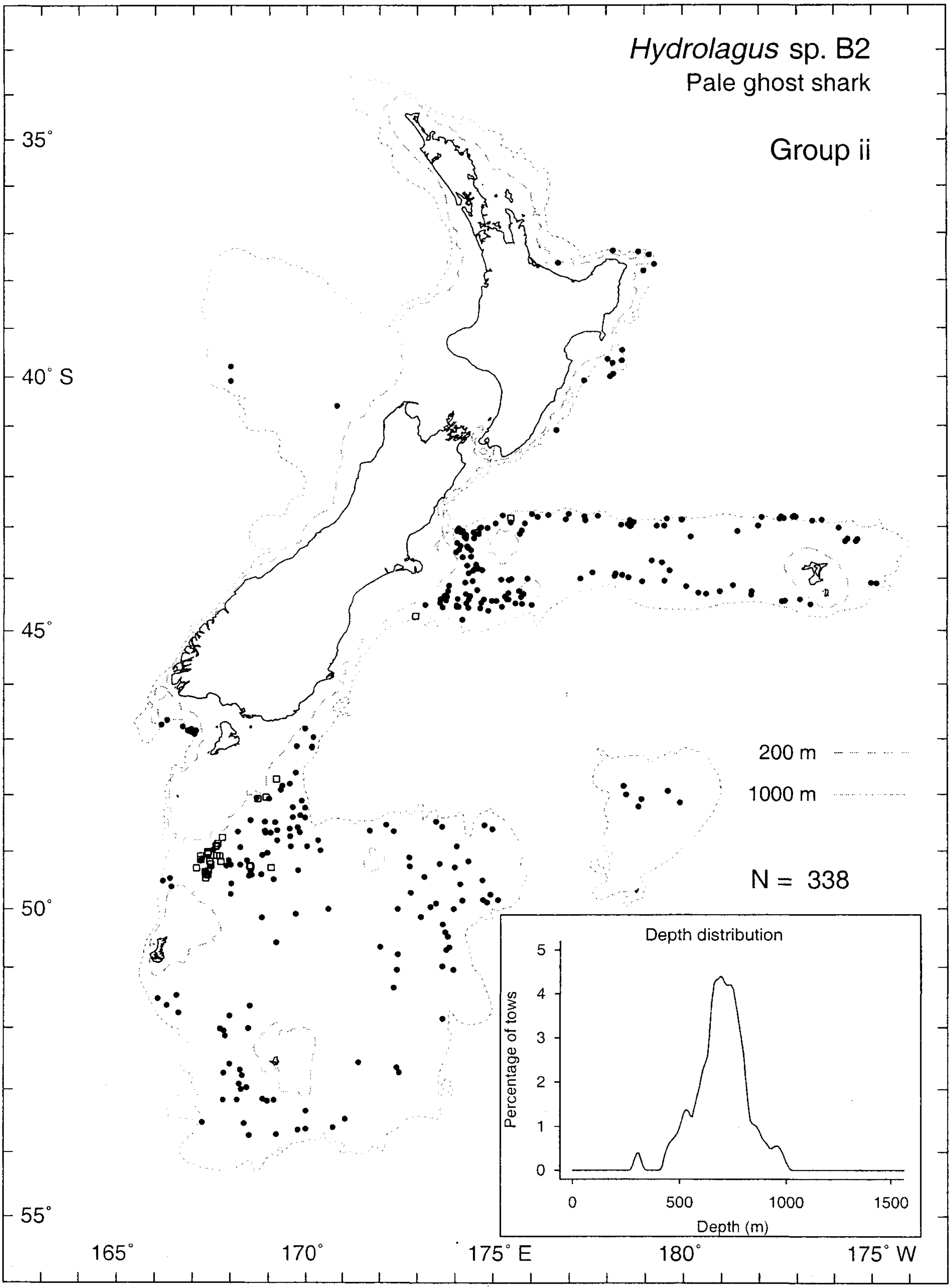
Hydrolagus novaezealandiae
Dark ghost shark
Group ii
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 389
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
10
12
0
500
1000
1500

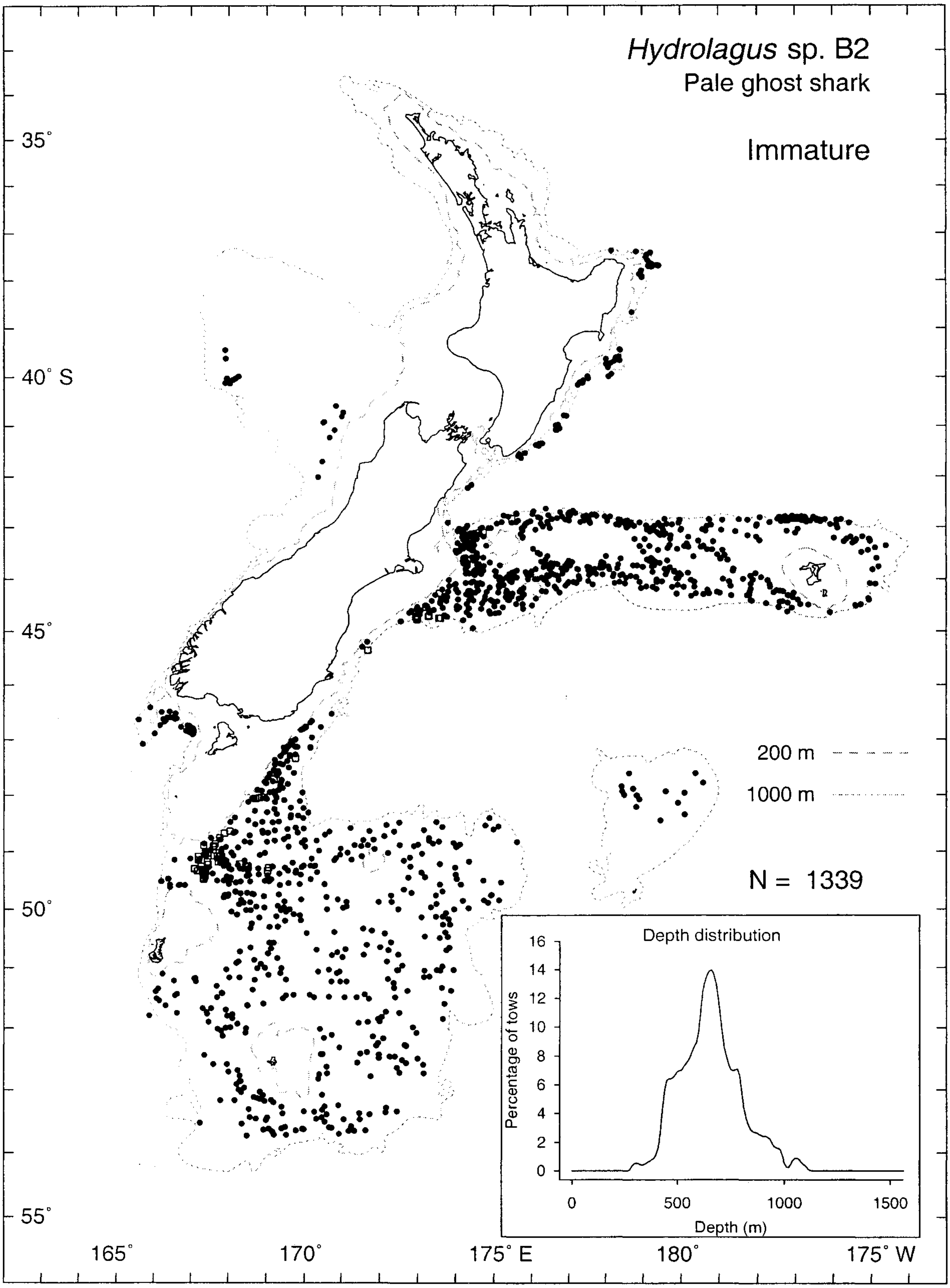

Hydrolagus novaezealandiae
Dark ghost shark
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 1007
Depth distribution
Percentage of tows
20
15
10
5
0
0
500
1000
1500
Depth (m)



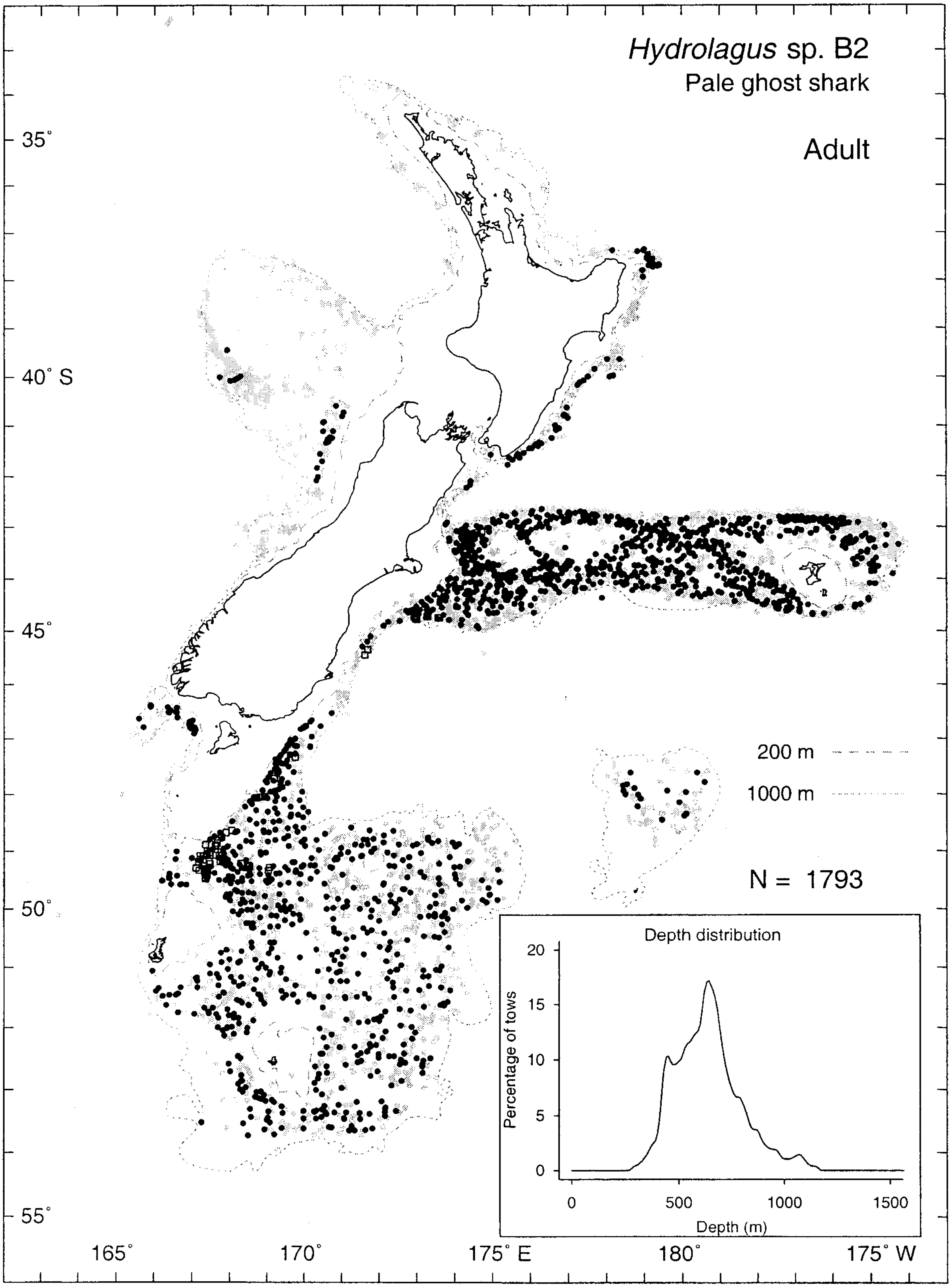
Hydrolagus novaezelandiae
Dark ghost shark
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 1130
Depth distribution
Percentage of tows
Depth (m)
0
5
10
15
20
500
1000
1500


Hydrolagus sp. B2
Pale ghost shark
Group i
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 141
Depth distribution
Percentage of tows
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Depth (m)

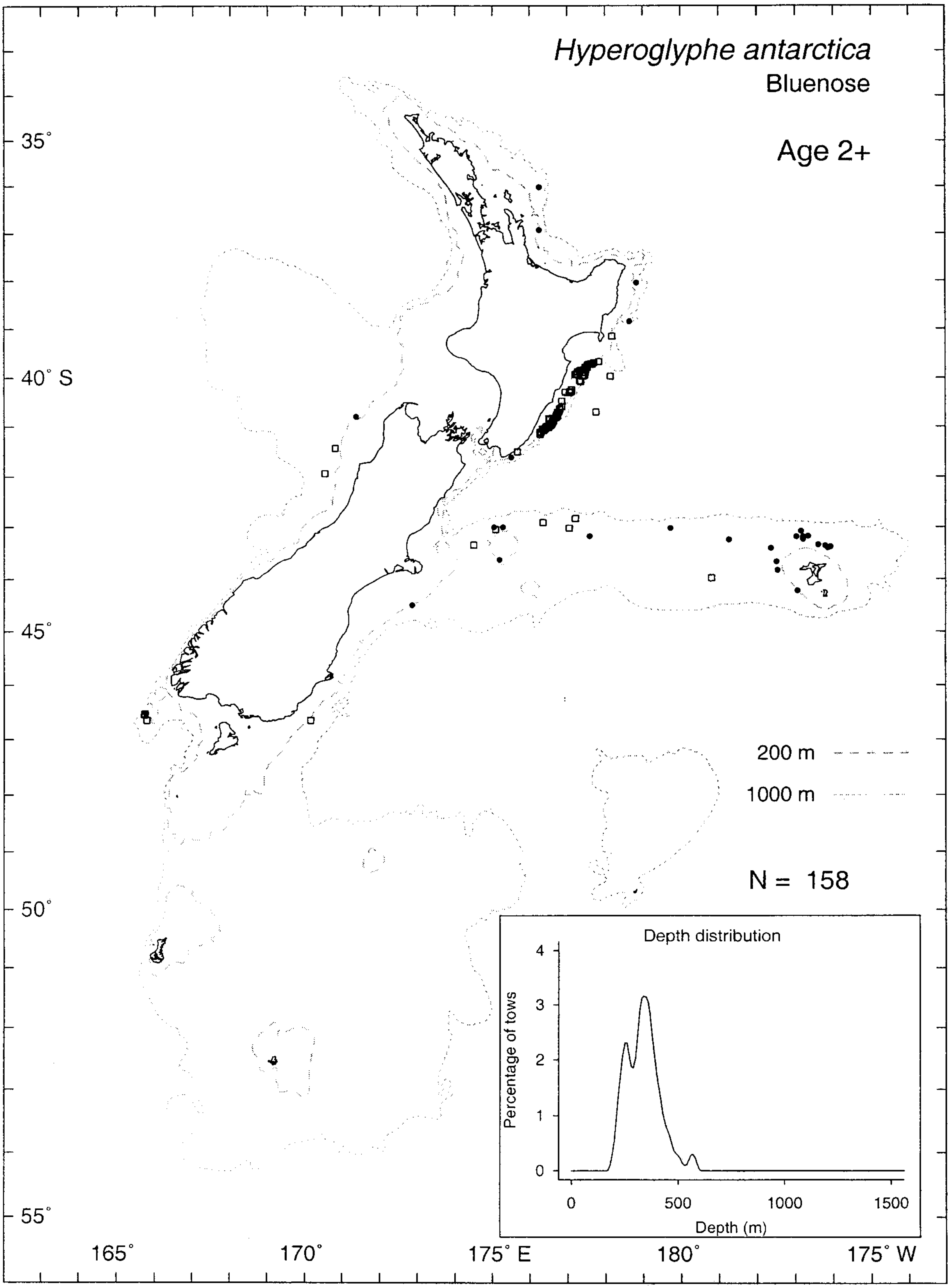

Hydrolagus sp. B2
Pale ghost shark
Group ii
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 338
Depth distribution
Percentage of tows
Depth (m)
0
500
1000
1500
0
1
2
3
4
5



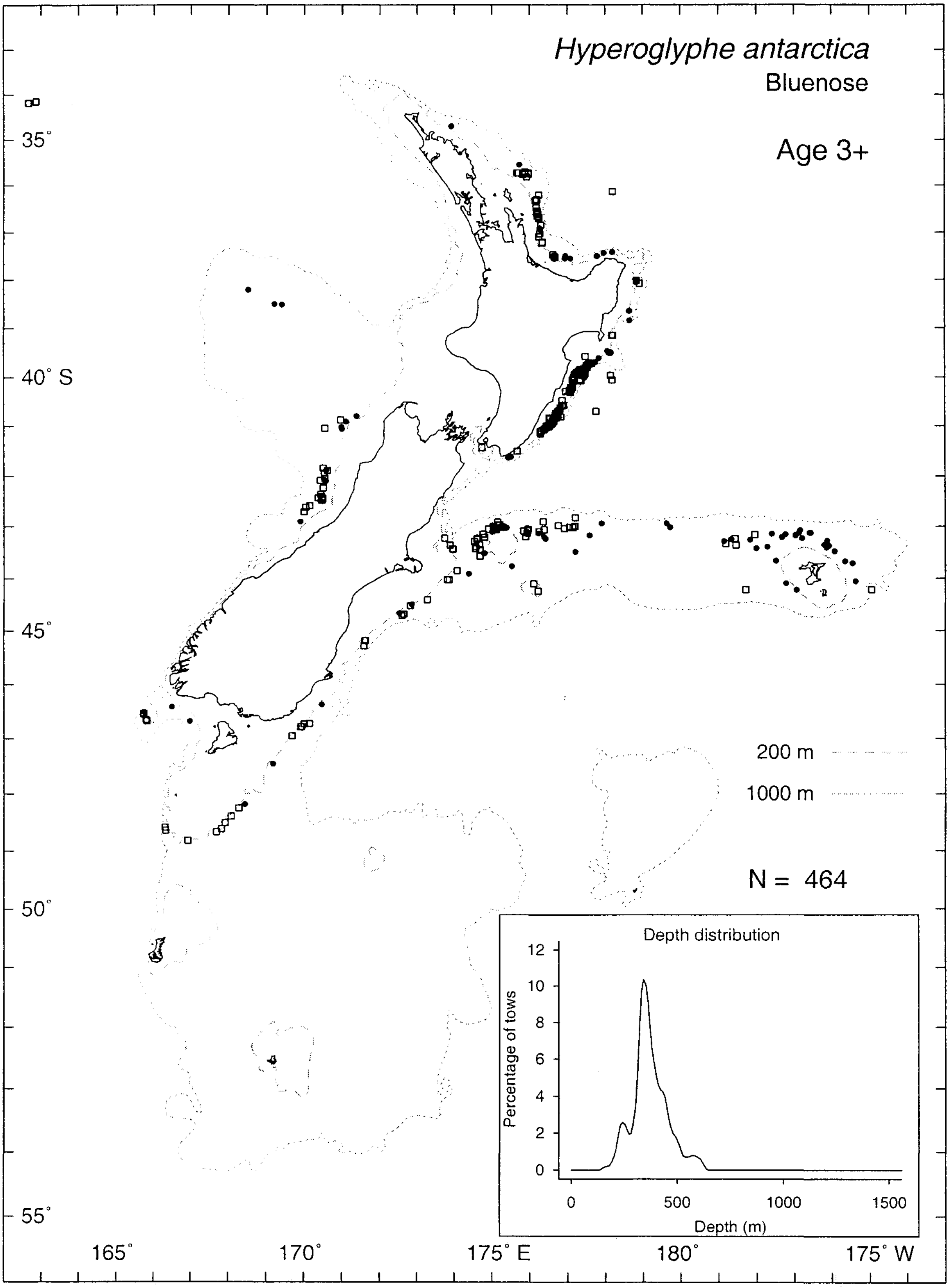
Hydrolagus sp. B2
Pale ghost shark
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 1339
Depth distribution
Percentage of tows
Depth (m)



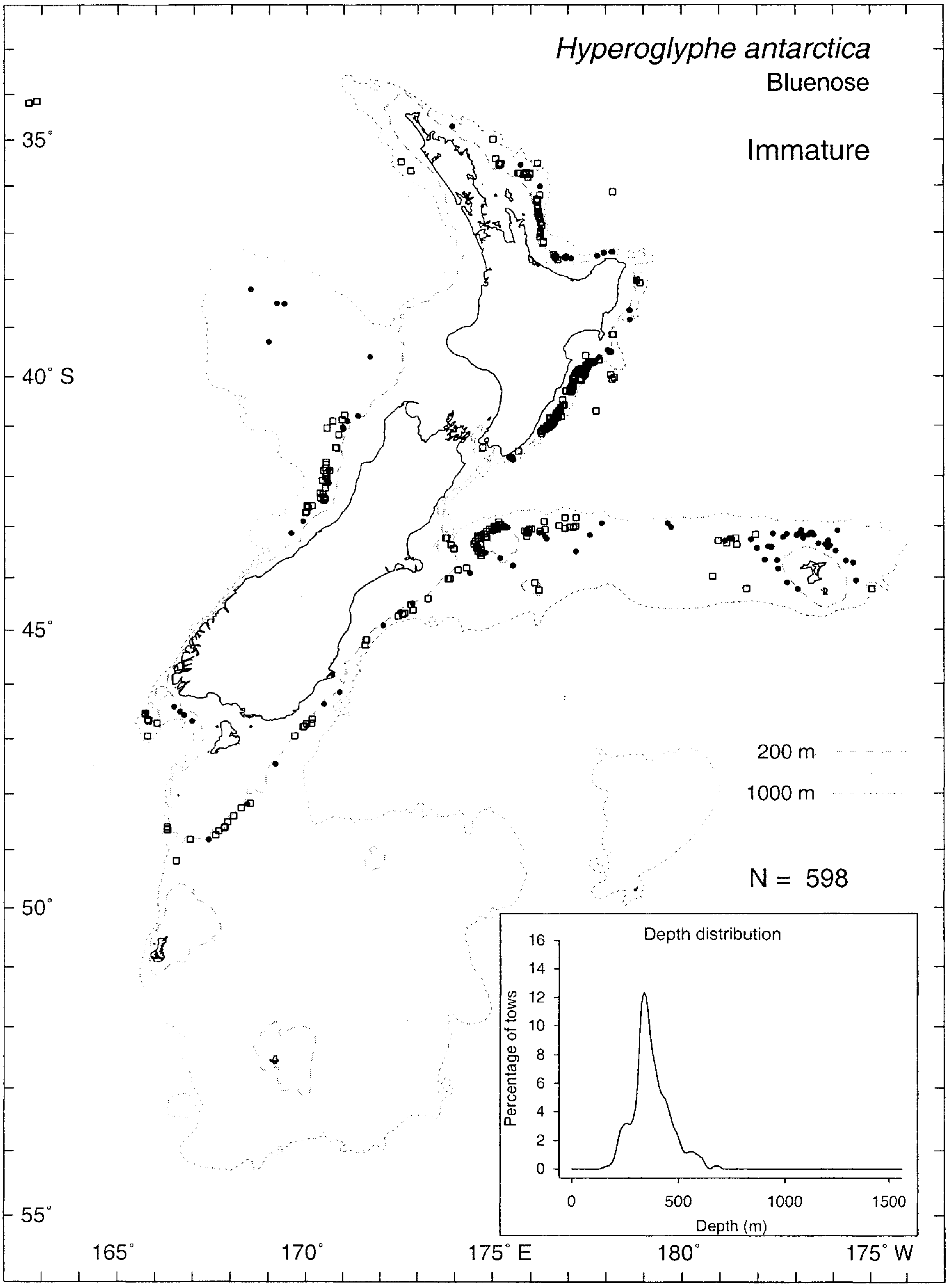
Hydrolagus sp. B2
Pale ghost shark
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 1793
Depth distribution
Percentage of tows
20
15
10
5
0
0
500
1000
1500
Depth (m)



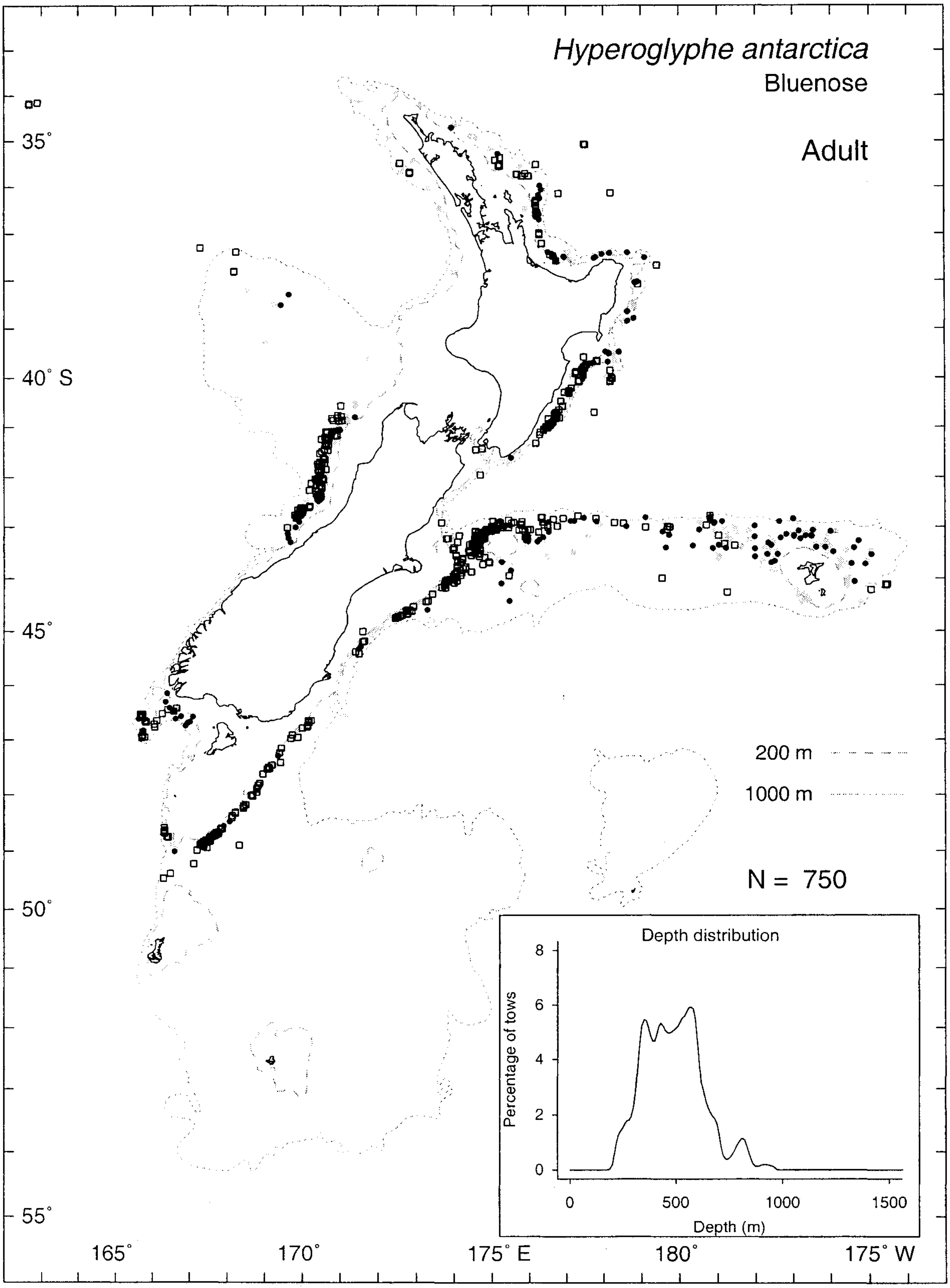
Hyperoglyphe antarctica
Bluenose
Age 2+
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 158
Depth distribution
Percentage of tows
Depth (m)
0
500
1000
1500
0
1
2
3
4



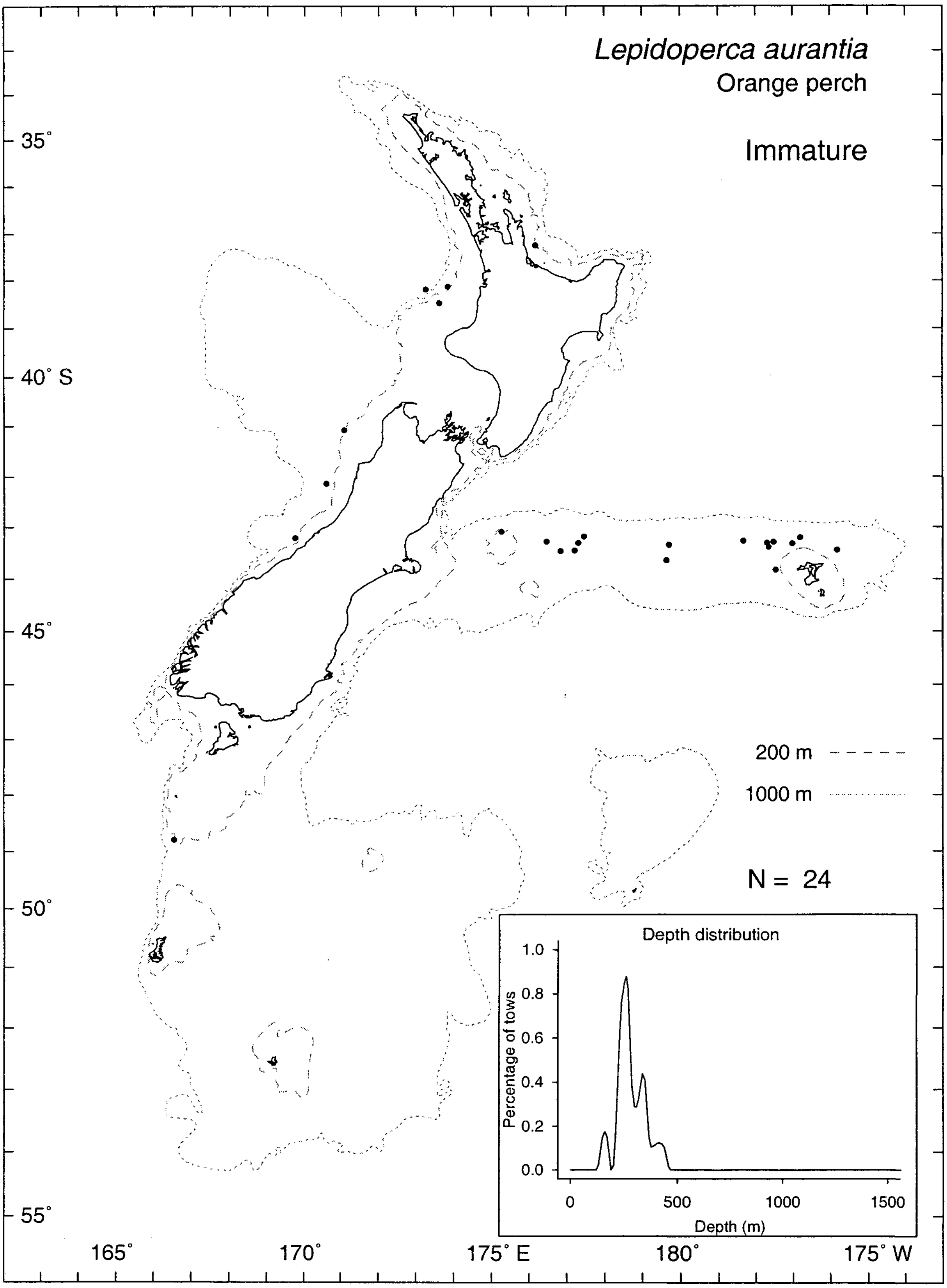
Hyperoglyphe antarctica
Bluenose
Age 3+
35°
40° S
45°
50°
55°
200 m
1000 m
N = 464
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
10
12
0
500
1000
1500
165°
170°
175° E
180°
175° W



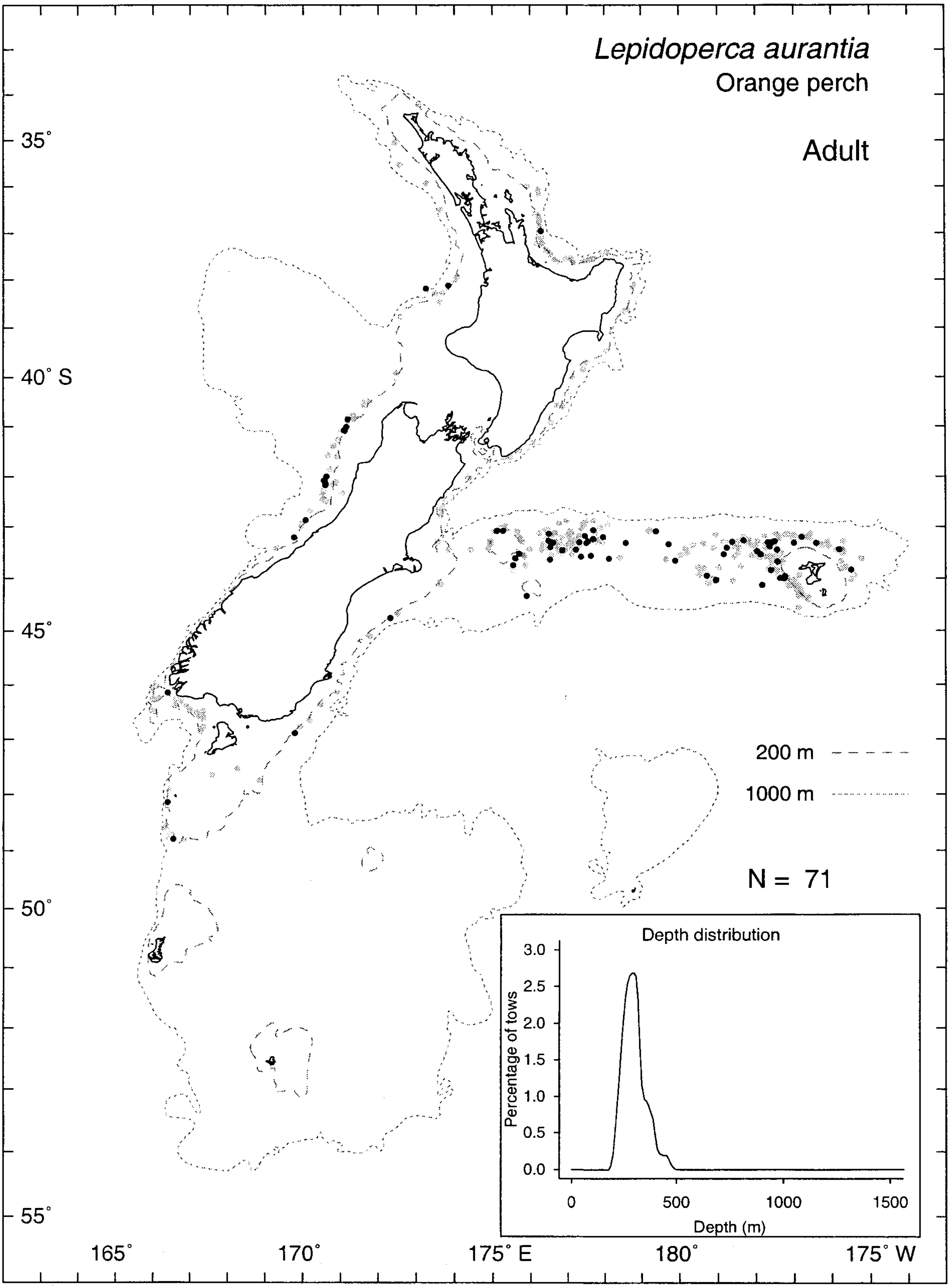
Hyperoglyphe antarctica
Bluenose
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 598
Depth distribution
Percentage of tows
16
14
12
10
8
6
4
2
0
0
500
1000
1500
Depth (m)



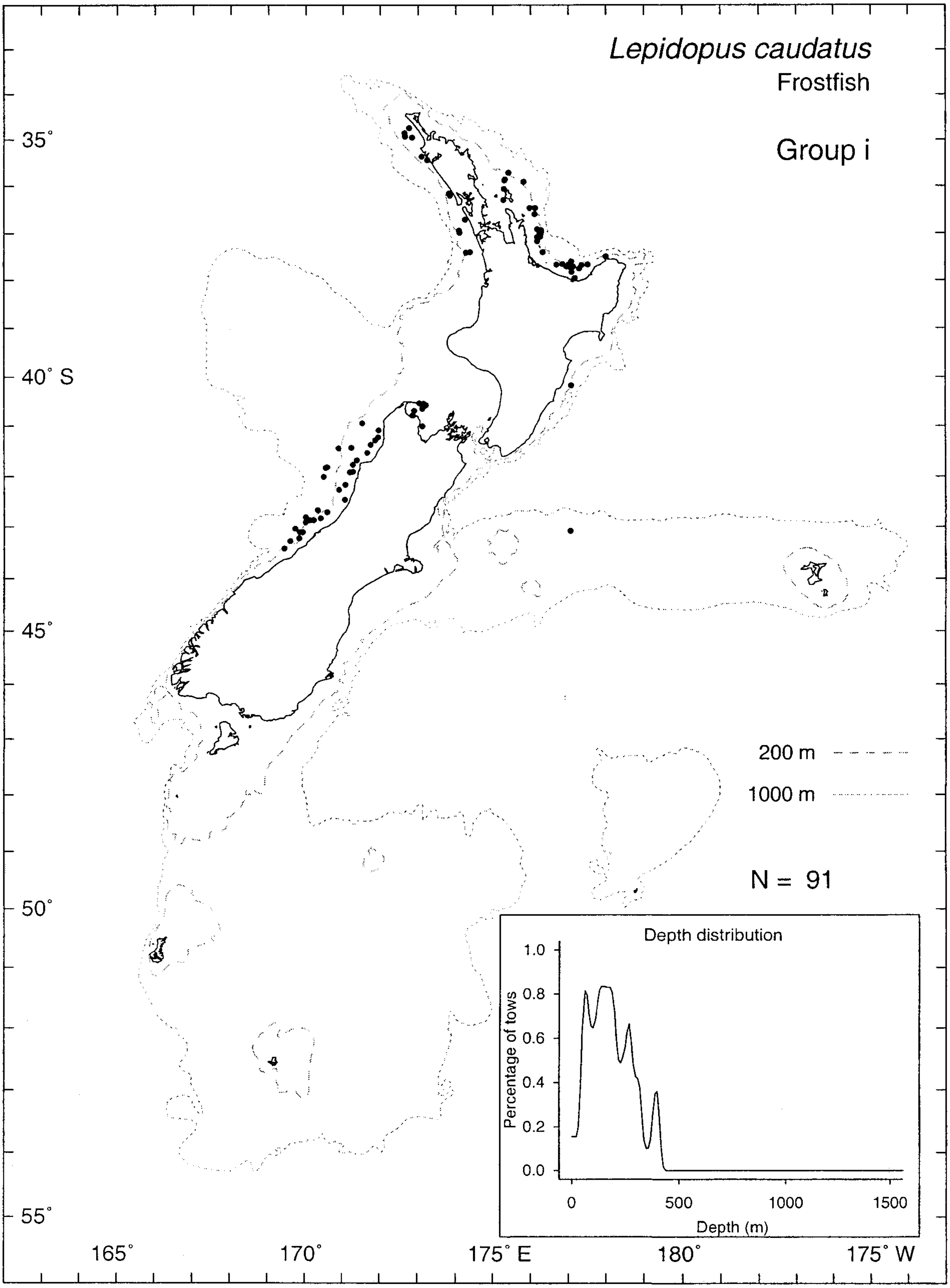
Hyperoglyphe antarctica
Bluenose
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 750
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
0
500
1000
1500



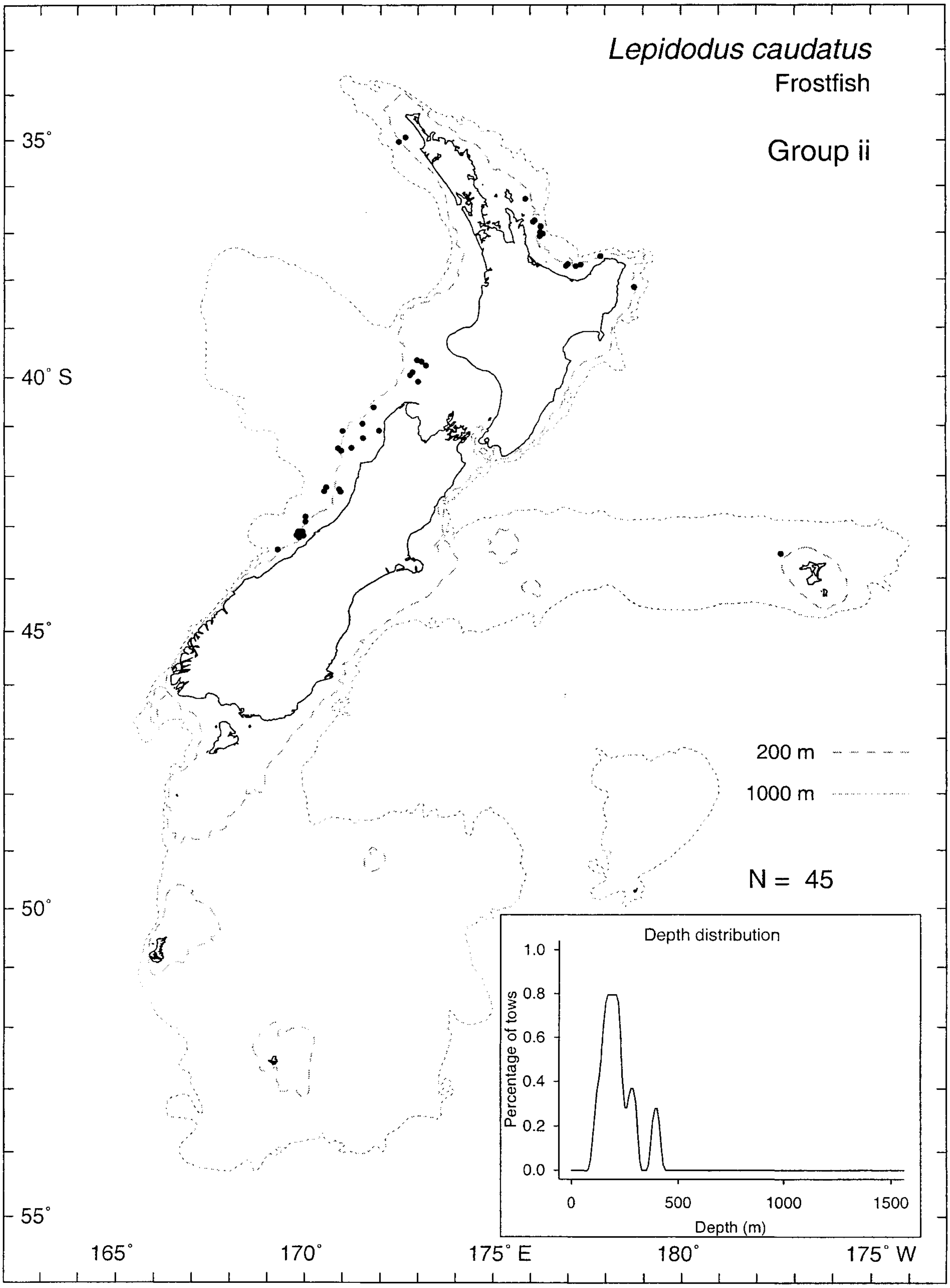
Lepidoperca aurantia
Orange perch
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 24
Depth distribution
Percentage of tows
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
Depth (m)



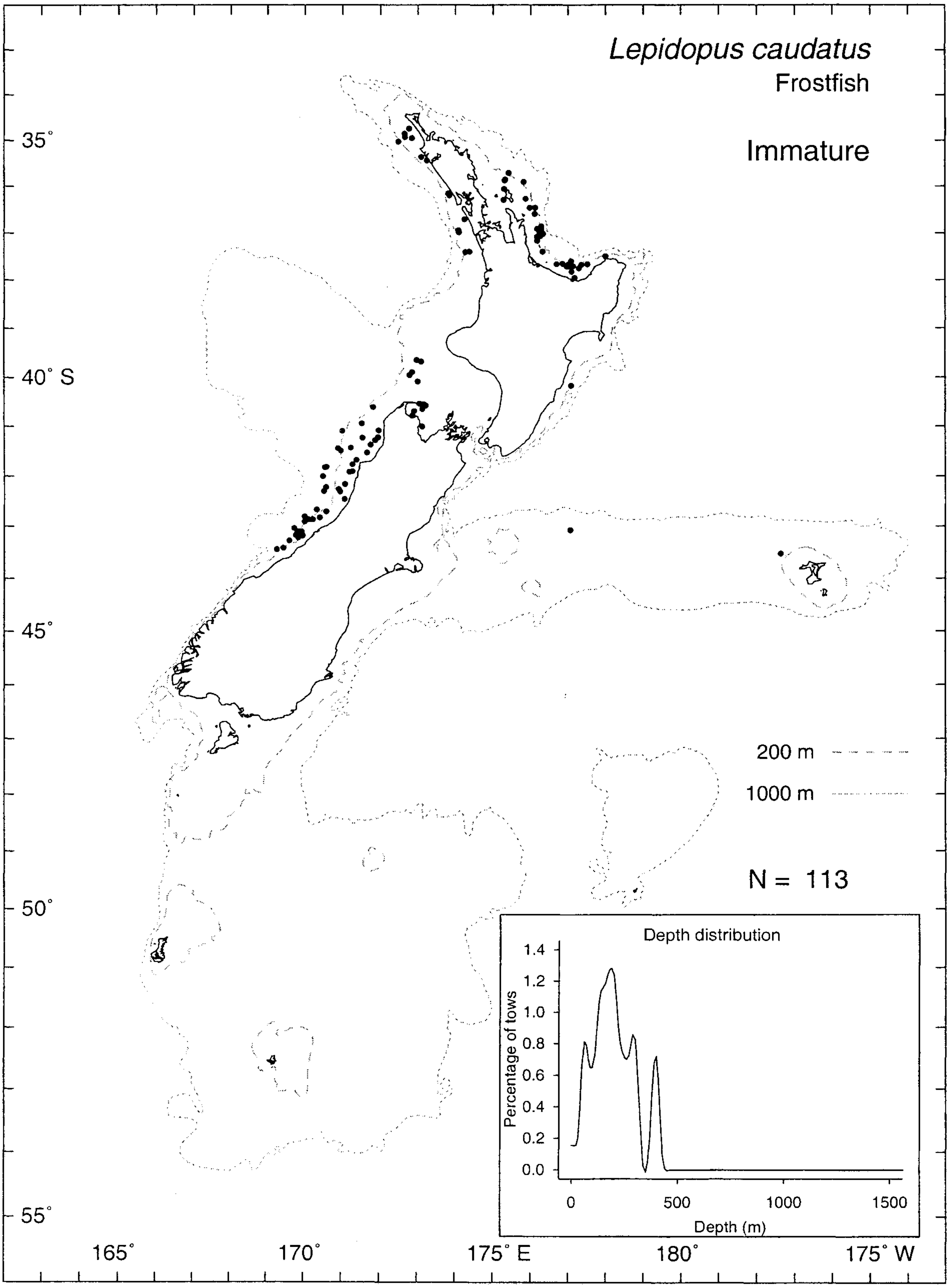
Lepidoperca aurantia
Orange perch
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 71
Depth distribution
Percentage of tows
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Depth (m)



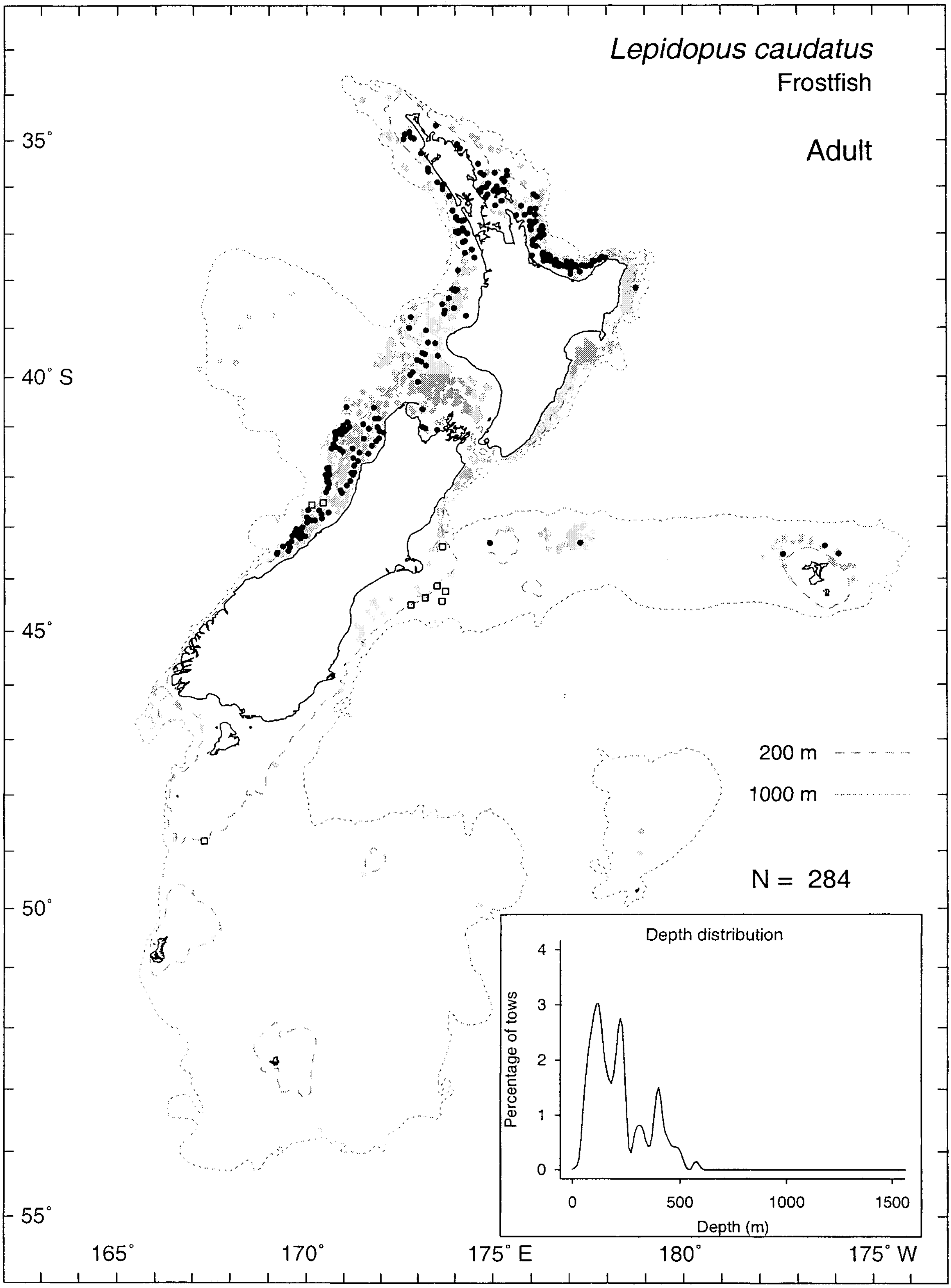
Lepidopus caudatus
Frostfish
Group i
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 91
Depth distribution
Percentage of tows
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
Depth (m)



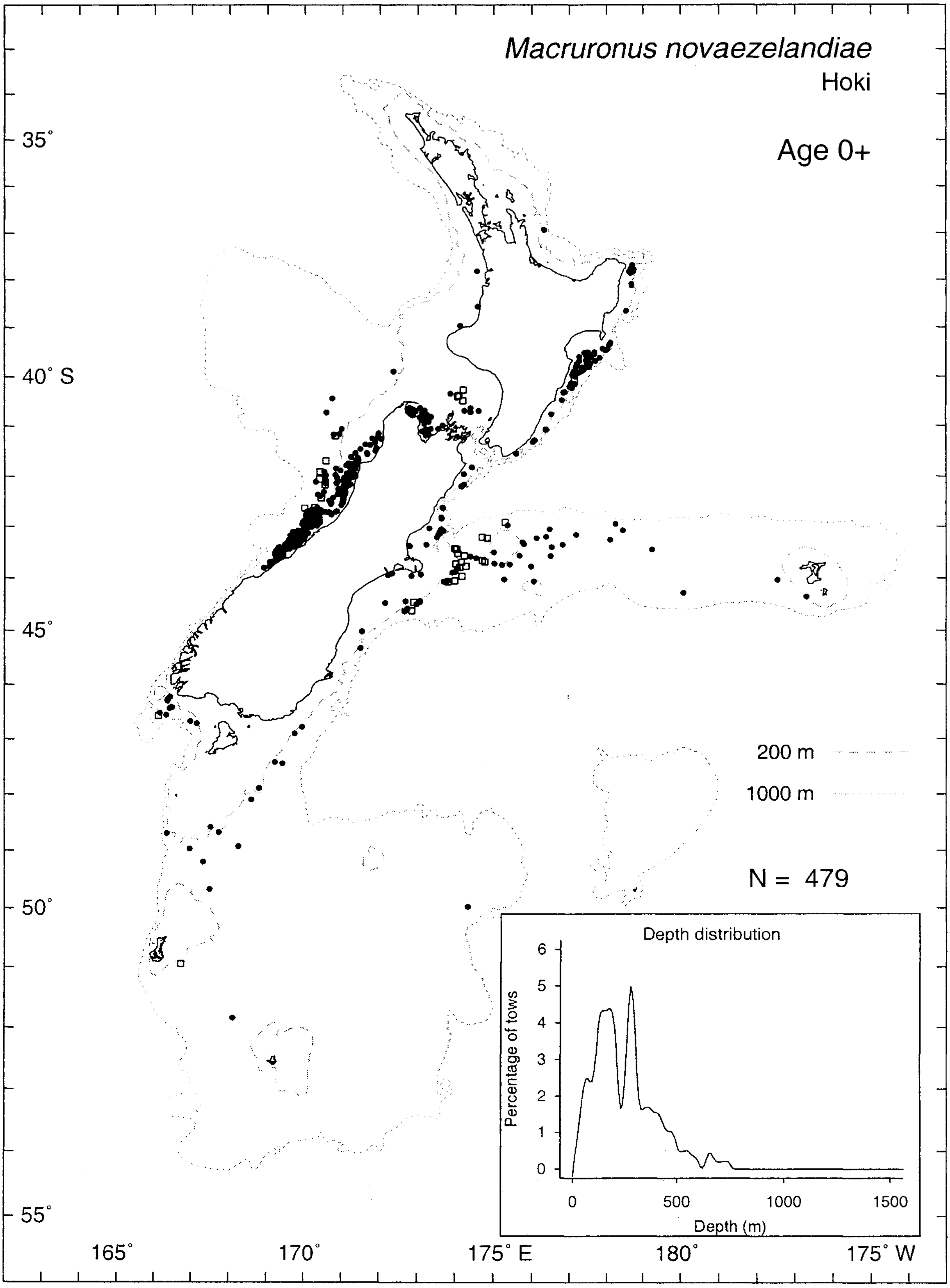
Lepidodus caudatus
Frostfish
Group ii
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 45
Depth distribution
Percentage of tows
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
Depth (m)

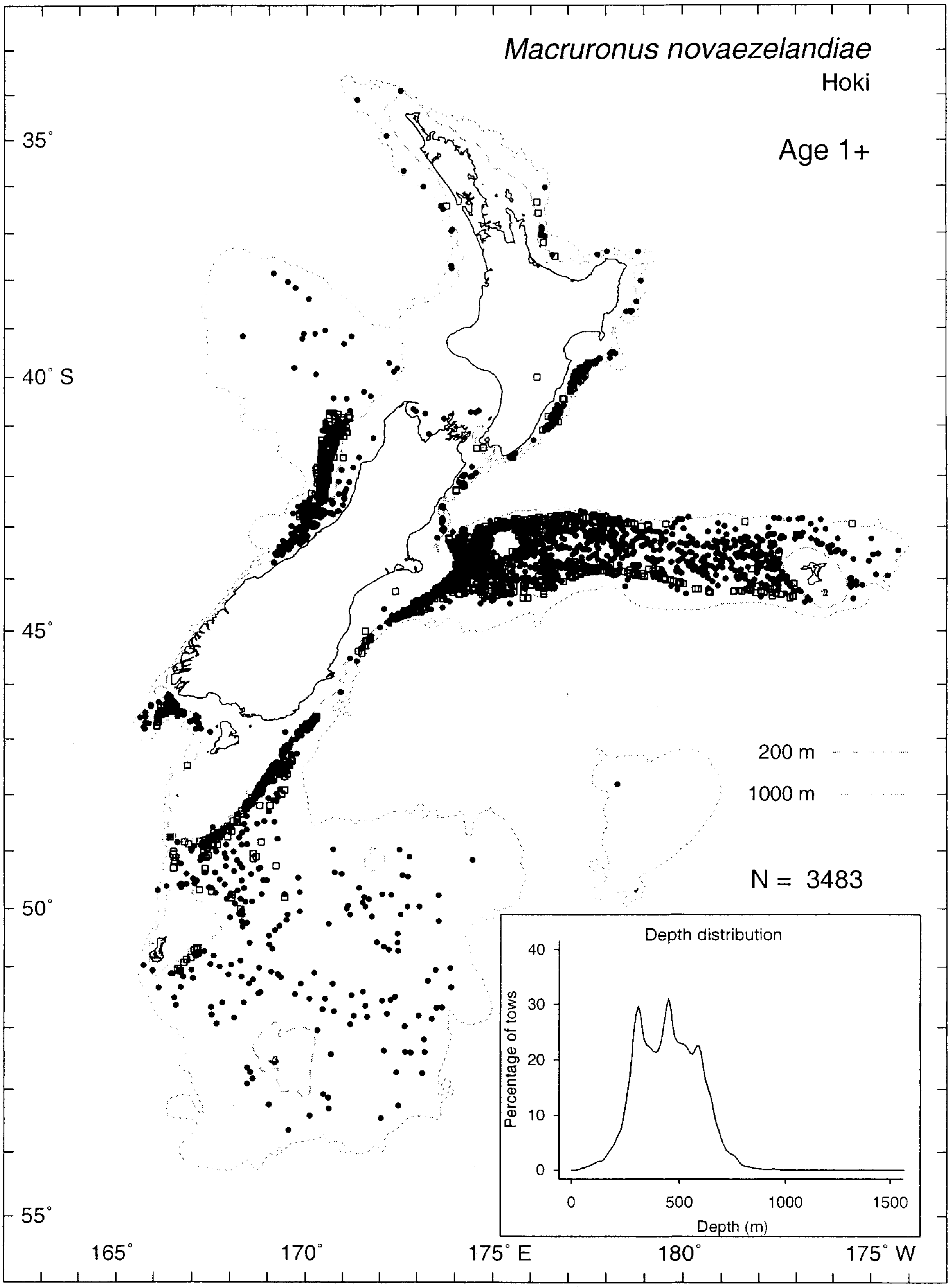


Lepidopus caudatus
Frostfish
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 113
Depth distribution
Percentage of tows
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
Depth (m)

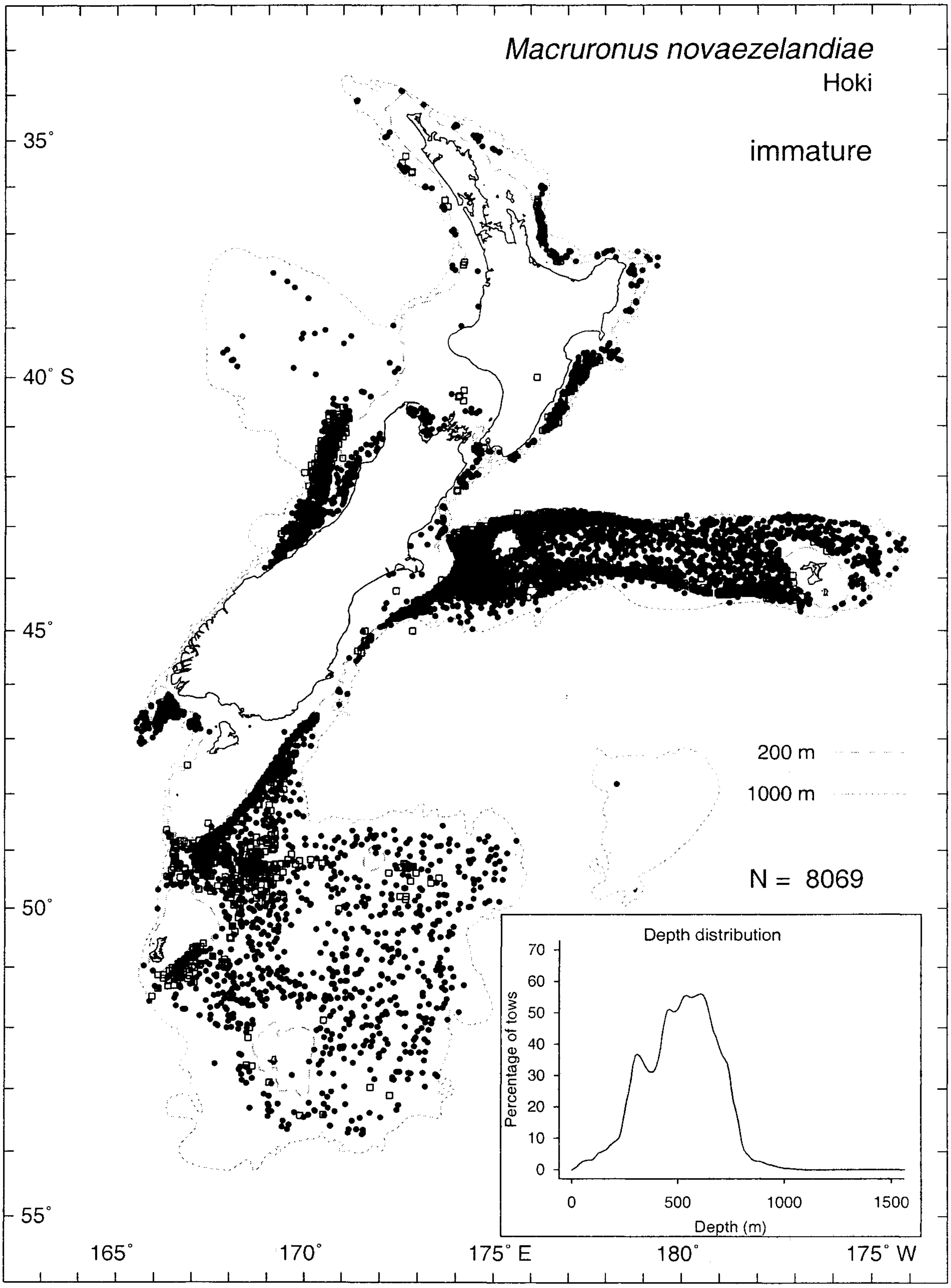


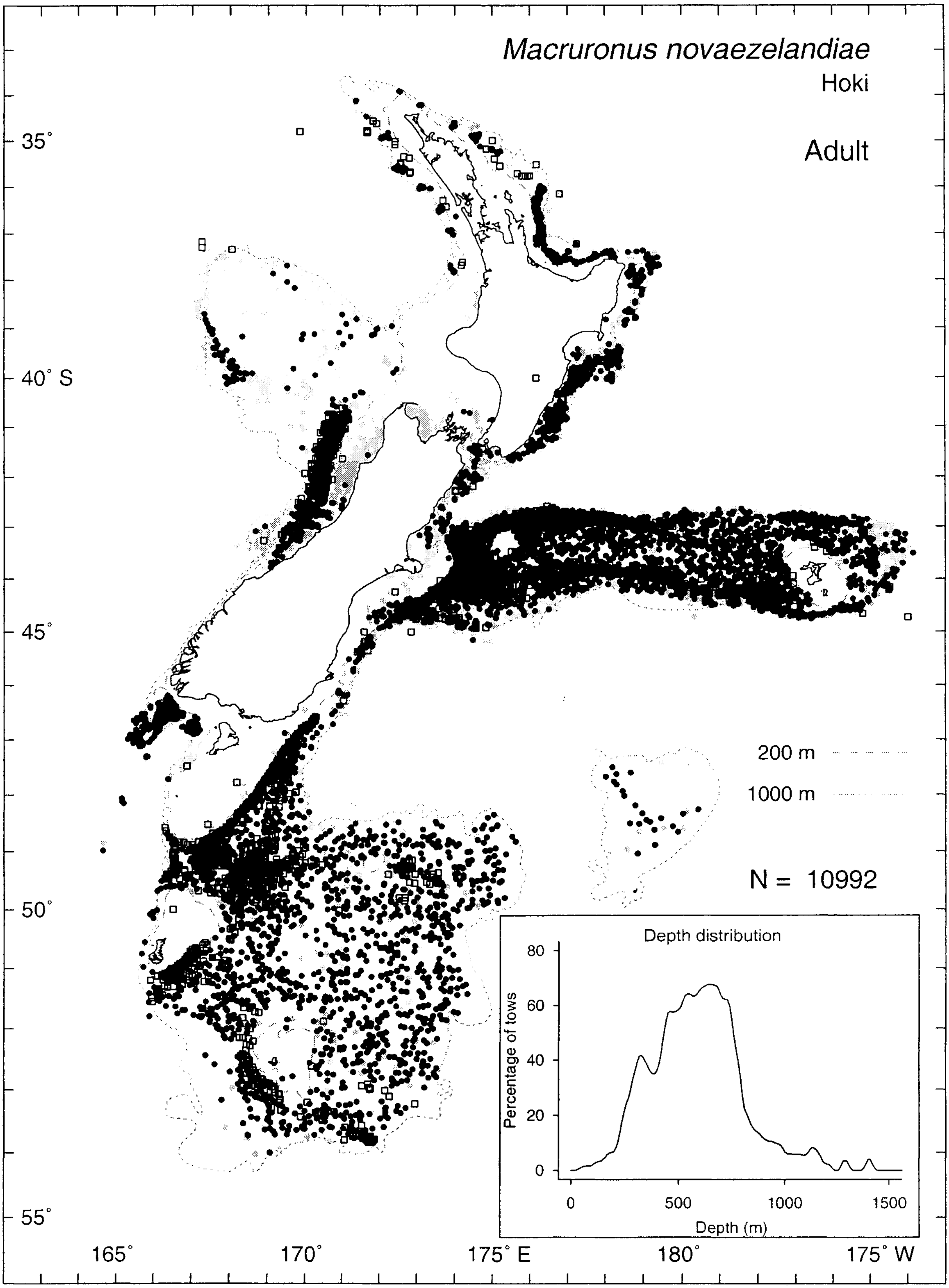
Lepidopus caudatus
Frostfish
Adult
200 m
1000 m
N = 284
Depth distribution
Percentage of tows
Depth (m)
0
500
1000
1500
0
1
2
3
4
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W


Macruronus novaezelandiae
Hoki
Age 0+
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 479
Depth distribution
Percentage of tows
Depth (m)
0
500
1000
1500
0
1
2
3
4
5
6

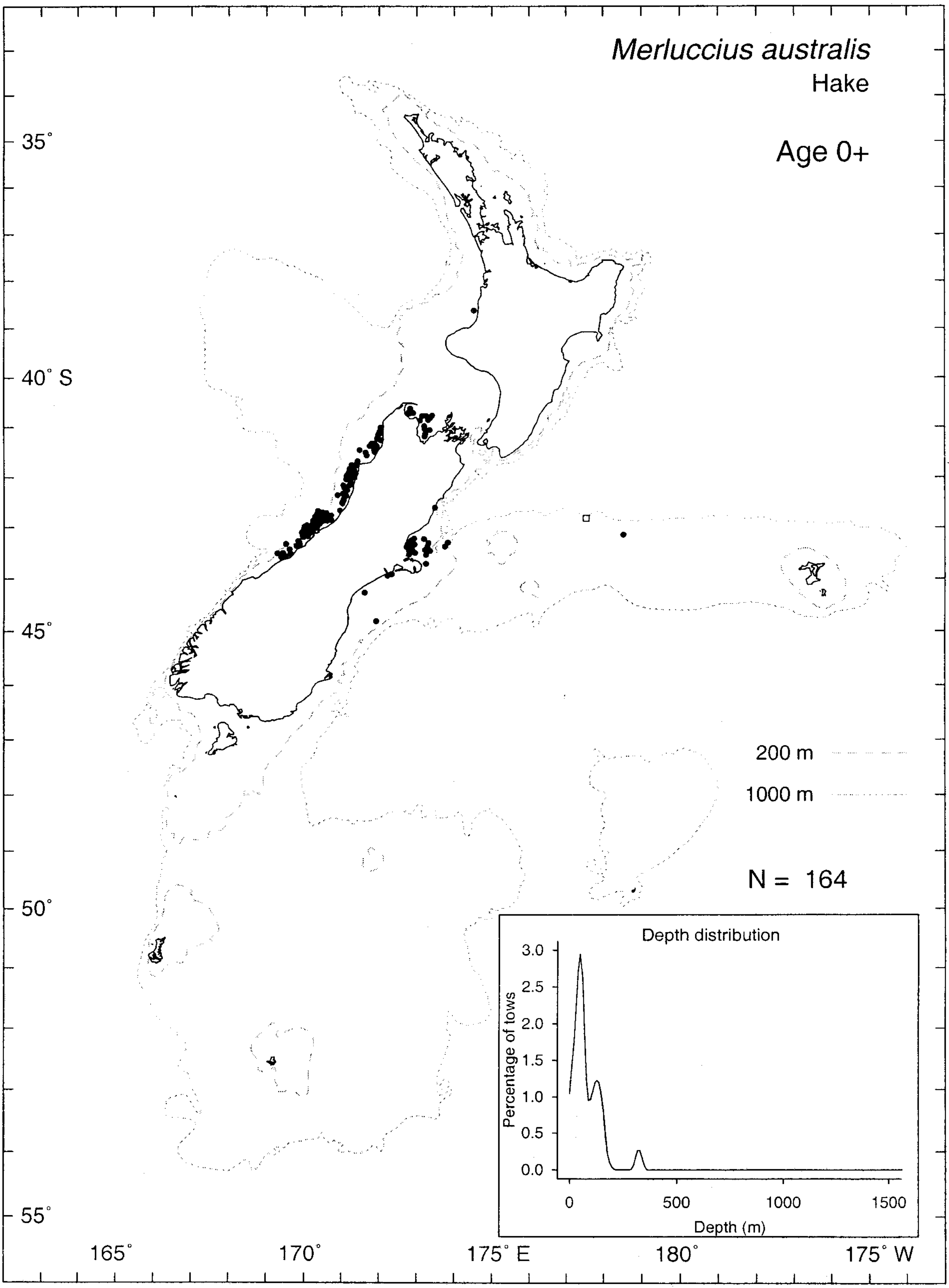


Macruronus novaezelandiae
Hoki
Age 1+
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 3483
Depth distribution
Percentage of tows
Depth (m)
0
10
20
30
40
0
500
1000
1500

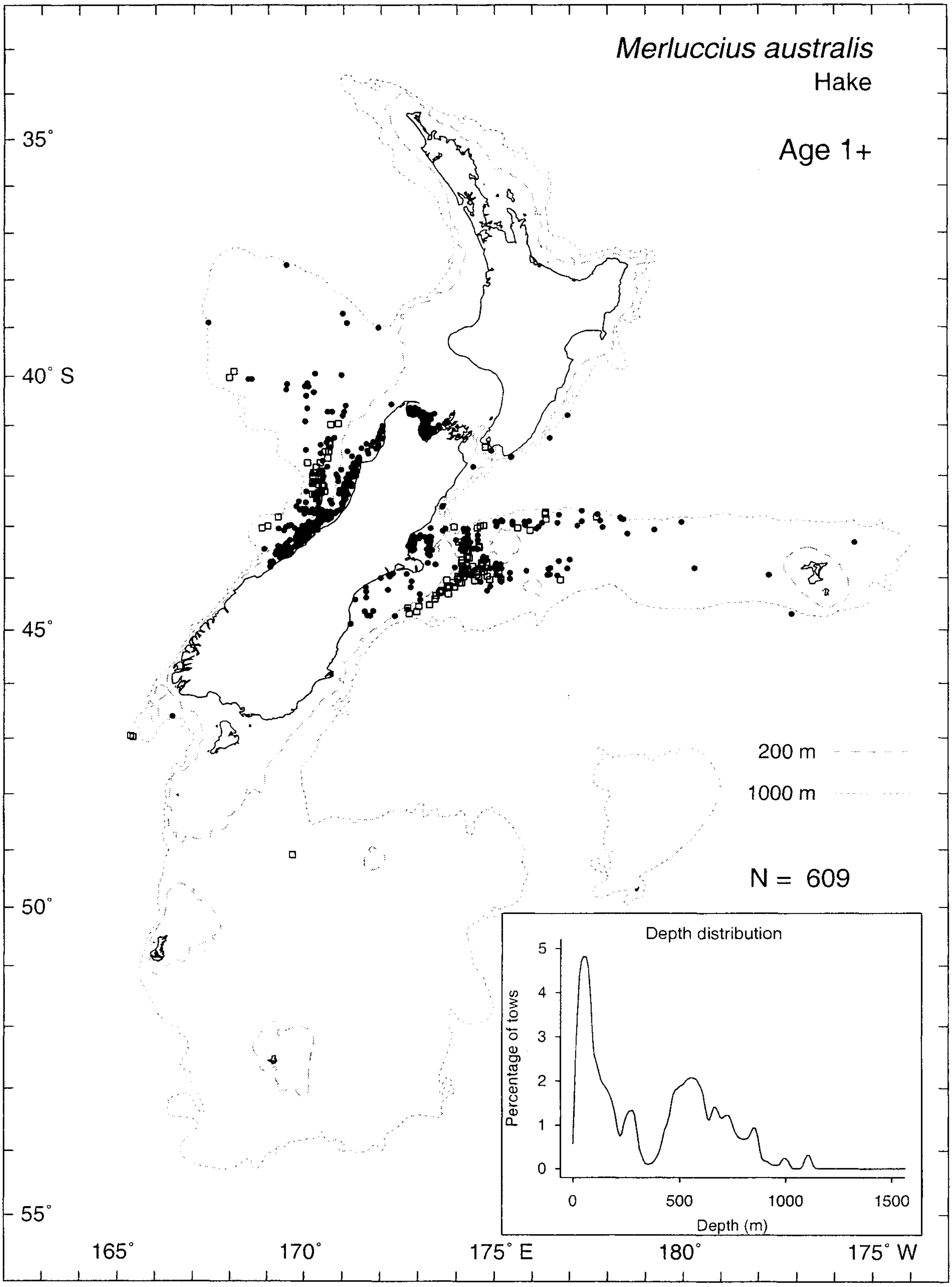

Macruronus novaezelandiae
Hoki
immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 8069
Depth distribution
Percentage of tows
Depth (m)
0
10
20
30
40
50
60
70
500
1000
1500



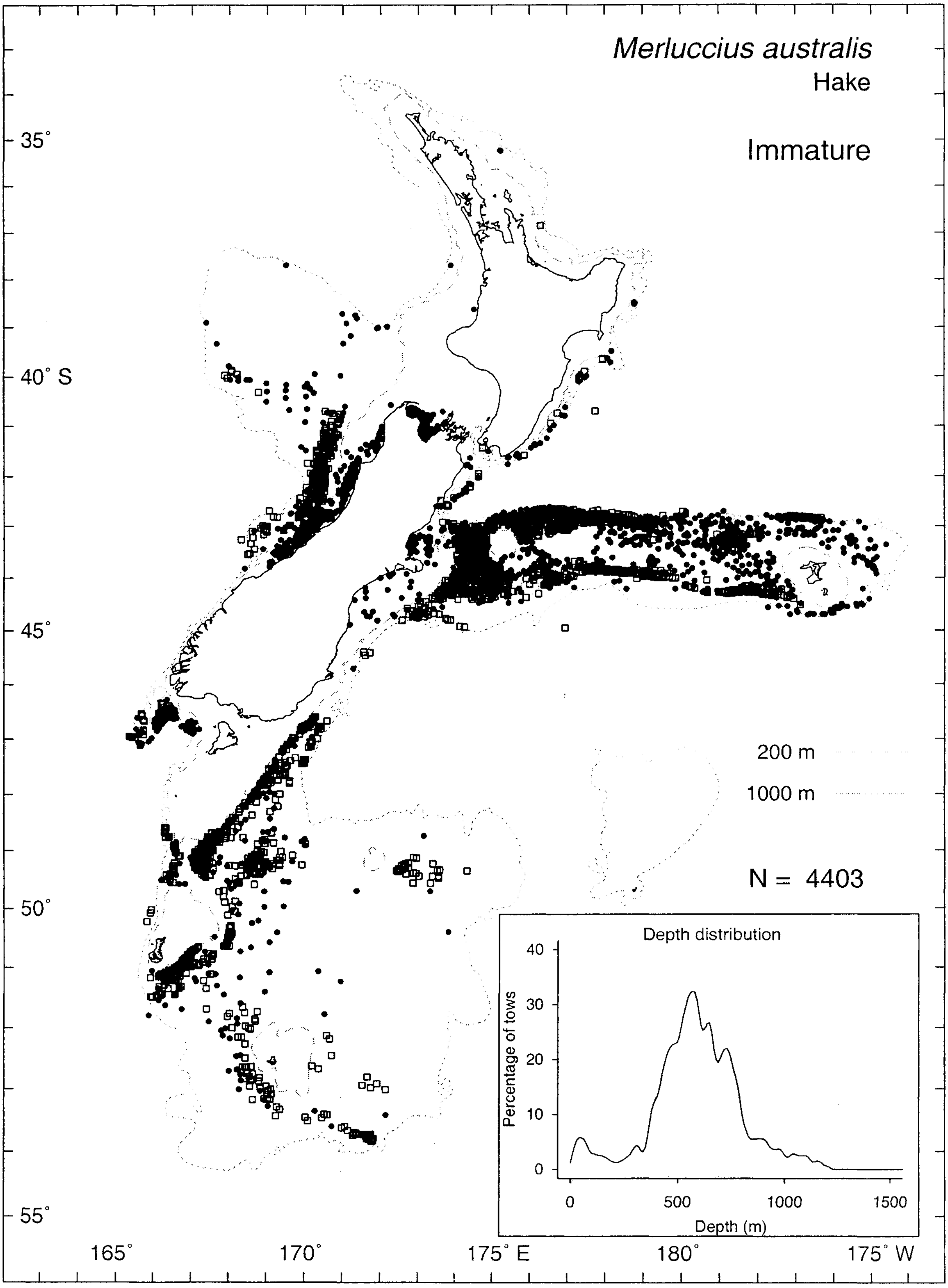
Macruronus novaezelandiae
Hoki
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 10992
Depth distribution
Percentage of tows
0
20
40
60
80
0
500
1000
1500
Depth (m)



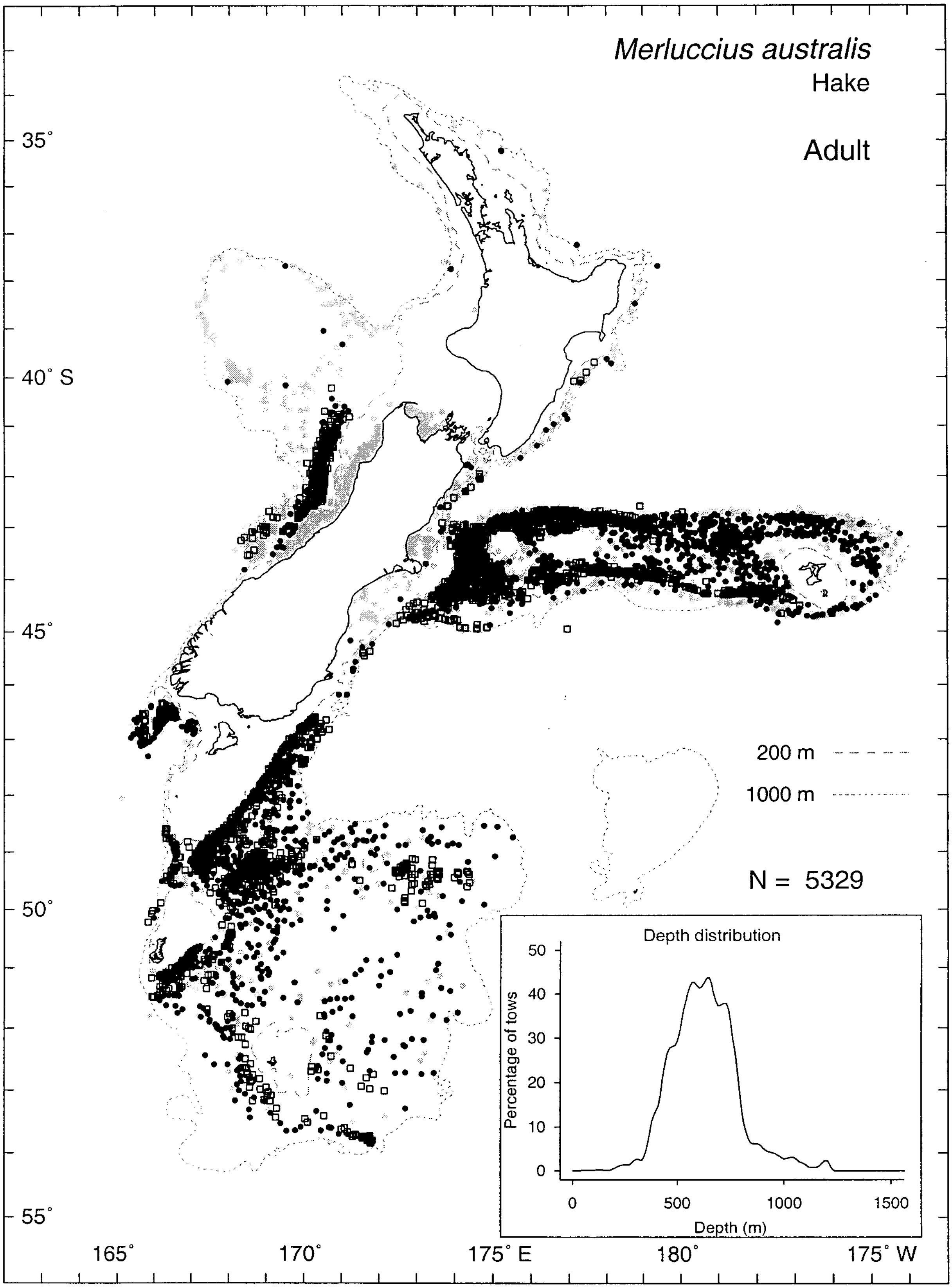
Merluccius australis
Hake
Age 0+
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 164
Depth distribution
Percentage of tows
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Depth (m)



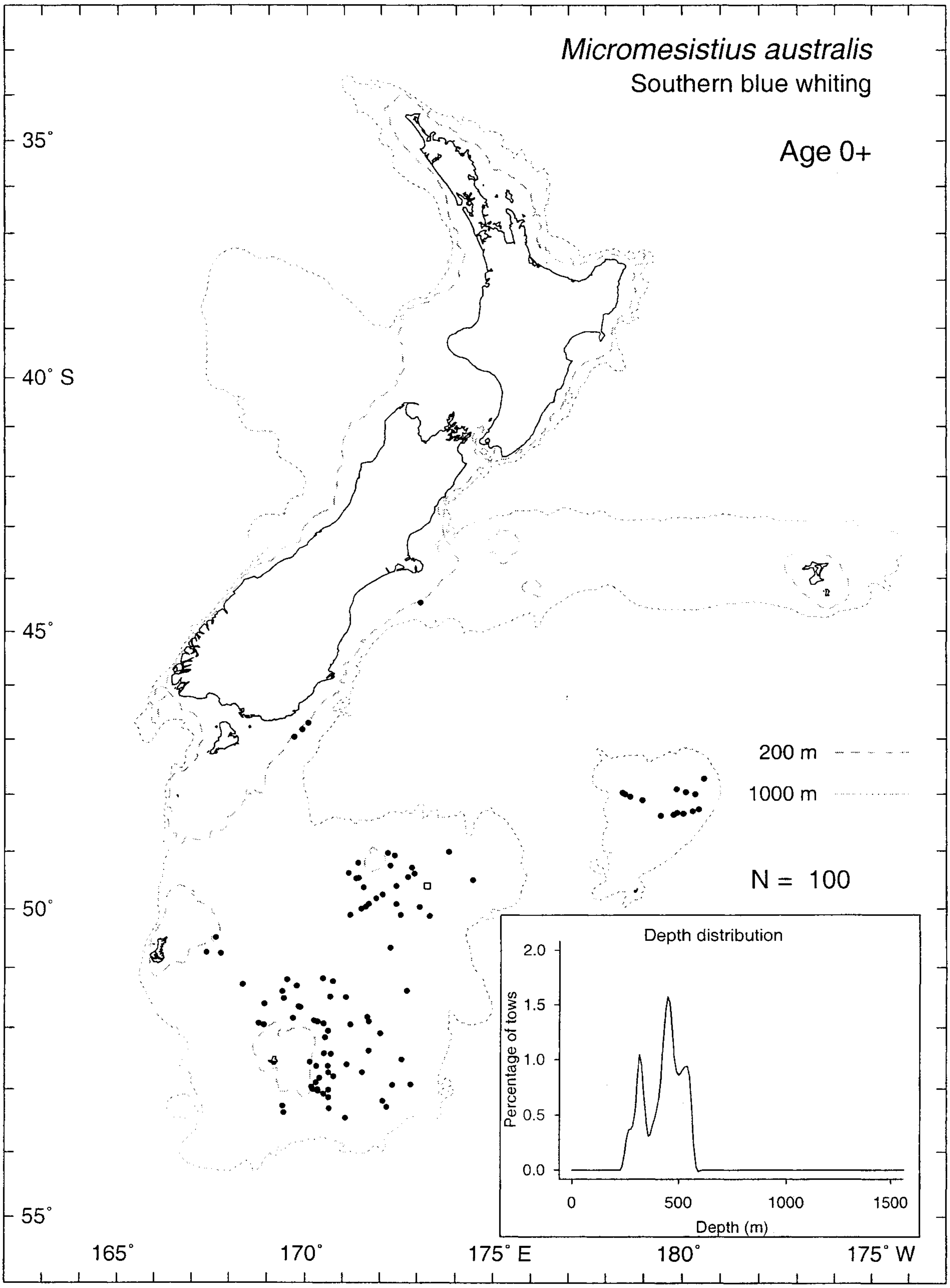
Merluccius australis
Hake
Age 1+
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 609
Depth distribution
Percentage of tows
Depth (m)
0
1
2
3
4
5
0
500
1000
1500



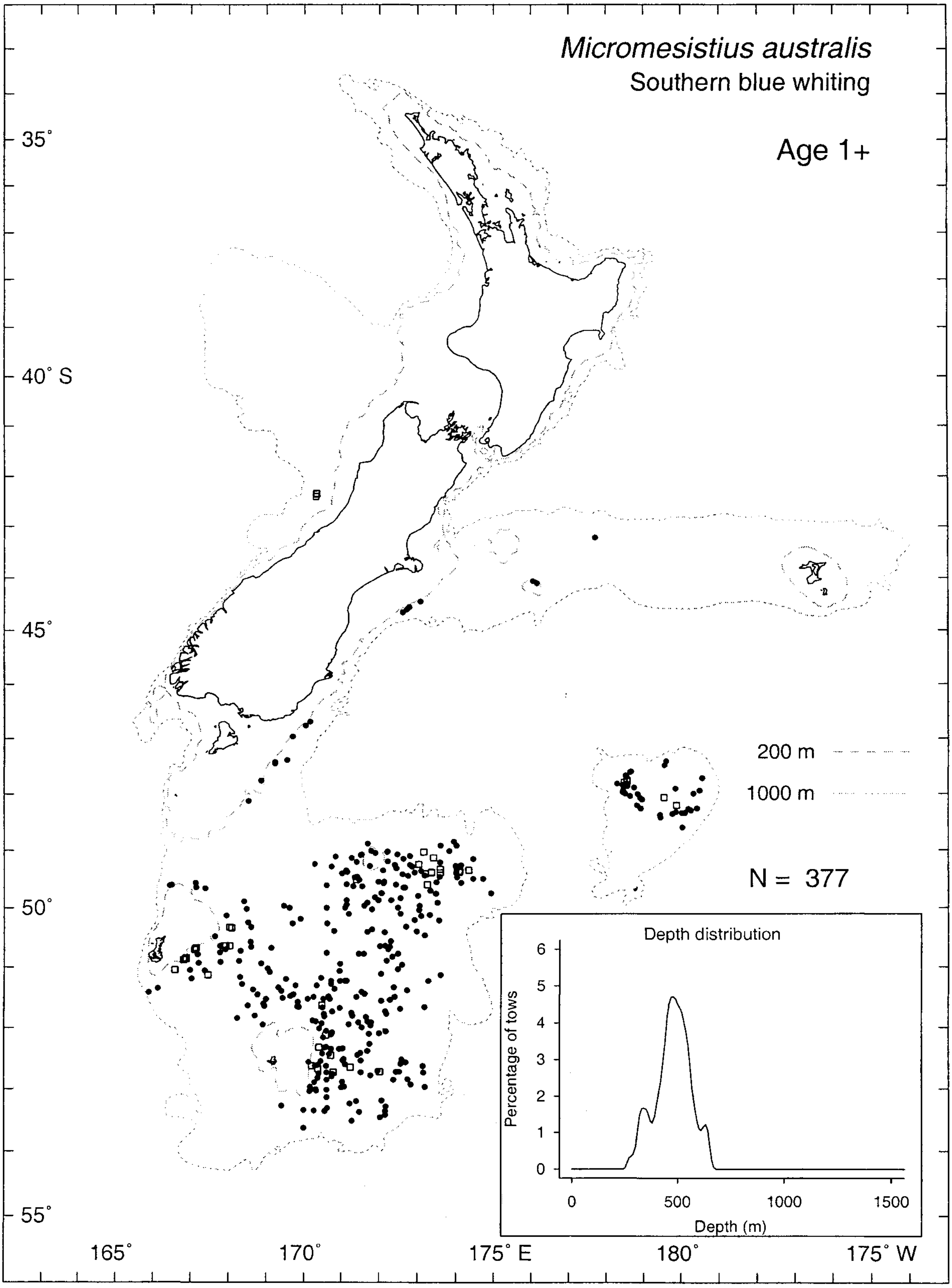
Merluccius australis
Hake
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 4403
Depth distribution
Percentage of tows
Depth (m)
0
10
20
30
40
500
1000
1500

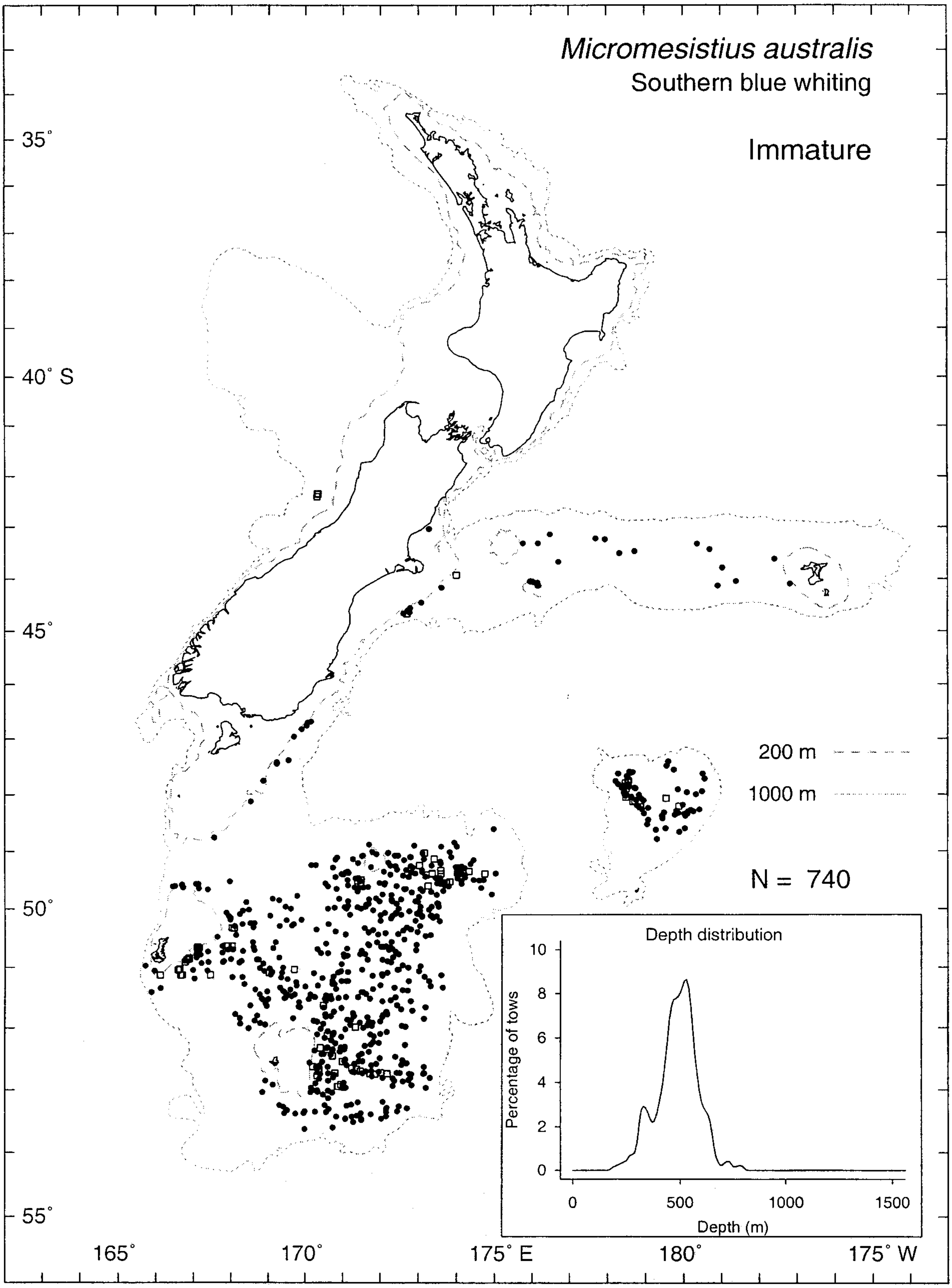


Merluccius australis
Hake
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 5329
Depth distribution
Percentage of tows
50
40
30
20
10
0
0
500
1000
1500
Depth (m)

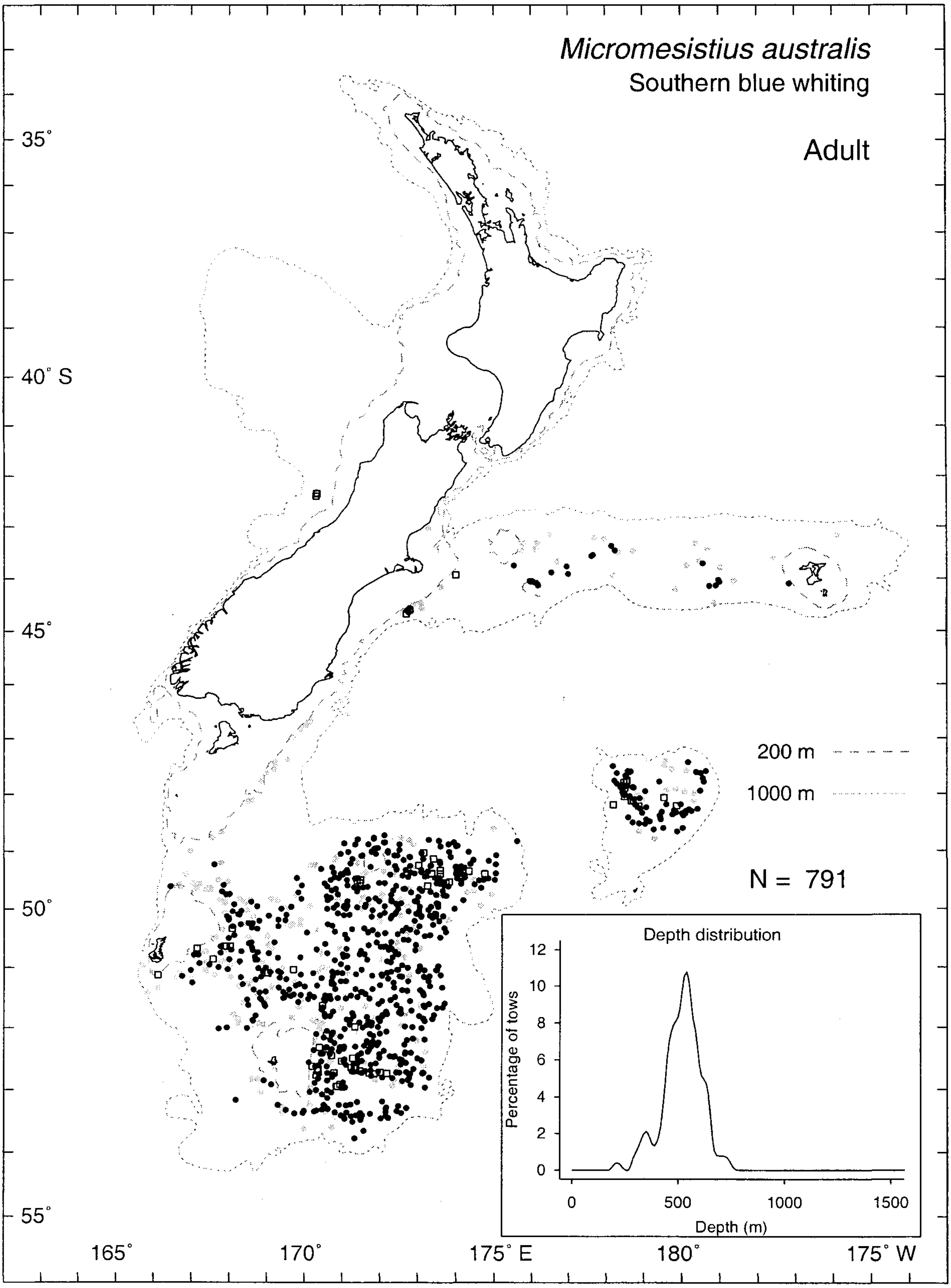


Micromesistius australis
Southern blue whiting
Age 0+
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 100
Depth distribution
Percentage of tows
Depth (m)
0
500
1000
1500
0.0
0.5
1.0
1.5
2.0

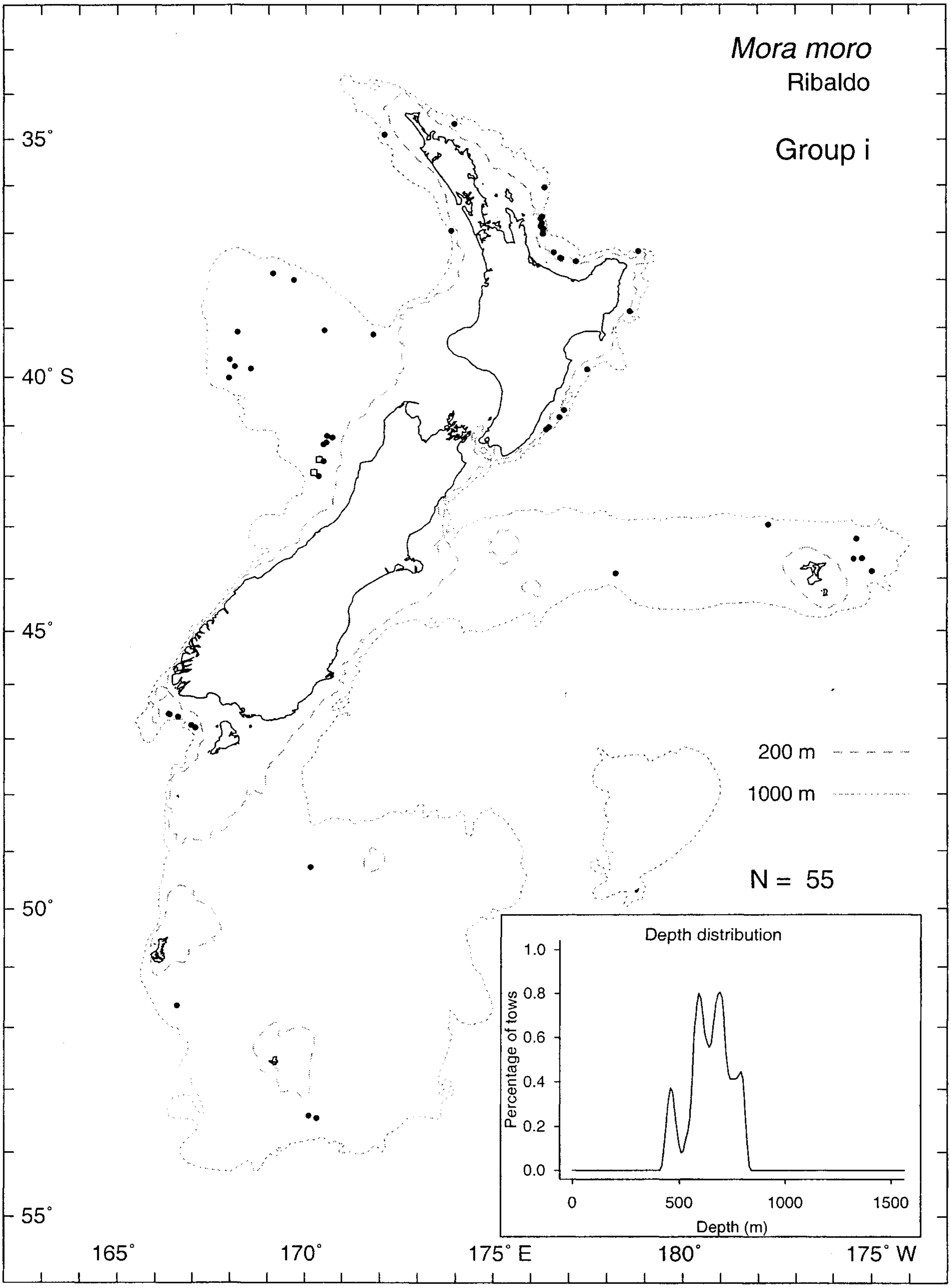

Micromesistius australis
Southern blue whiting
Age 1+
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 377
Depth distribution
Percentage of tows
0
1
2
3
4
5
6
0
500
1000
1500
Depth (m)



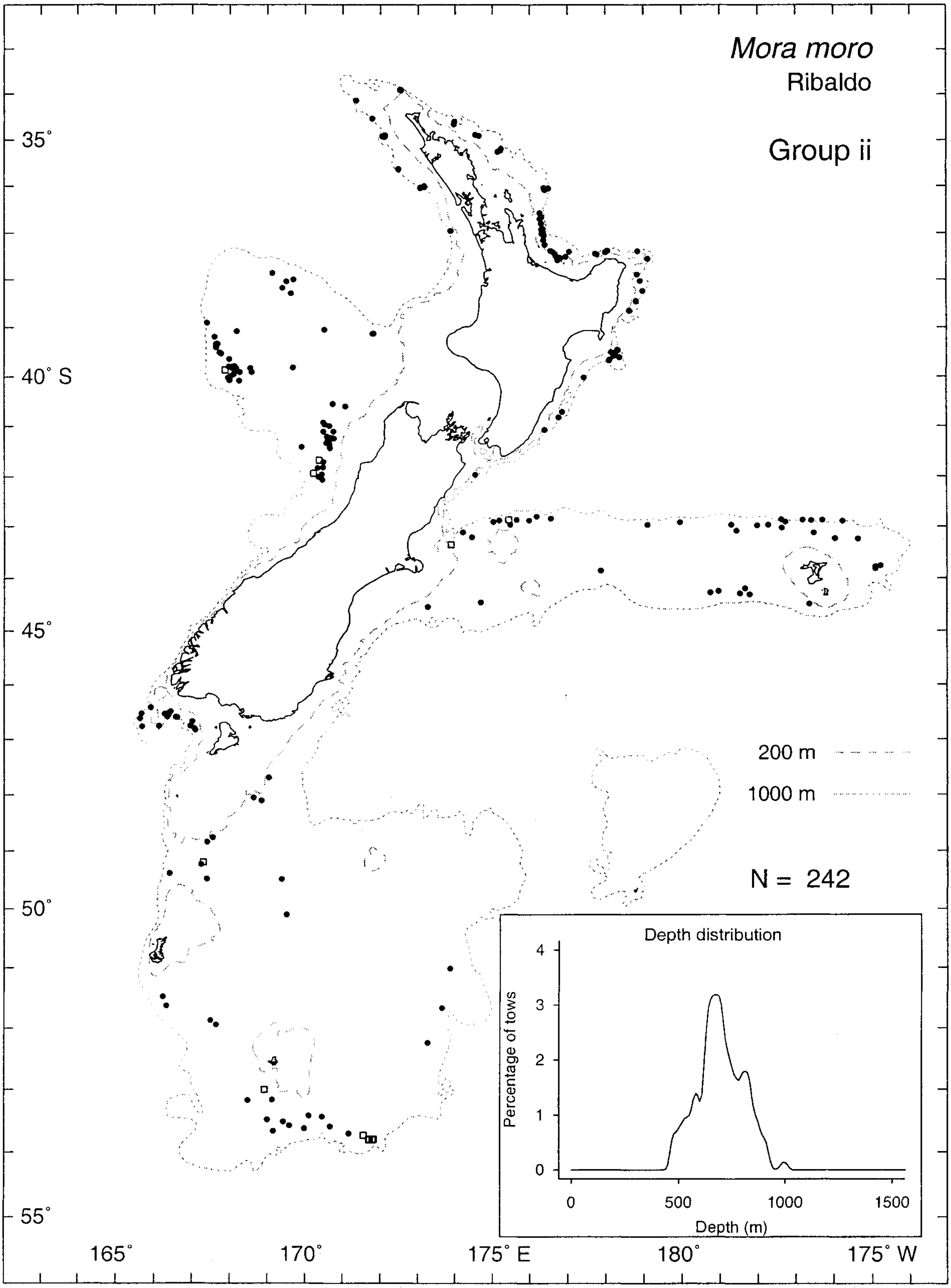
Micromesistius australis
Southern blue whiting
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 740
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
10
500
1000
1500

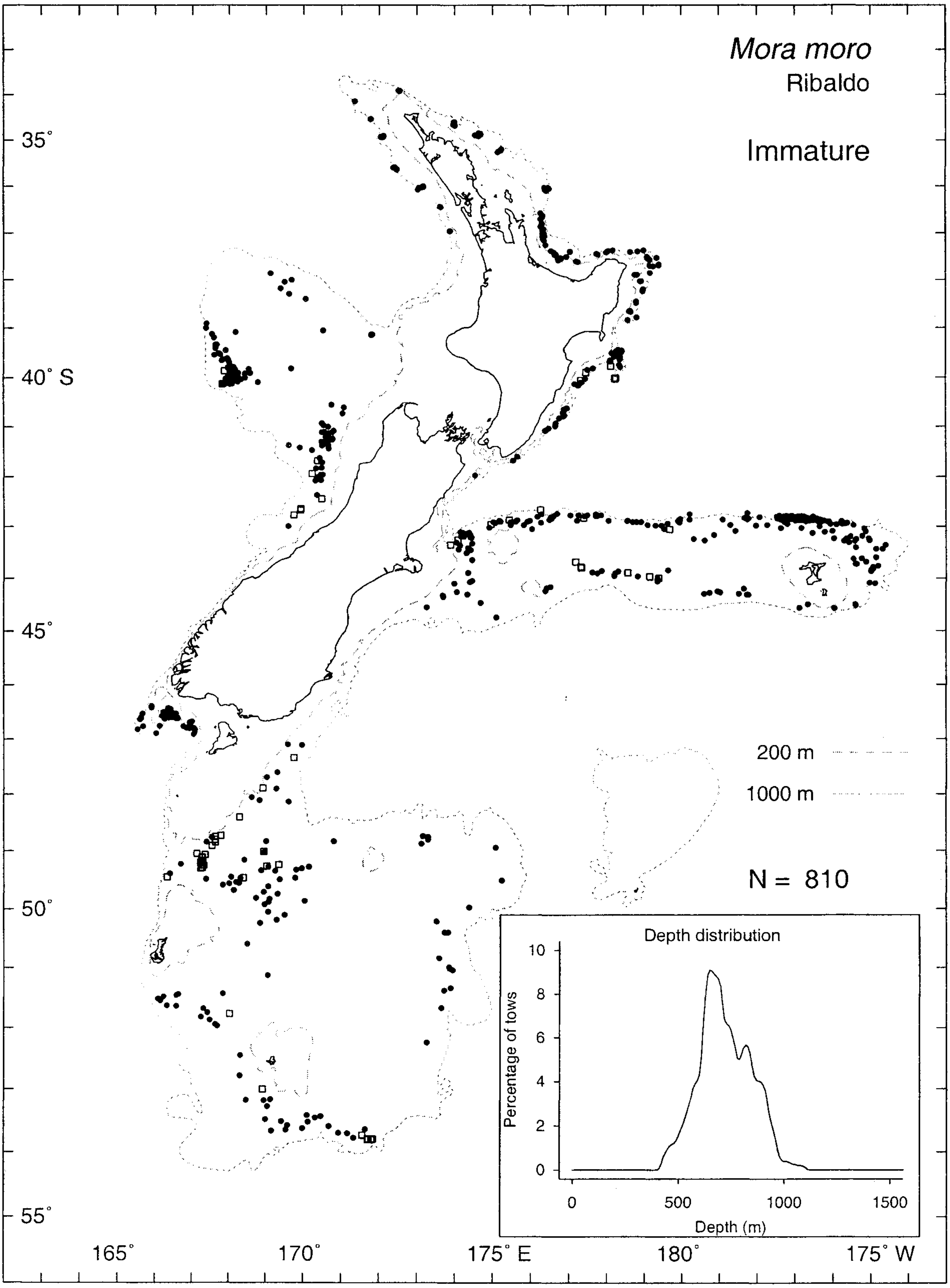


Micromesistius australis
Southern blue whiting
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 791
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
10
12
500
1000
1500

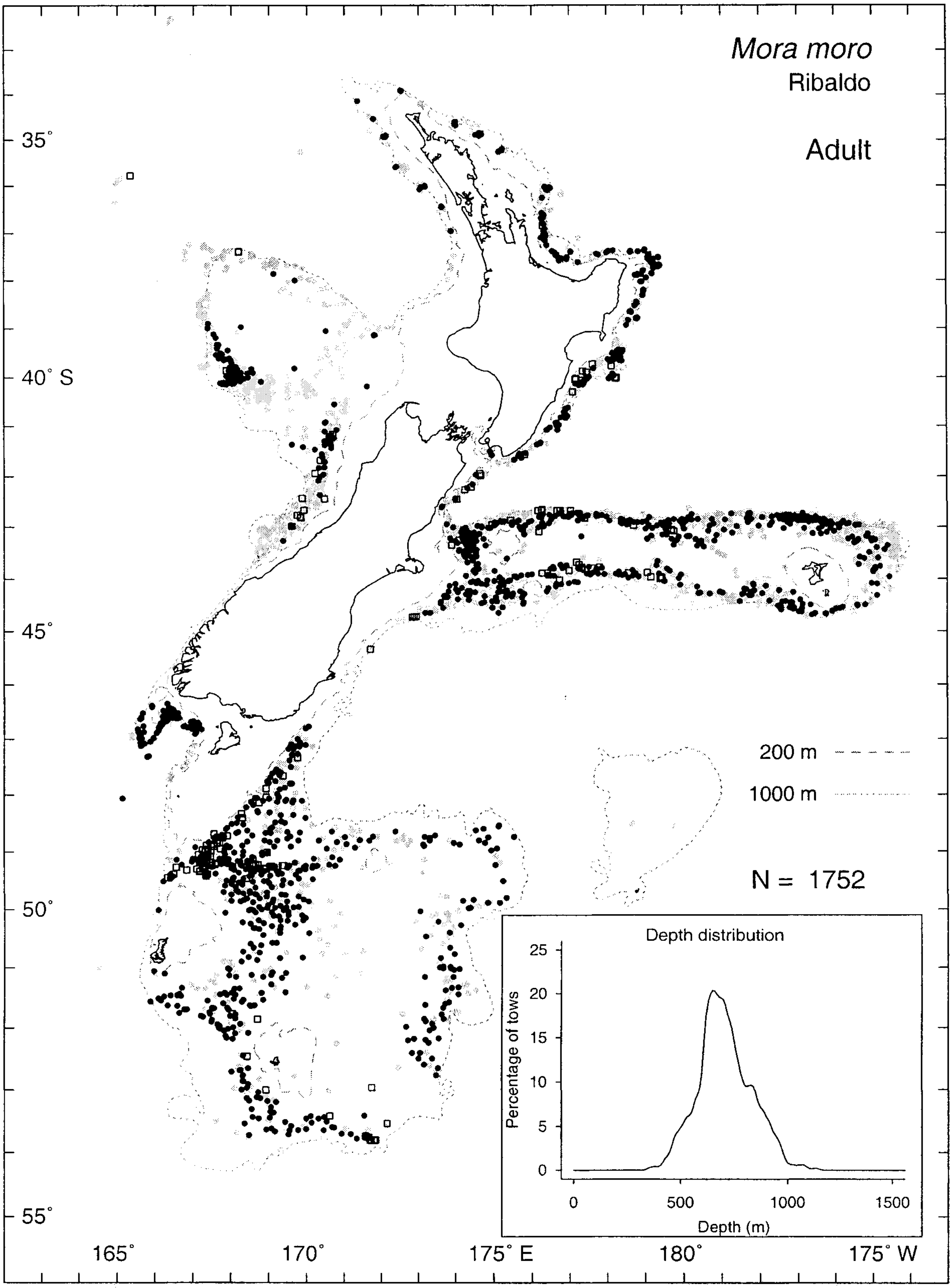


Mora moro
Ribaldo
Group i
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 55
Depth distribution
Percentage of tows
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
Depth (m)

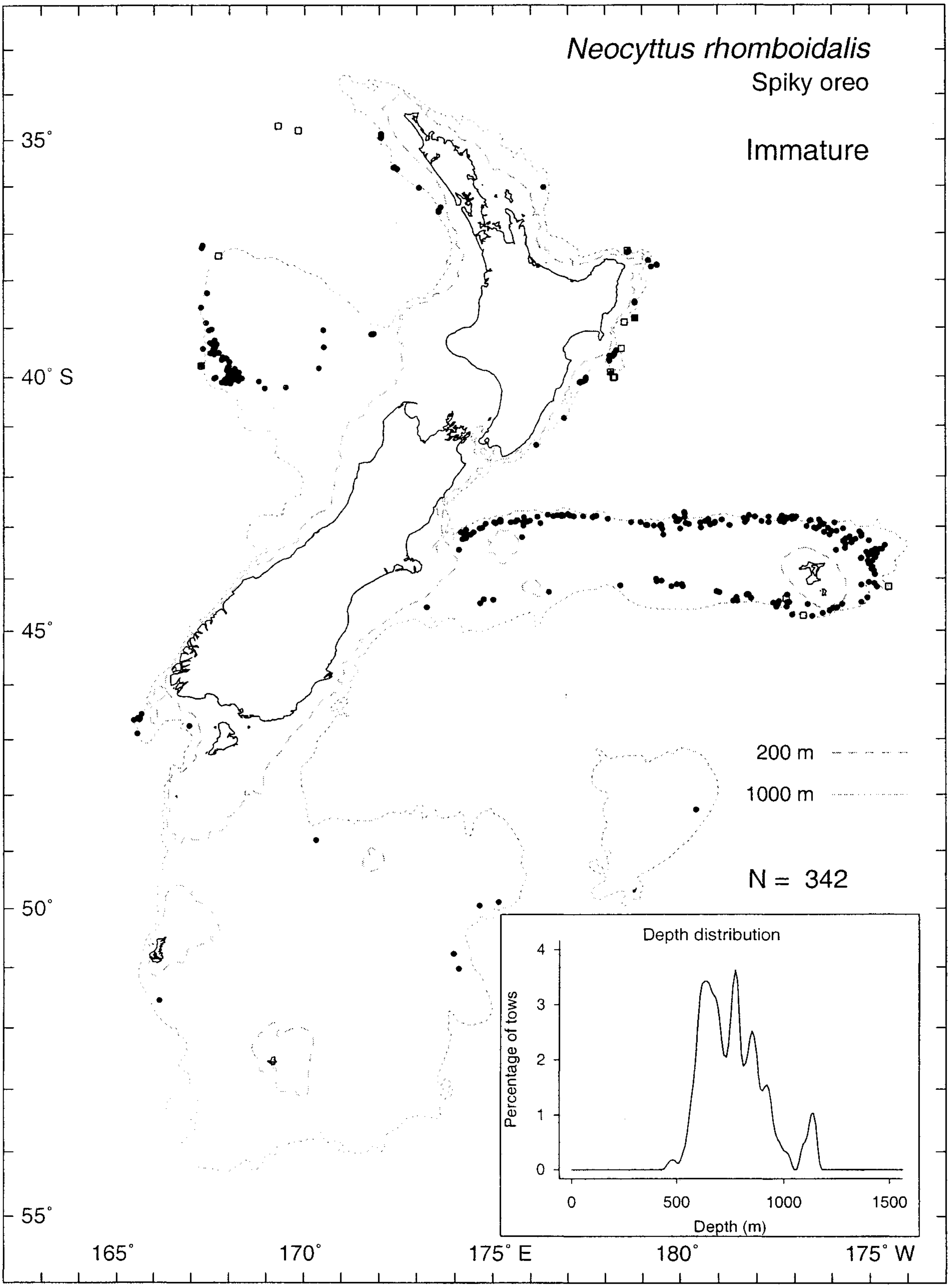

Mora moro
Ribaldo
Group ii
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 242
Depth distribution
Percentage of tows
Depth (m)
0
1
2
3
4
0
500
1000
1500



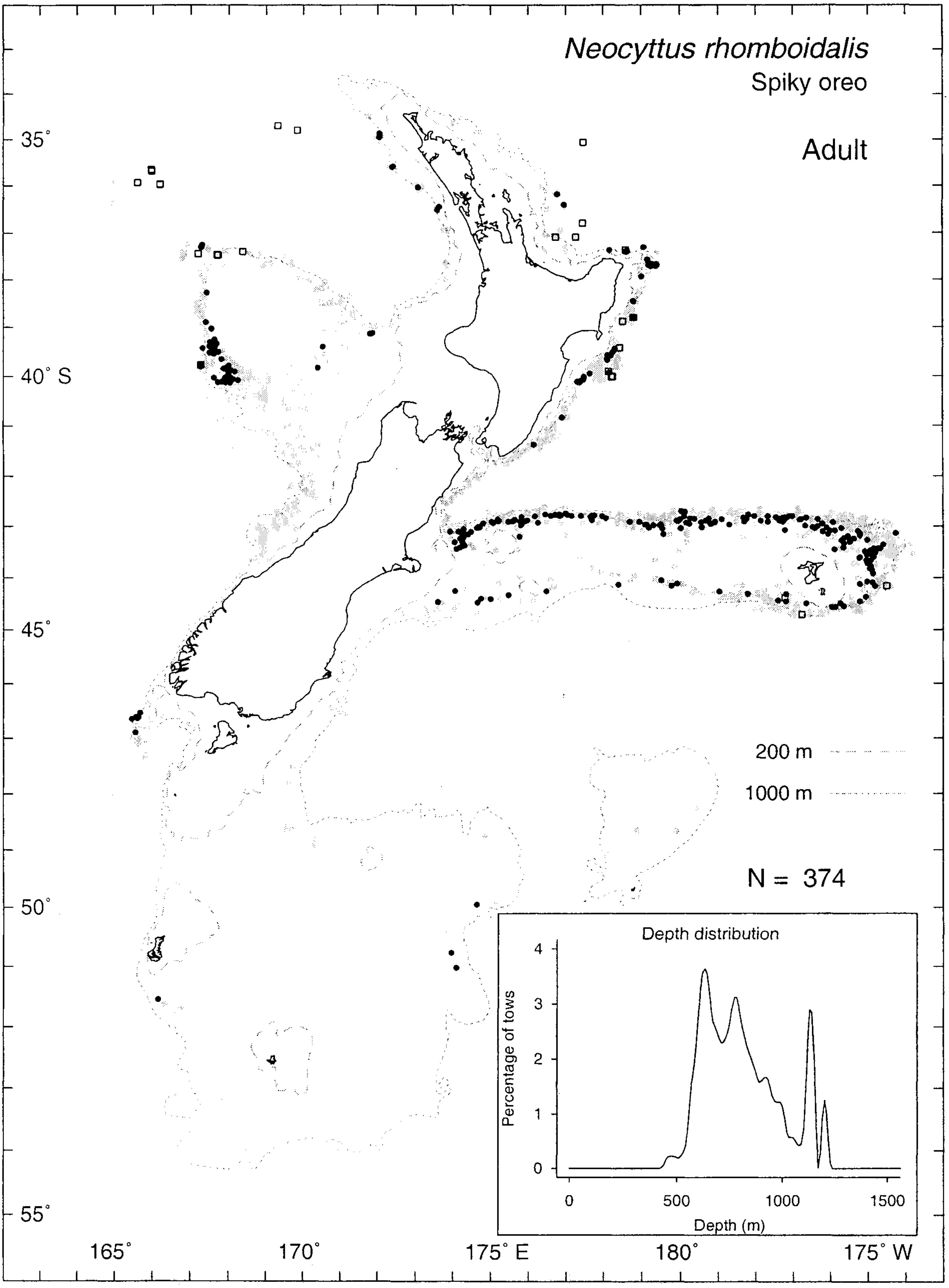
Mora moro
Ribaldo
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 810
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
10
0
500
1000
1500



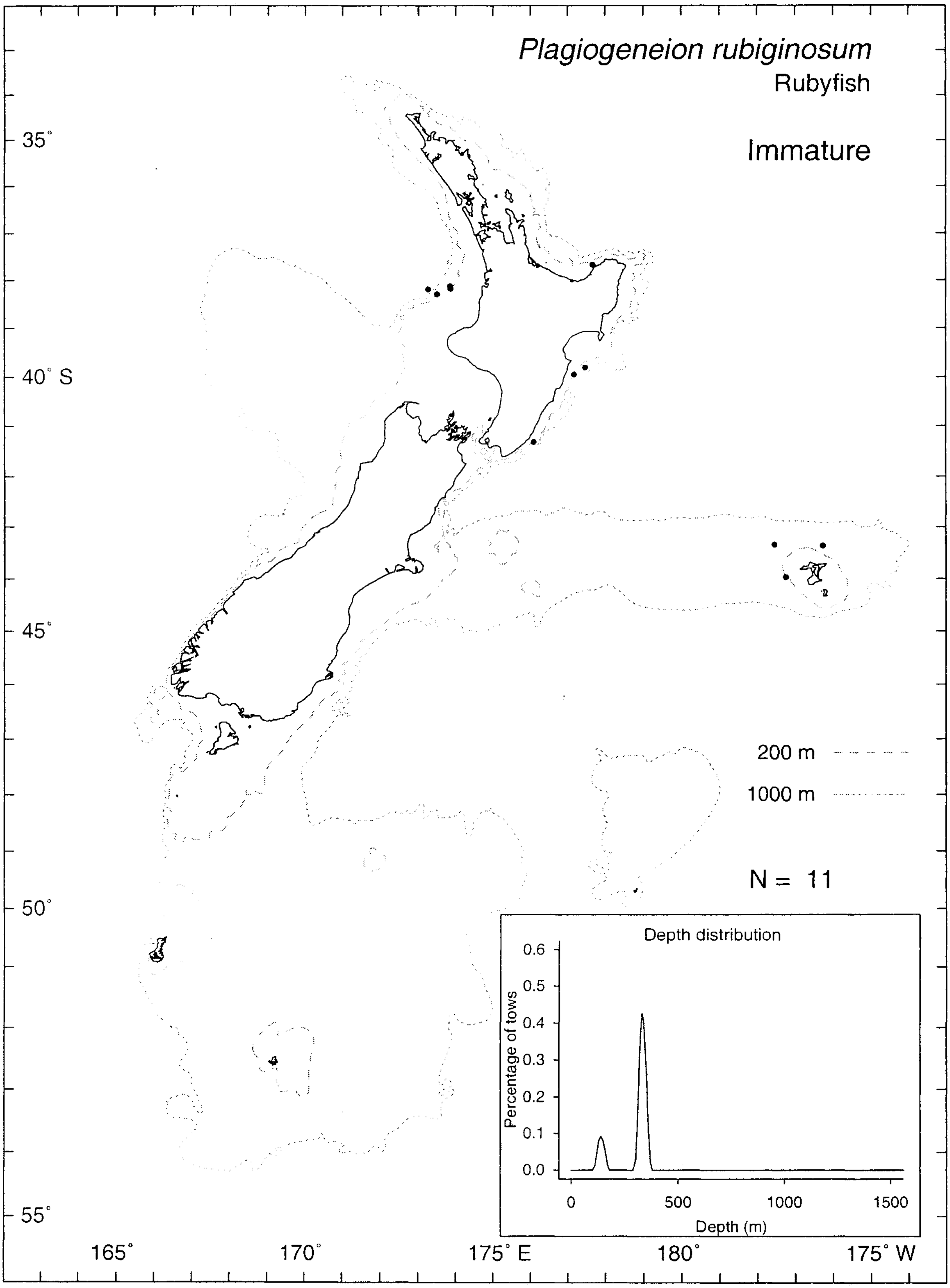
Mora moro
Ribaldo
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 1752
Depth distribution
Percentage of tows
25
20
15
10
5
0
0
500
1000
1500
Depth (m)



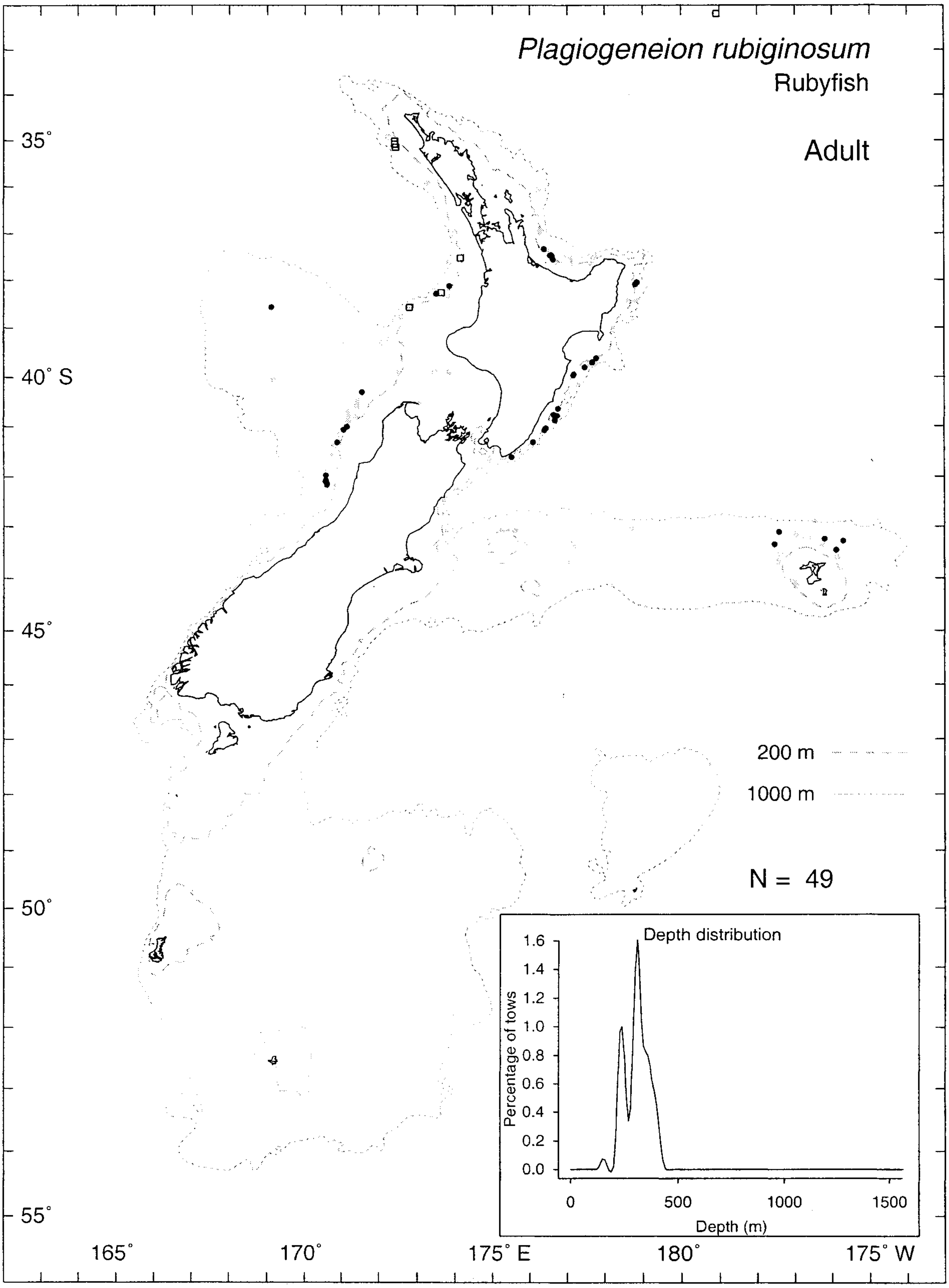
Neocyttus rhomboidalis
Spiky oreo
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 342
Depth distribution
Percentage of tows
0
1
2
3
4
0
500
1000
1500
Depth (m)



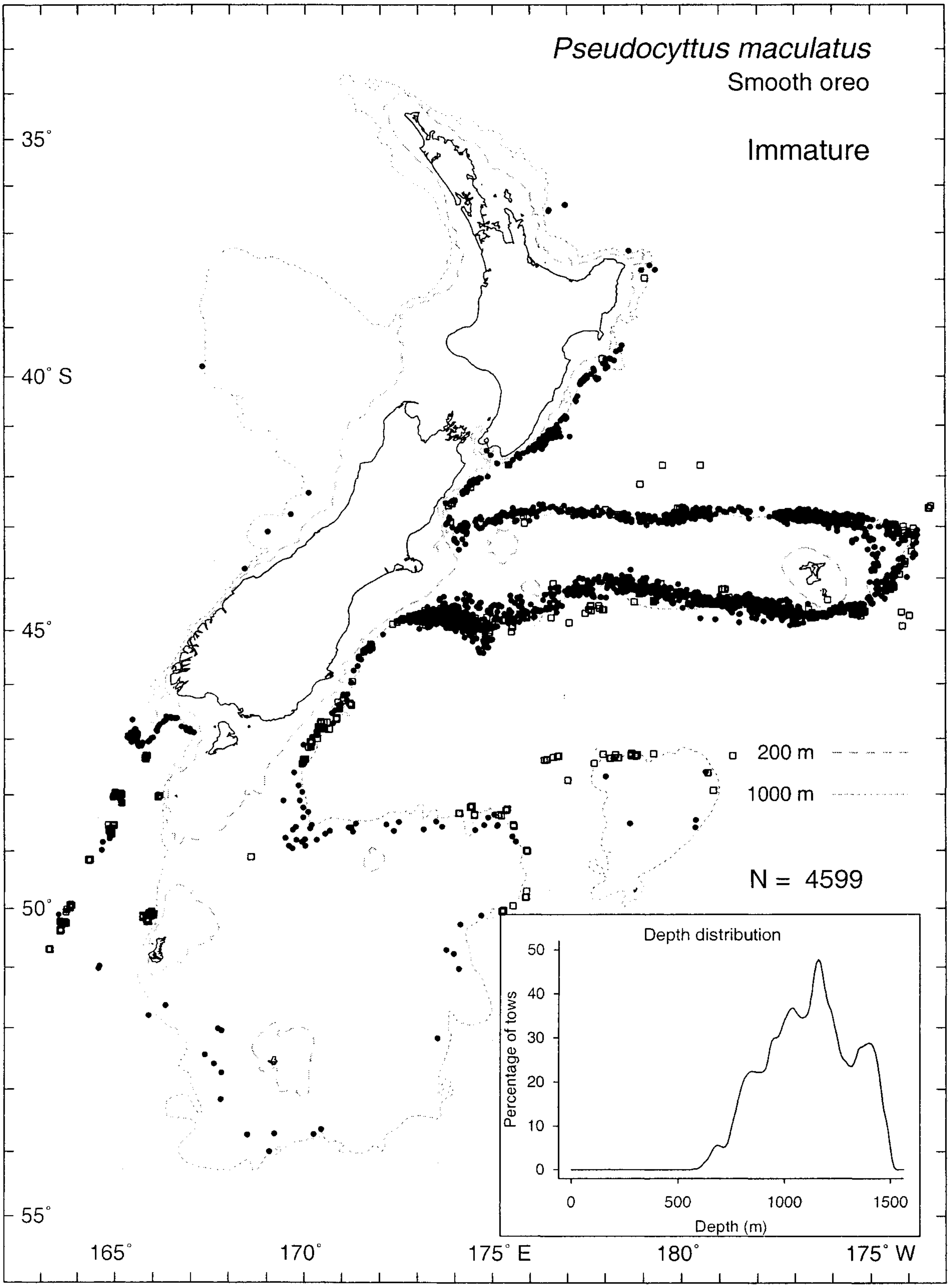
Neocyttus rhomboidalis
Spiky oreo
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 374
Depth distribution
Percentage of tows
Depth (m)
0
1
2
3
4
500
1000
1500



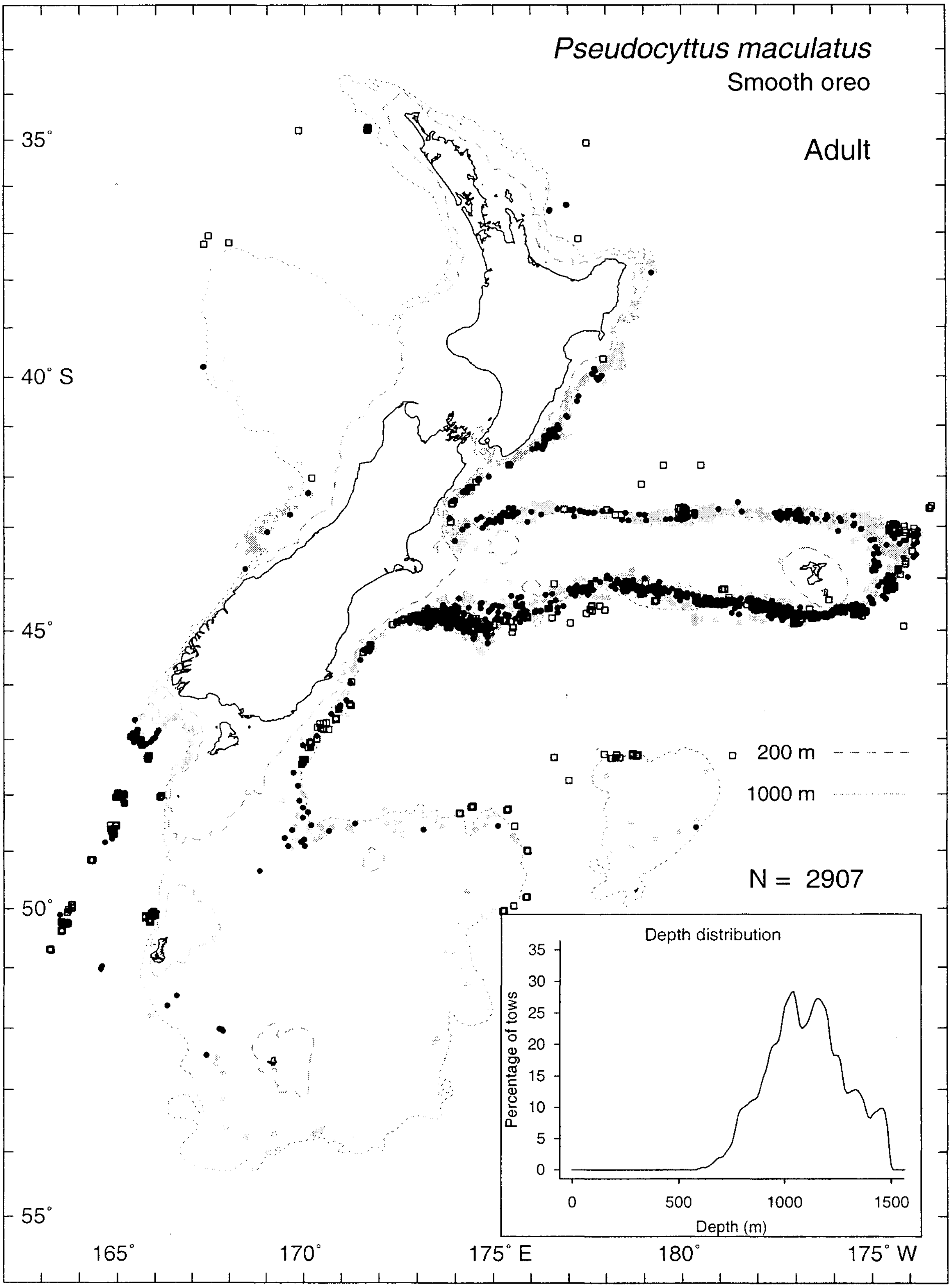
Plagiogeneion rubiginosum
Rubyfish
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 11
Depth distribution
Percentage of tows
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
500
1000
1500
Depth (m)



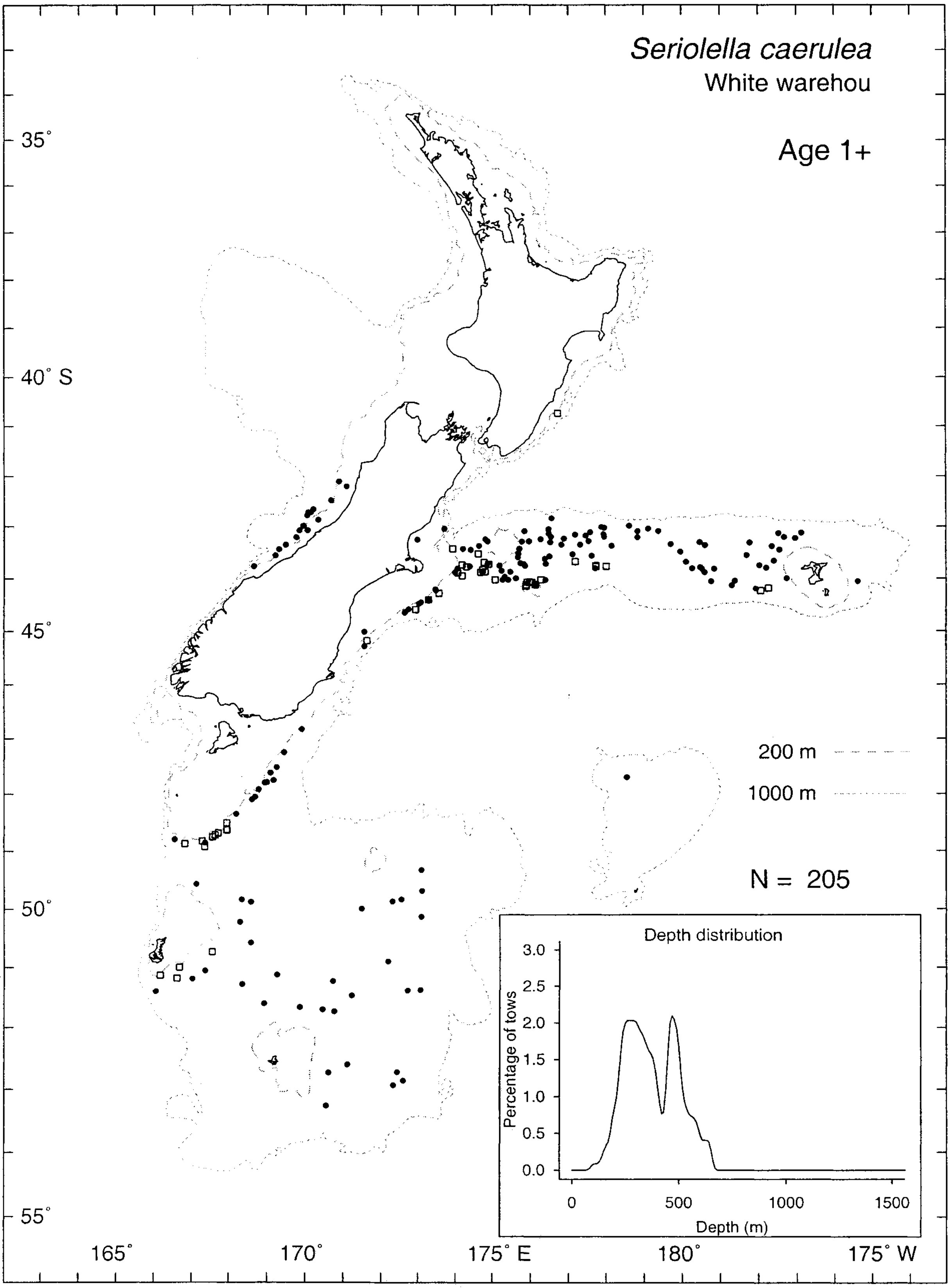
Plagiogeneion rubiginosum
Rubyfish
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 49
Depth distribution
Percentage of tows
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
Depth (m)



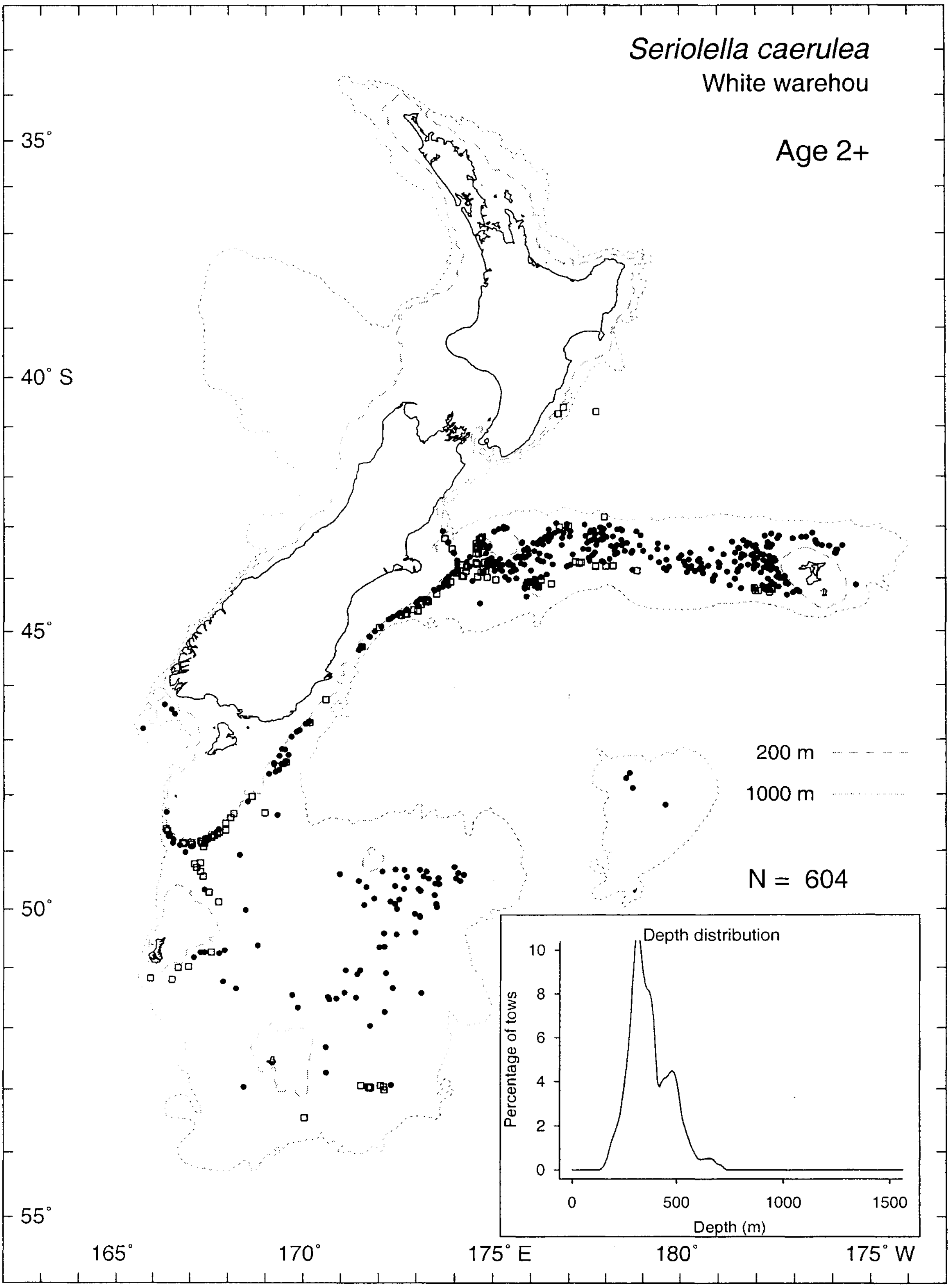
Pseudocyttus maculatus
Smooth oreo
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 4599
Depth distribution
Percentage of tows
Depth (m)
0
10
20
30
40
50
500
1000
1500



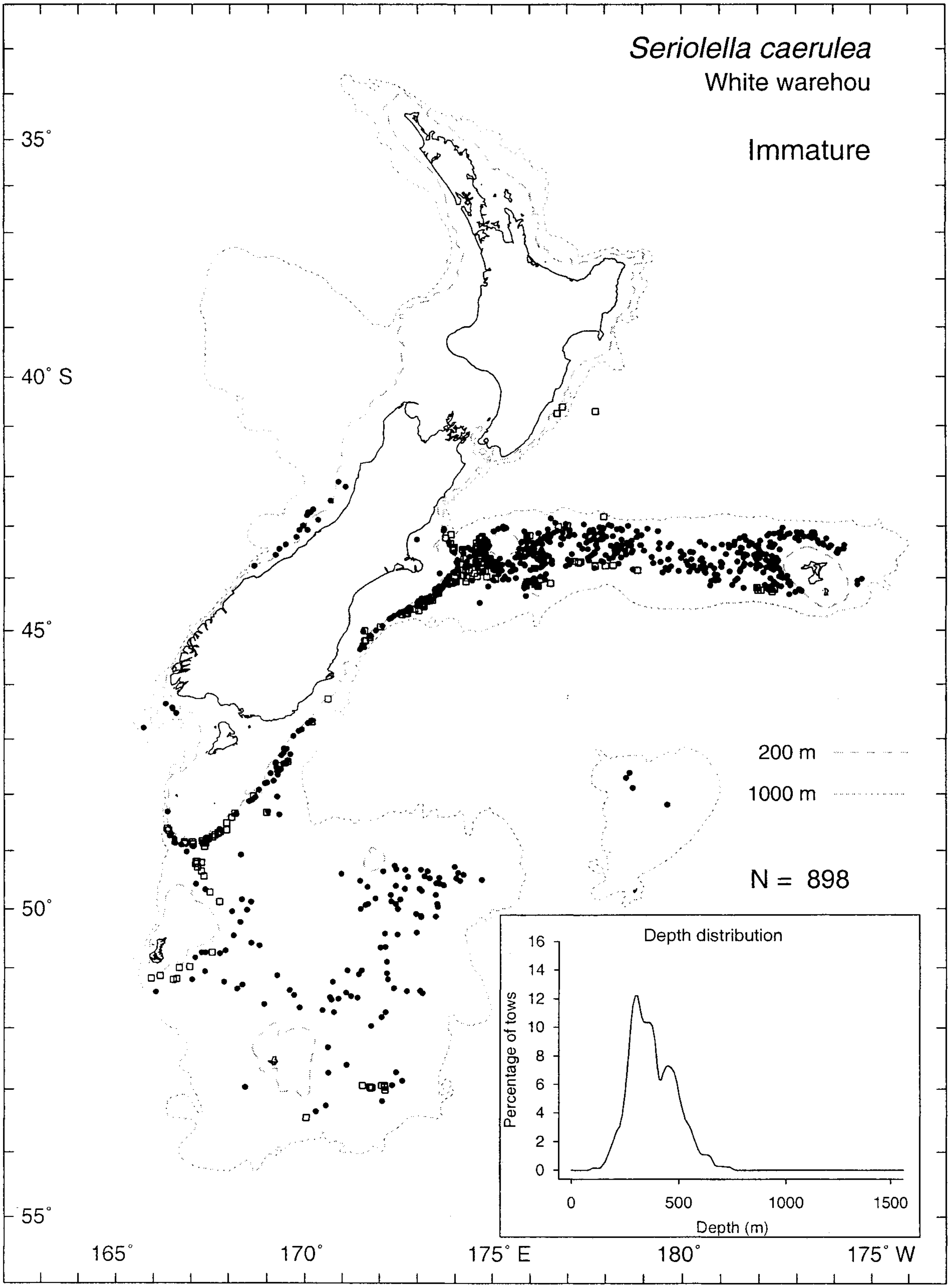
Pseudocyttus maculatus
Smooth oreo
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 2907
Depth distribution
Percentage of tows
35
30
25
20
15
10
5
0
0
500
1000
1500
Depth (m)

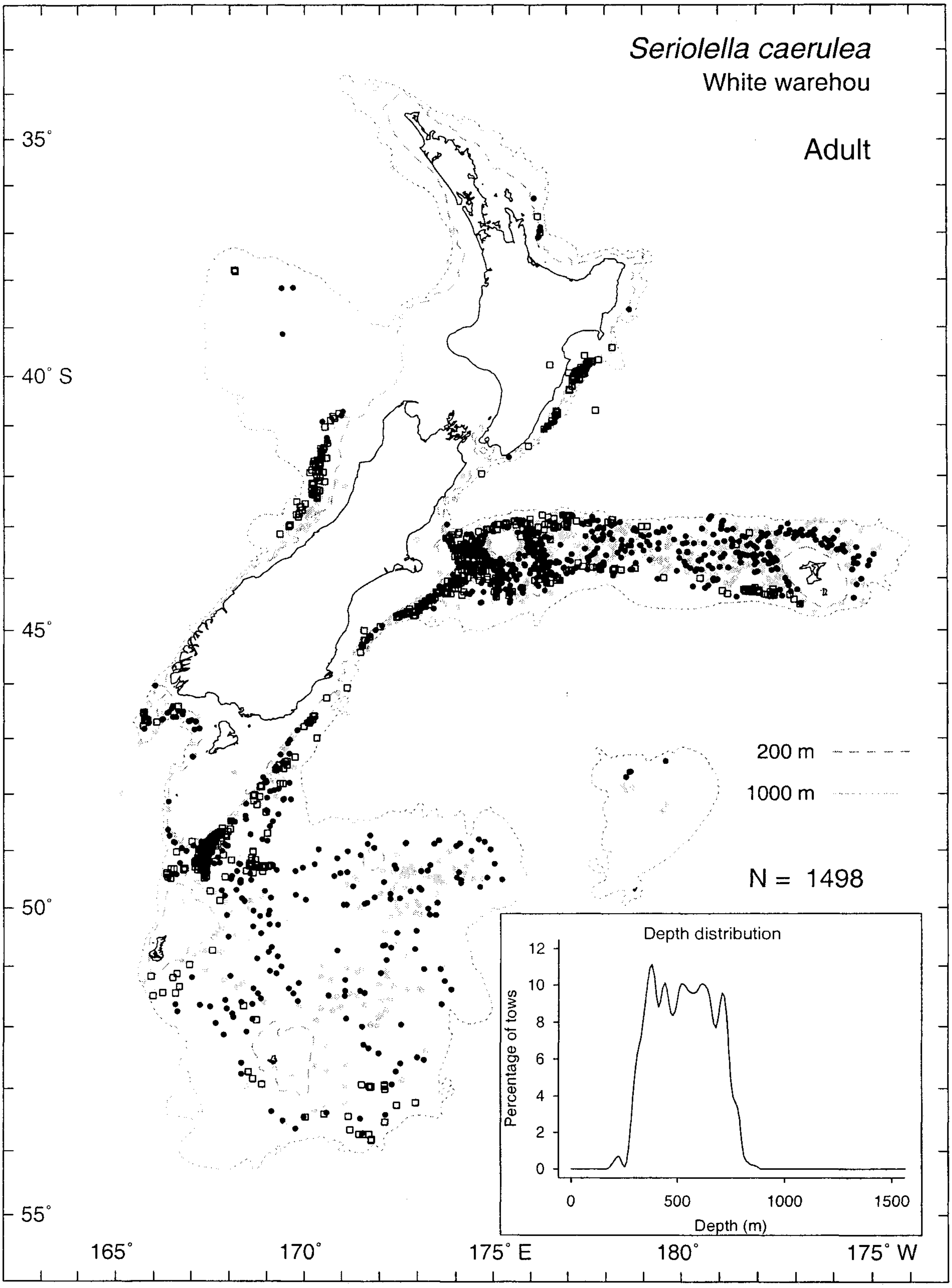


Seriolella caerulea
White warehou
Age 1+
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 205
Depth distribution
Percentage of tows
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Depth (m)

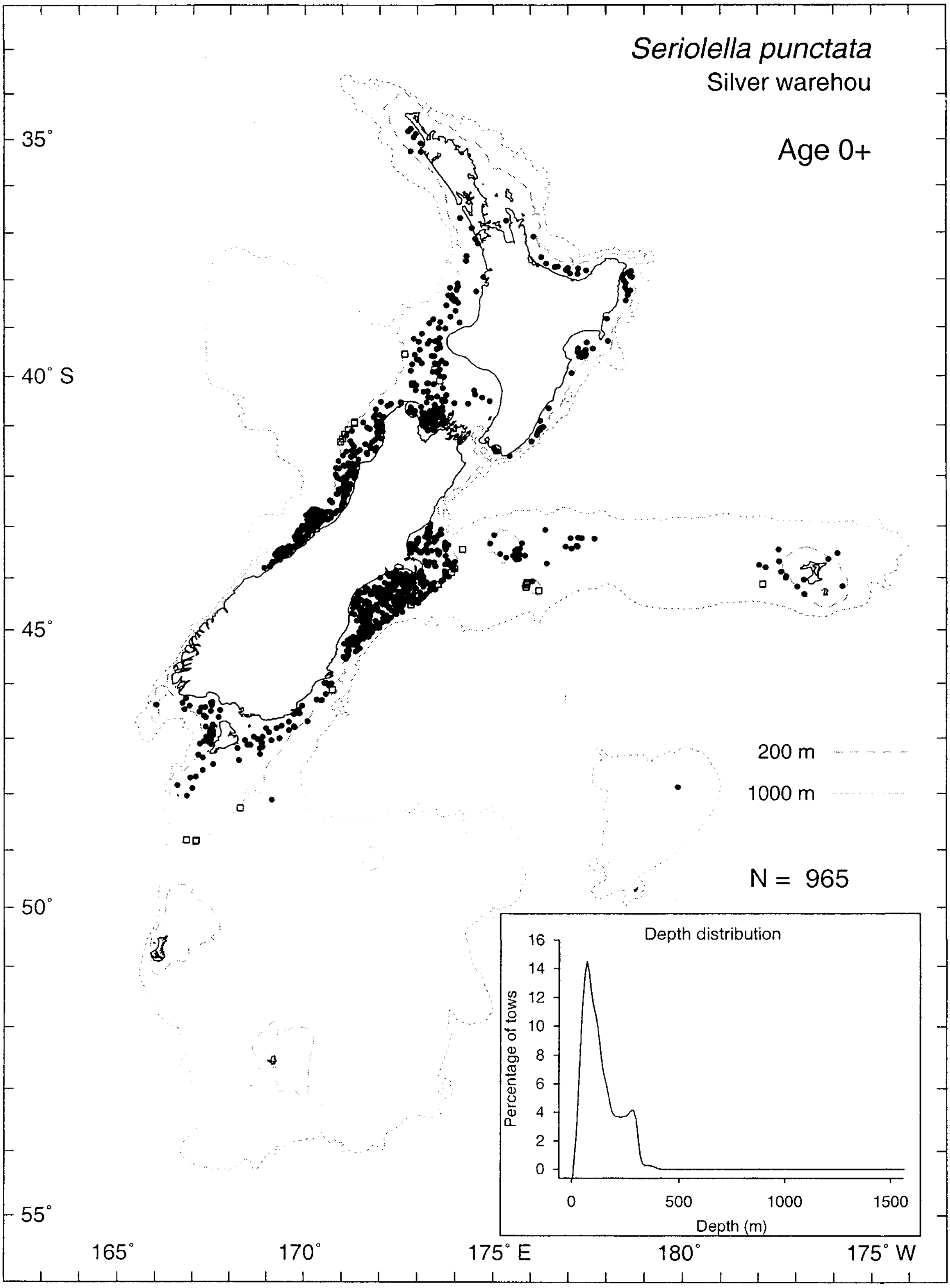


Seriolella caerulea
White warehou
Age 2+
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 604
Depth distribution
Percentage of tows
10
8
6
4
2
0
0
500
1000
1500
Depth (m)

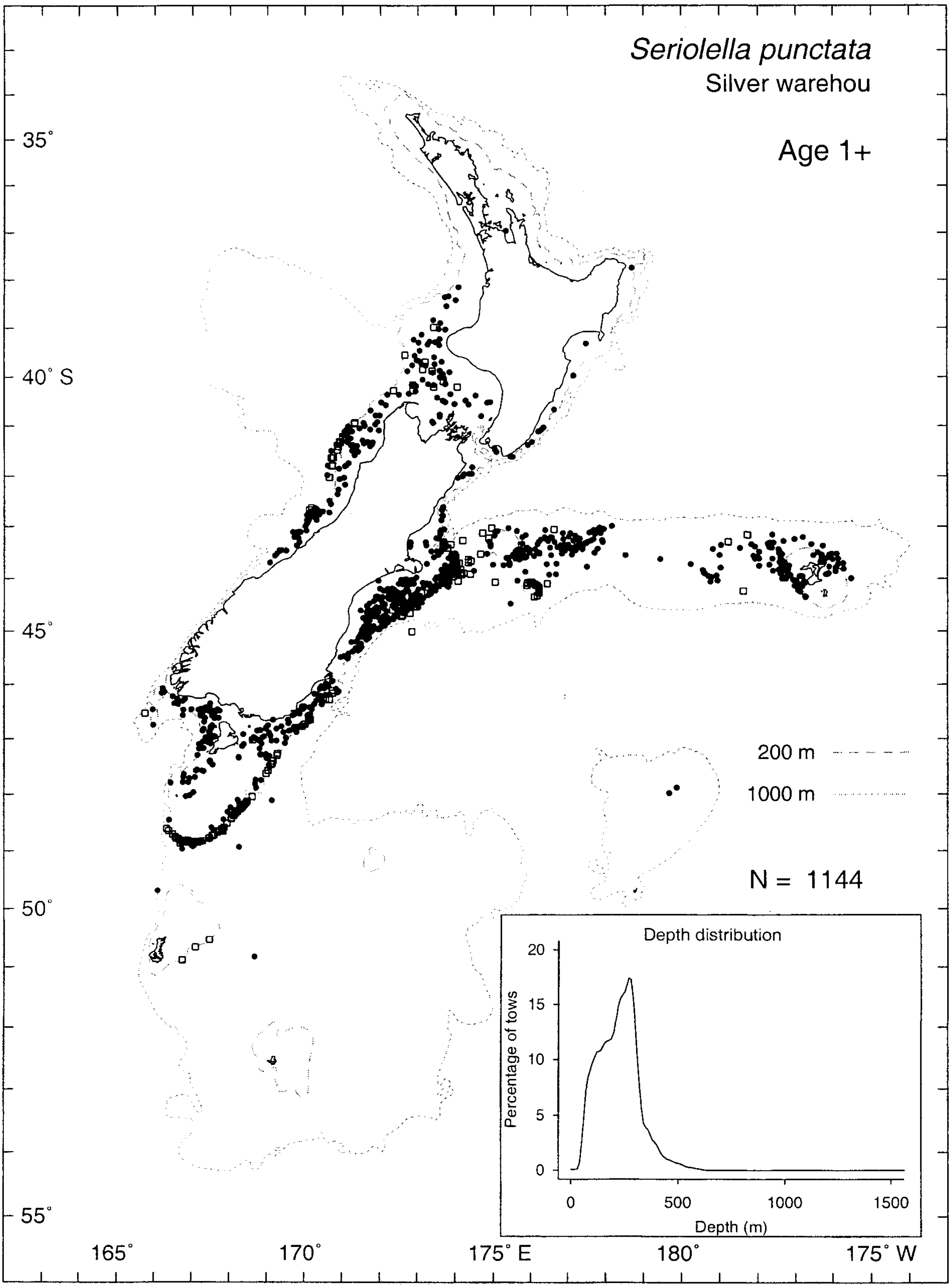

Seriolella caerulea
White warehou
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 898
Depth distribution
Percentage of tows
16
14
12
10
8
6
4
2
0
0
500
1000
1500
Depth (m)



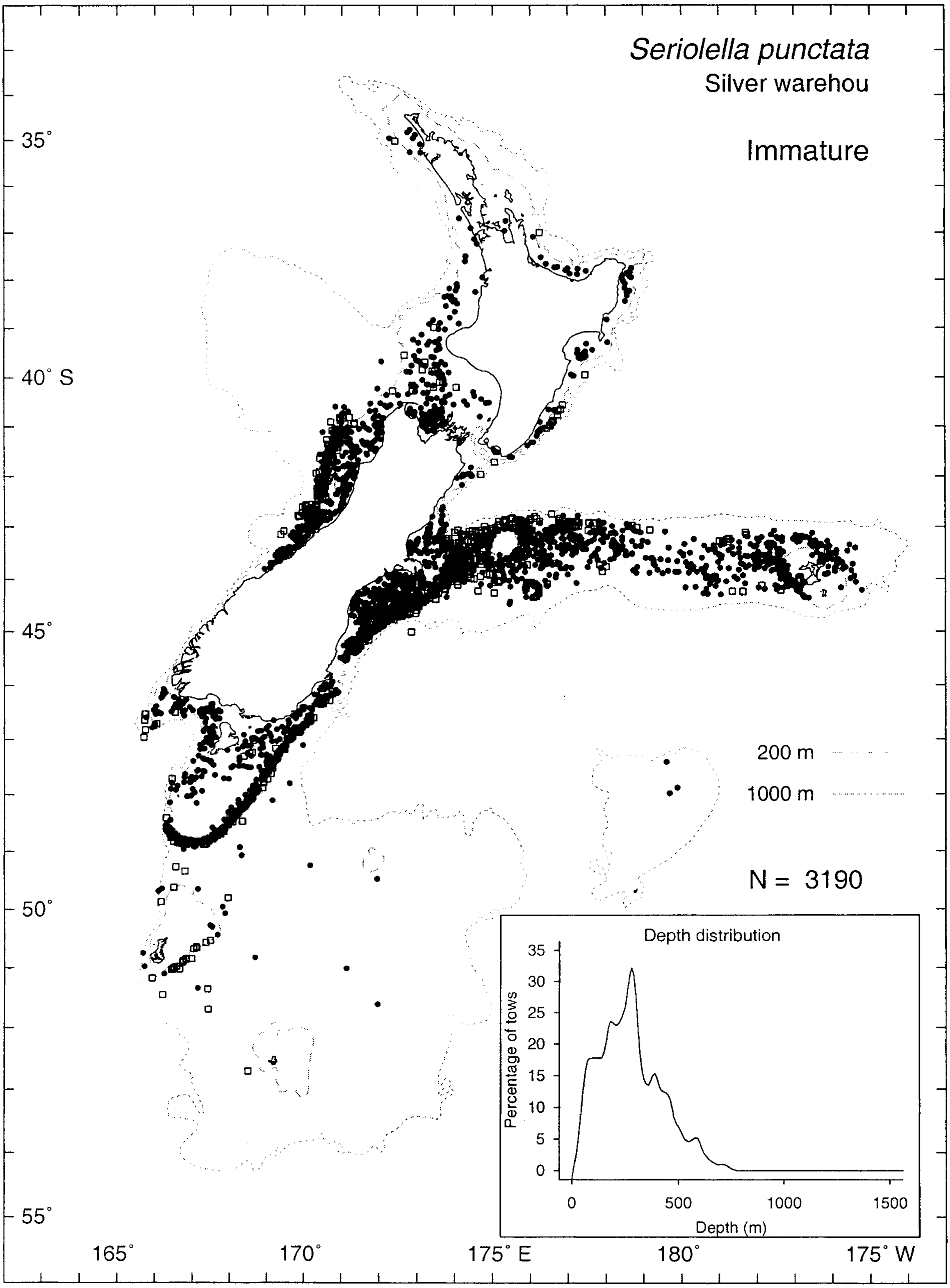
Seriolella caerulea
White warehou
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 1498
Depth distribution
Percentage of tows
12
10
8
6
4
2
0
0
500
1000
1500
Depth (m)



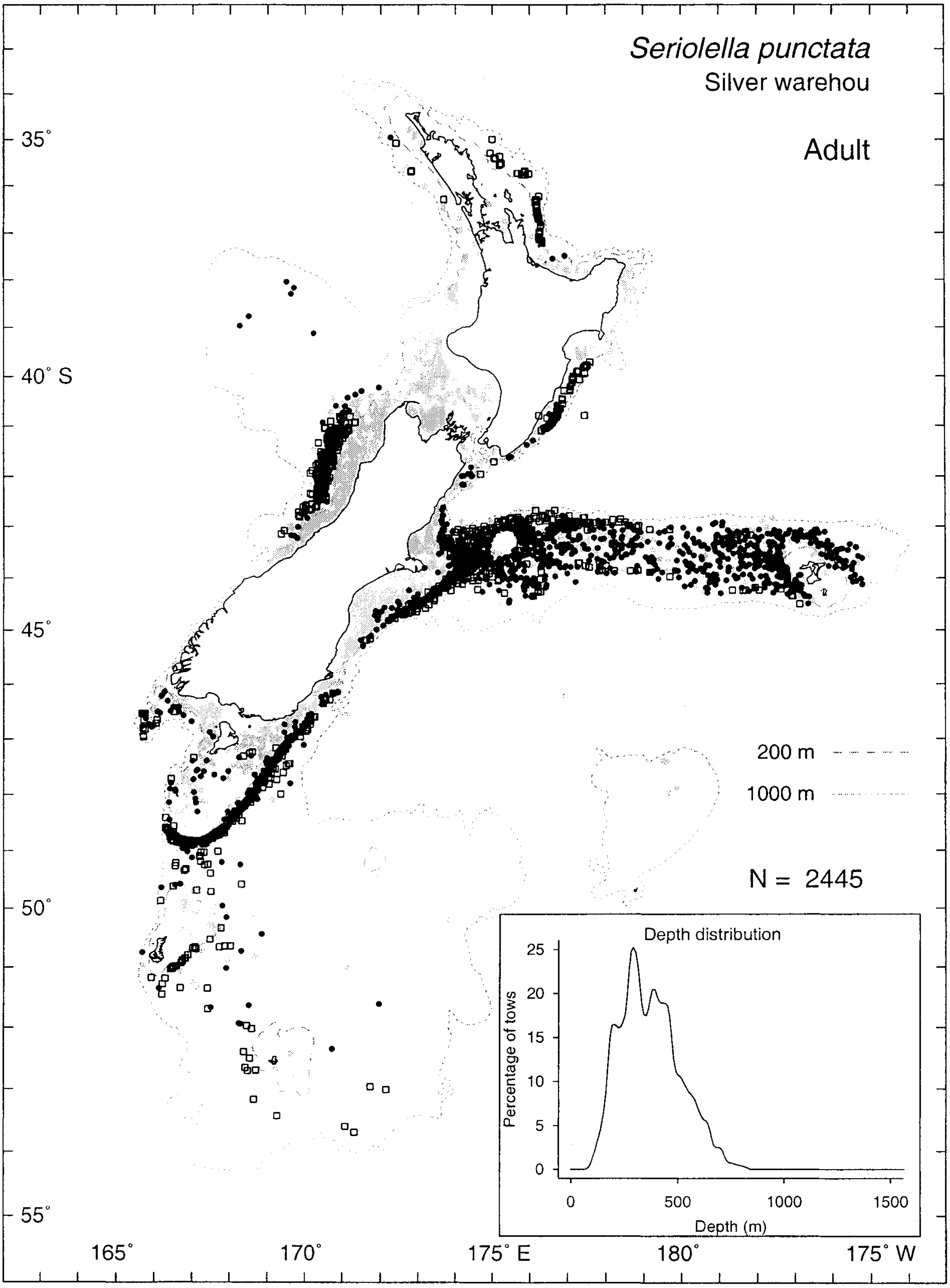
Seriolella punctata
Silver warehou
Age 0+
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 965
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
10
12
14
16
0
500
1000
1500



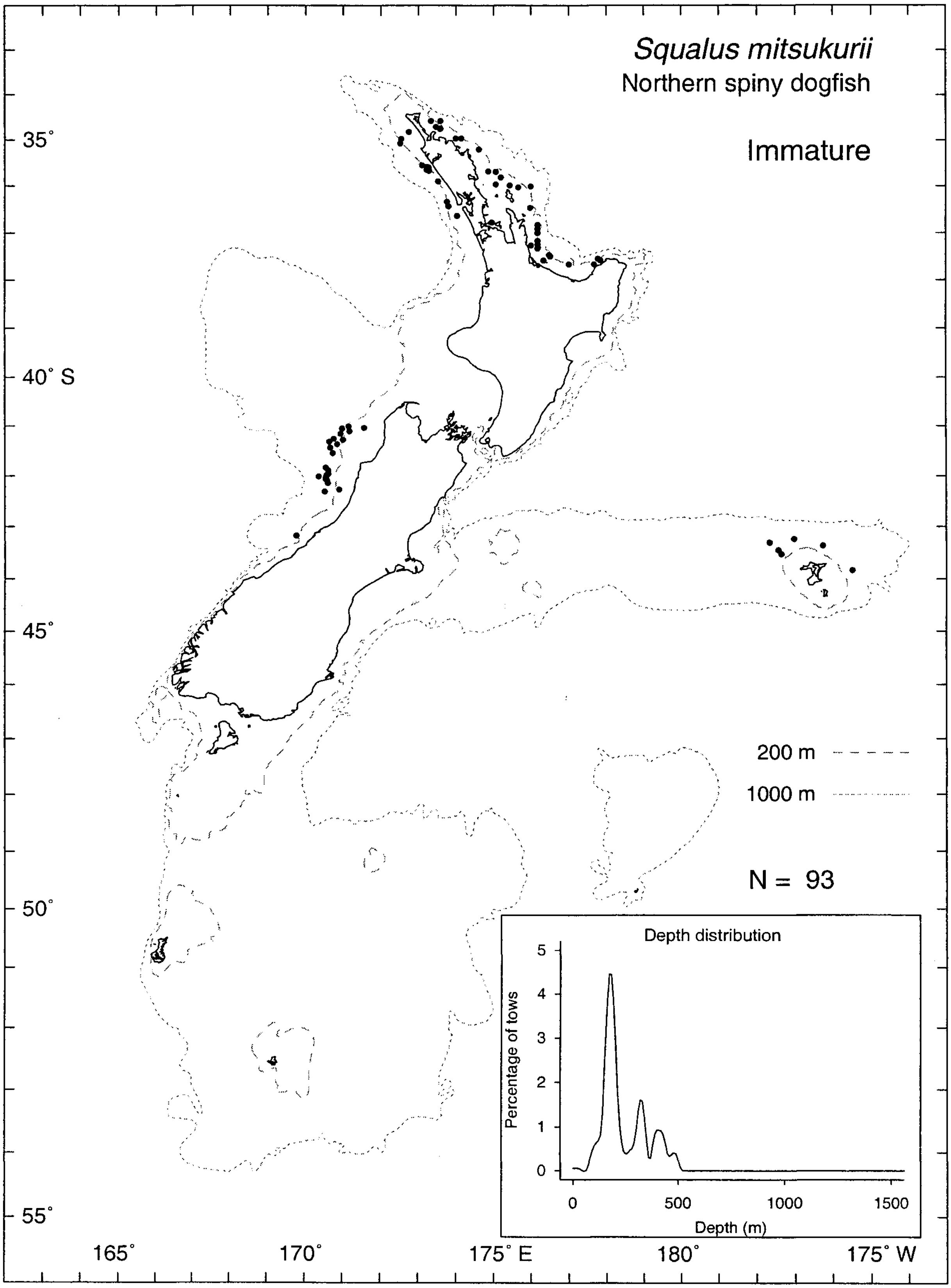
Seriolella punctata
Silver warehou
Age 1+
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 1144
Depth distribution
Percentage of tows
20
15
10
5
0
0
500
1000
1500
Depth (m)

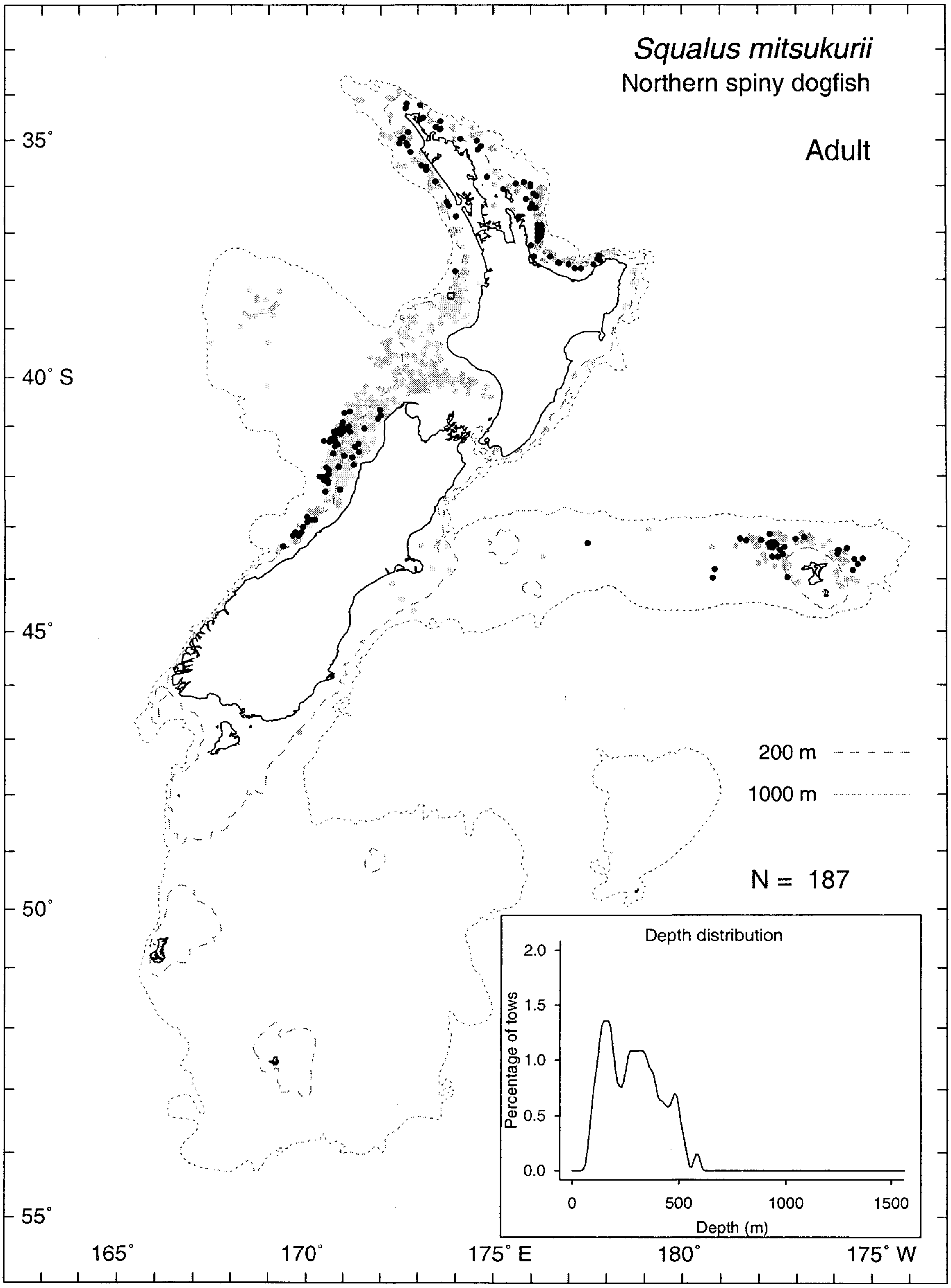


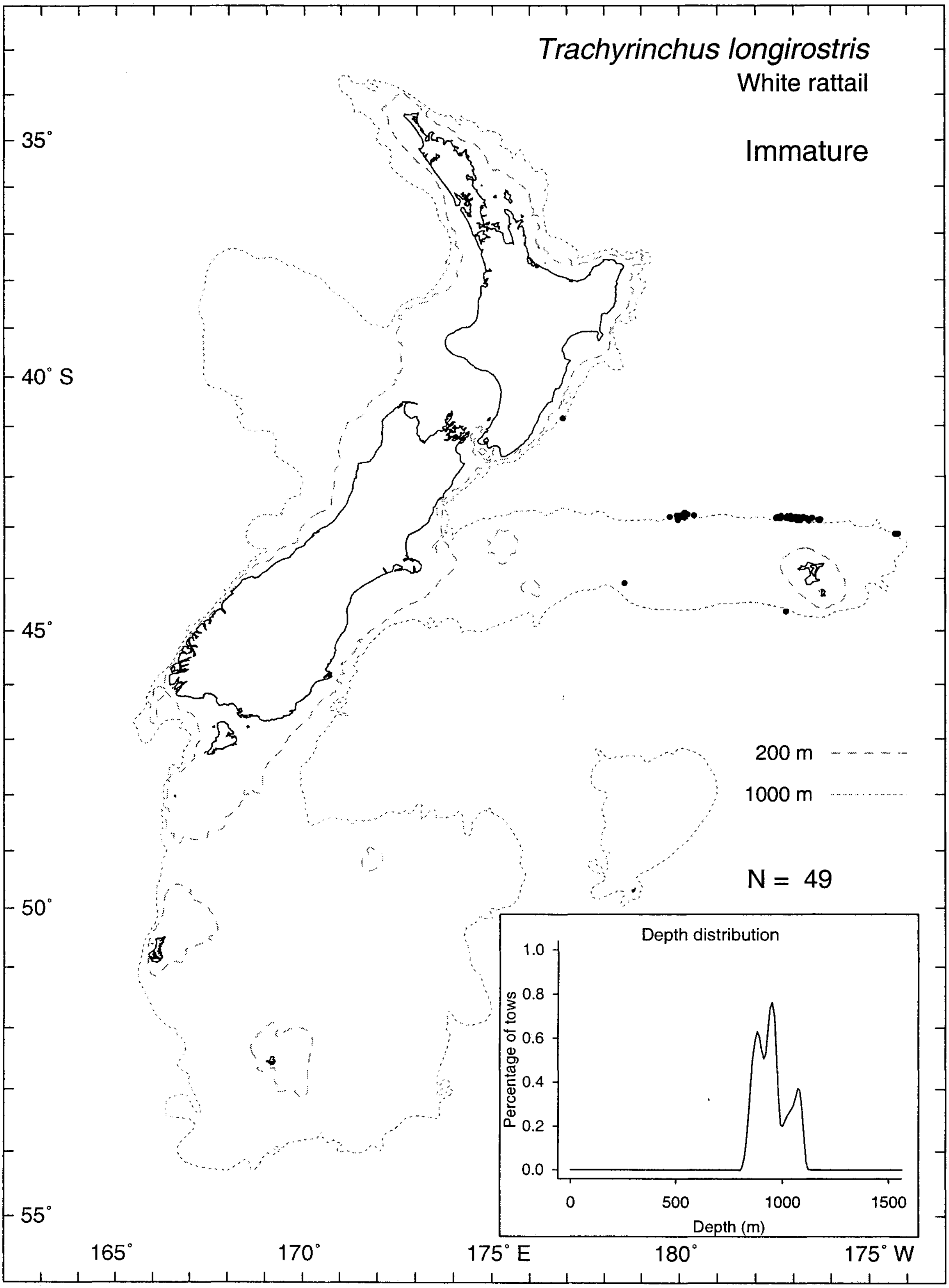
Seriolella punctata
Silver warehou
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 3190
Depth distribution
Percentage of tows
35
30
25
20
15
10
5
0
0
500
1000
1500
Depth (m)



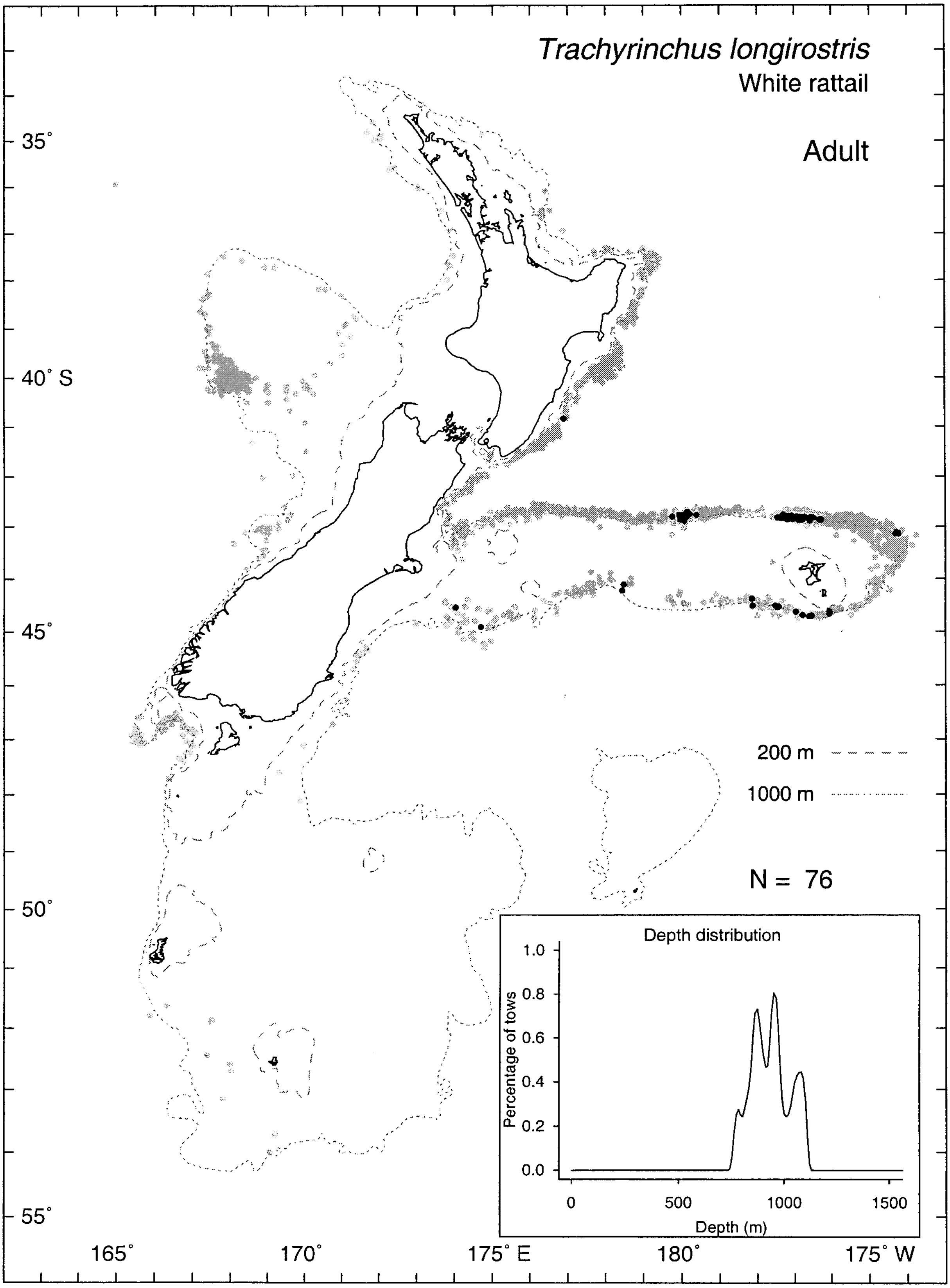
Seriolella punctata
Silver warehou
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 2445
Depth distribution
Percentage of tows
25
20
15
10
5
0
0
500
1000
1500
Depth (m)


Squalus mitsukurii
Northern spiny dogfish
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 93
Depth distribution
Percentage of tows
Depth (m)
0
1
2
3
4
5
500
1000
1500

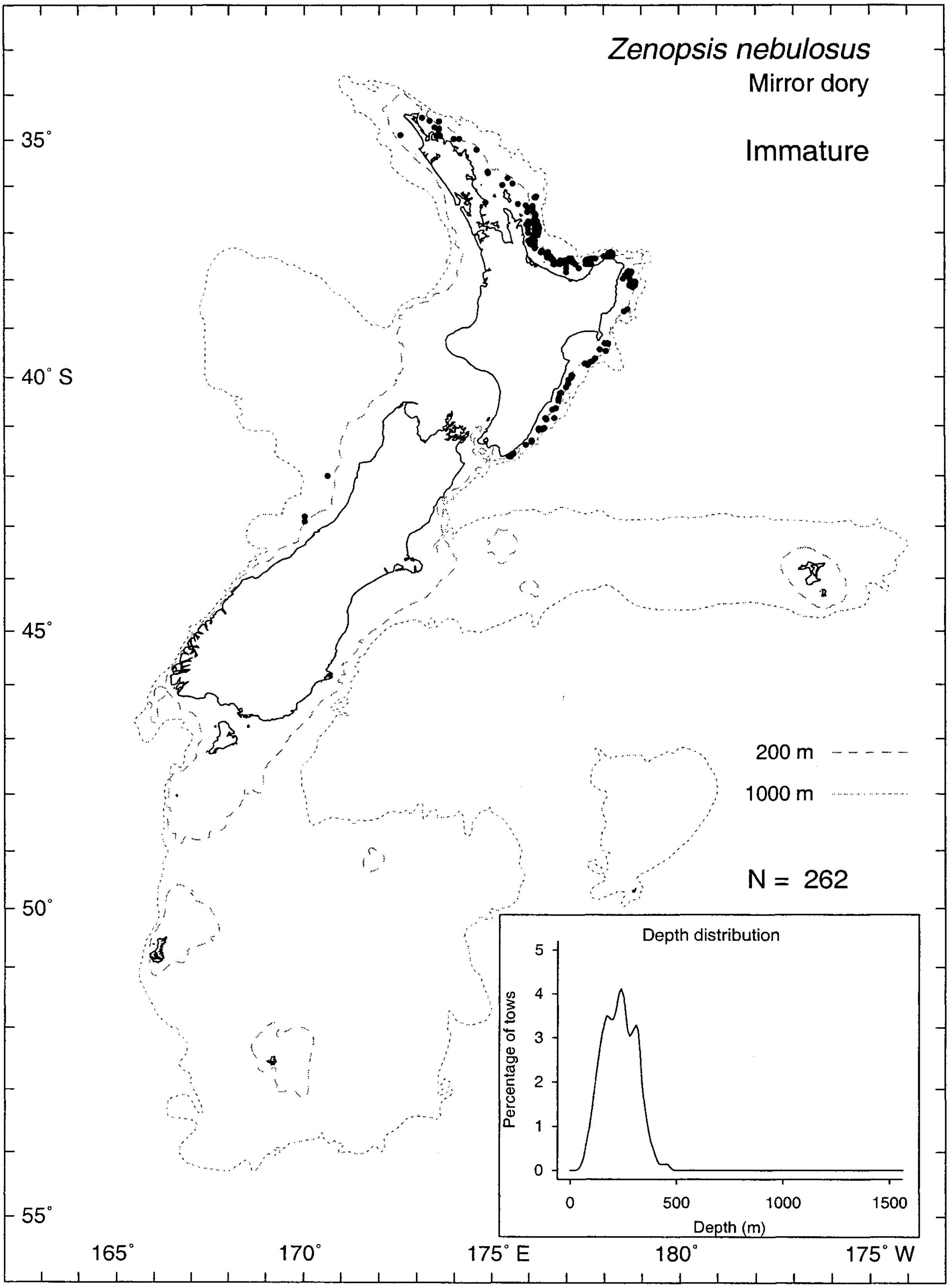

Squalus mitsukurii
Northern spiny dogfish
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 187
Depth distribution
Percentage of tows
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Depth (m)



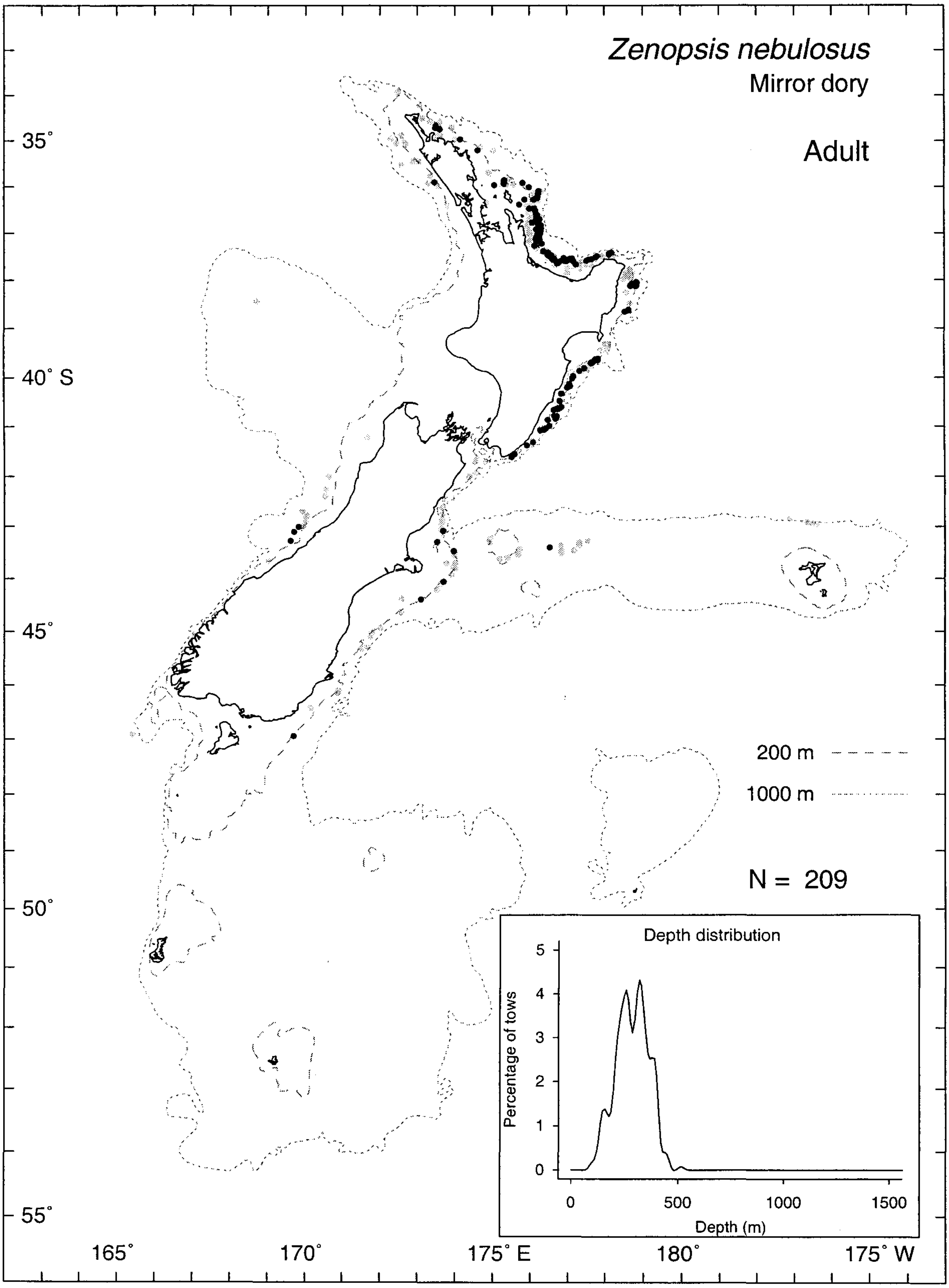
Trachyrinchus longirostris
White rattail
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 49
Depth distribution
Percentage of tows
Depth (m)
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500



Trachyrinchus longirostris
White rattail
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 76
Depth distribution
Percentage of tows
Depth (m)
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500



Zenopsis nebulosus
Mirror dory
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 262
Depth distribution
Percentage of tows
0
1
2
3
4
5
0
500
1000
1500
Depth (m)



Zenopsis nebulosus
Mirror dory
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 209
Depth distribution
Percentage of tows
Depth (m)
0
1
2
3
4
5
0
500
1000
1500

1.2.1 Deepwater fish juvenile abundance

Middle depth and deepwater surveys

Key to symbols and interpretation of middle depth and deepwater abundance plots

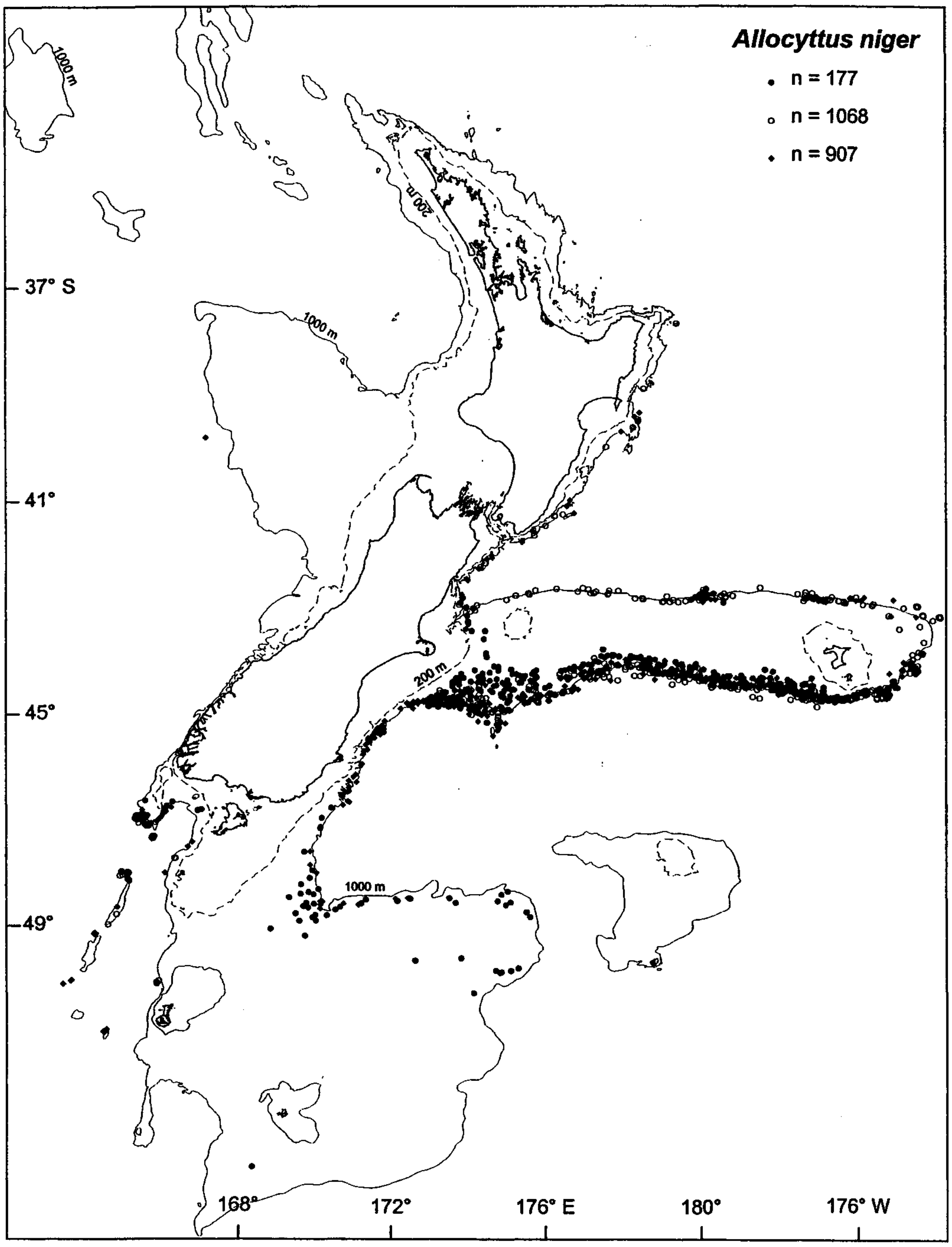
Left-hand pages are reference plots of where the species was caught in the trawl survey series (see Table 3); n, number of stations.

Right-hand pages show catch rates of juveniles. Symbol size is proportional to the maximum catch rate indicated; n, number of stations with juveniles.

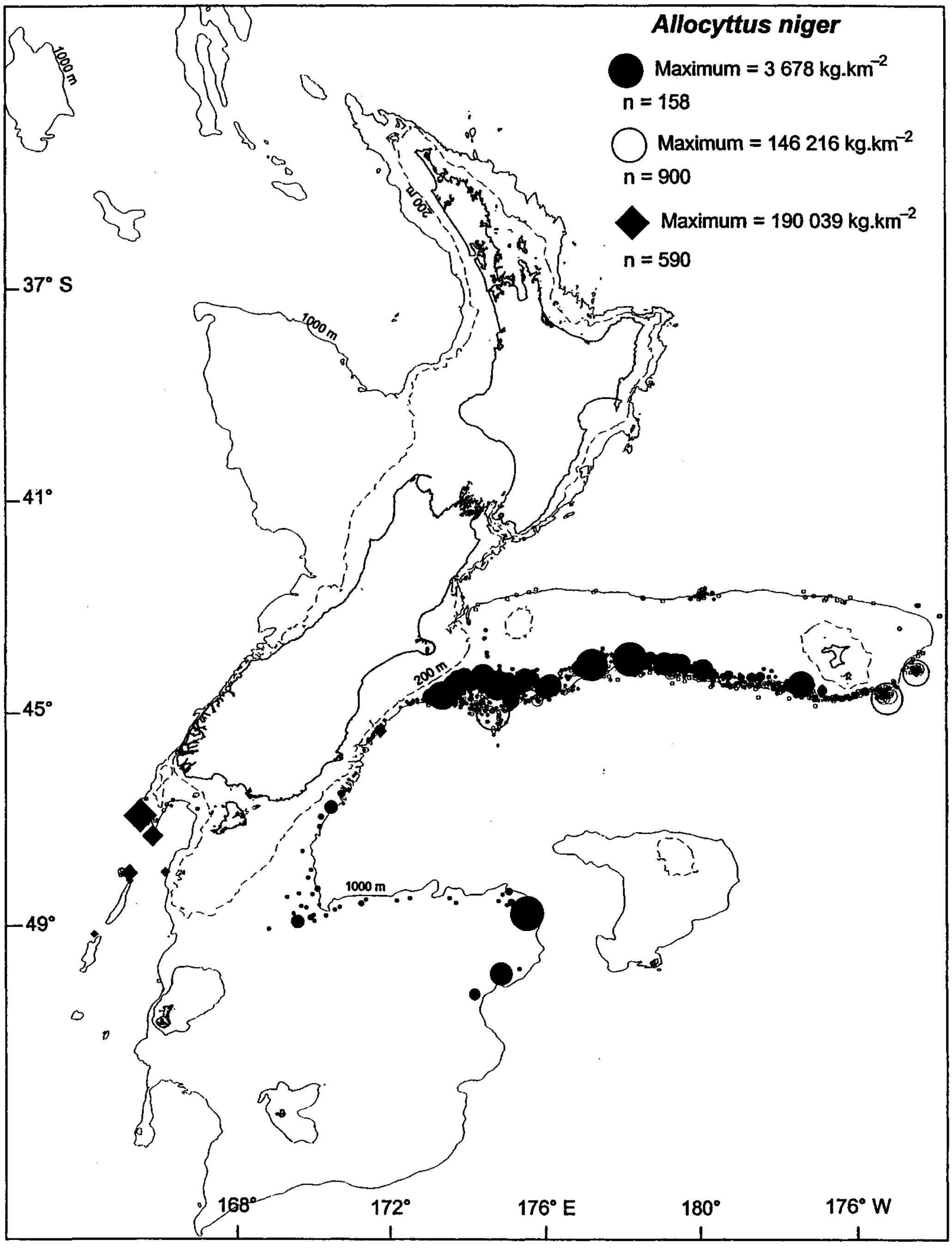
Solid circles, *Tangaroa* time series with hoki trawl, 60 mm codend, daylight tows

Open circles, *Tangaroa* time series with orange roughy trawl, 100 mm codend

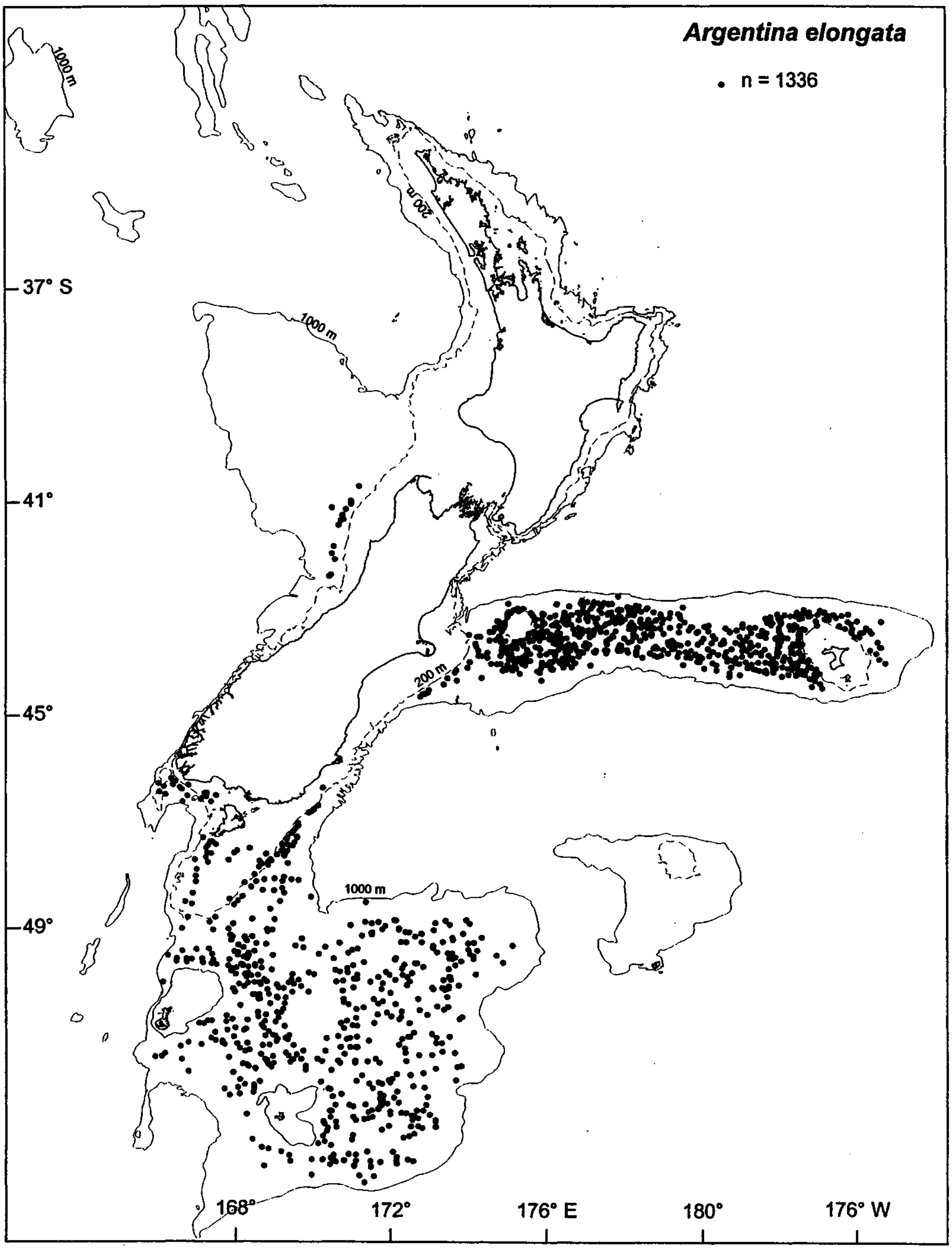
Solid diamonds, other charter vessels with orange roughy trawl, 100 mm codend

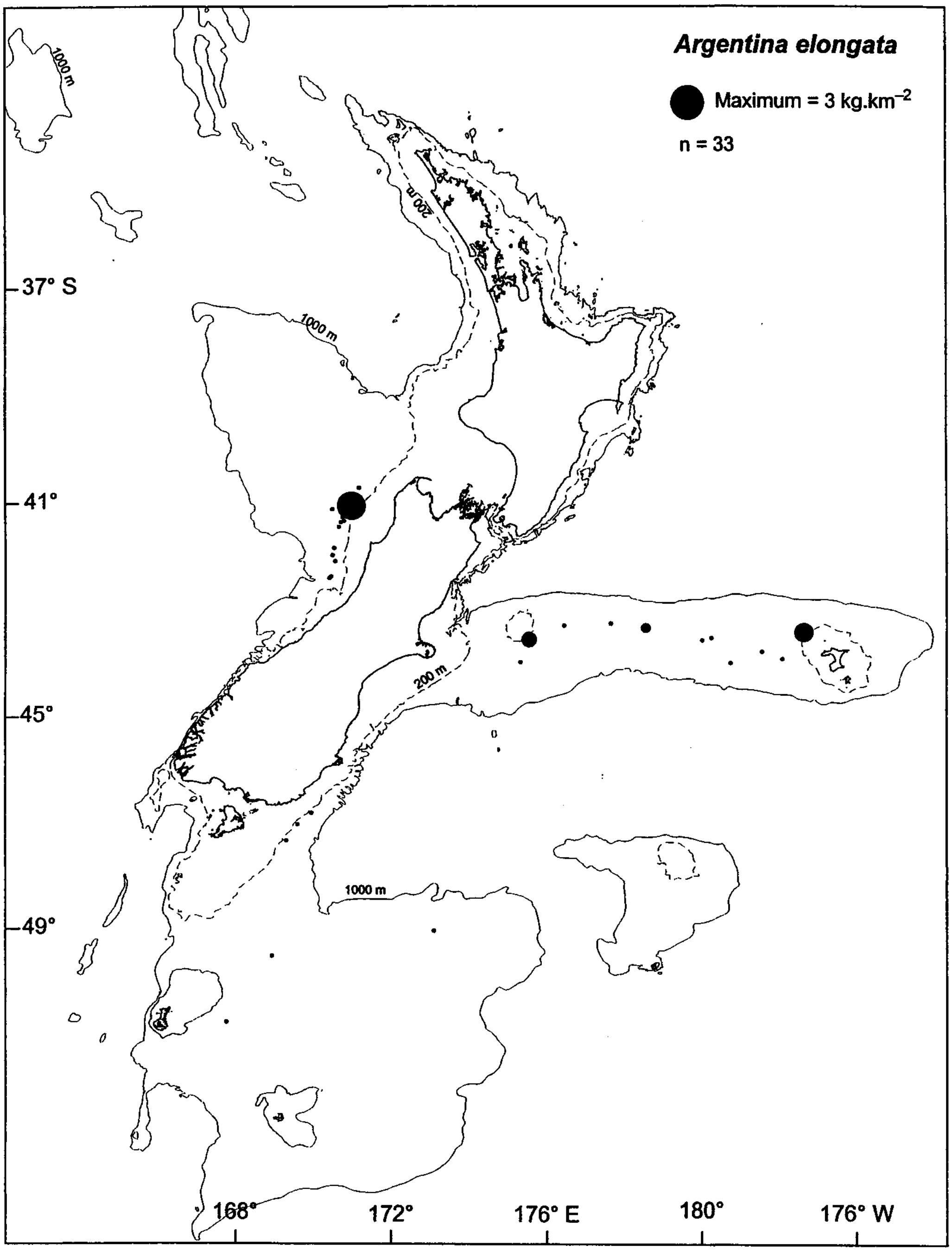


Allocyttus niger
n = 177
n = 1068
n = 907
1000 m
200 m
1000 m
200 m
1000 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

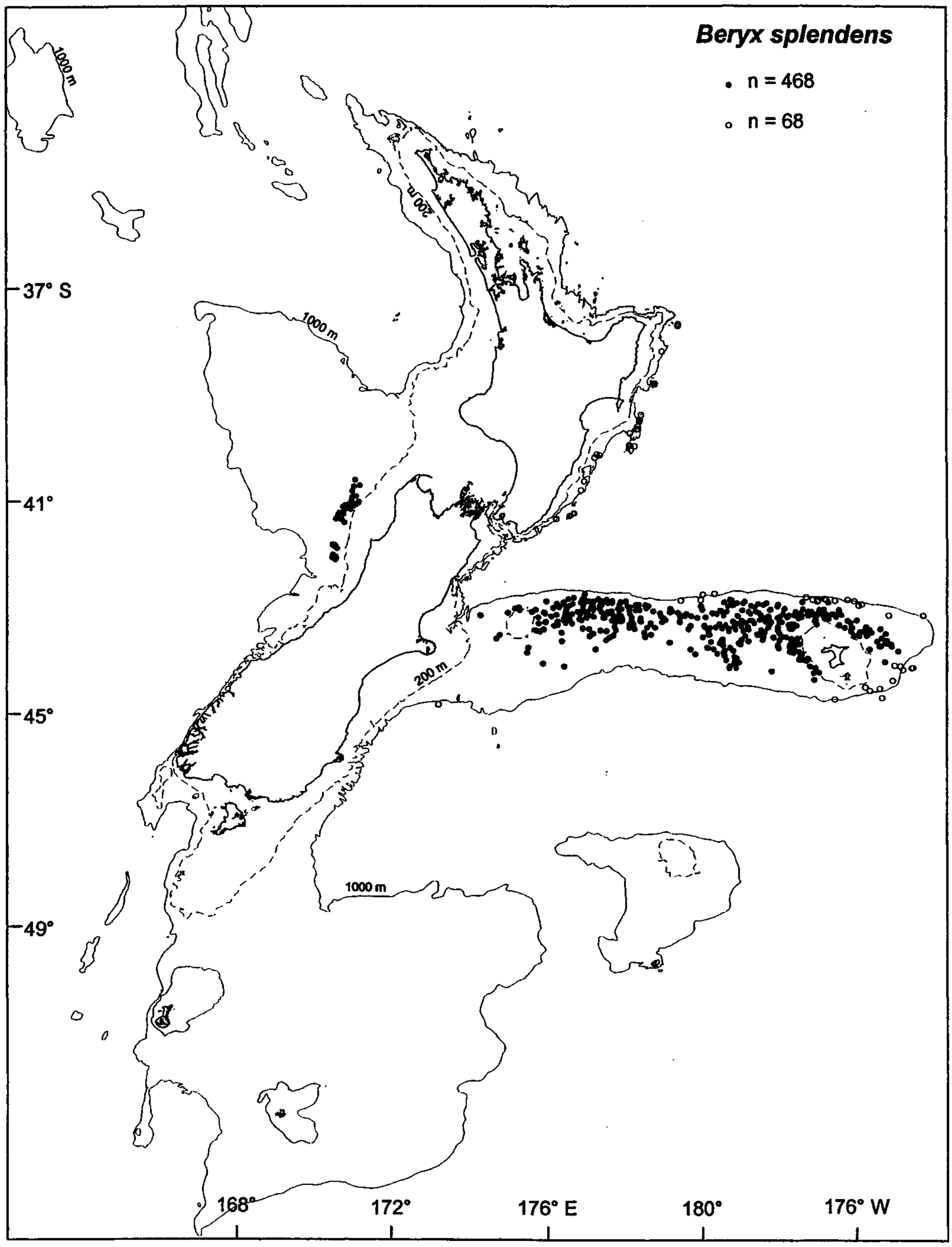


Allocyttus niger
Maximum = 3 678 kg.km^{-2}
n = 158
Maximum = 146 216 kg.km^{-2}
n = 900
Maximum = 190 039 kg.km^{-2}
n = 590
37° S
41°
45°
49°
1000 m
200 m
168°
172°
176° E
180°
176° W

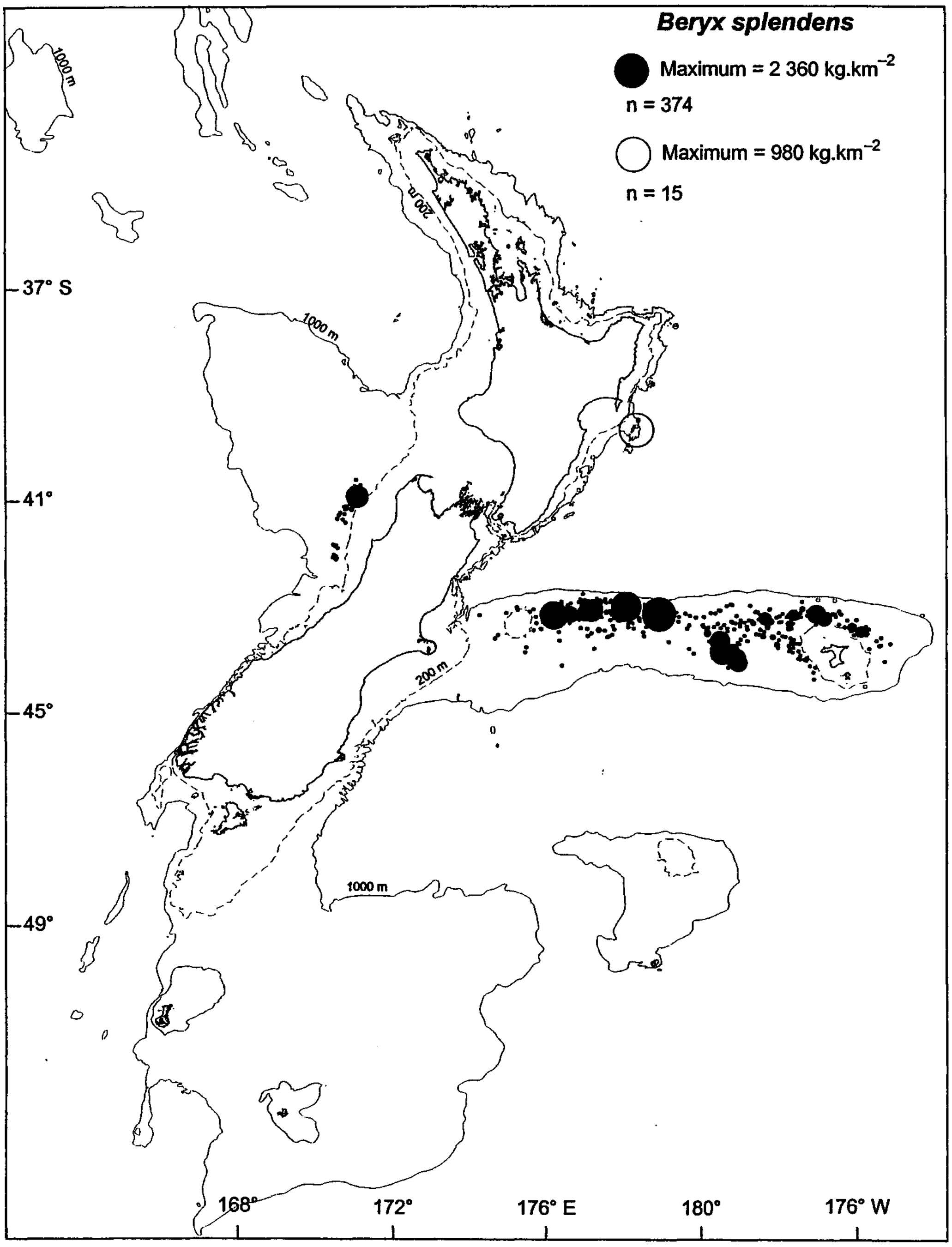

Argentina elongata
n = 1336
1000 m
200 m
1000 m
200 m
1000 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



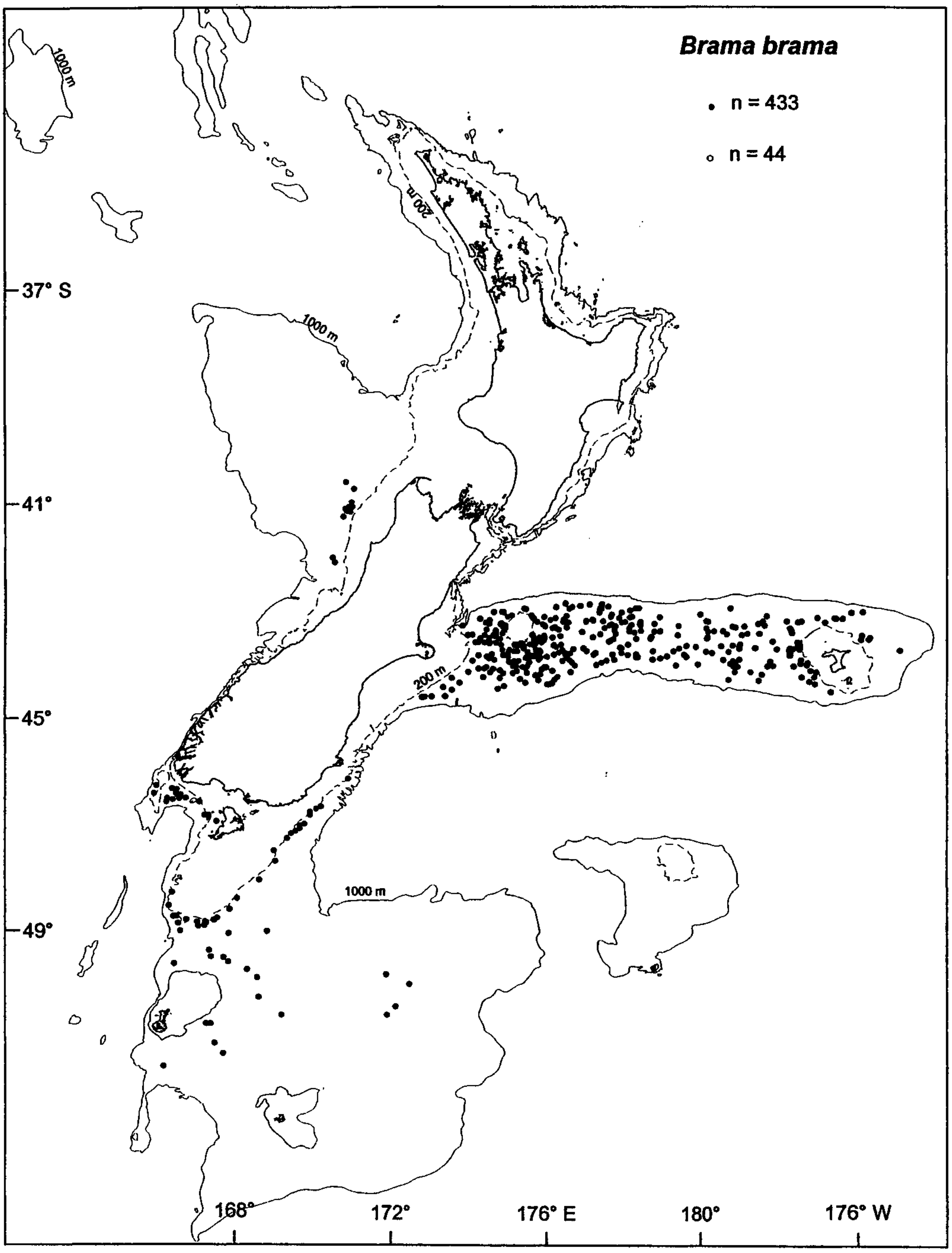
Argentina elongata
Maximum = 3 kg.km^{-2}
n = 33
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W
1000 m
200 m

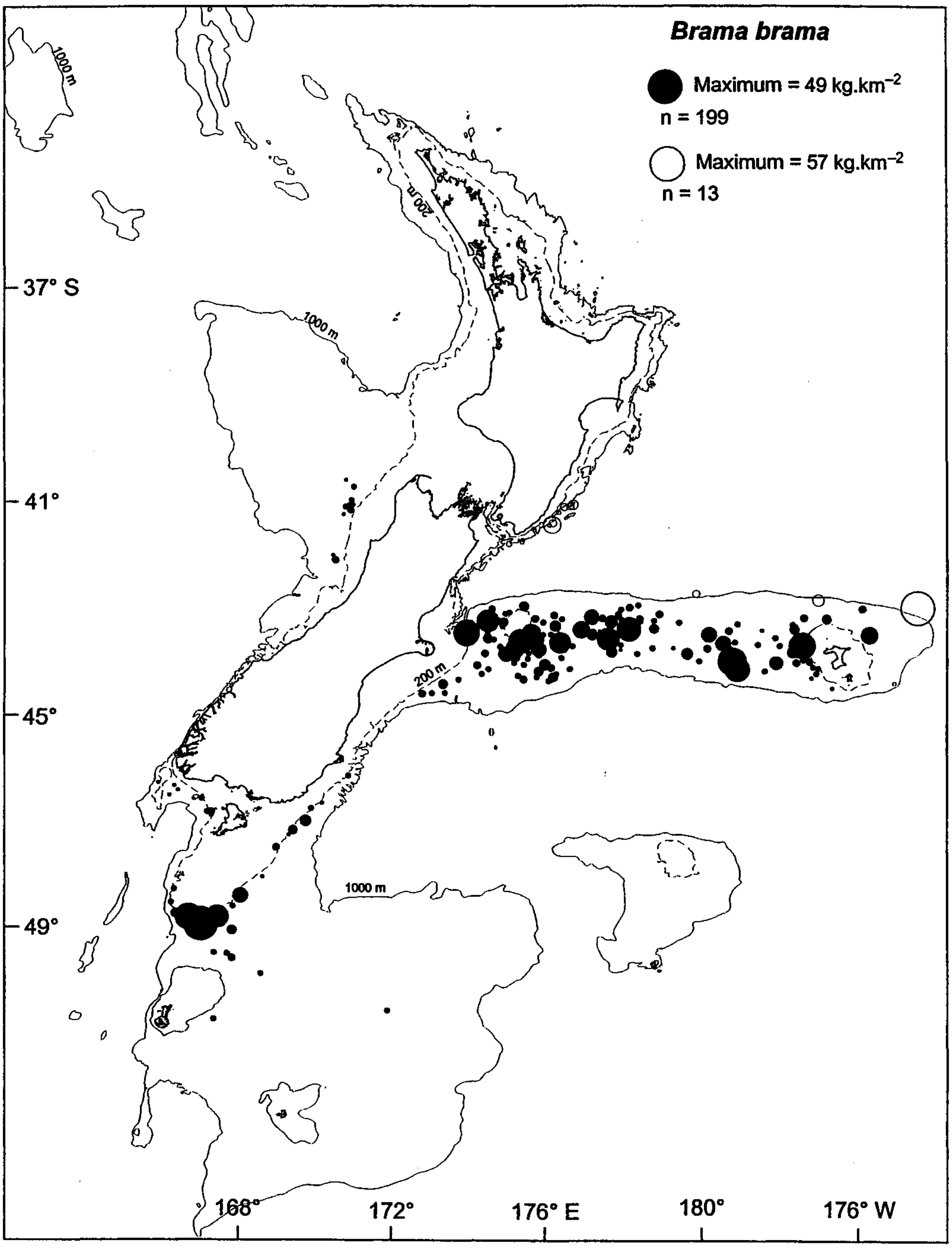


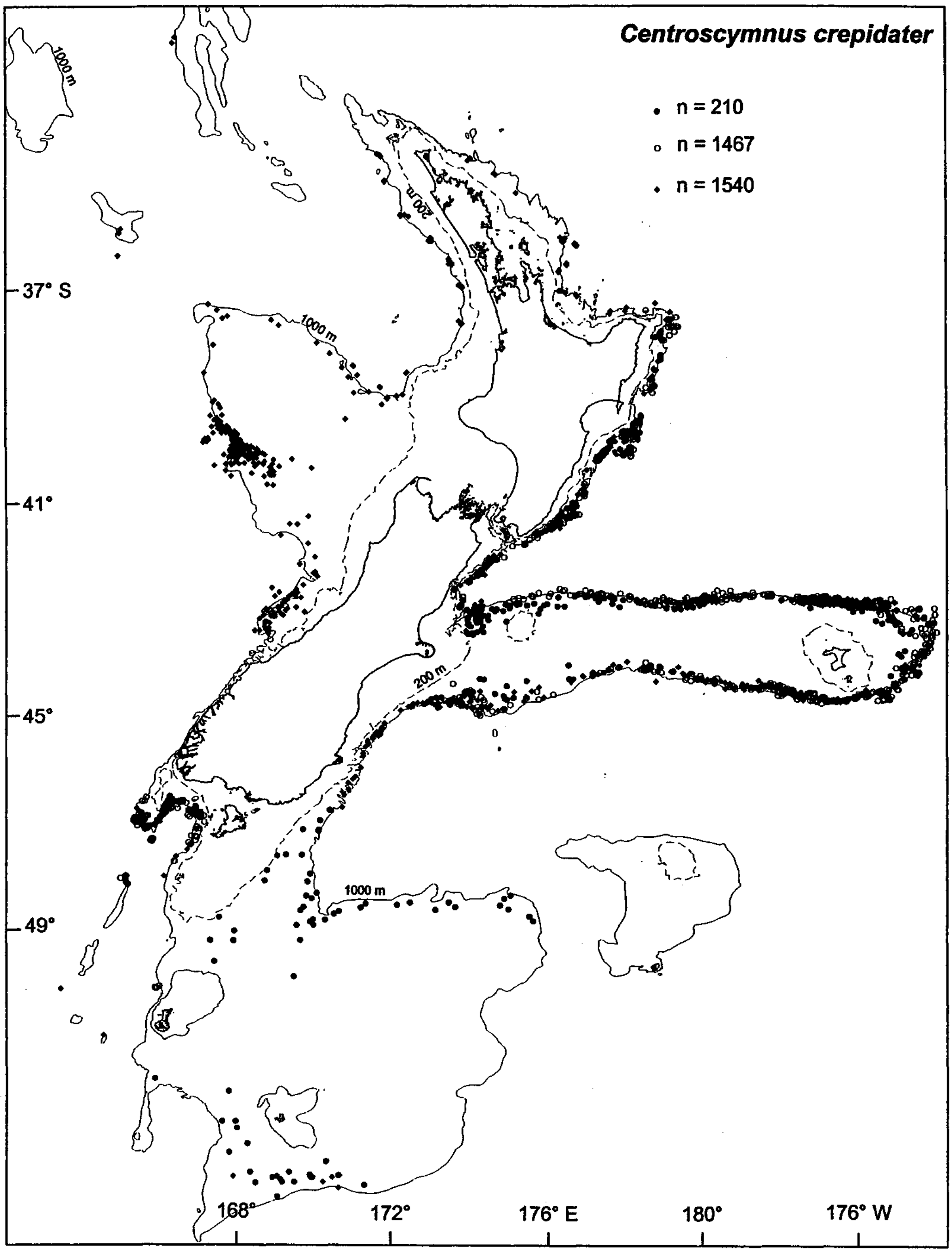
Beryx splendens
n = 468
n = 68
1000 m
200 m
1000 m
200 m
1000 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

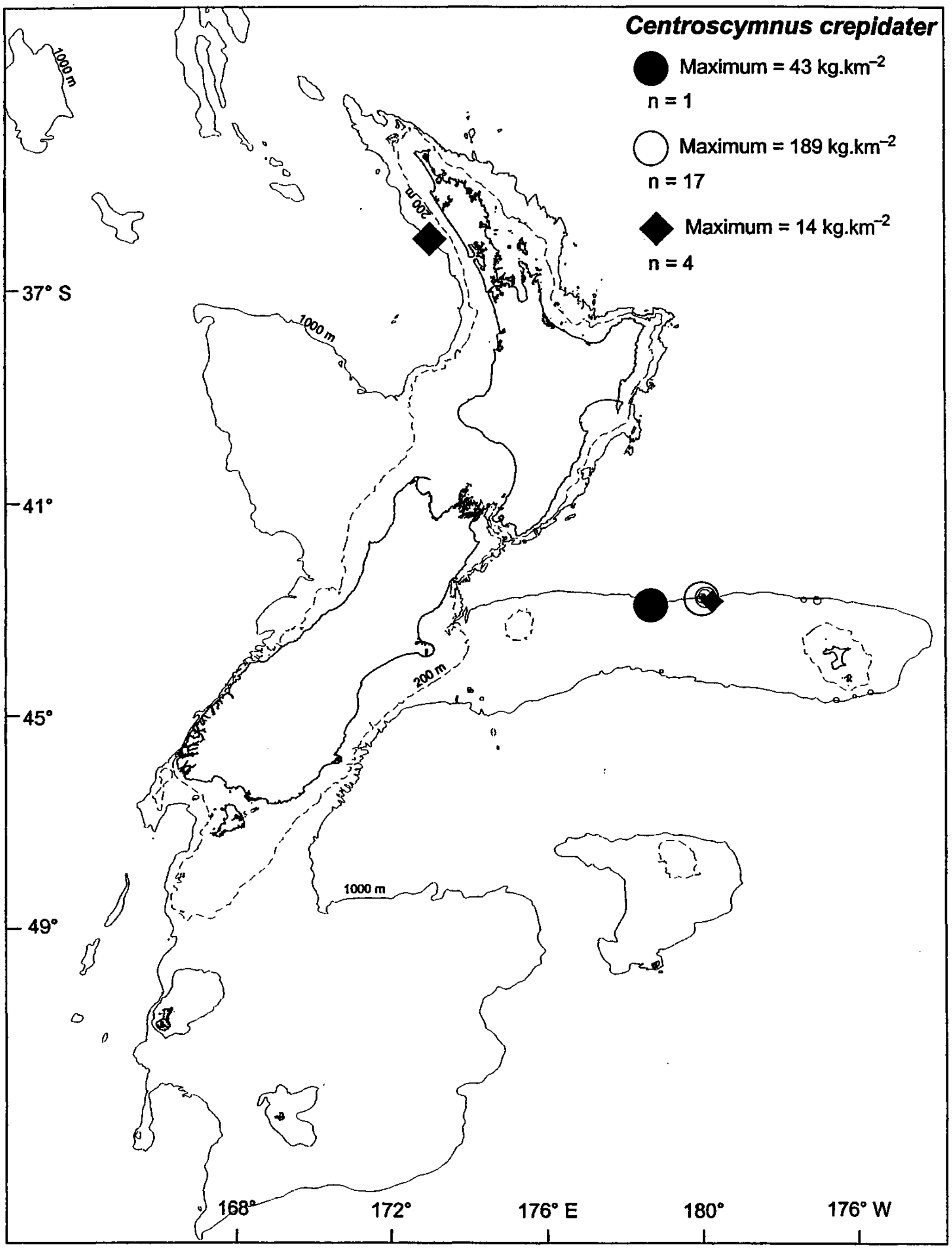


Beryx splendens
Maximum = 2 360 kg.km⁻²
n = 374
Maximum = 980 kg.km⁻²
n = 15
37° S
41°
45°
49°
1000 m
200 m
168°
172°
176° E
180°
176° W

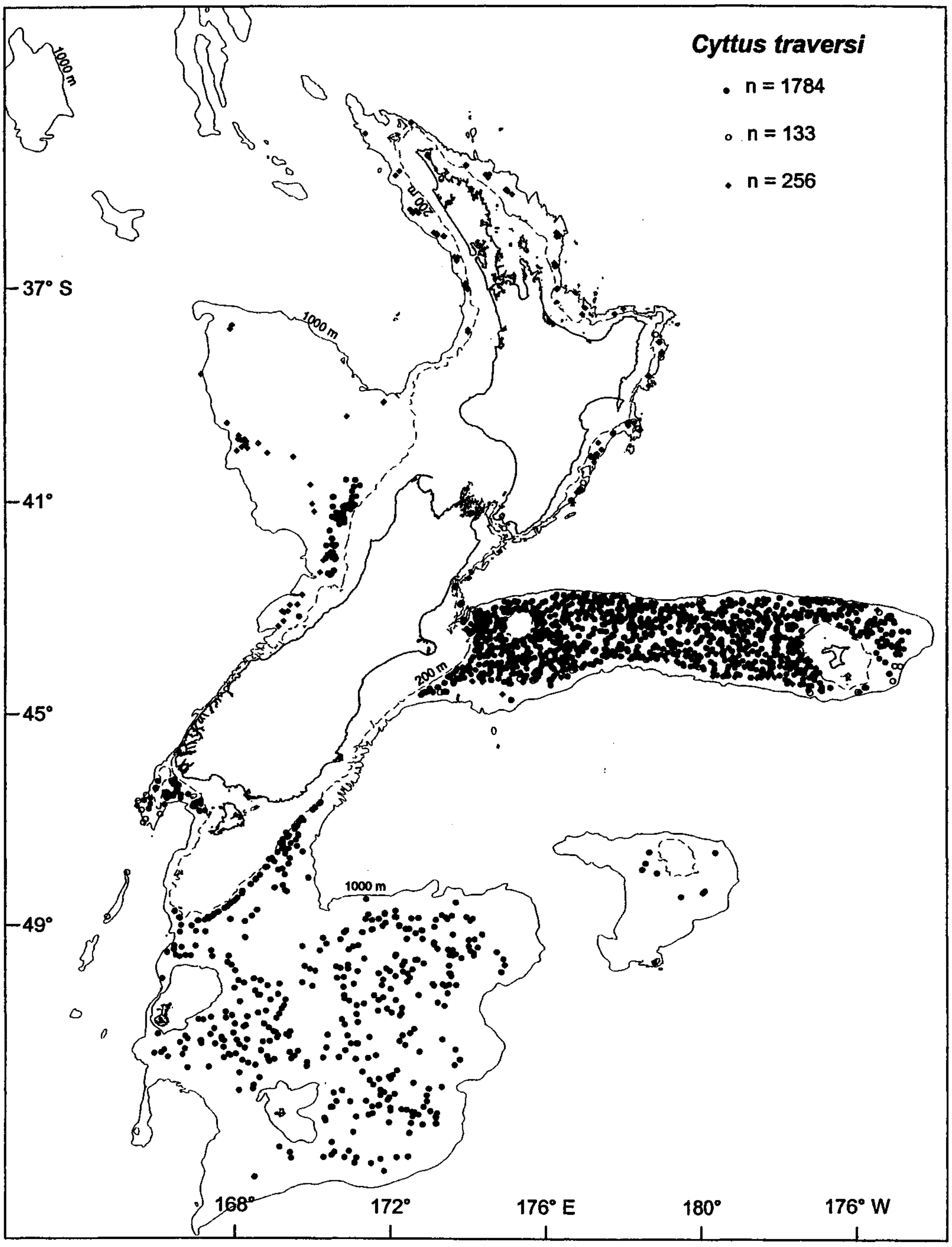

Brama brama
n = 433
n = 44
1000 m
200 m
1000 m
200 m
1000 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

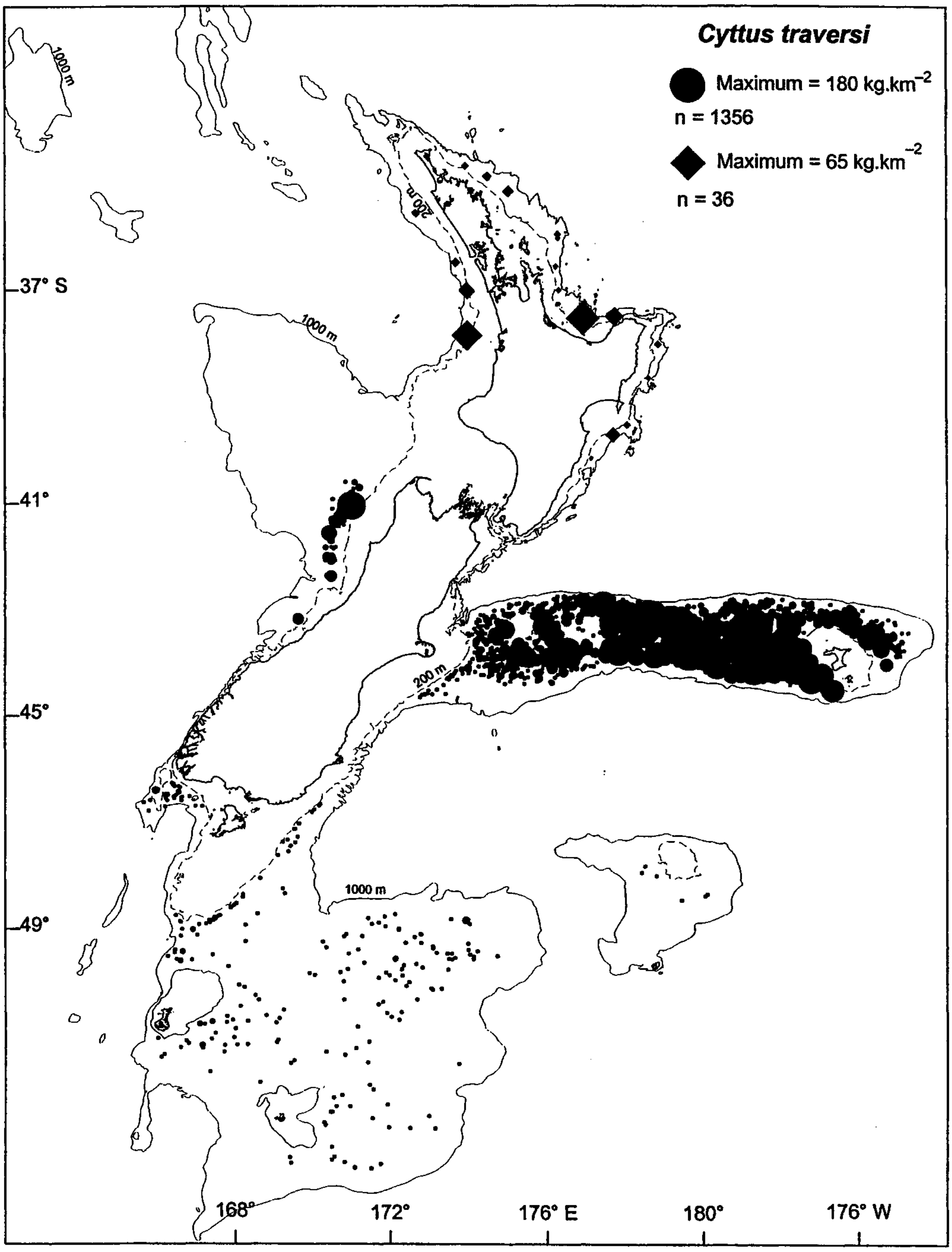

Brama brama
Maximum = 49 kg.km⁻²
n = 199
Maximum = 57 kg.km⁻²
n = 13
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W


Centroscymnus crepidater
n = 210
n = 1467
n = 1540
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

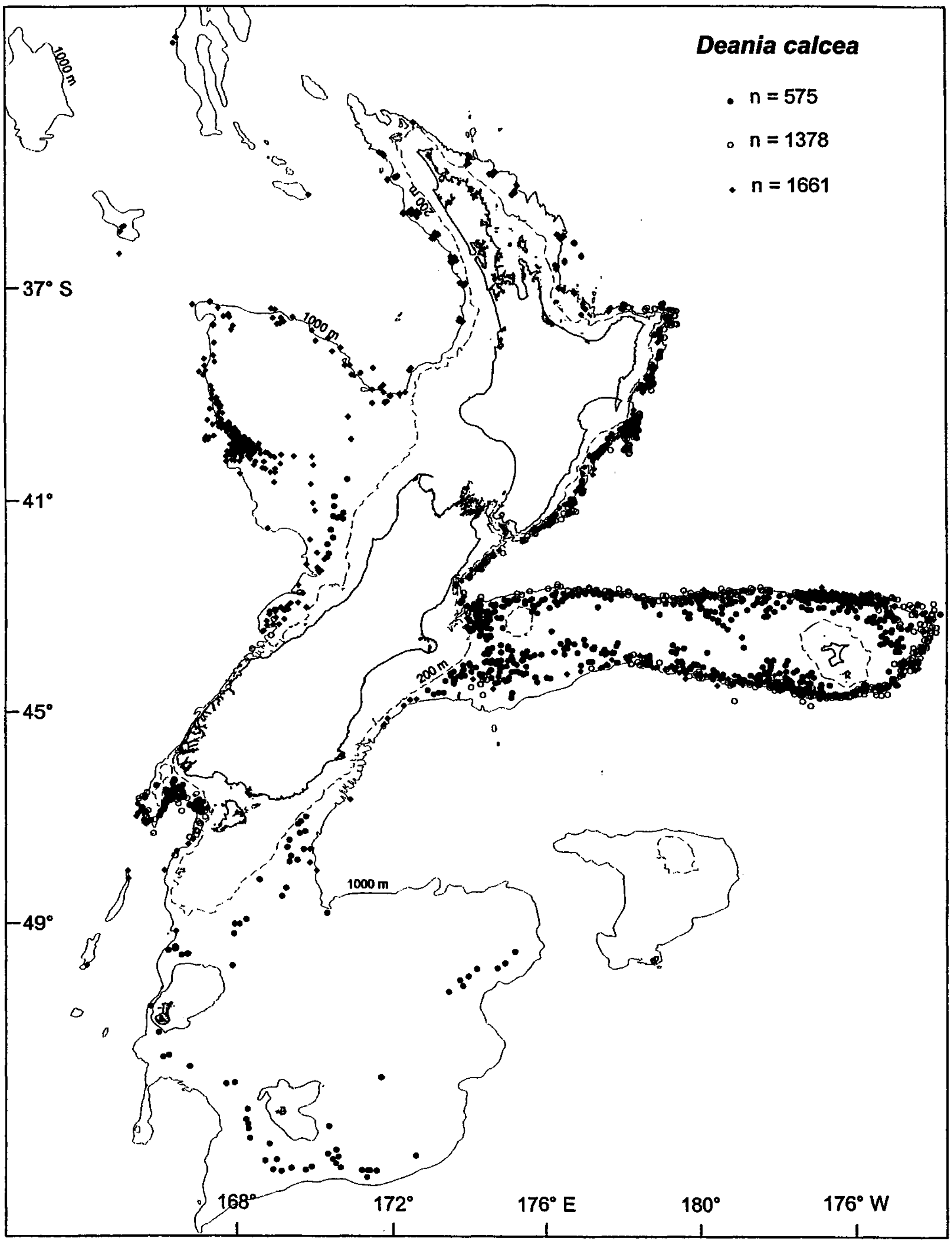


Centroscymnus crepidater
Maximum = 43 kg.km^{-2}
n = 1
Maximum = 189 kg.km^{-2}
n = 17
Maximum = 14 kg.km^{-2}
n = 4
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

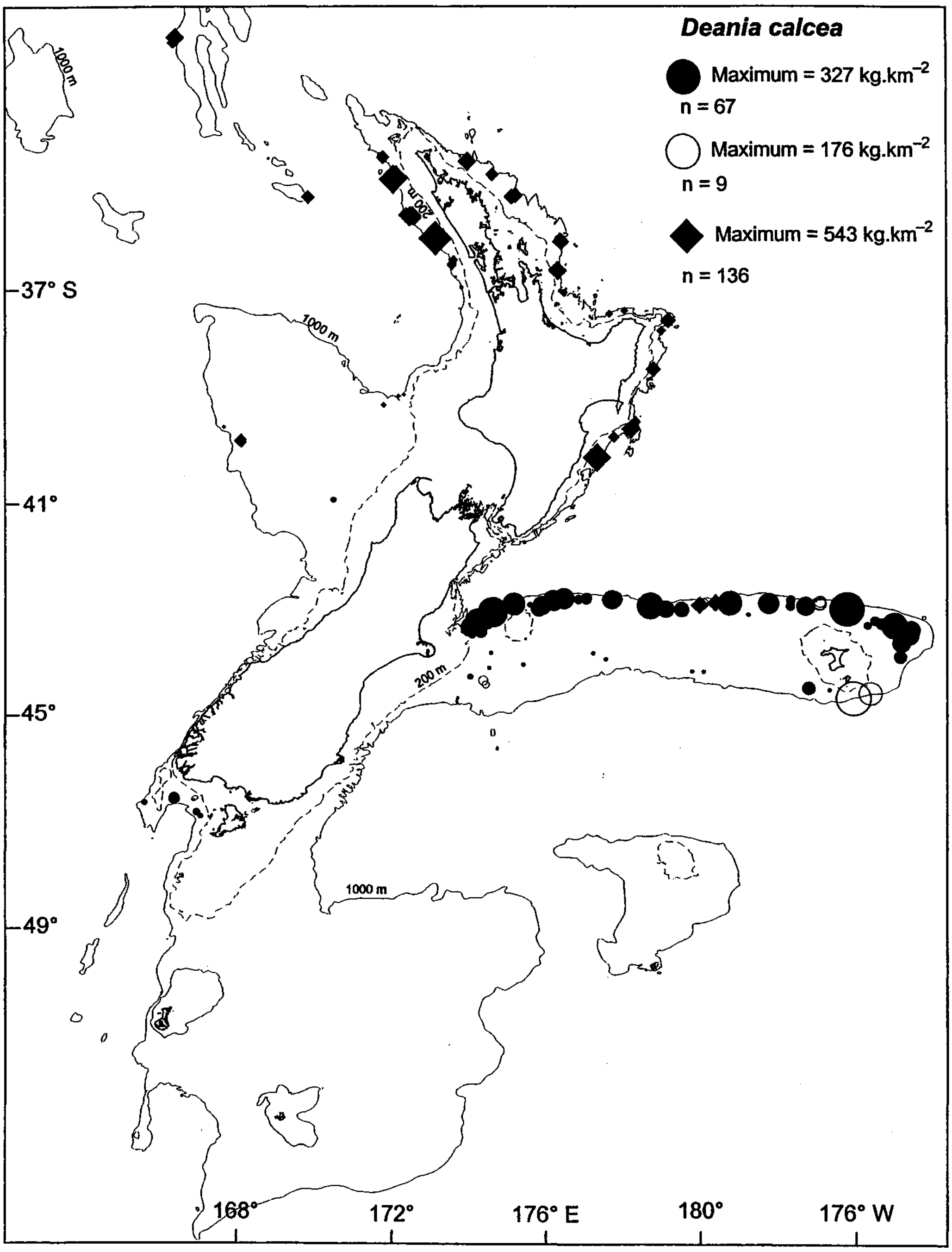

Cyttus traversi
n = 1784
n = 133
n = 256
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



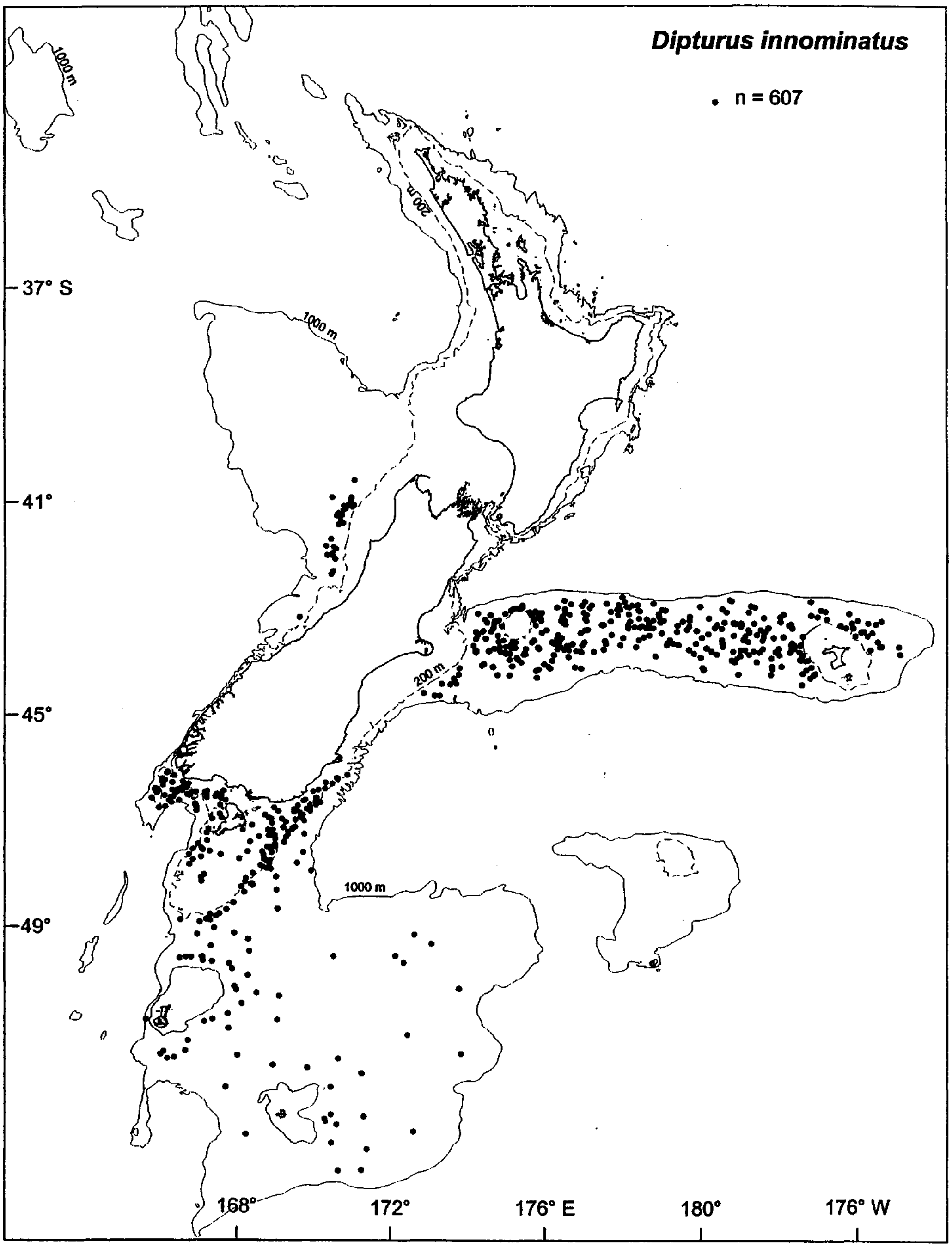
Cyttus traversi
Maximum = 180 kg.km^{-2}
n = 1356
Maximum = 65 kg.km^{-2}
n = 36
37° S
41°
45°
49°
1000 m
200 m
168°
172°
176° E
180°
176° W



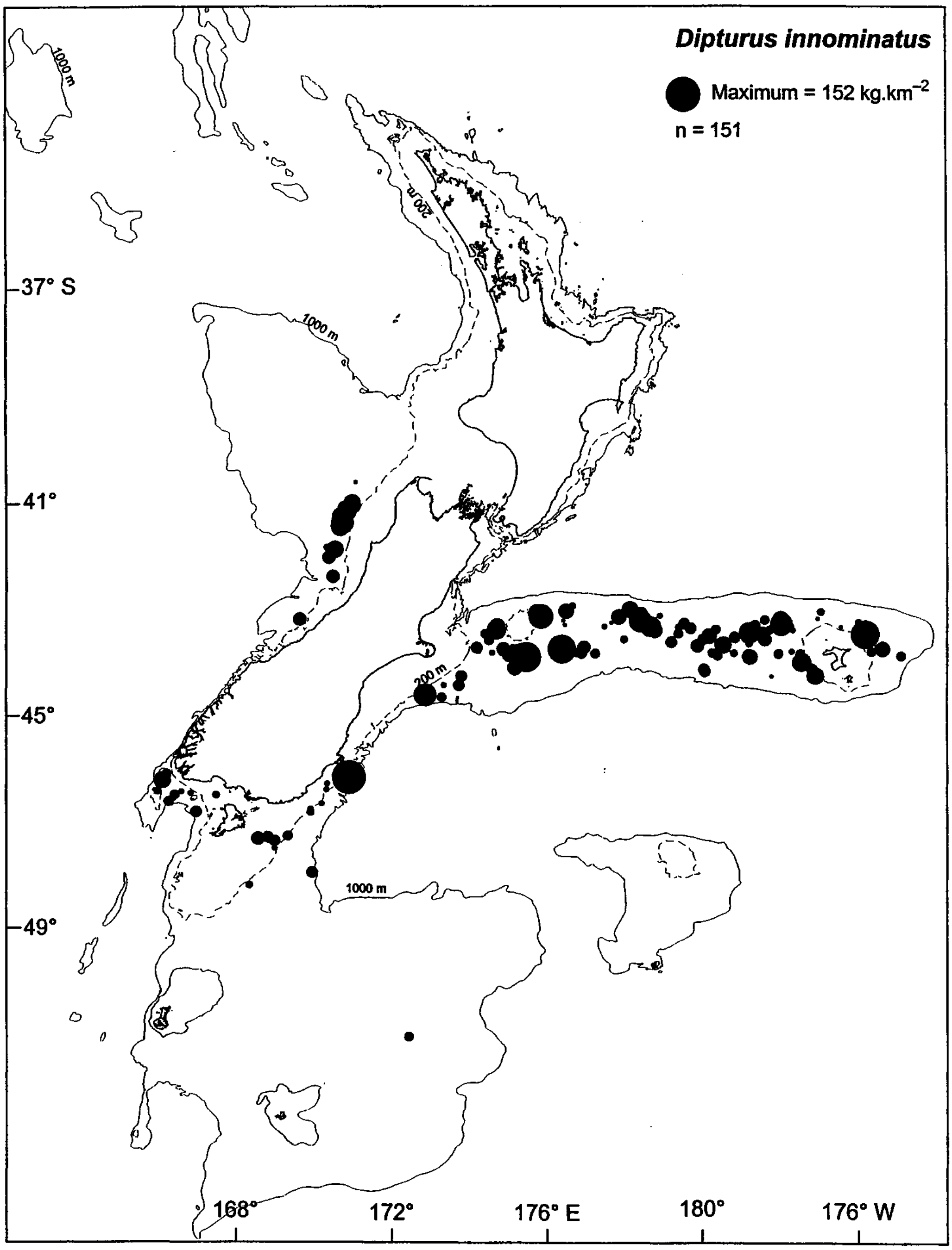
Deania calcea
n = 575
n = 1378
n = 1661
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



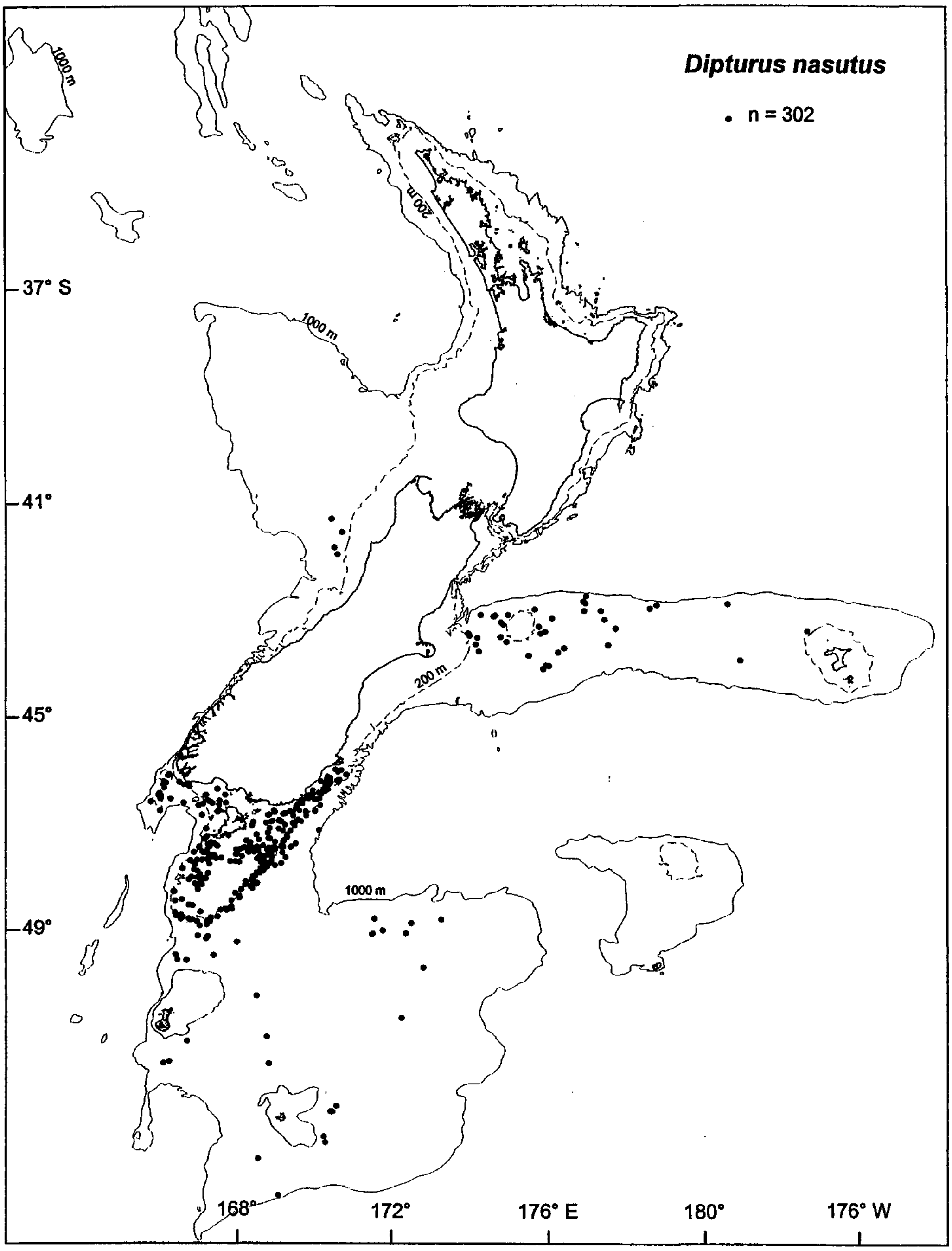
Deania calcea
Maximum = 327 kg.km⁻²
n = 67
Maximum = 176 kg.km⁻²
n = 9
Maximum = 543 kg.km⁻²
n = 136
1000 m
200 m
-37° S
-41°
-45°
-49°
168°
172°
176° E
180°
176° W



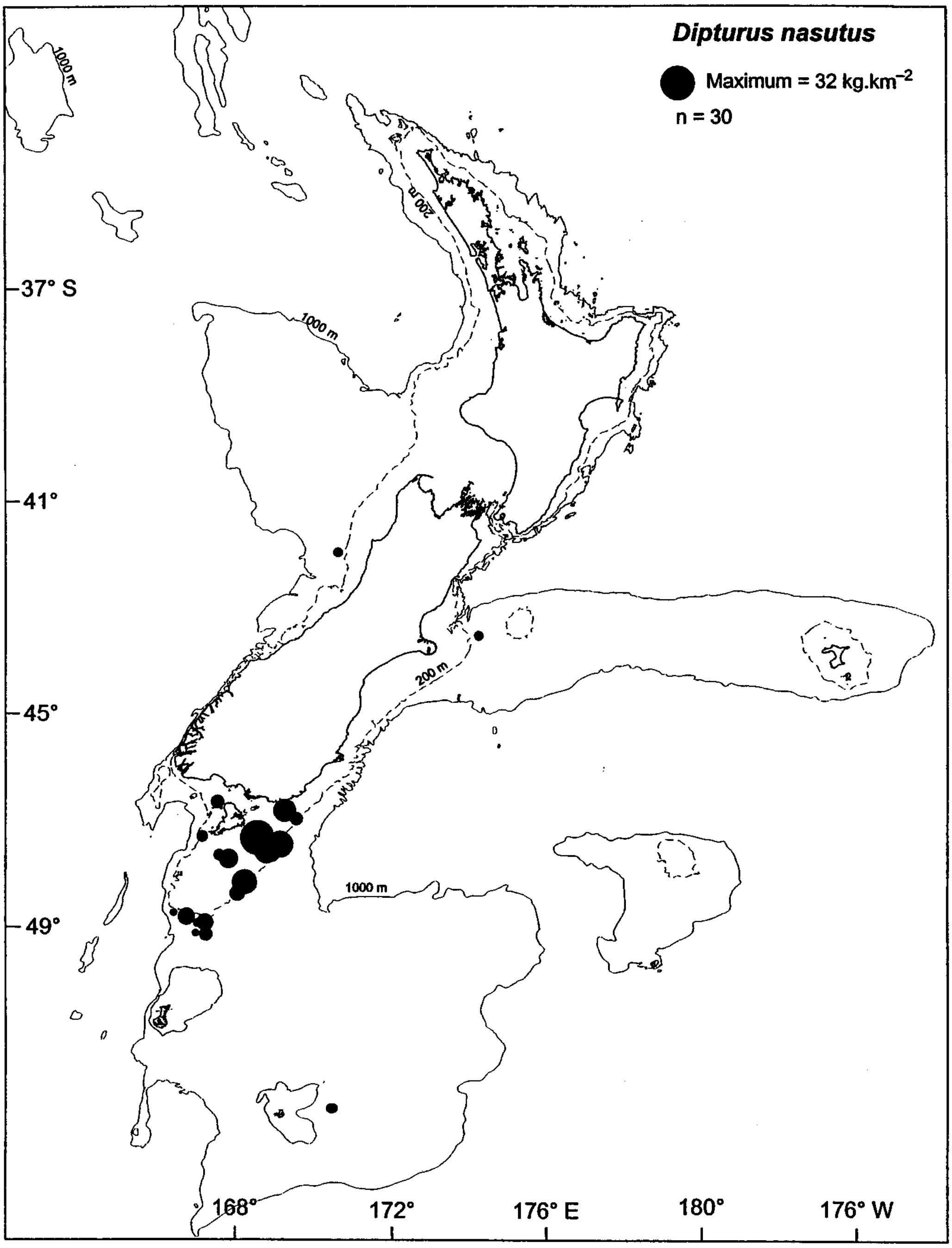
Dipturus innominatus
n = 607
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



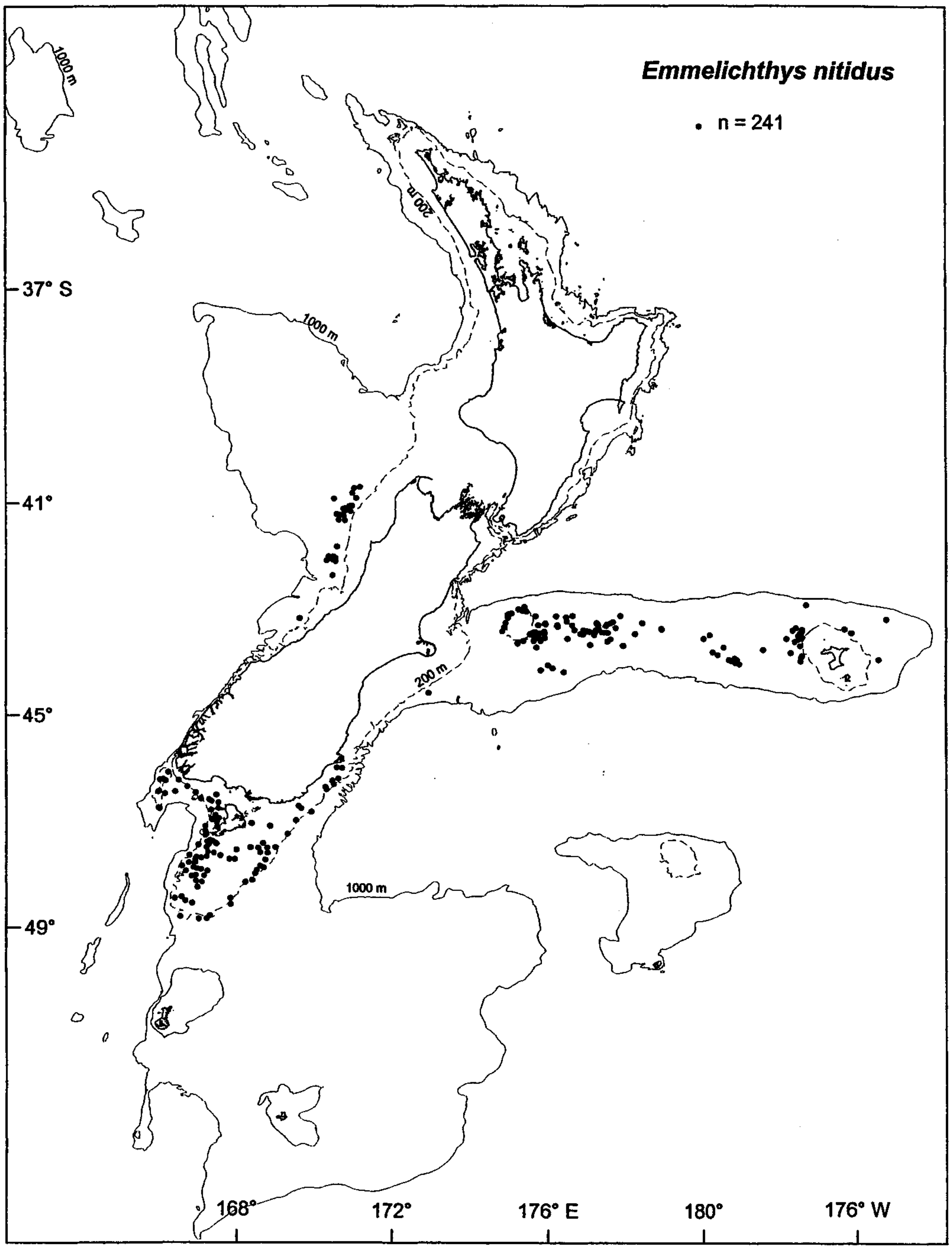
Dipturus innominatus
Maximum = 152 kg.km^{-2}
n = 151
1000 m
200 m
1000 m
200 m
1000 m
-37° S
-41°
-45°
-49°
168°
172°
176° E
180°
176° W

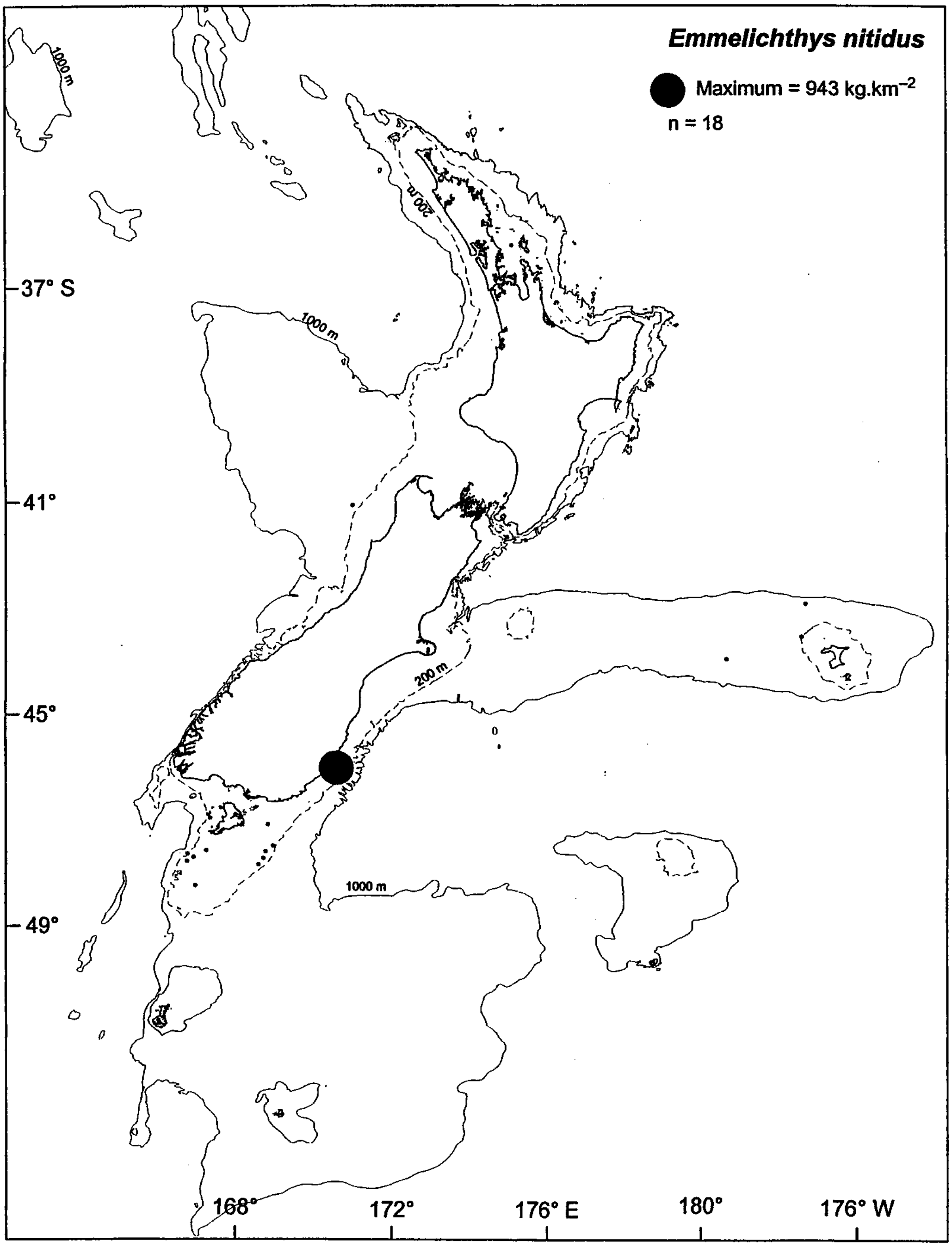


Dipturus nasutus
n = 302
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

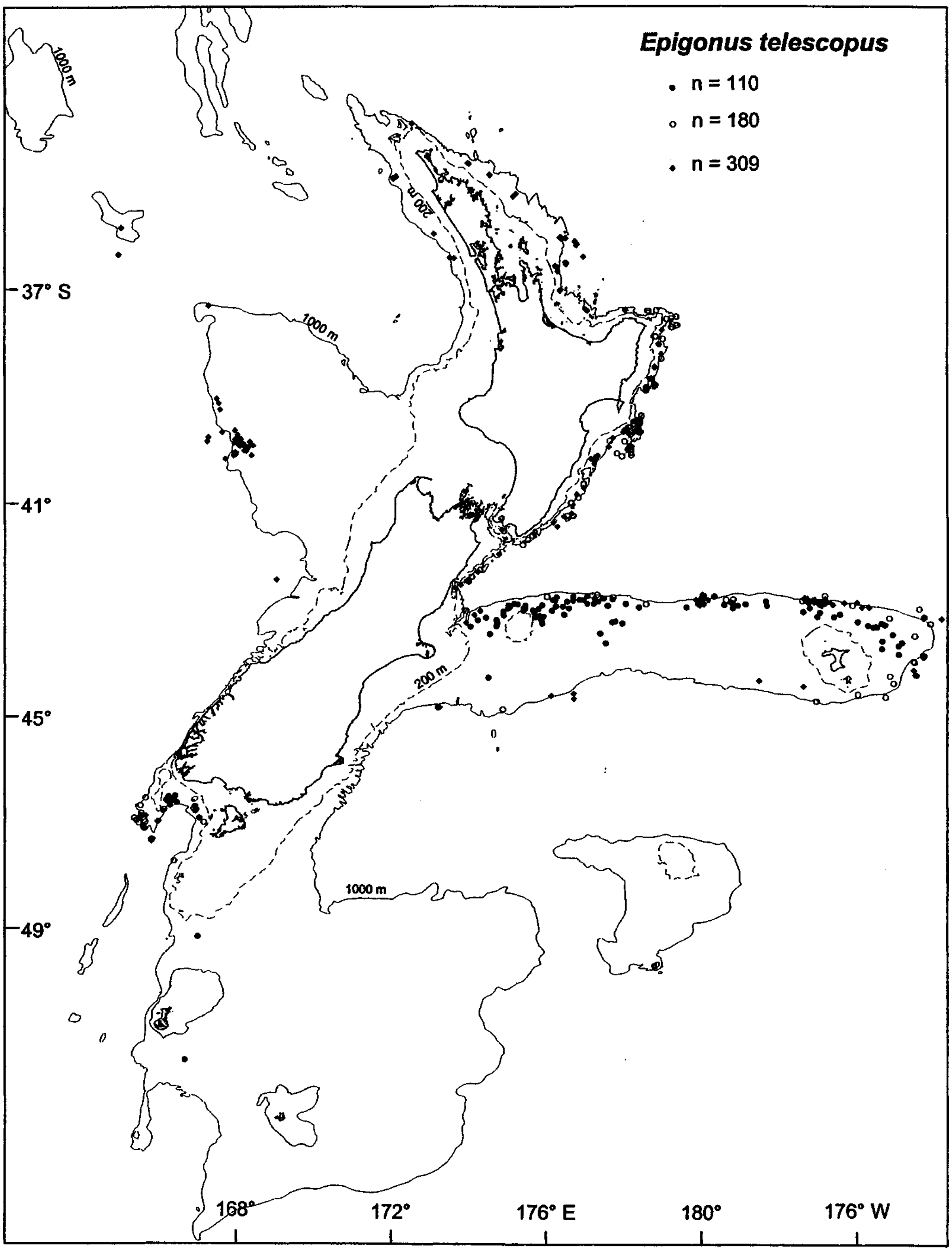


Dipturus nasutus
Maximum = 32 kg.km^{-2}
n = 30
1000 m
200 m
1000 m
200 m
1000 m
1000 m
-37° S
-41°
-45°
-49°
168°
172°
176° E
180°
176° W

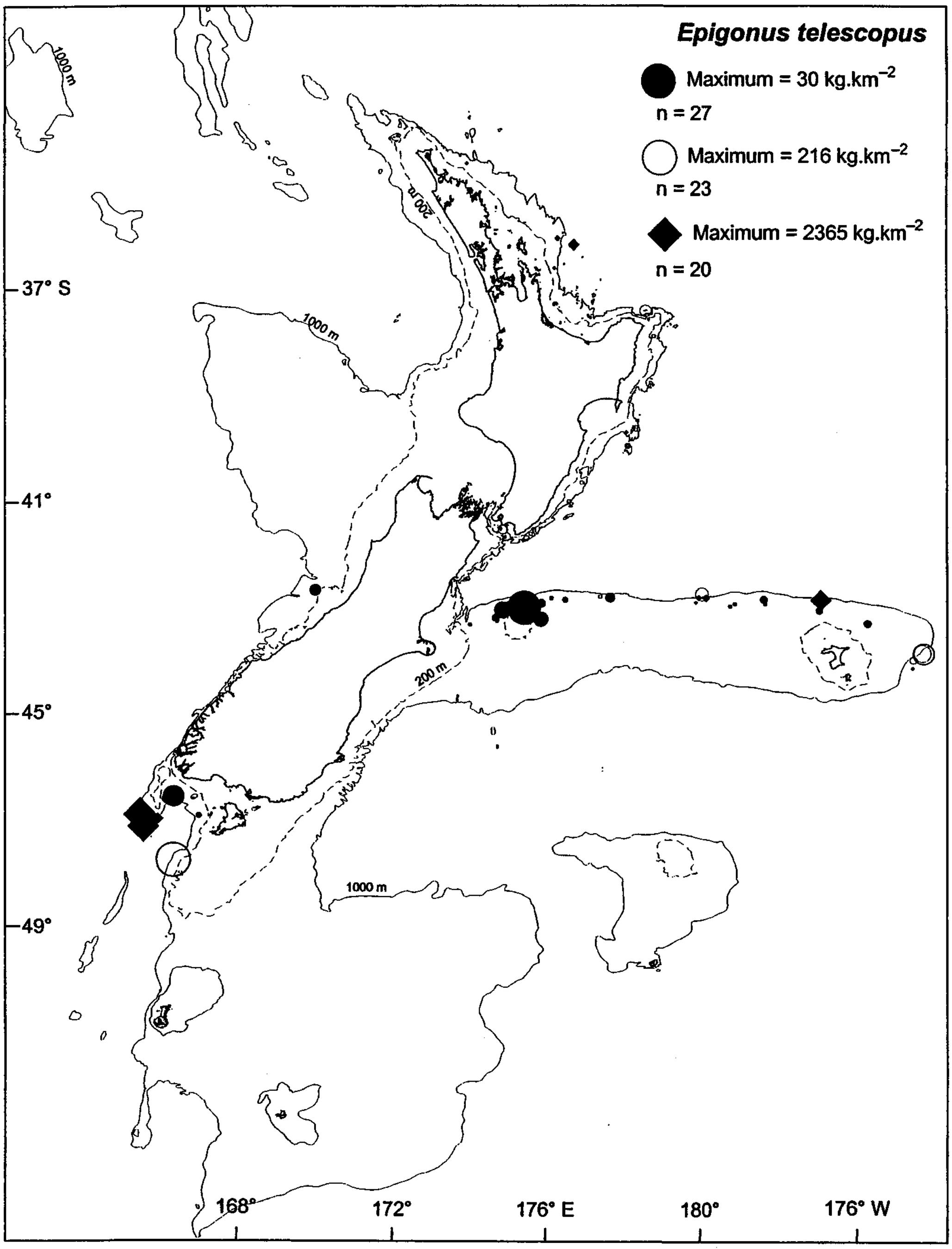

Emmelichthys nitidus
n = 241
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



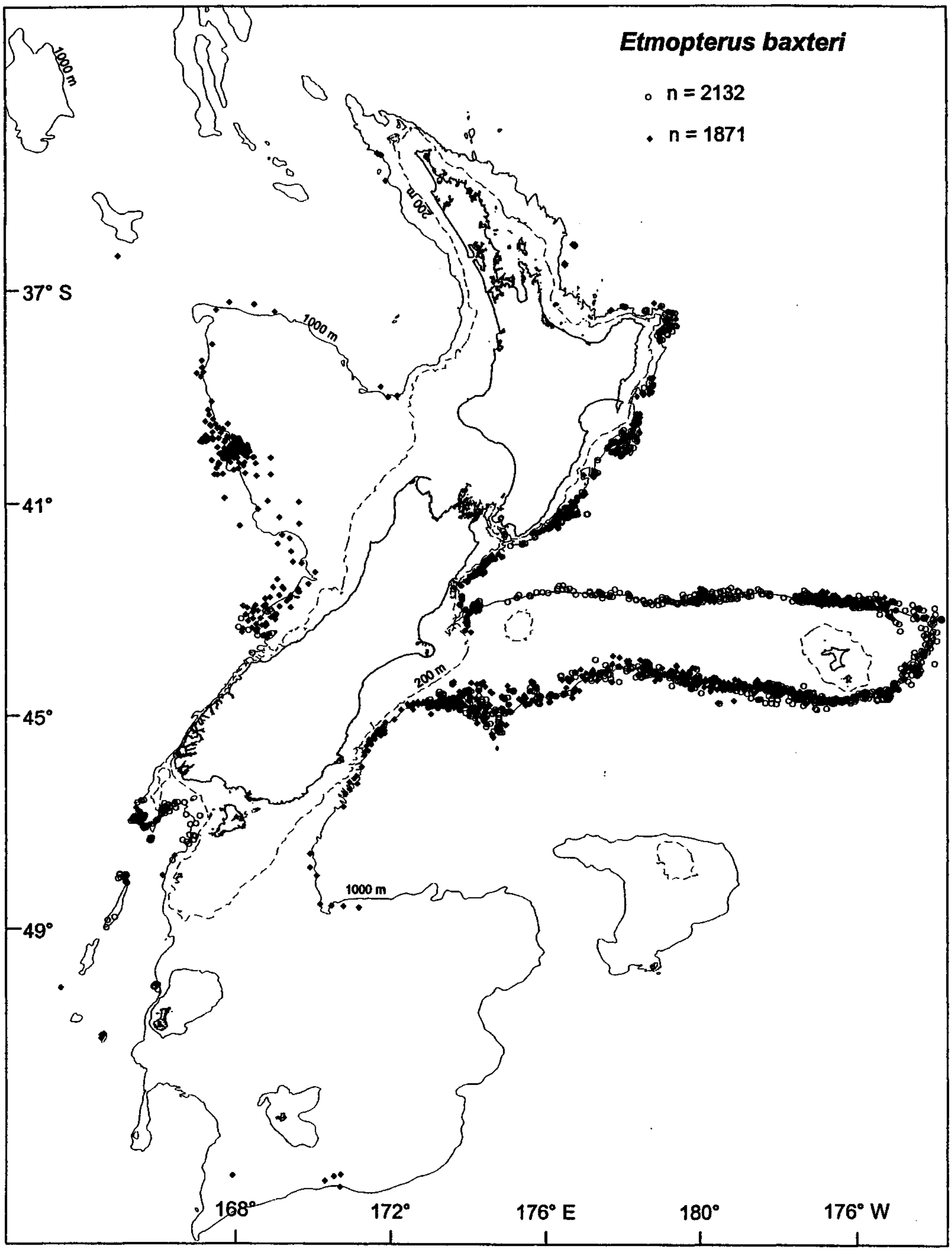
Emmelichthys nitidus
Maximum = 943 kg.km^{-2}
n = 18
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



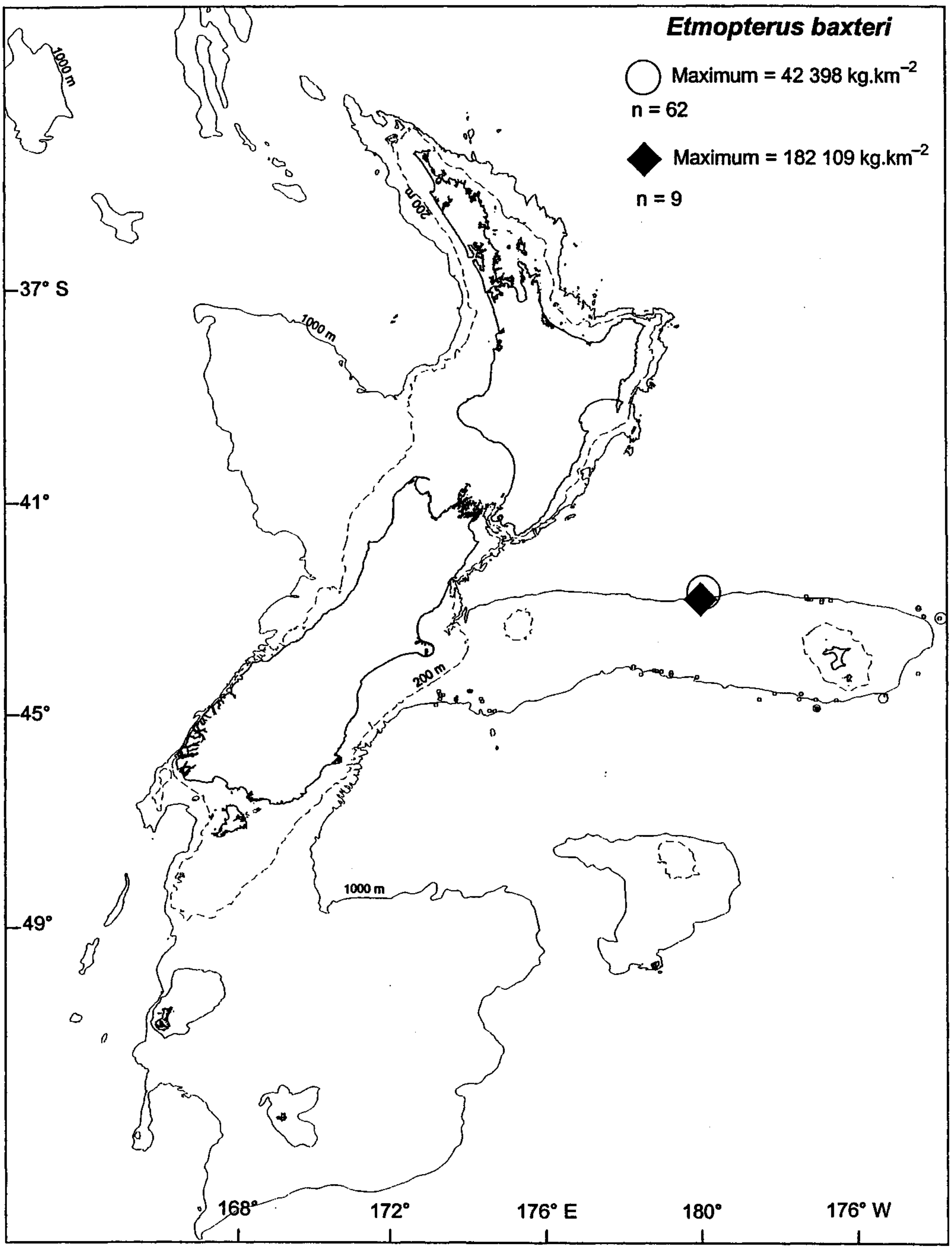
Epigonus telescopus
n = 110
n = 180
n = 309
1000 m
200 m
1000 m
200 m
1000 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



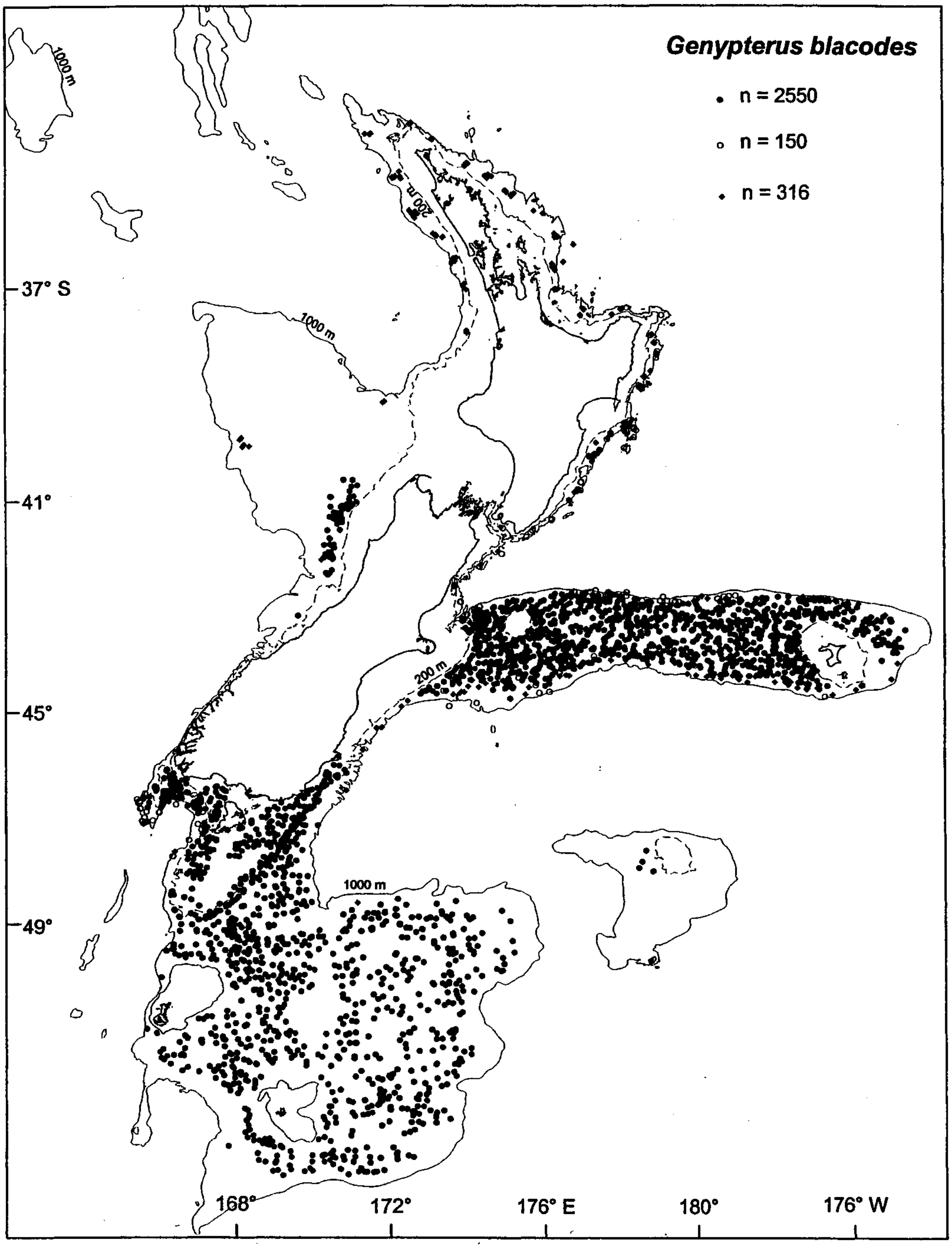
Epigonus telescopus
Maximum = 30 kg.km^-2
n = 27
Maximum = 216 kg.km^-2
n = 23
Maximum = 2365 kg.km^-2
n = 20
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



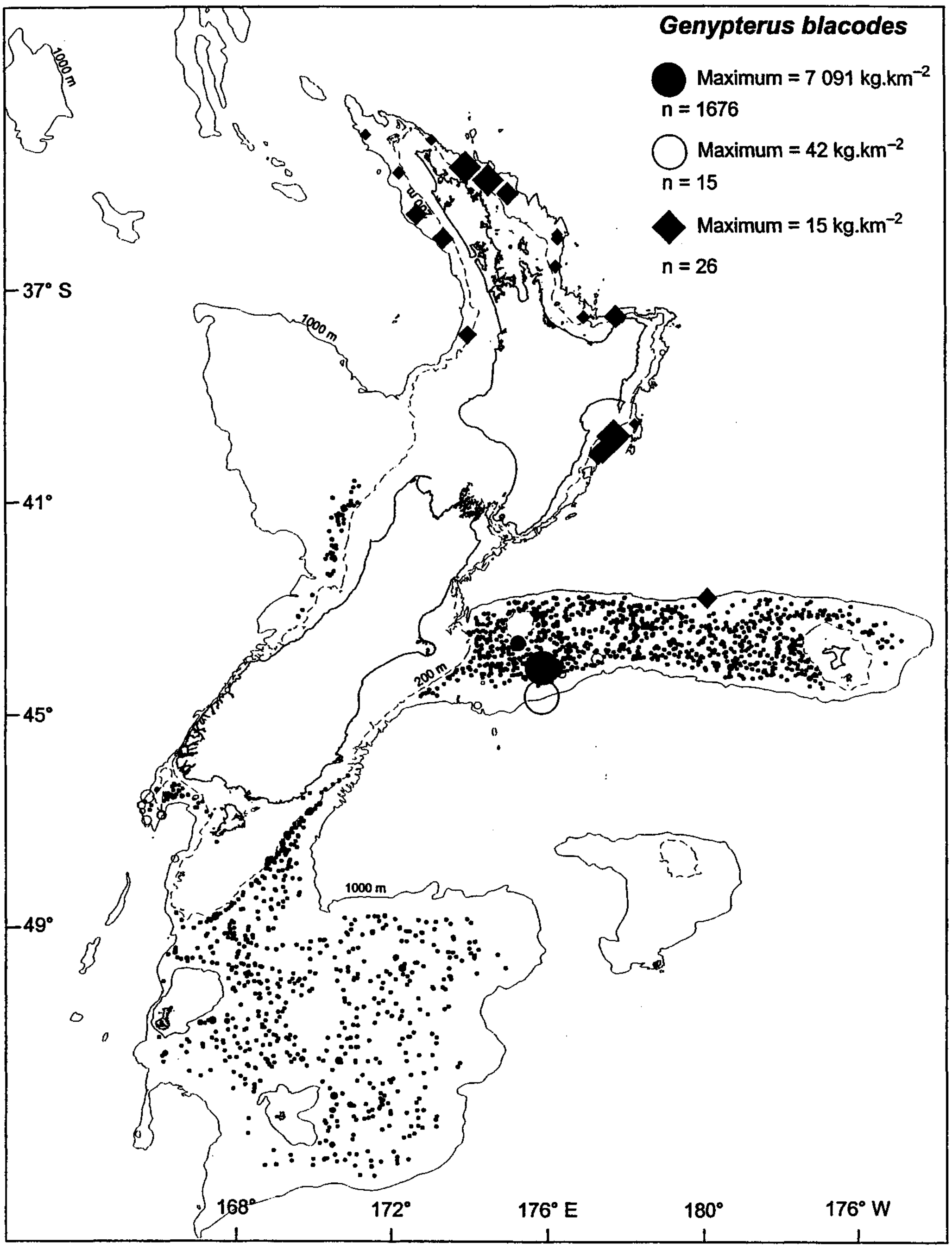
Etmopterus baxteri
n = 2132
n = 1871
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



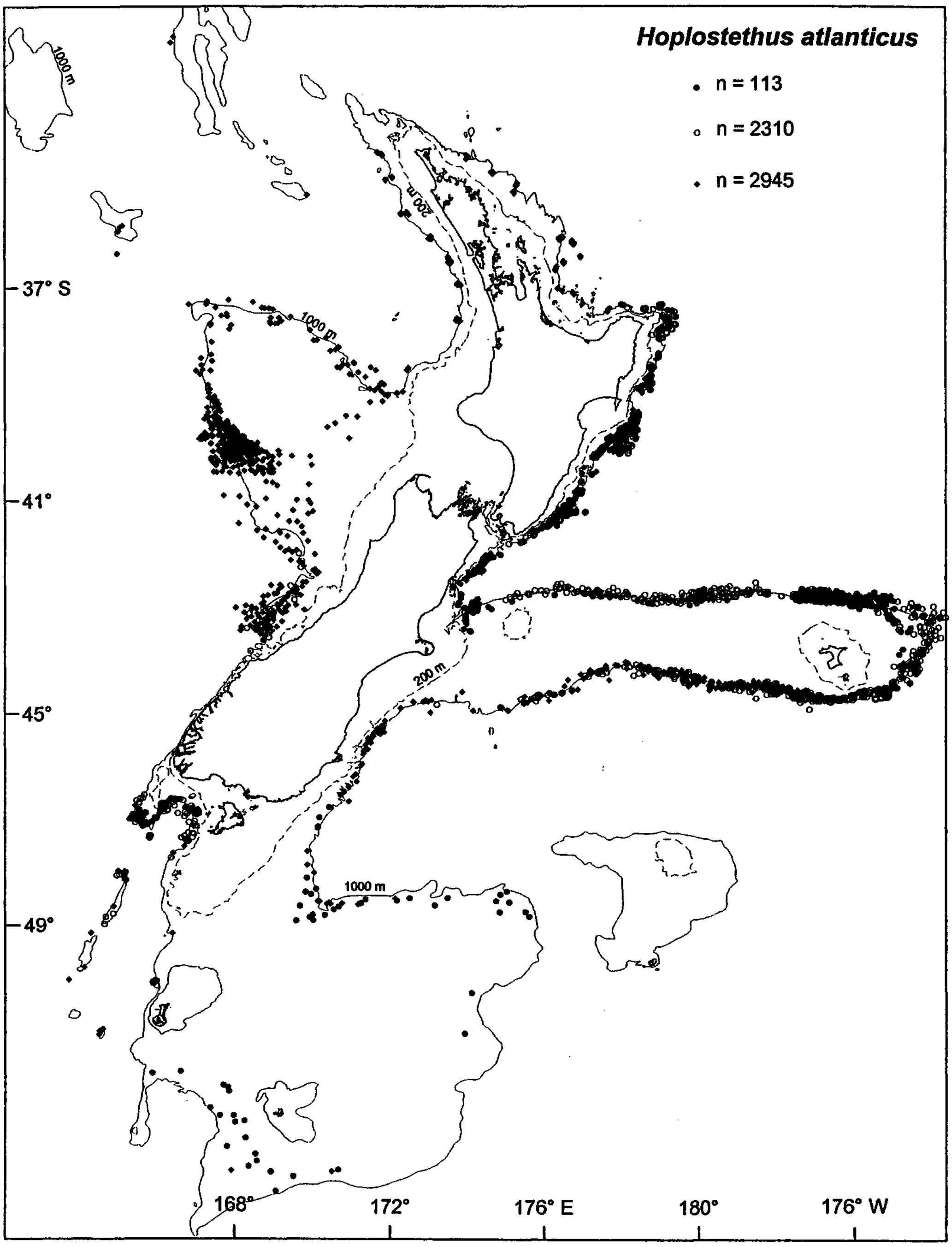
Etmopterus baxteri
Maximum = 42 398 kg.km^{-2}
n = 62
Maximum = 182 109 kg.km^{-2}
n = 9
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



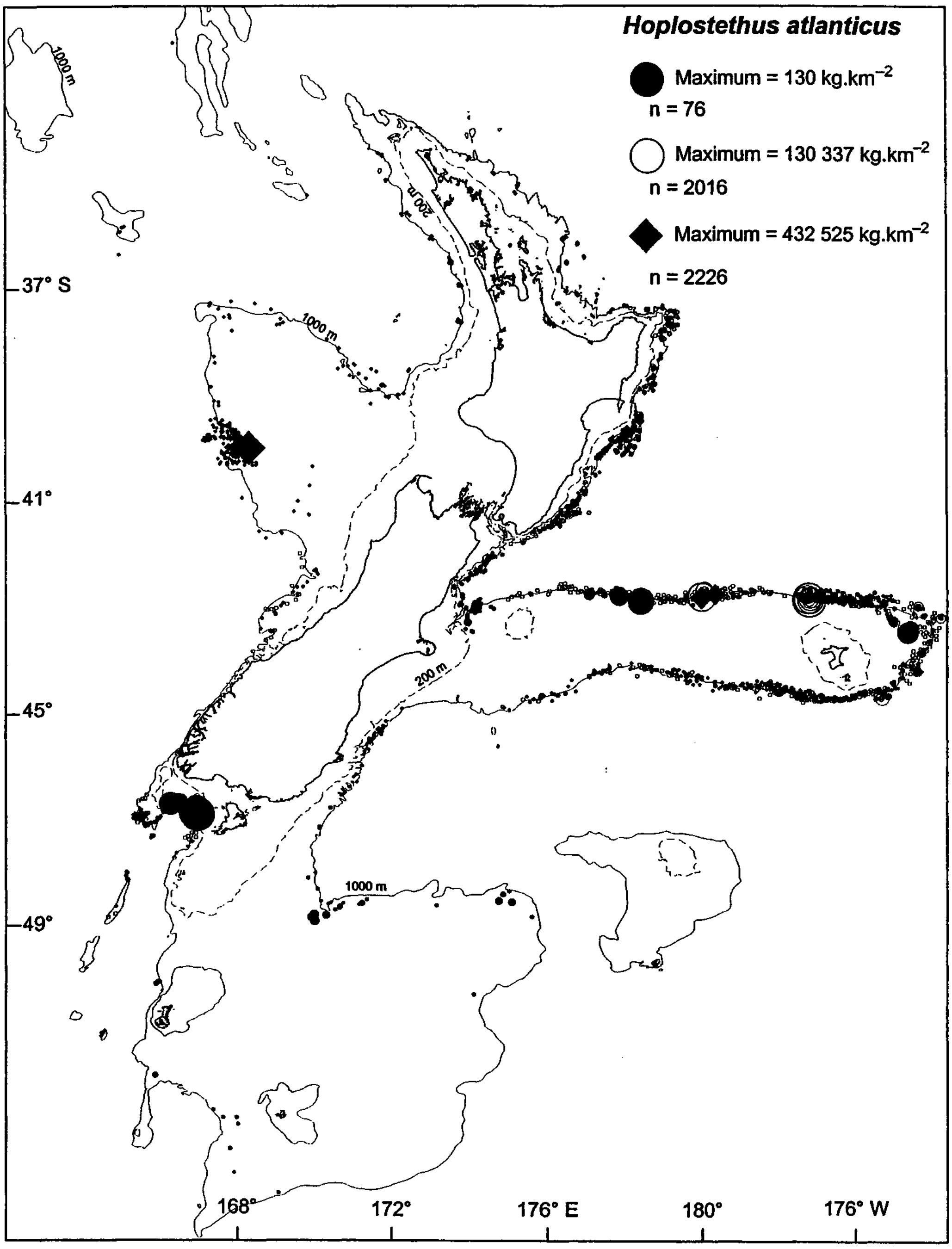
Genypterus blacodes
n = 2550
n = 150
n = 316
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



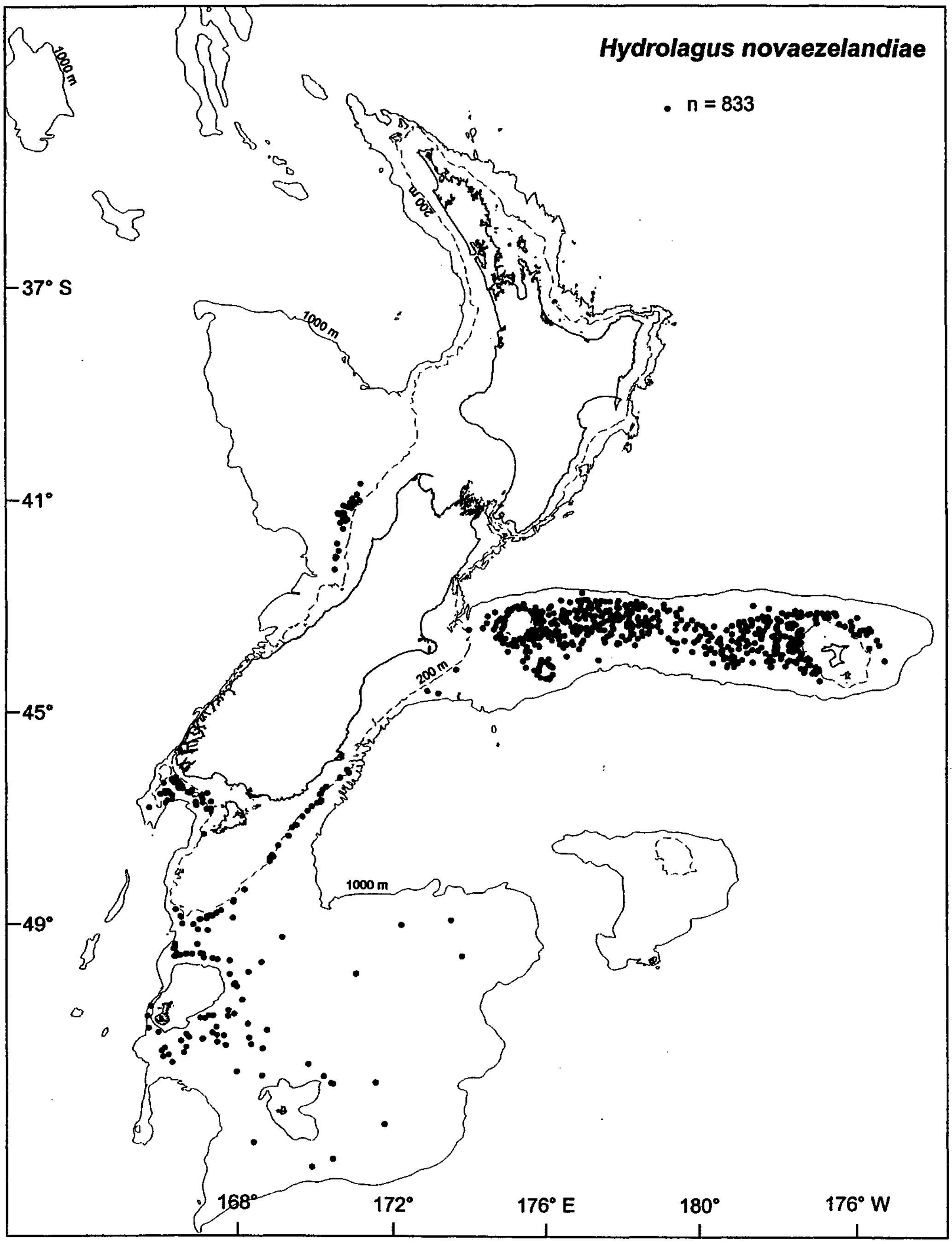
Genypterus blacodes
Maximum = 7 091 kg.km⁻²
n = 1676
Maximum = 42 kg.km⁻²
n = 15
Maximum = 15 kg.km⁻²
n = 26
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



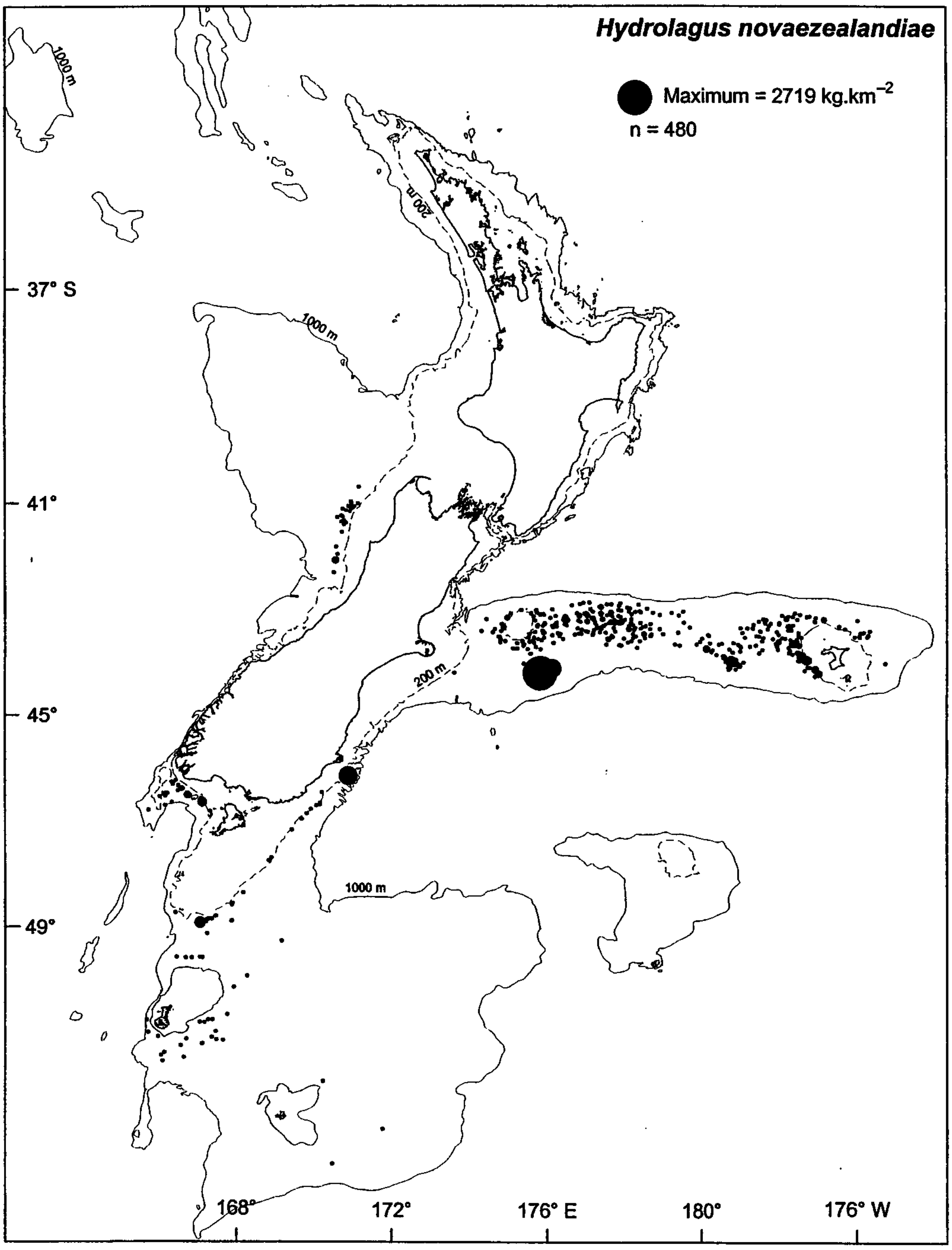
Hoplostethus atlanticus
n = 113
n = 2310
n = 2945
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W
1000 m
200 m



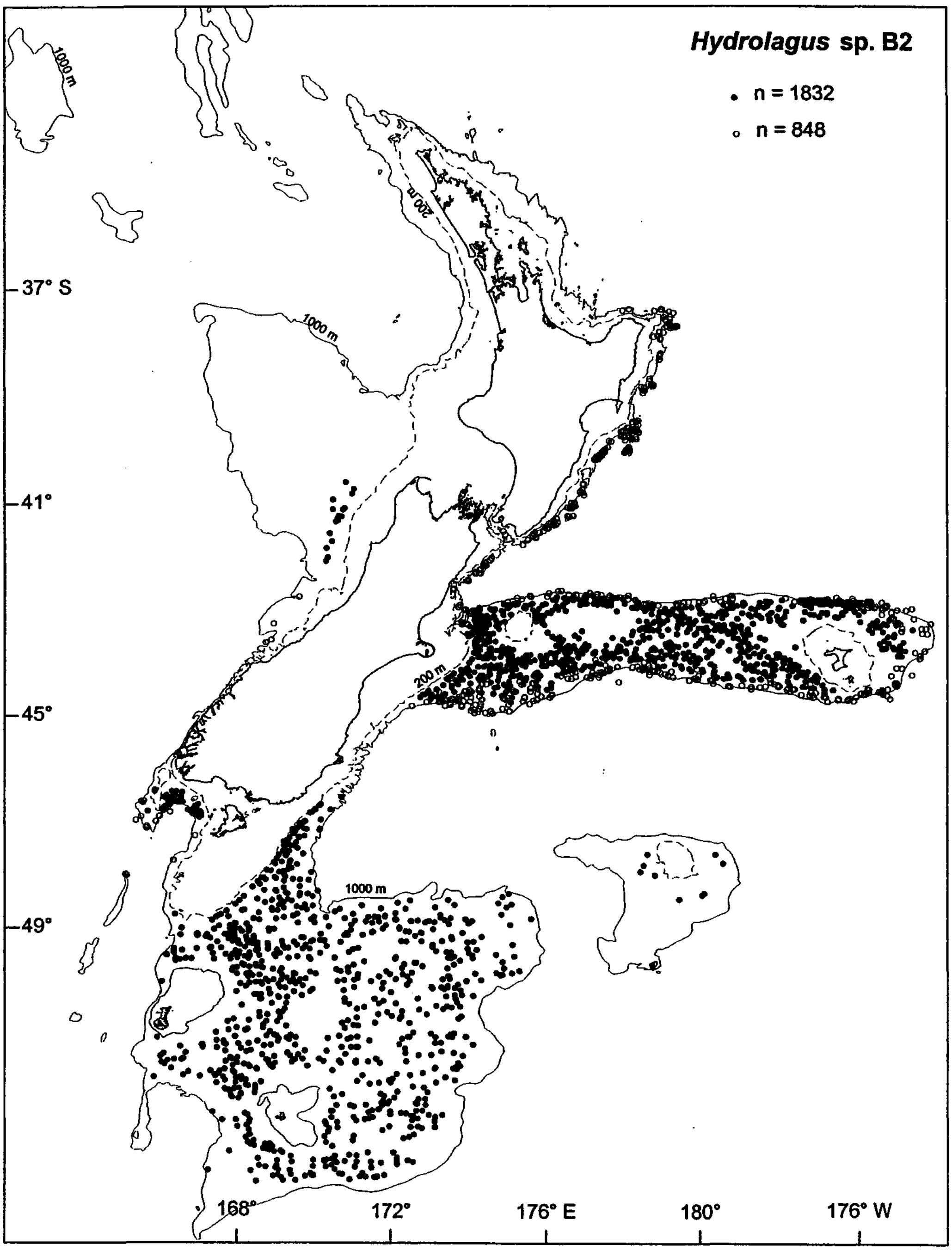
Hoplostethus atlanticus
Maximum = 130 kg.km^{-2}
n = 76
Maximum = 130 337 kg.km^{-2}
n = 2016
Maximum = 432 525 kg.km^{-2}
n = 2226
37° S
41°
45°
49°
1000 m
200 m
168°
172°
176° E
180°
176° W



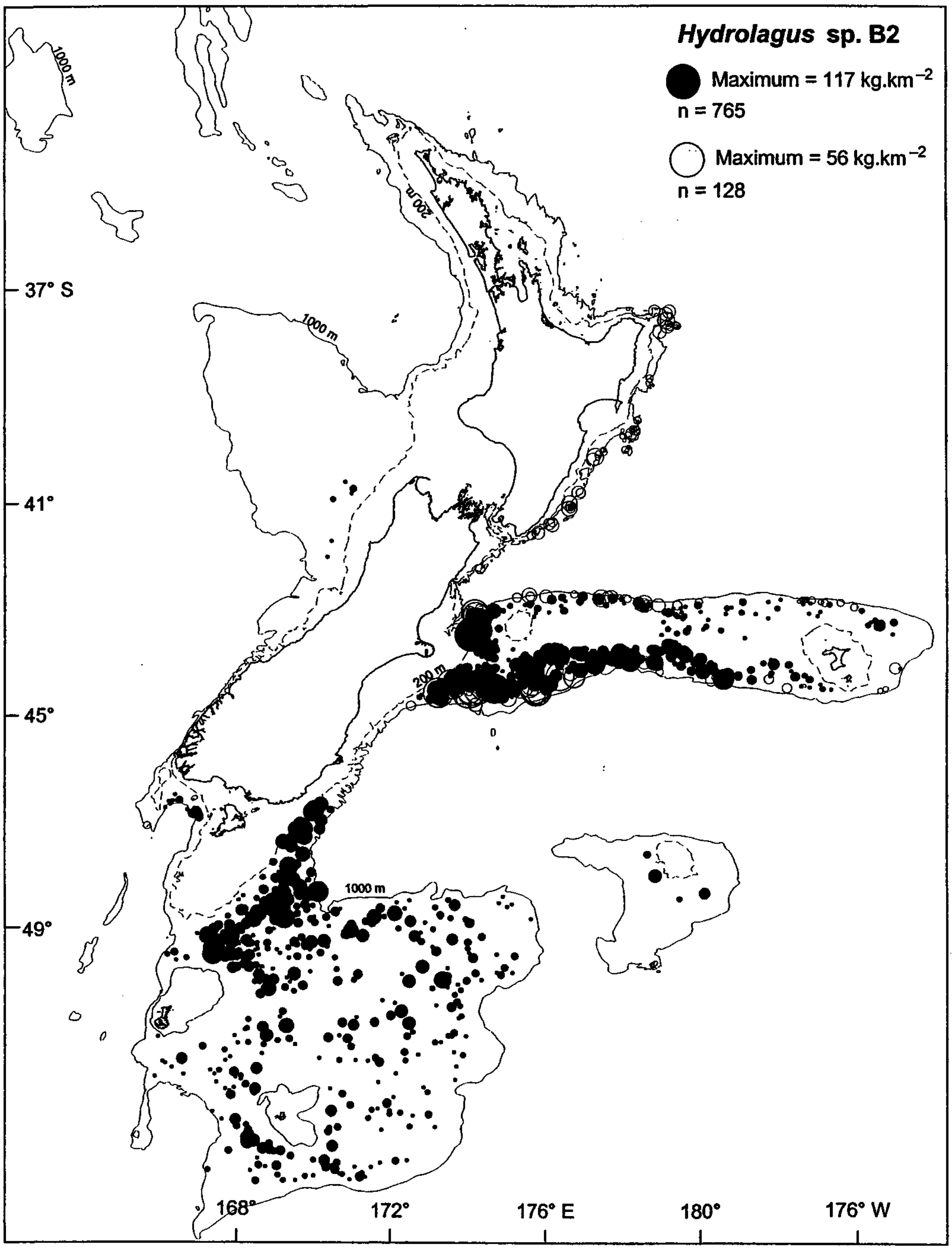
Hydrolagus novaezelandiae
• n = 833
1000 m
200 m
1000 m
200 m
1000 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



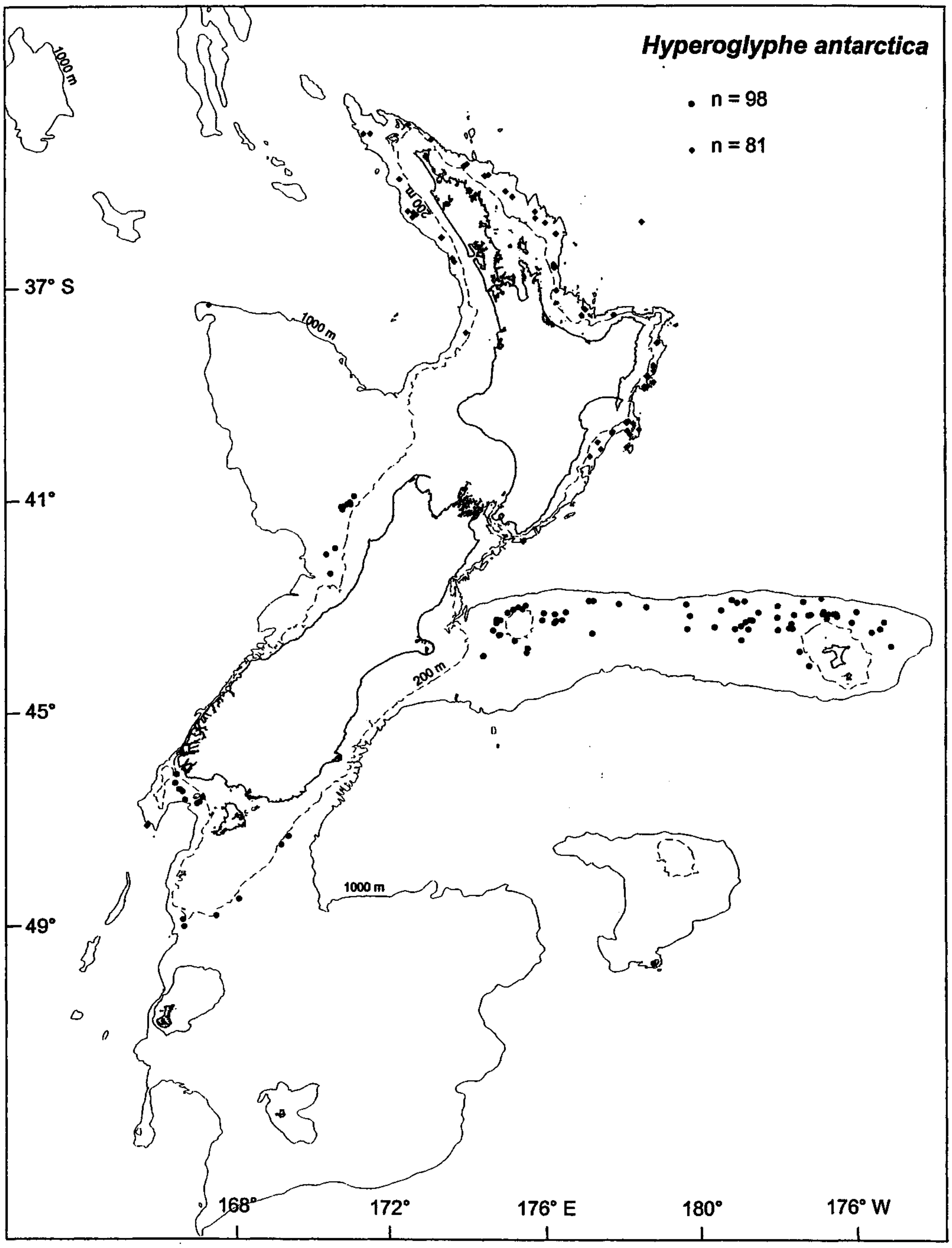
Hydrolagus novaezealandiae
Maximum = 2719 kg.km^{-2}
n = 480
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



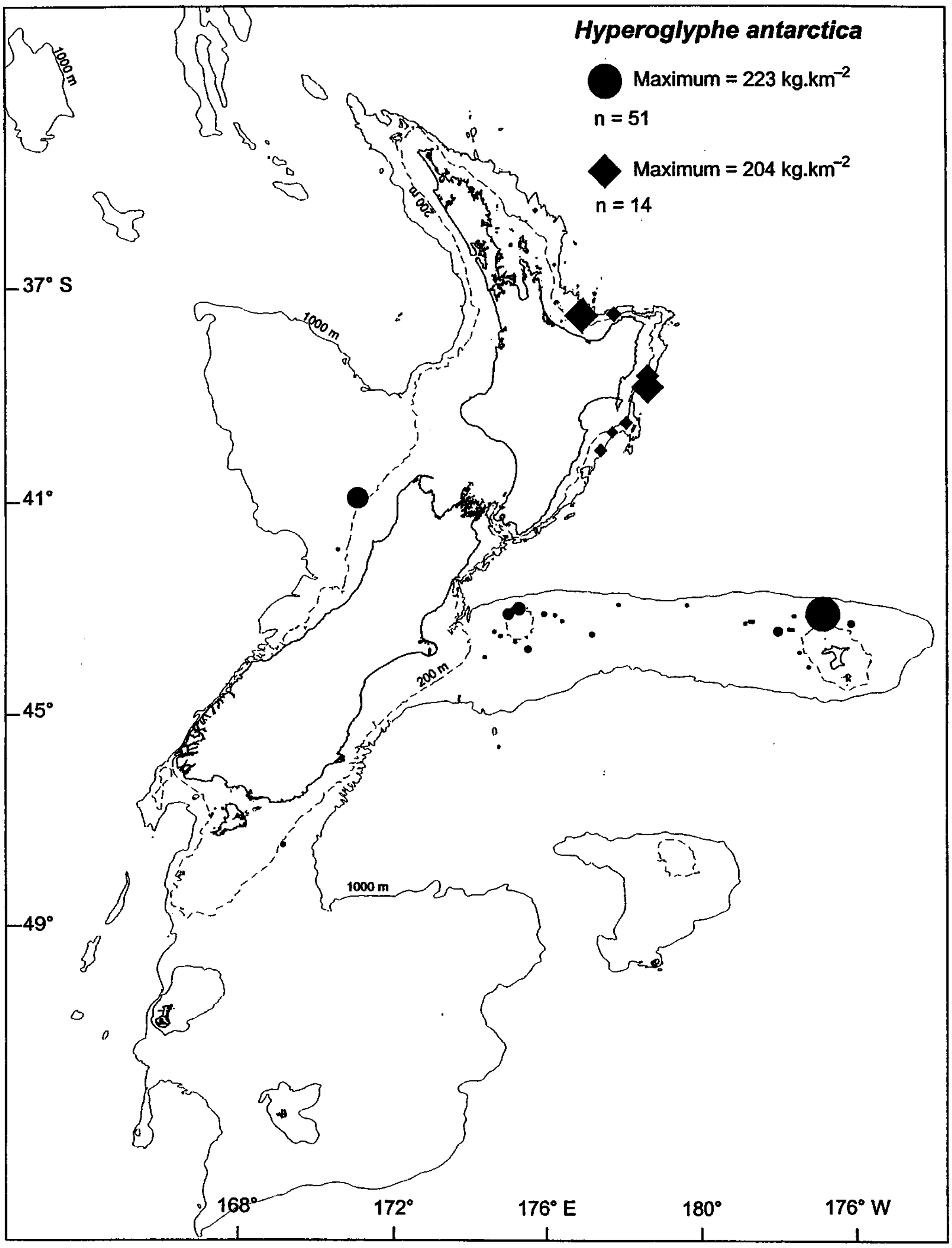
Hydrolagus sp. B2
n = 1832
n = 848
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W
1000 m
200 m



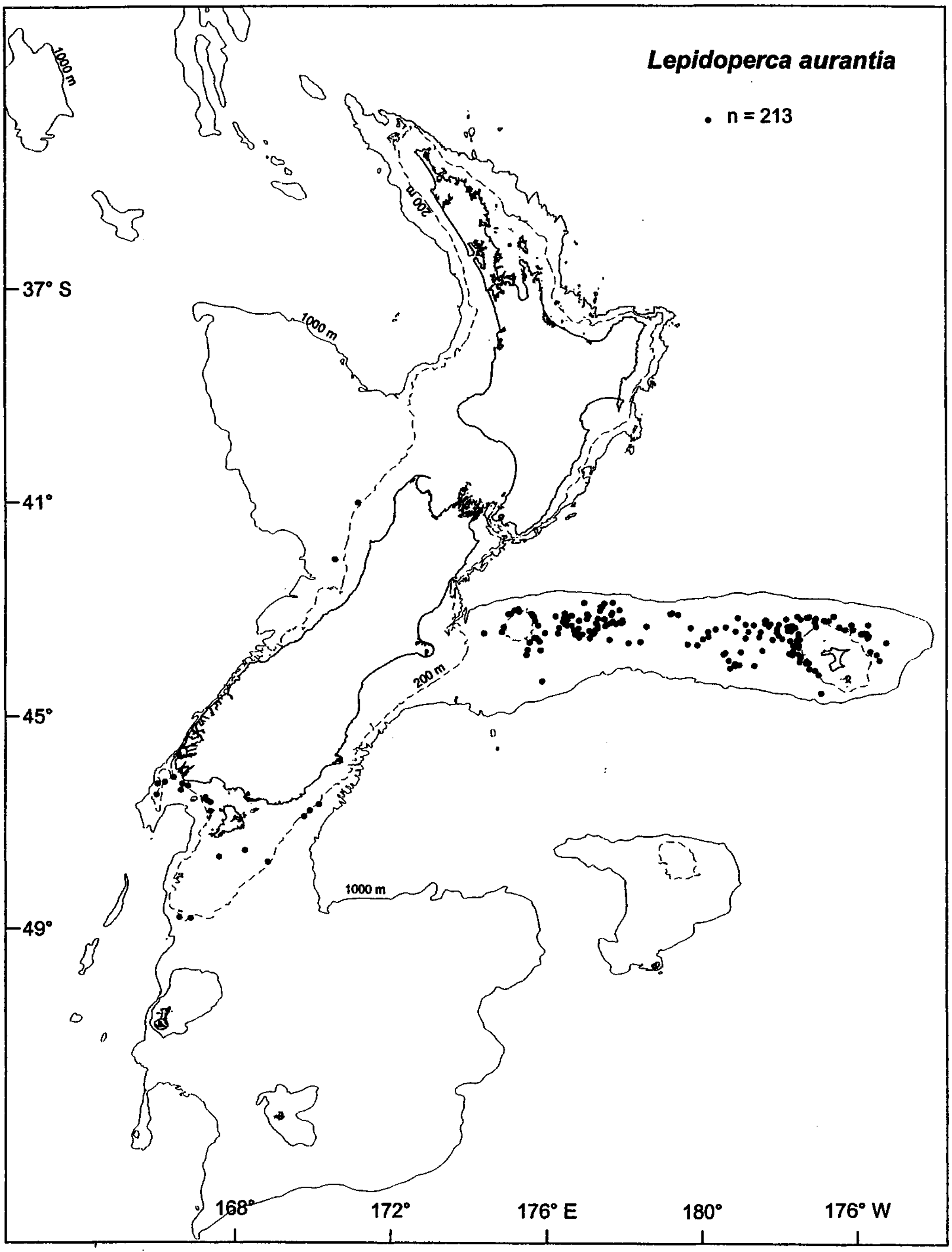
Hydrolagus sp. B2
Maximum = 117 kg.km⁻²
n = 765
Maximum = 56 kg.km⁻²
n = 128
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



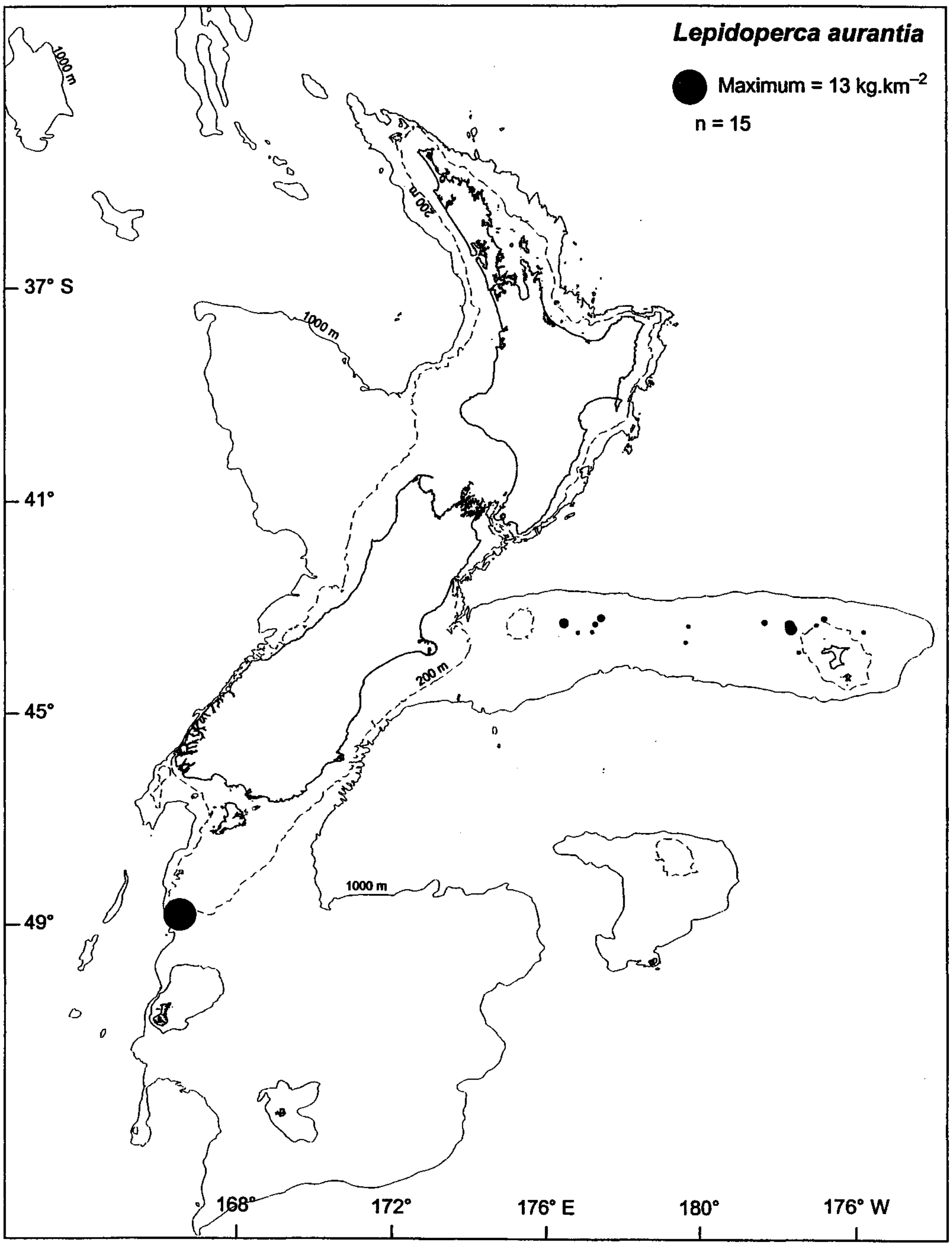
Hyperoglyphe antarctica
n = 98
n = 81
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

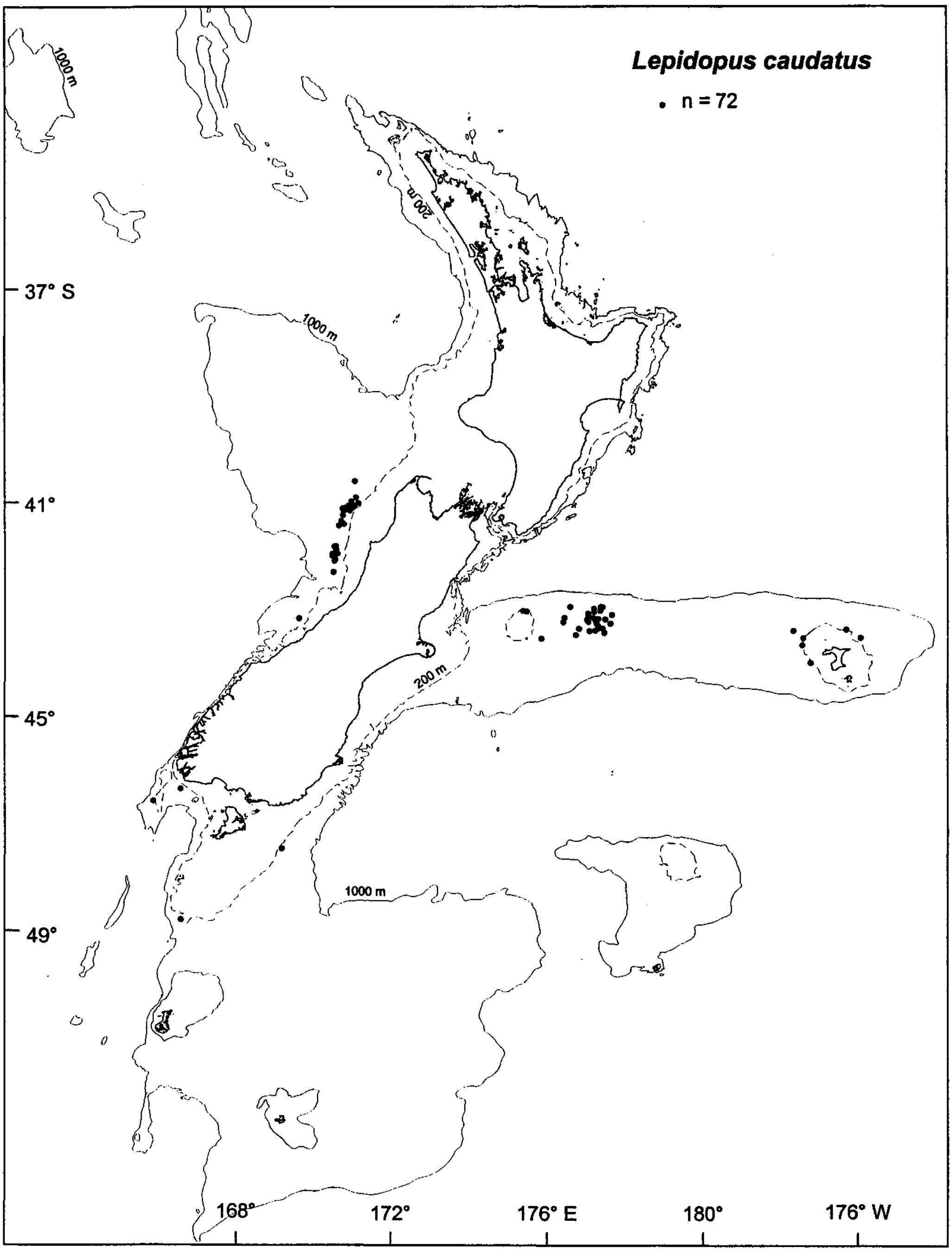


Hyperoglyphe antarctica
Maximum = 223 kg.km^{-2}
n = 51
Maximum = 204 kg.km^{-2}
n = 14
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

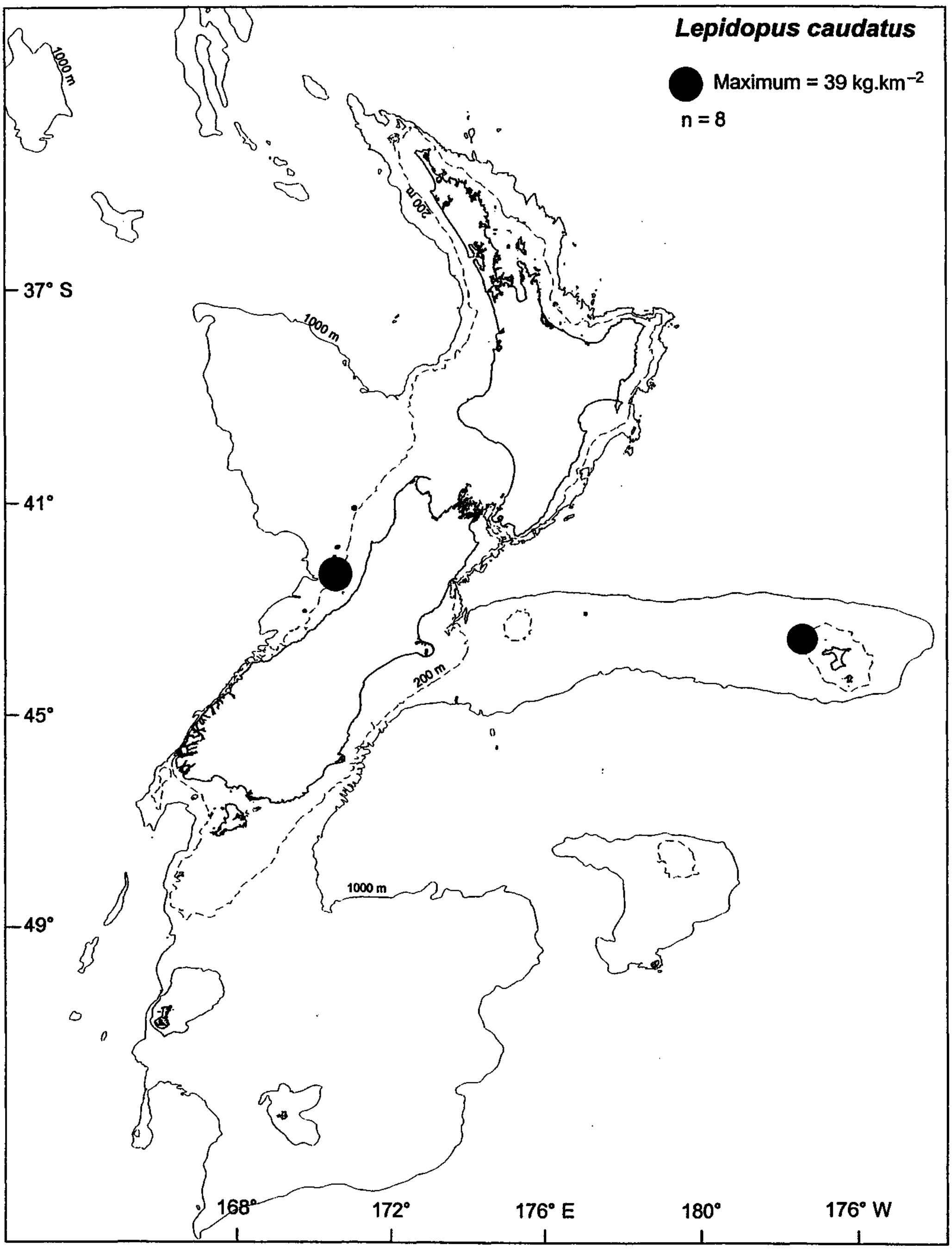


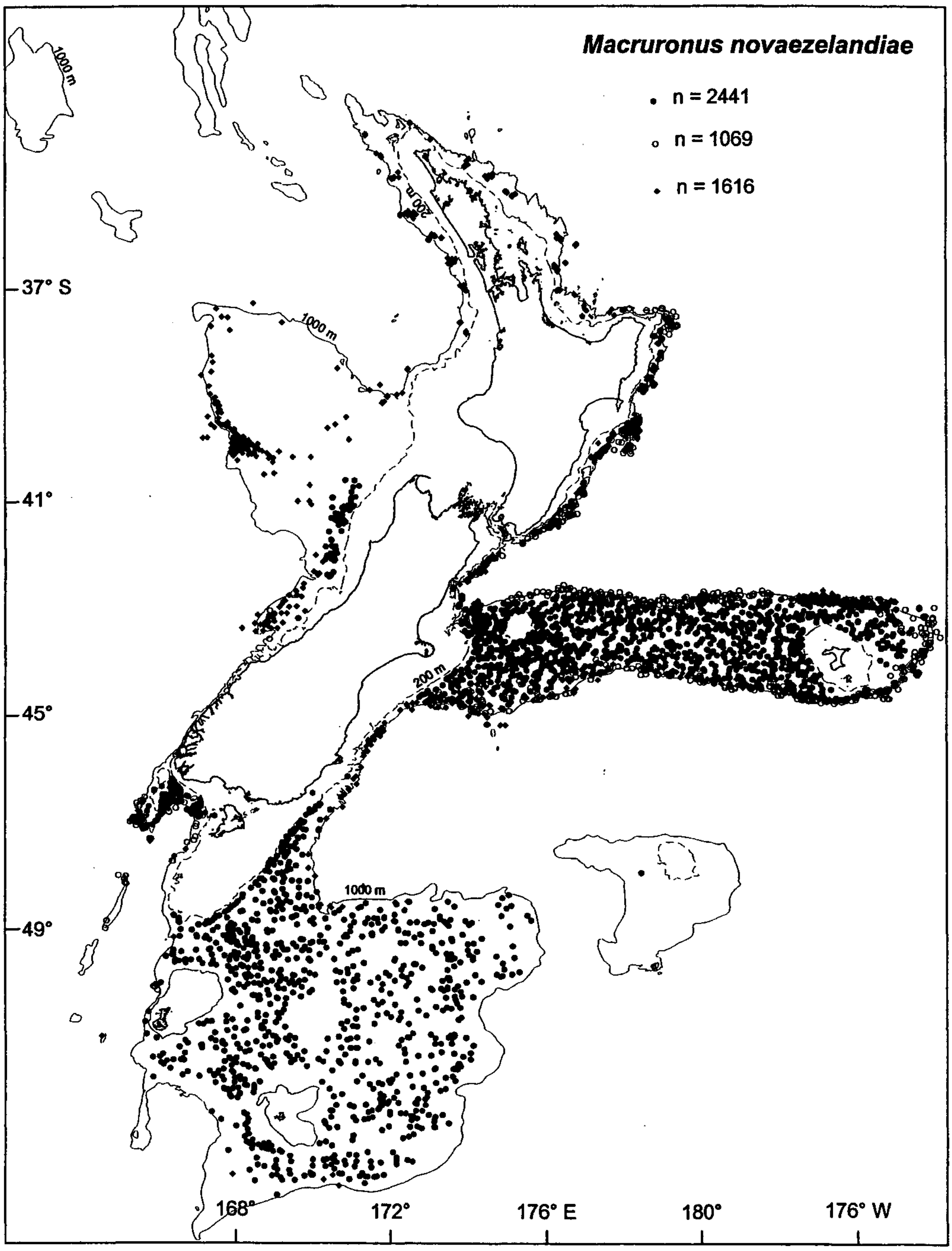
Lepidoperca aurantia
n = 213
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W


Lepidoperca aurantia
Maximum = 13 kg.km^{-2}
n = 15
1000 m
200 m
1000 m
200 m
1000 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

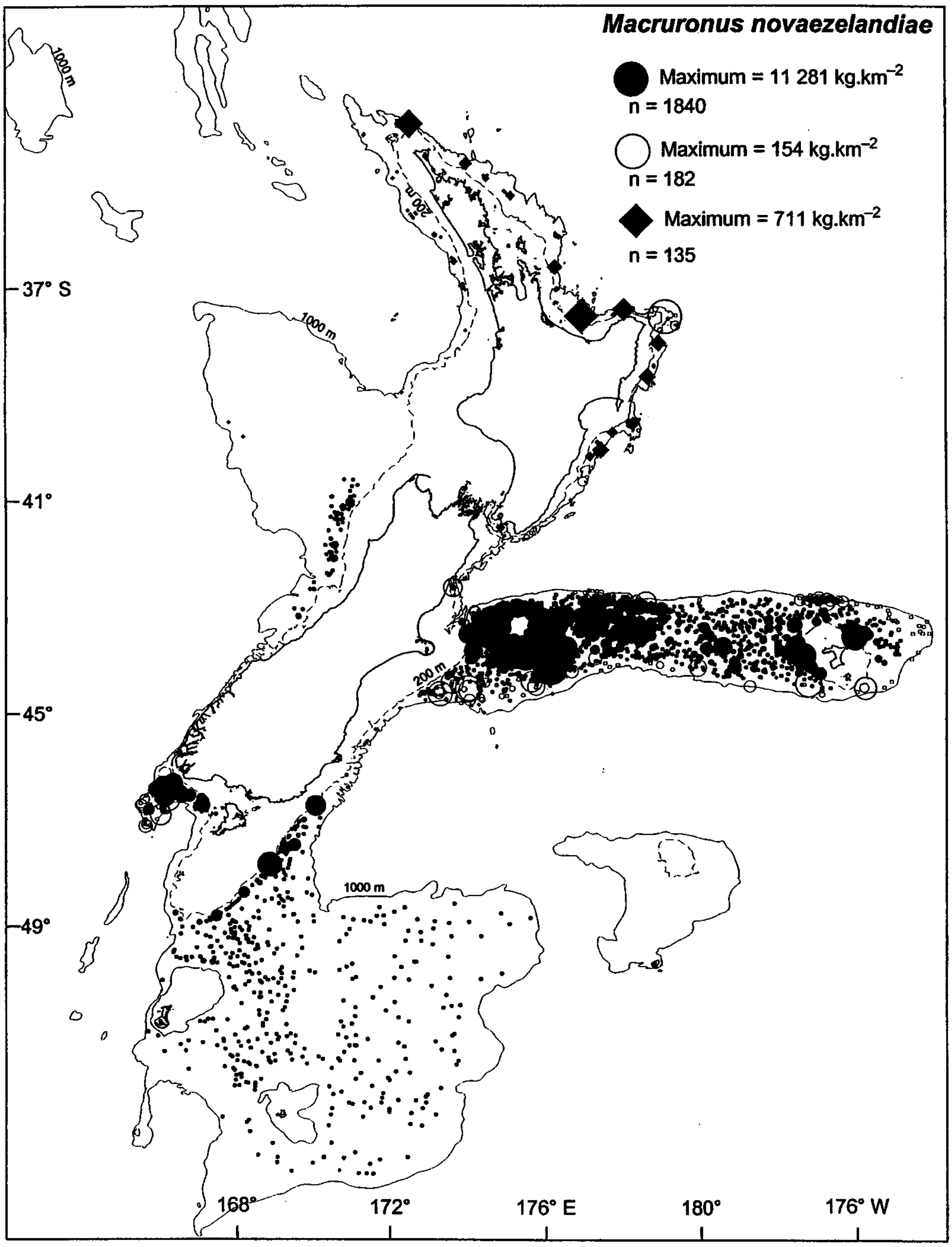


Lepidopus caudatus
n = 72
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

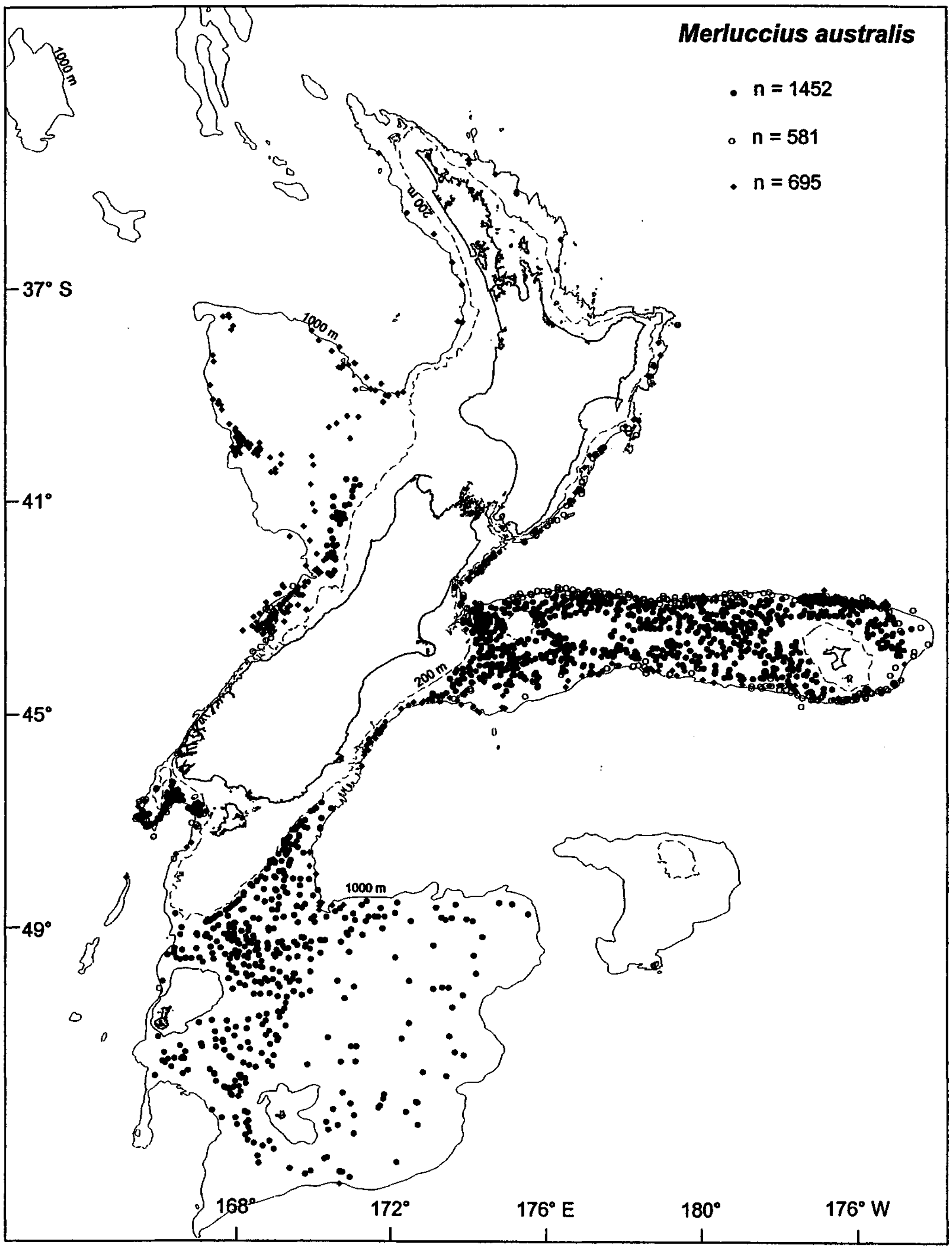

Lepidopus caudatus
Maximum = 39 kg.km^{-2}
n = 8
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

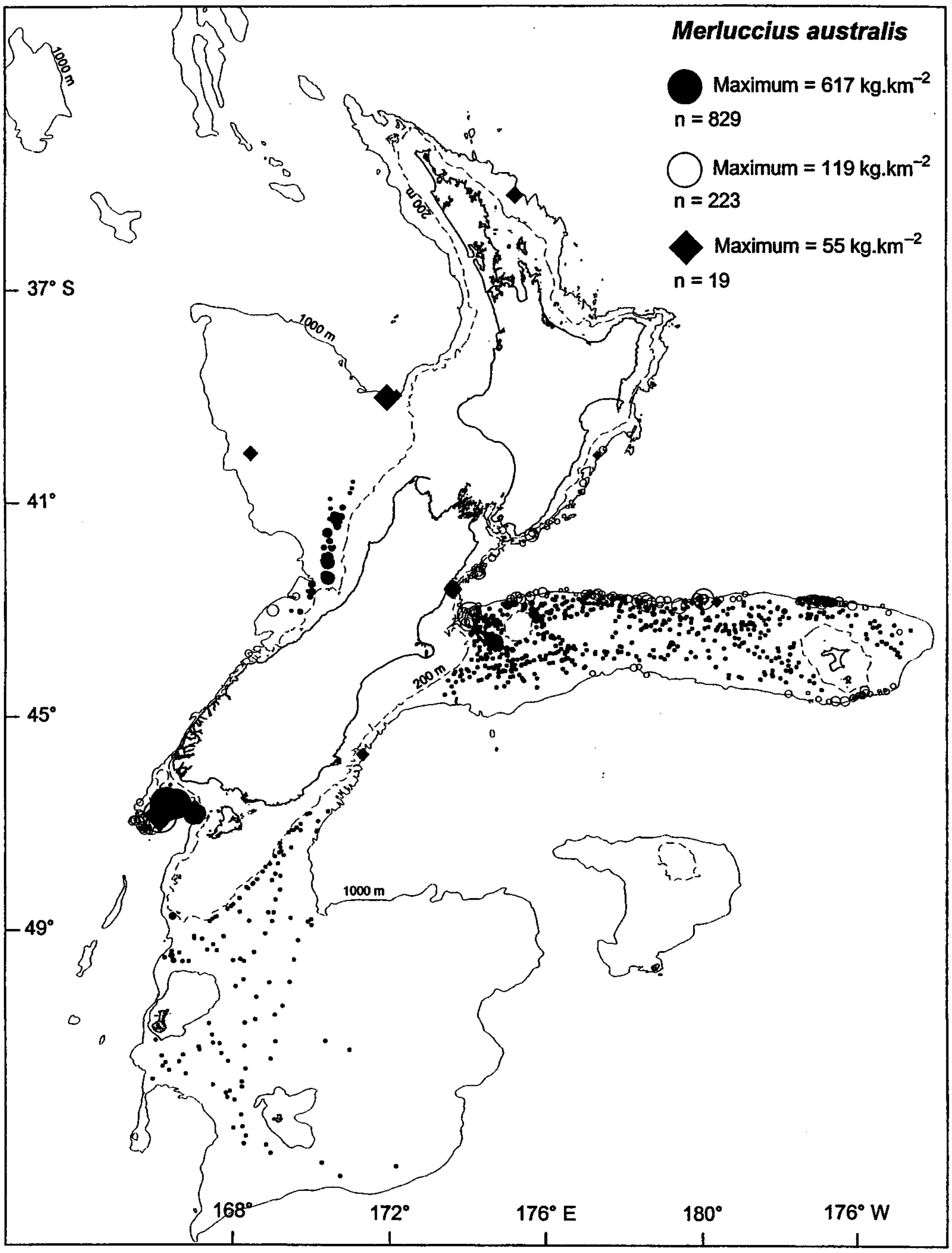


Macruronus novaezelandiae
n = 2441
n = 1069
n = 1616
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

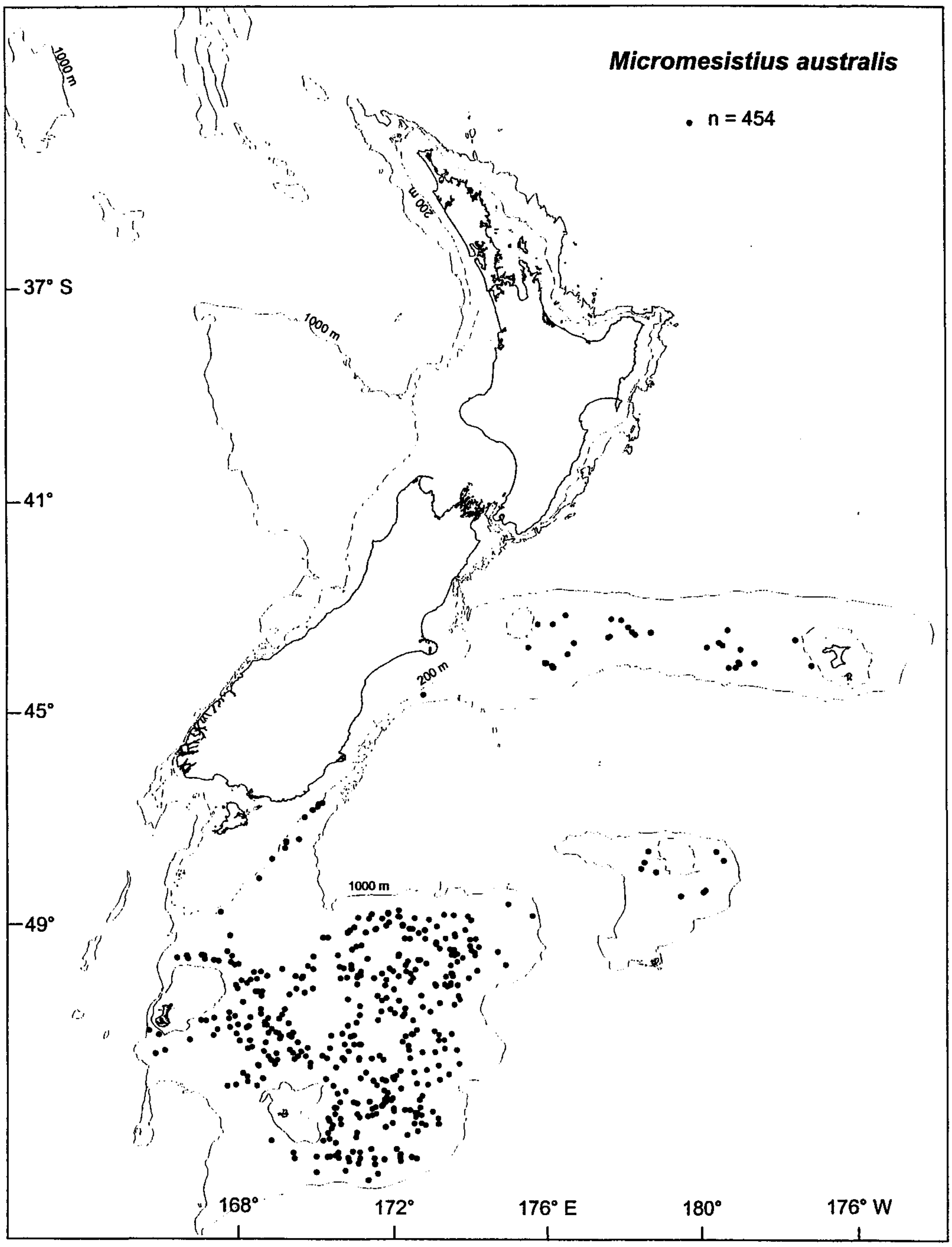


Macruronus novaezelandiae
Maximum = 11 281 kg.km⁻²
n = 1840
Maximum = 154 kg.km⁻²
n = 182
Maximum = 711 kg.km⁻²
n = 135
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

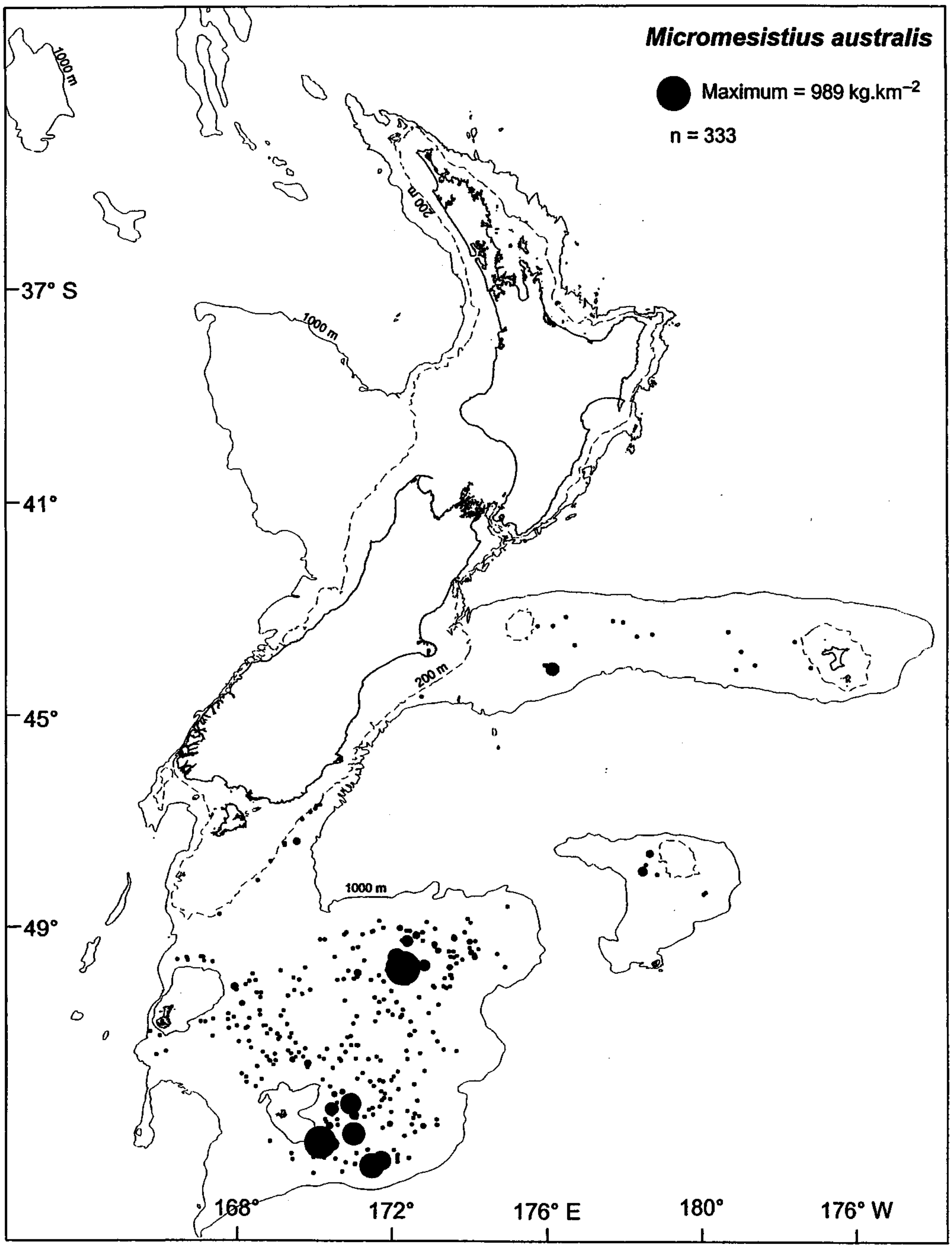

Merluccius australis
n = 1452
n = 581
n = 695
1000 m
200 m
1000 m
200 m
1000 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



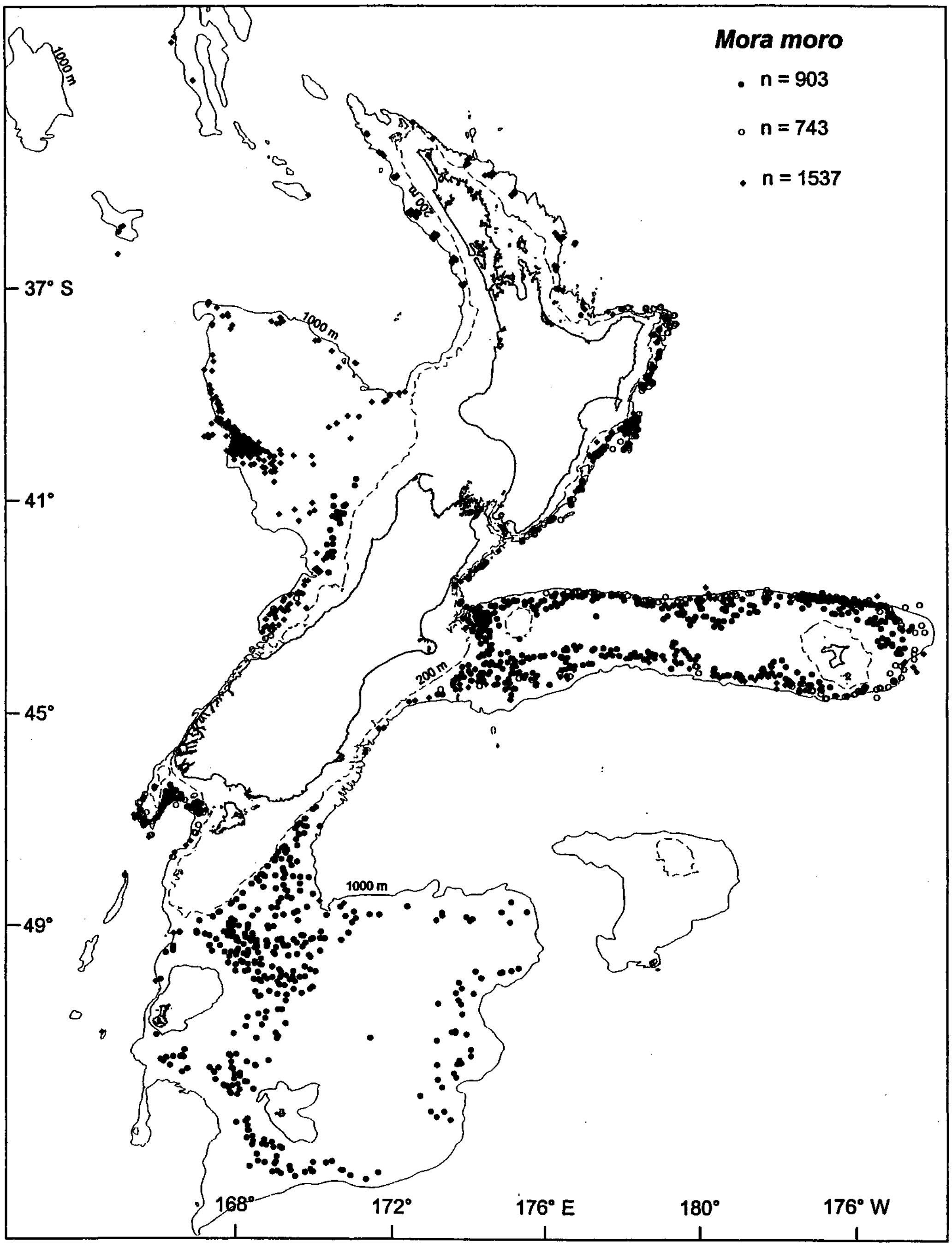
Merluccius australis
Maximum = 617 kg.km^{-2}
n = 829
Maximum = 119 kg.km^{-2}
n = 223
Maximum = 55 kg.km^{-2}
n = 19
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

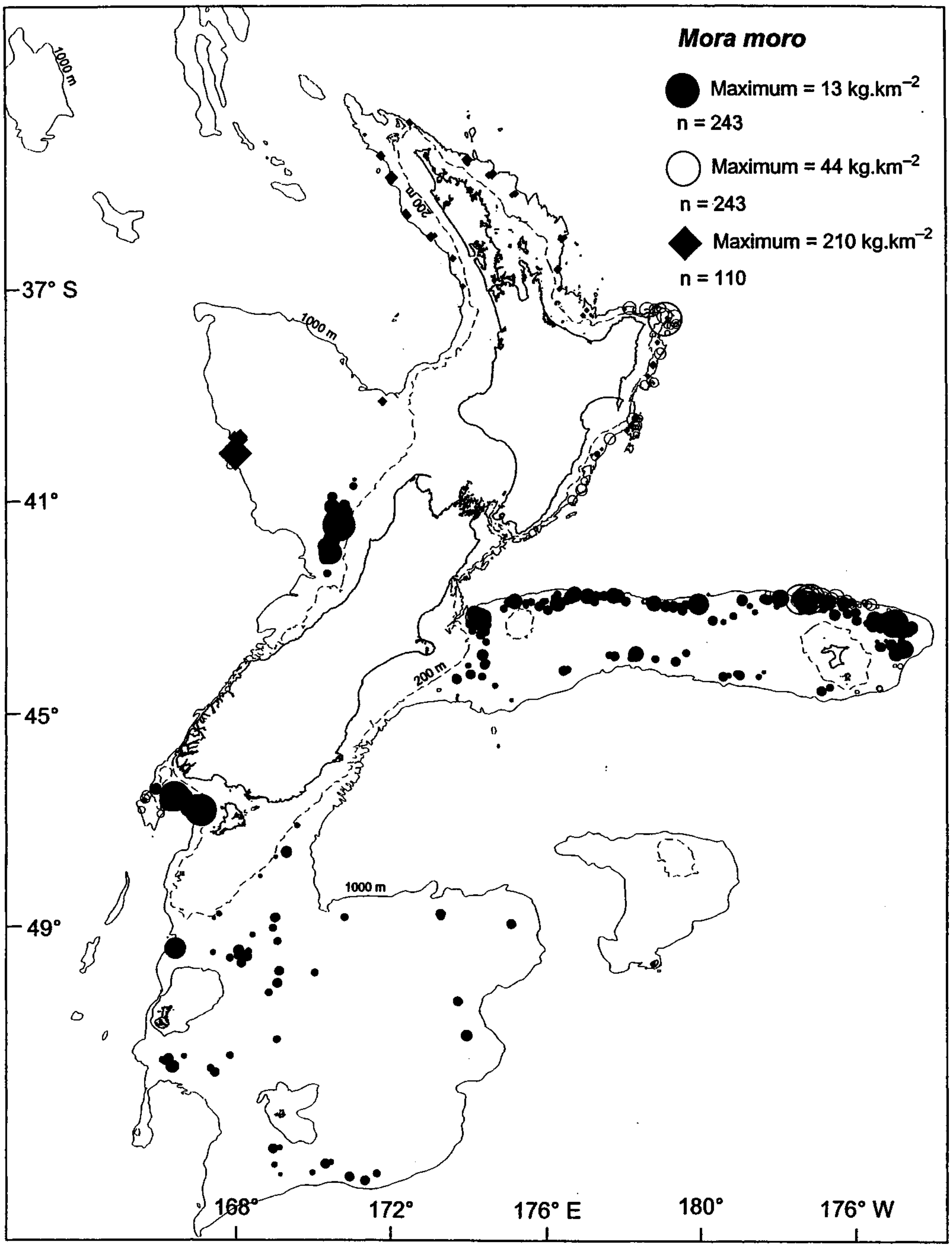


Micromesistius australis
n = 454
1000 m
200 m
1000 m
200 m
1000 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

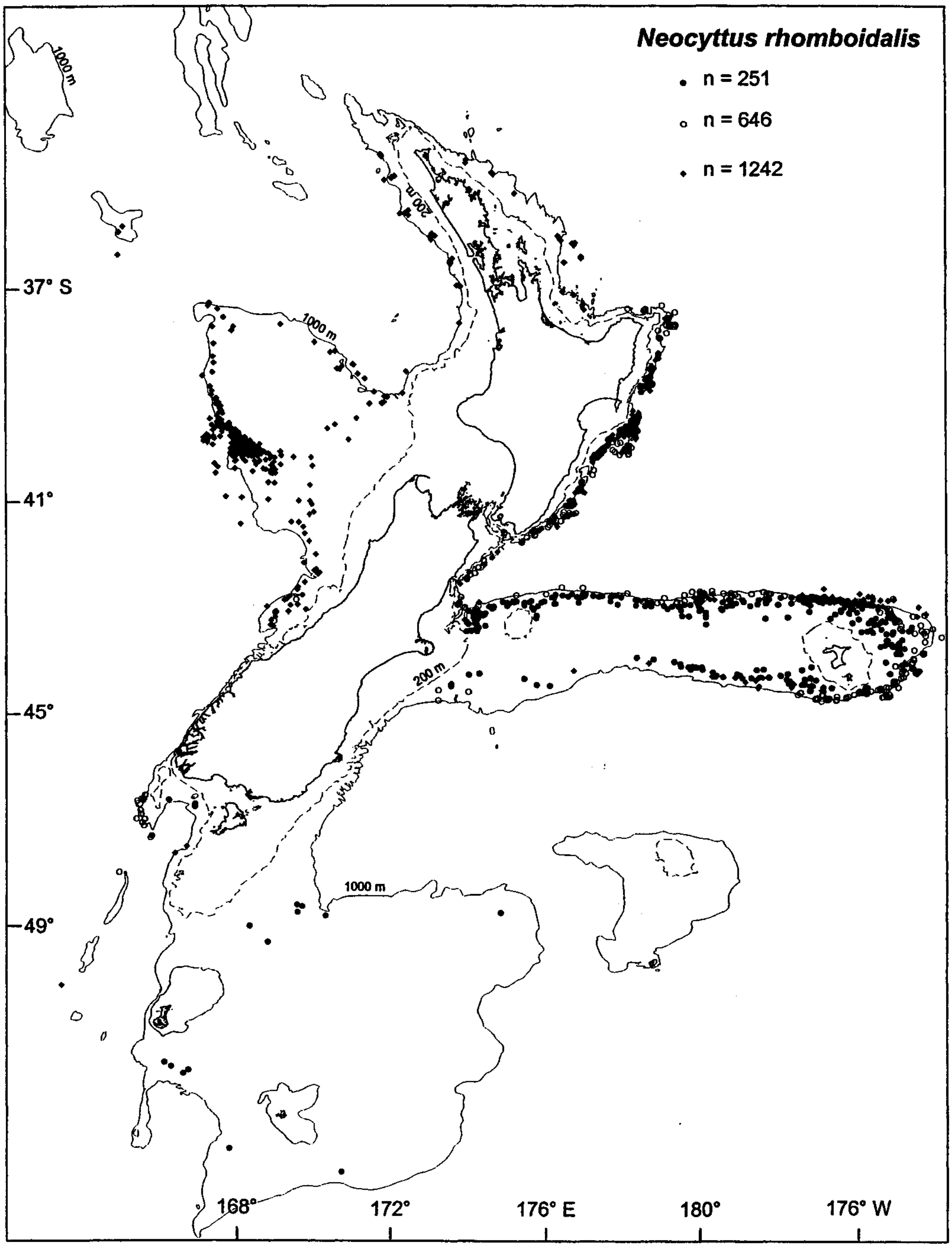


Micromesistius australis
Maximum = 989 kg.km⁻²
n = 333
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W
1000 m
200 m

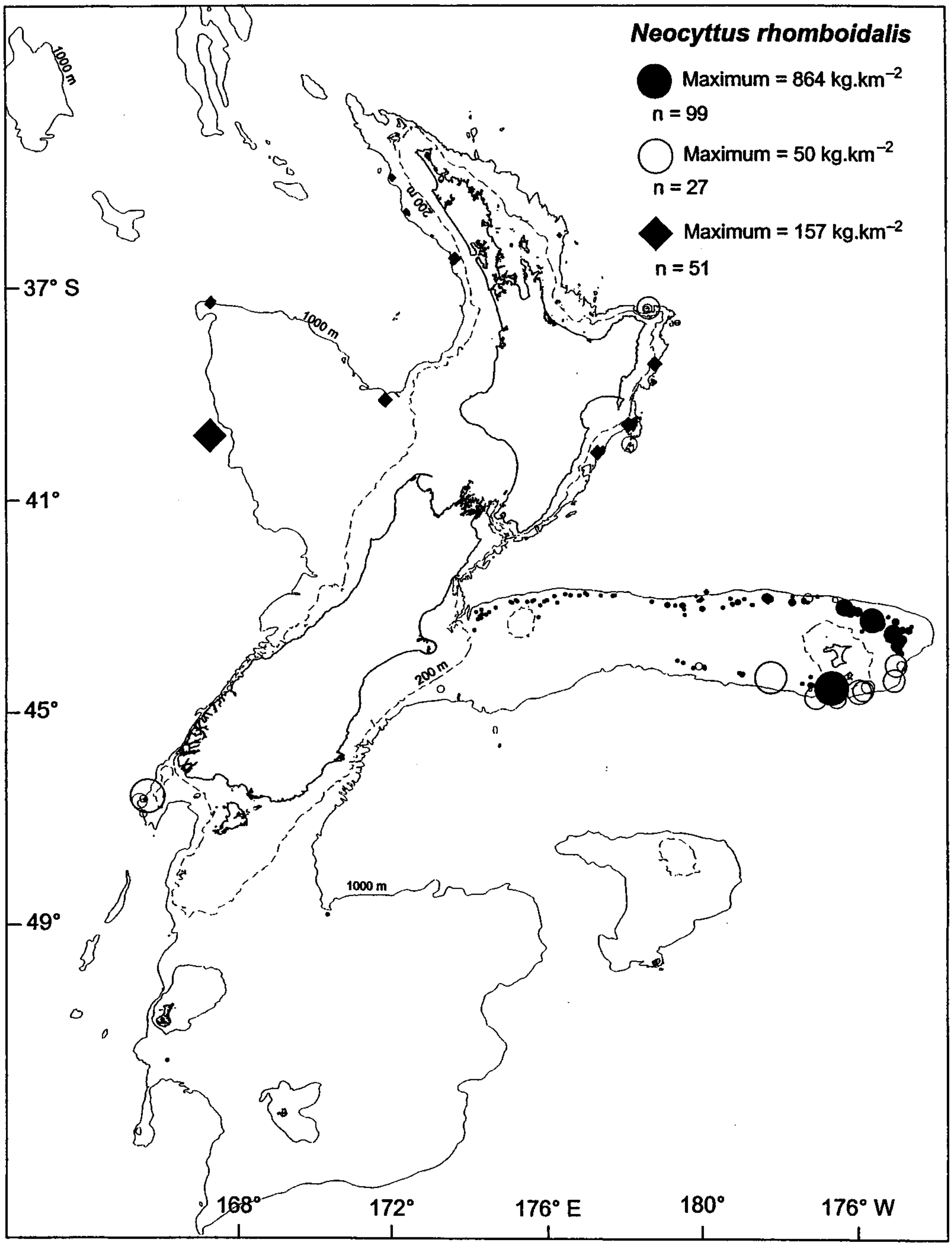

Mora moro
n = 903
n = 743
n = 1537
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

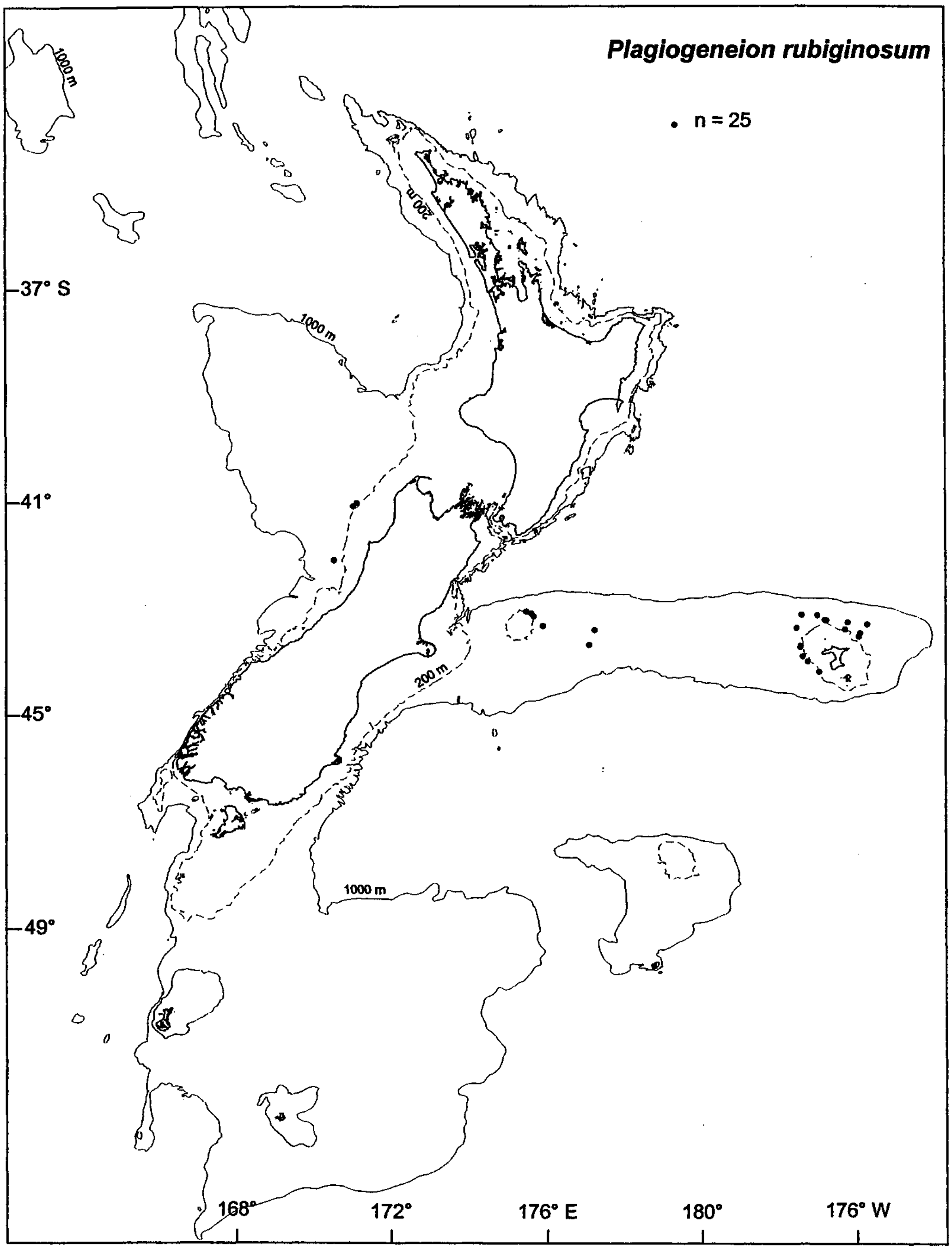


Mora moro
Maximum = 13 kg.km^{-2}
n = 243
Maximum = 44 kg.km^{-2}
n = 243
Maximum = 210 kg.km^{-2}
n = 110
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W
1000 m
200 m

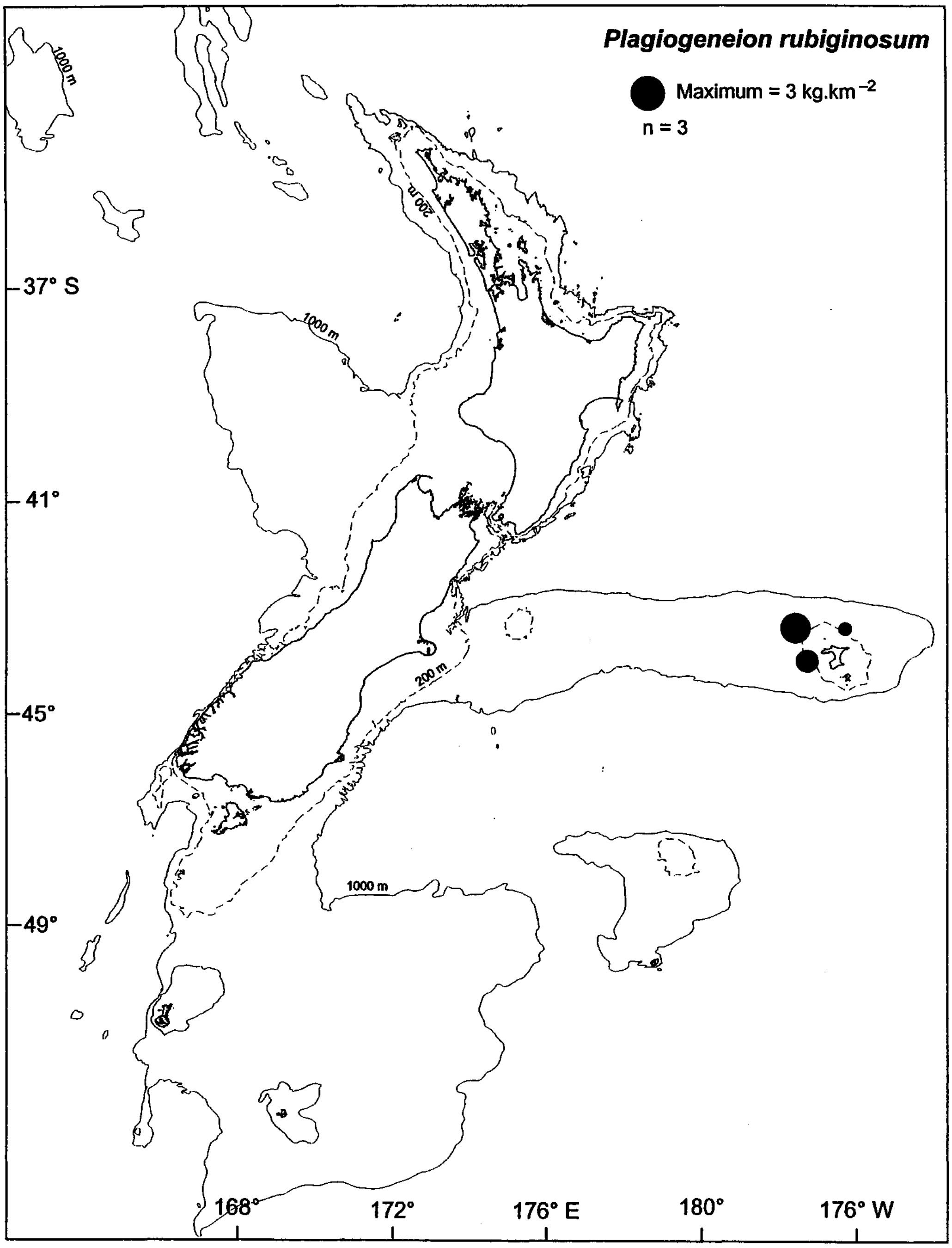


Neocyttus rhomboidalis
n = 251
n = 646
n = 1242
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

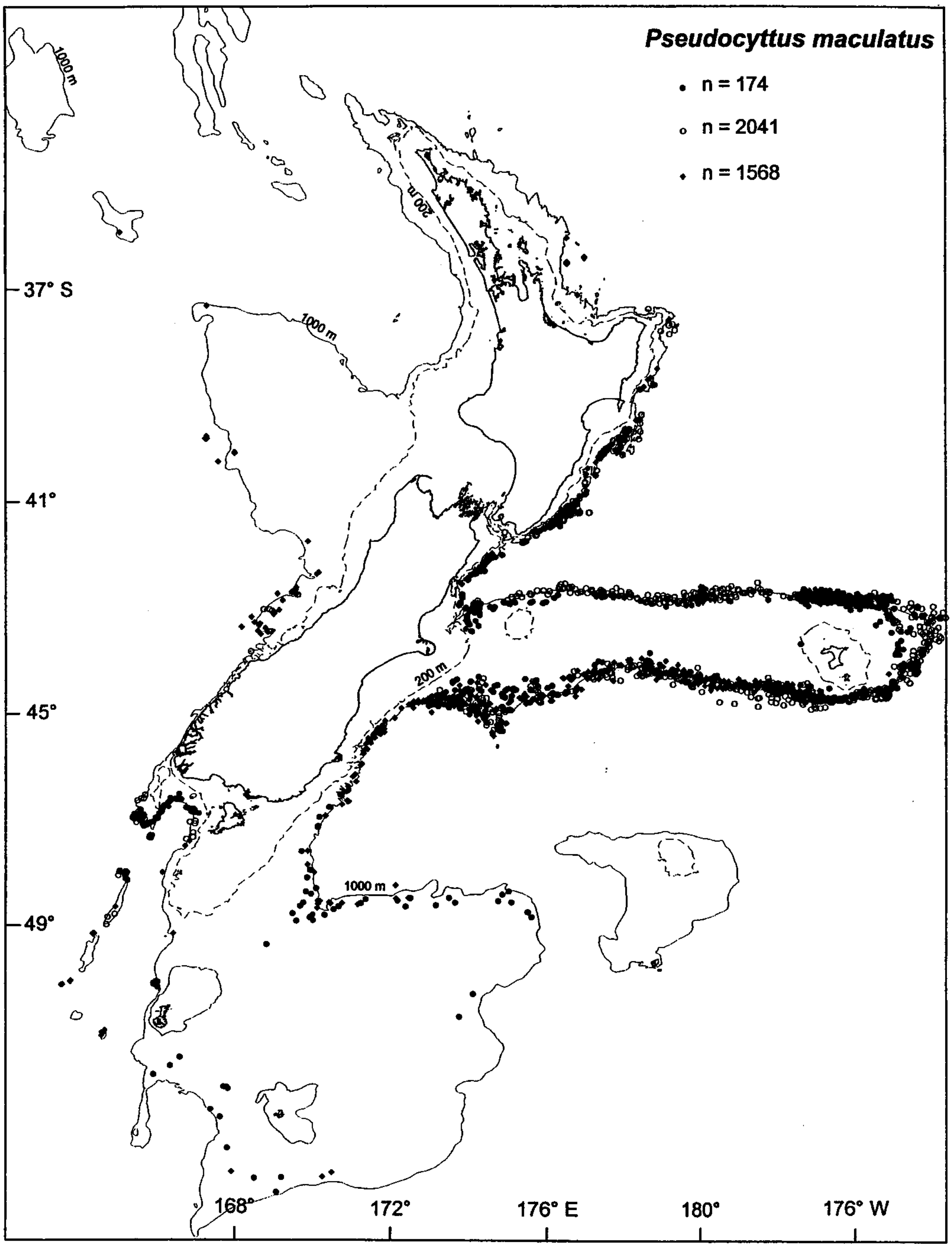

Neocyttus rhomboidalis
Maximum = 864 kg.km^{-2}
n = 99
Maximum = 50 kg.km^{-2}
n = 27
Maximum = 157 kg.km^{-2}
n = 51
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W
1000 m
200 m
1000 m
200 m
1000 m



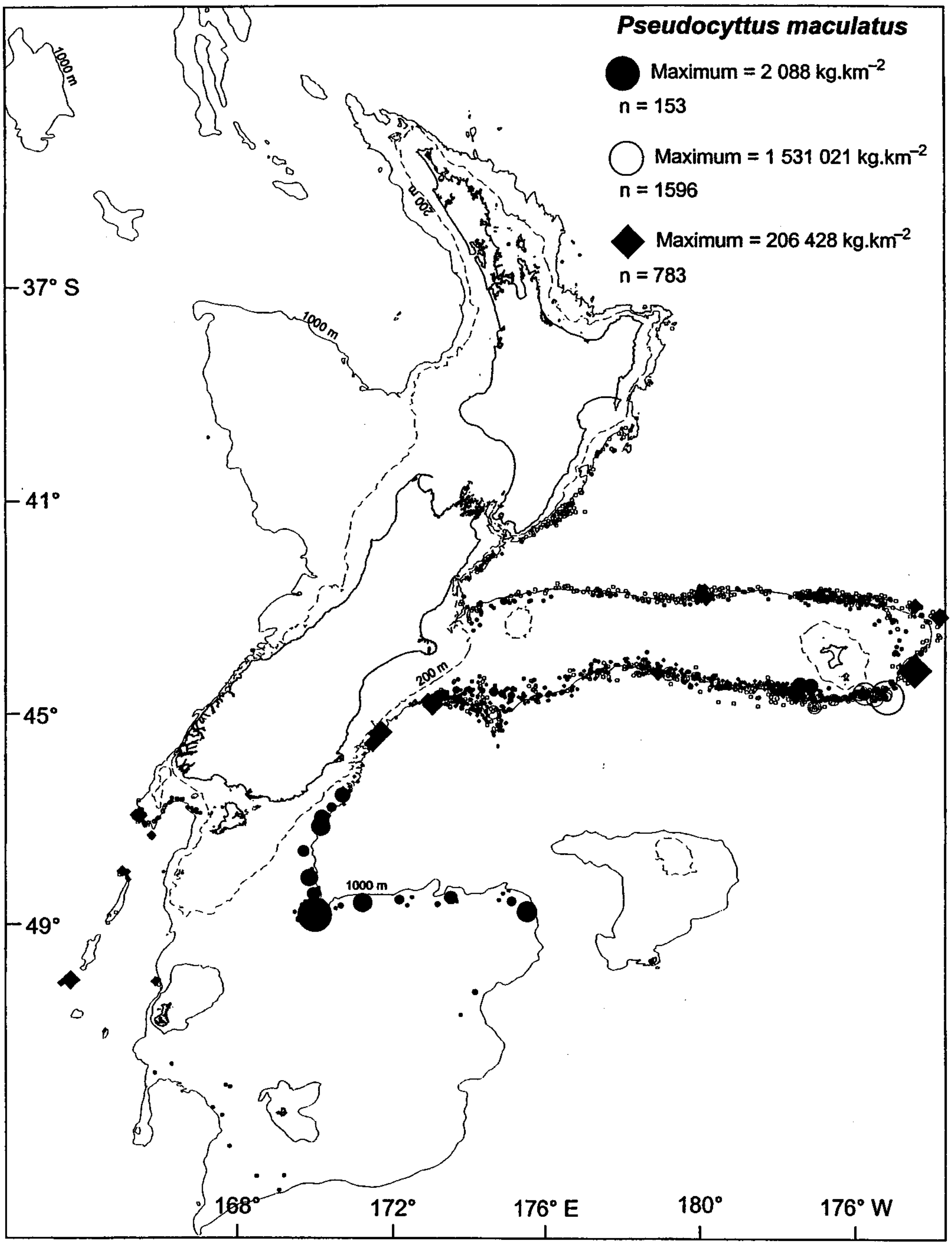
Plagiogeneion rubiginosum
n = 25
1000 m
200 m
1000 m
200 m
1000 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

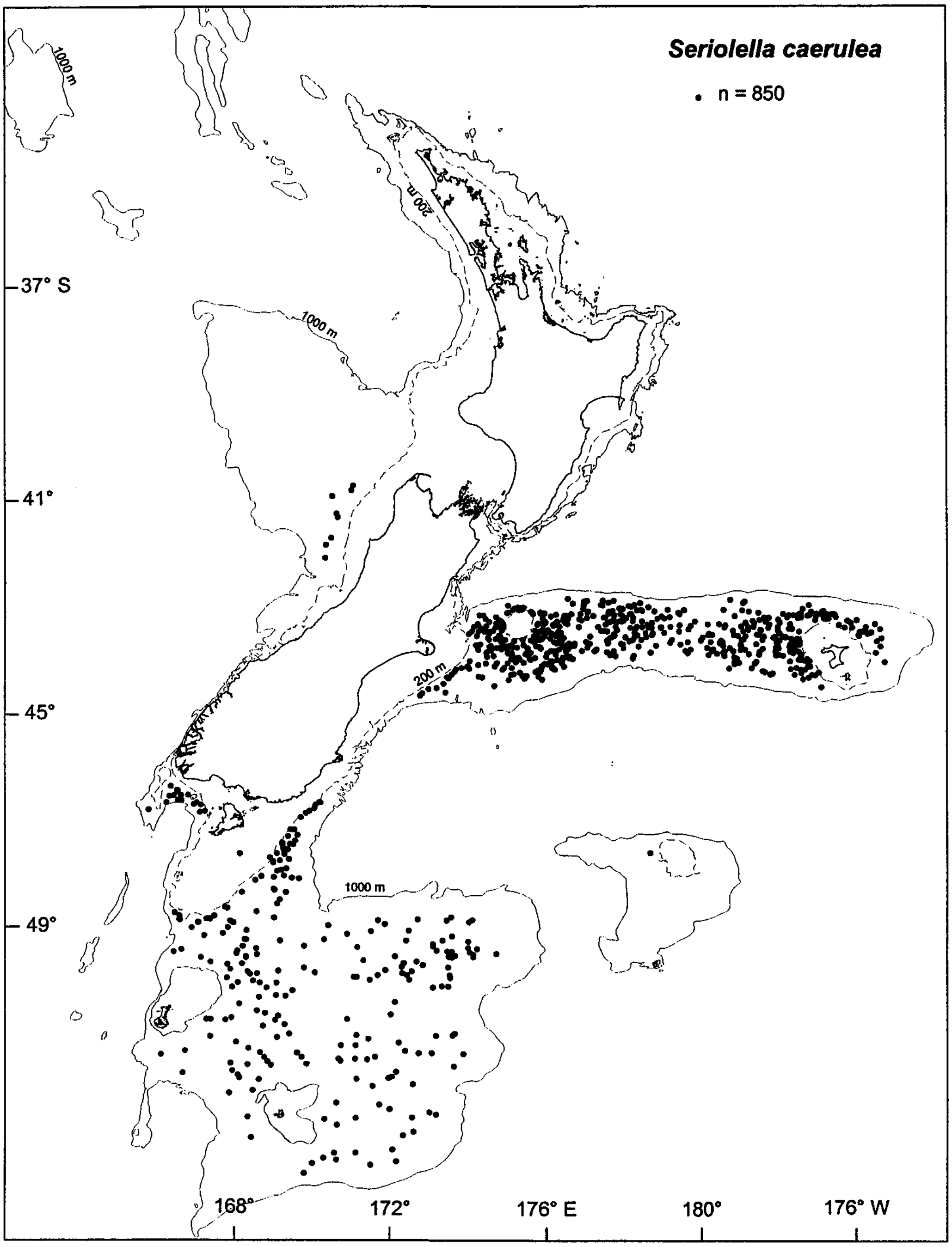


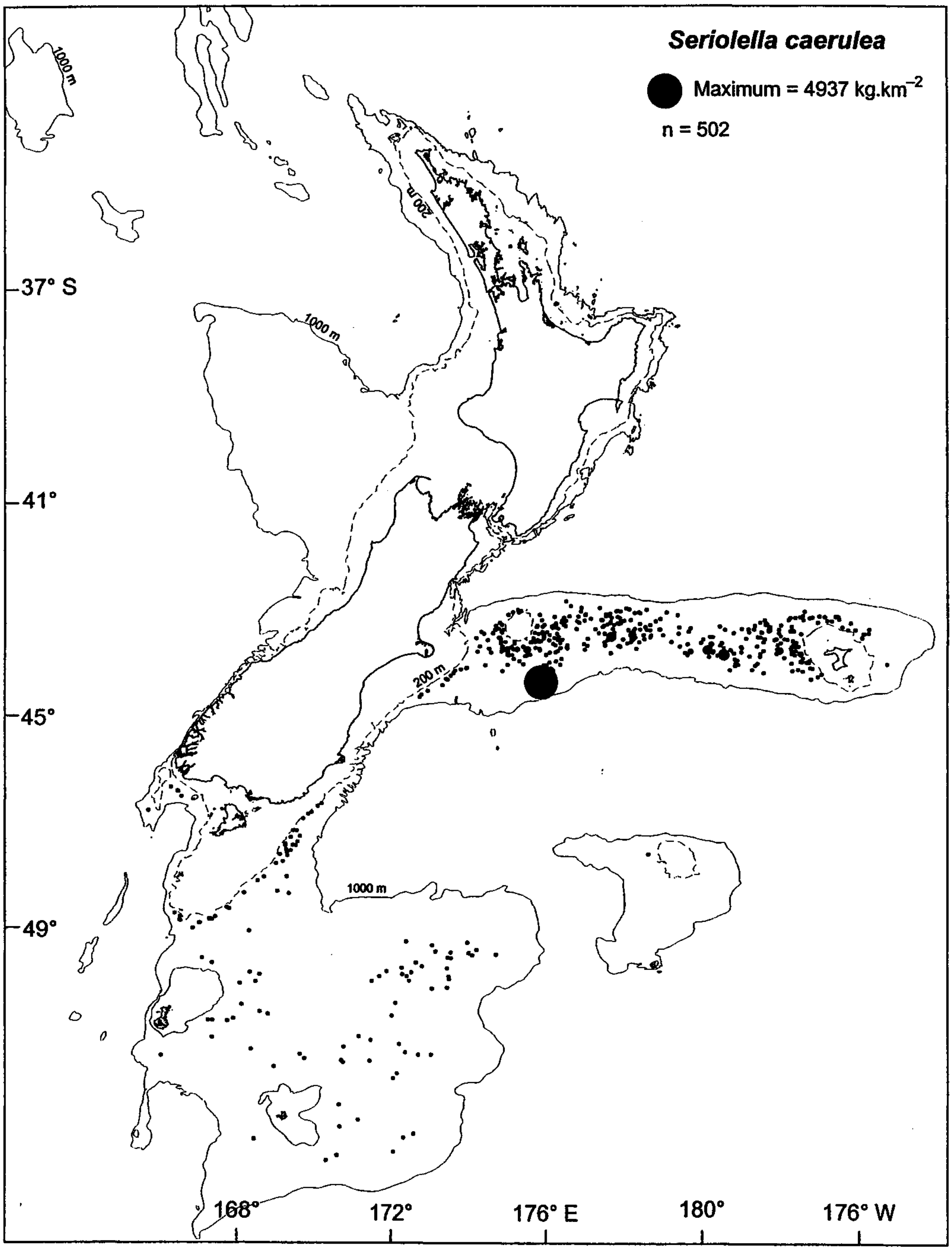
Plagiogeneion rubiginosum
Maximum = 3 kg.km⁻²
n = 3
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



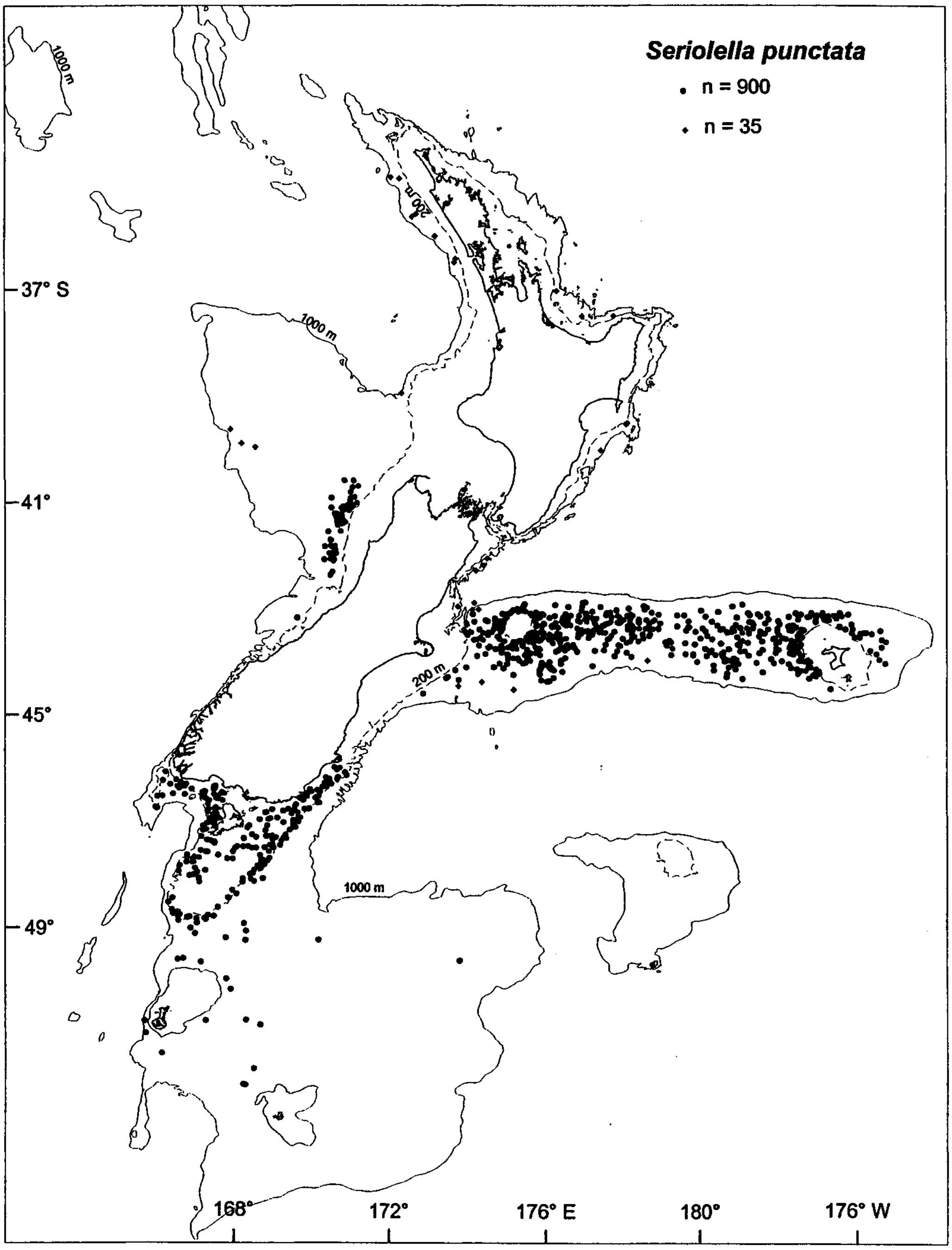
Pseudocyttus maculatus
n = 174
n = 2041
n = 1568
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W
1000 m
200 m


Pseudocyttus maculatus
Maximum = 2 088 kg.km^{-2}
n = 153
Maximum = 1 531 021 kg.km^{-2}
n = 1596
Maximum = 206 428 kg.km^{-2}
n = 783
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W
1000 m
200 m
1000 m
200 m
1000 m

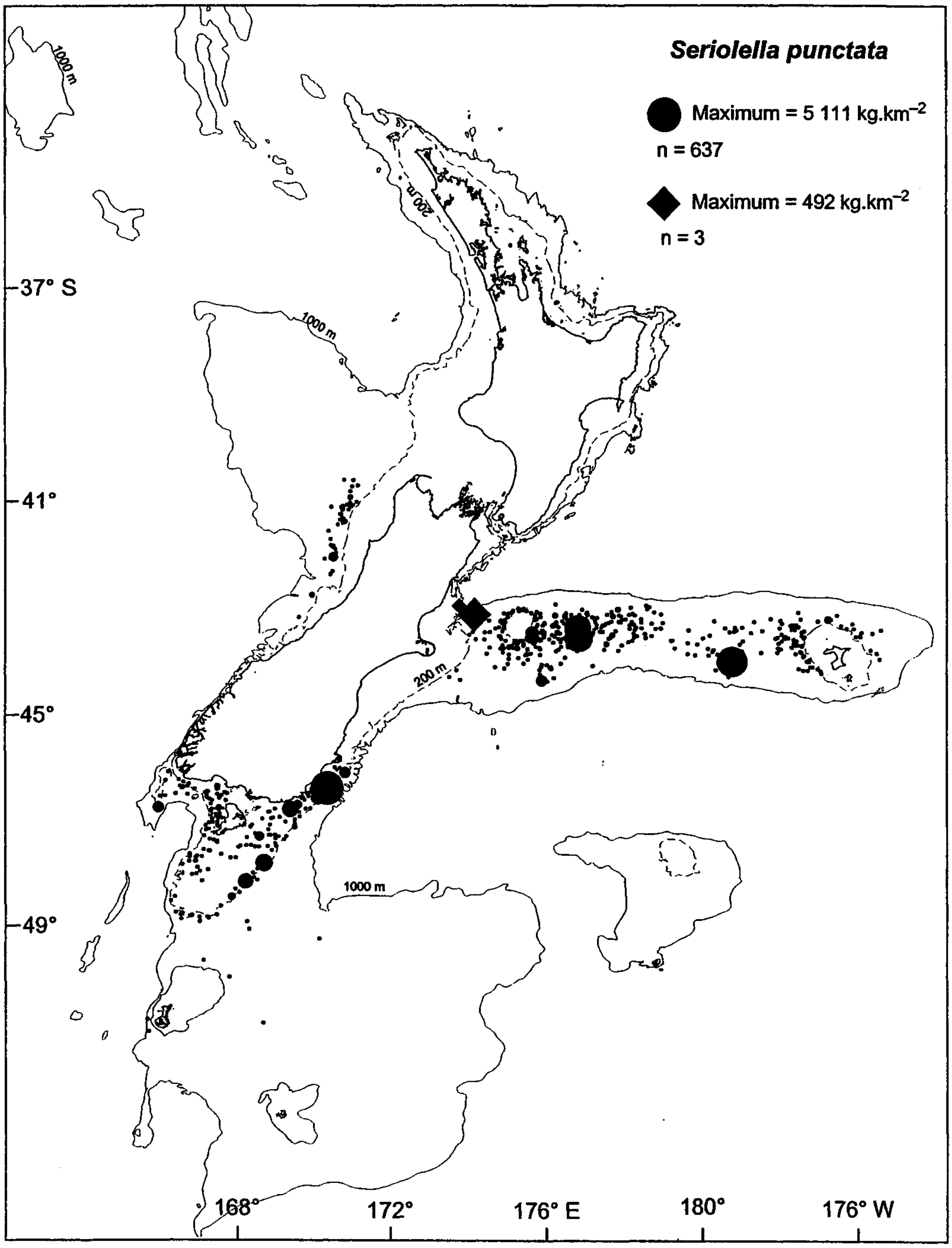

Seriolella caerulea
n = 850
1000 m
200 m
1000 m
200 m
1000 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

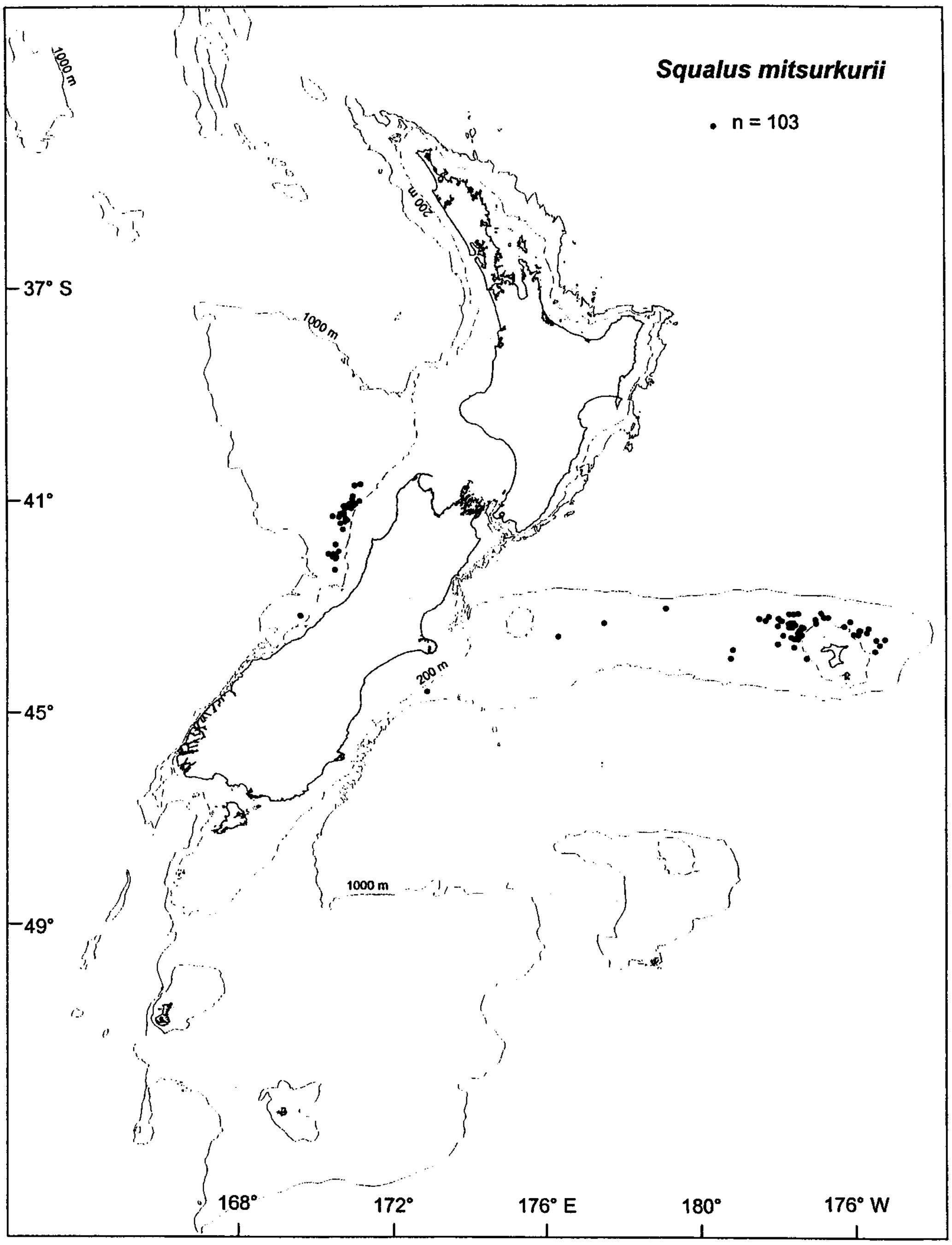


Seriolella caerulea
Maximum = 4937 kg.km^{-2}
n = 502
1000 m
200 m
1000 m
200 m
1000 m
-37° S
-41°
-45°
-49°
168°
172°
176° E
180°
176° W

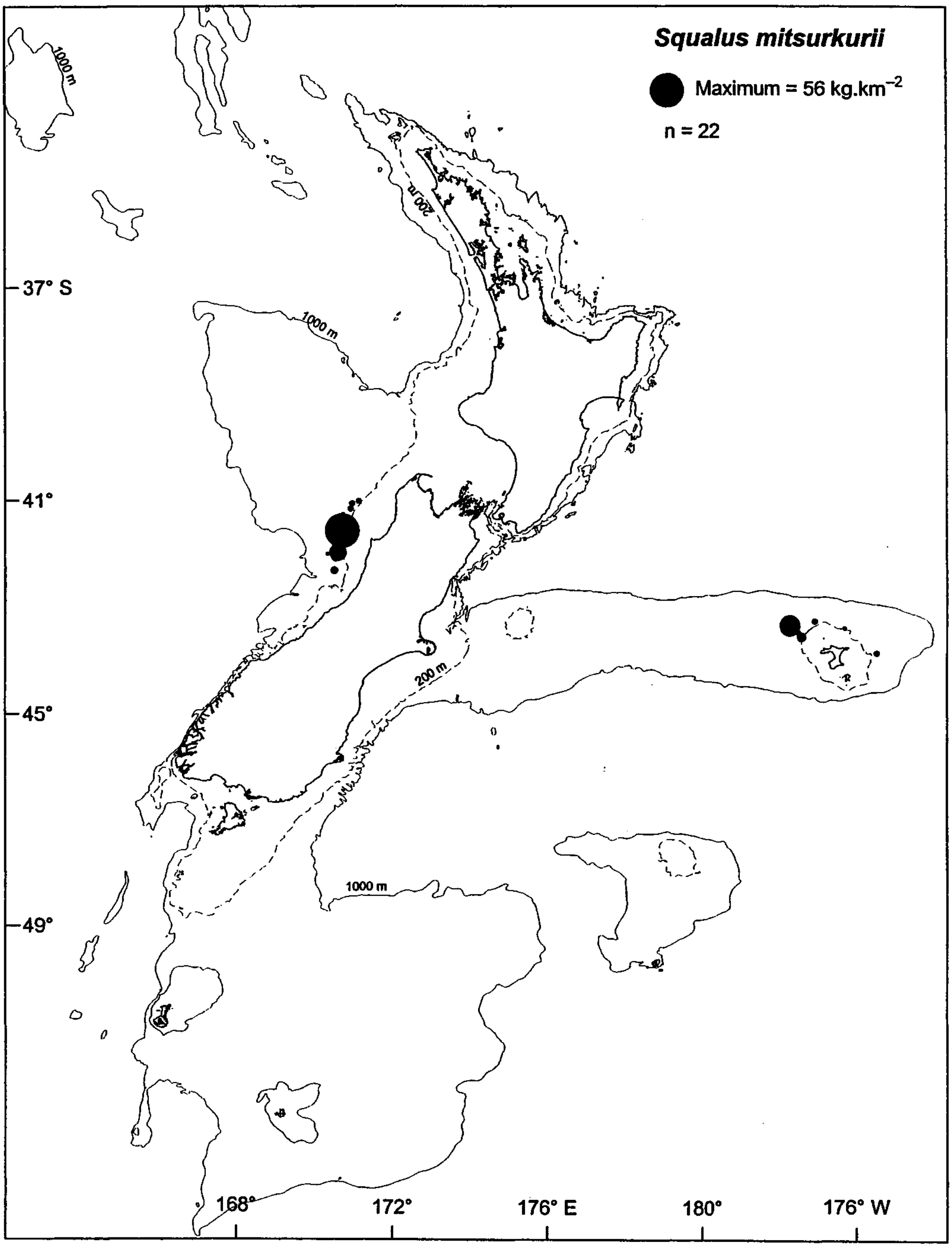


Seriolella punctata
n = 900
n = 35
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

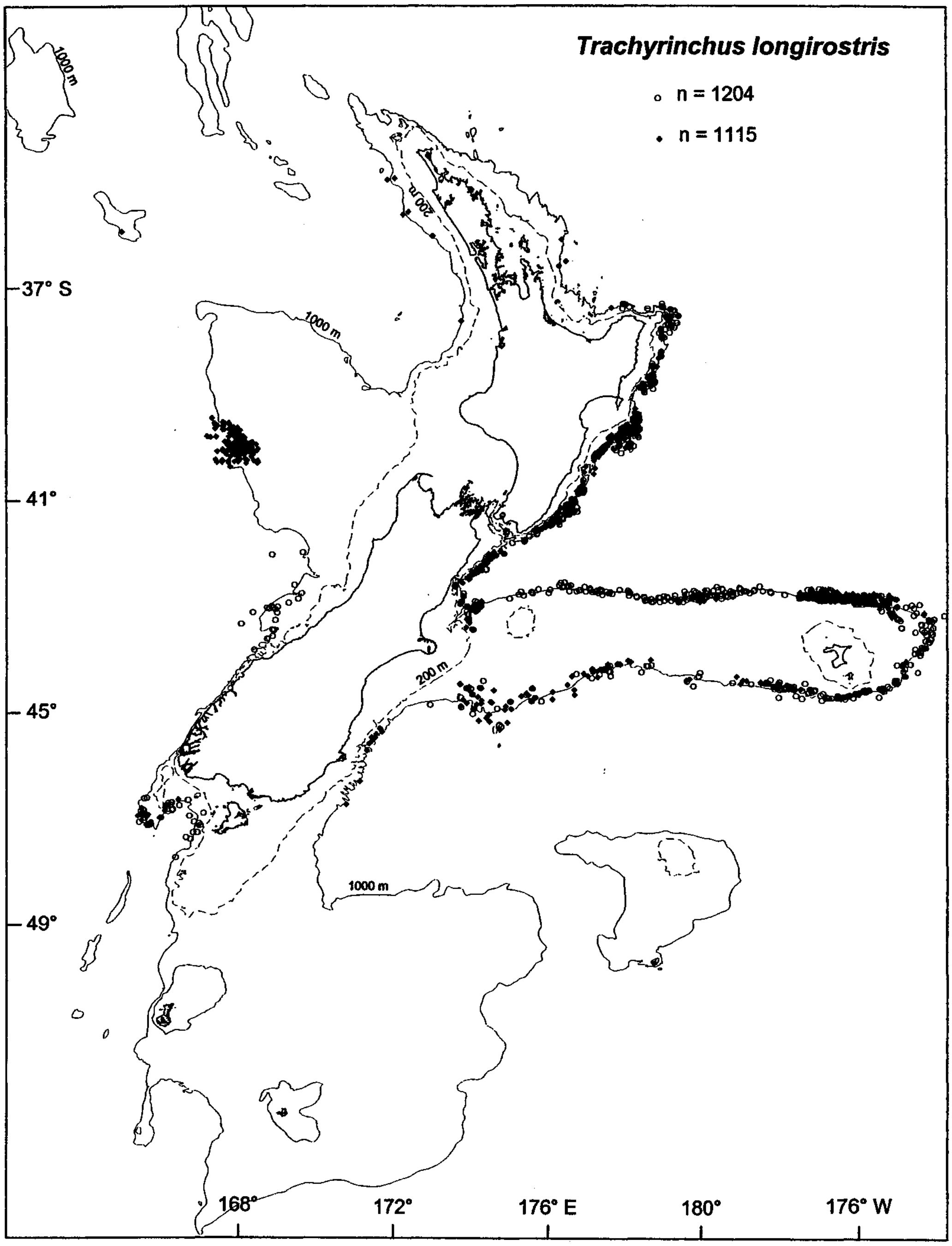

Seriolella punctata
Maximum = 5 111 kg.km−2
n = 637
Maximum = 492 kg.km−2
n = 3
1000 m
200 m
1000 m
200 m
200 m
1000 m
-37° S
-41°
-45°
-49°
168°
172°
176° E
180°
176° W



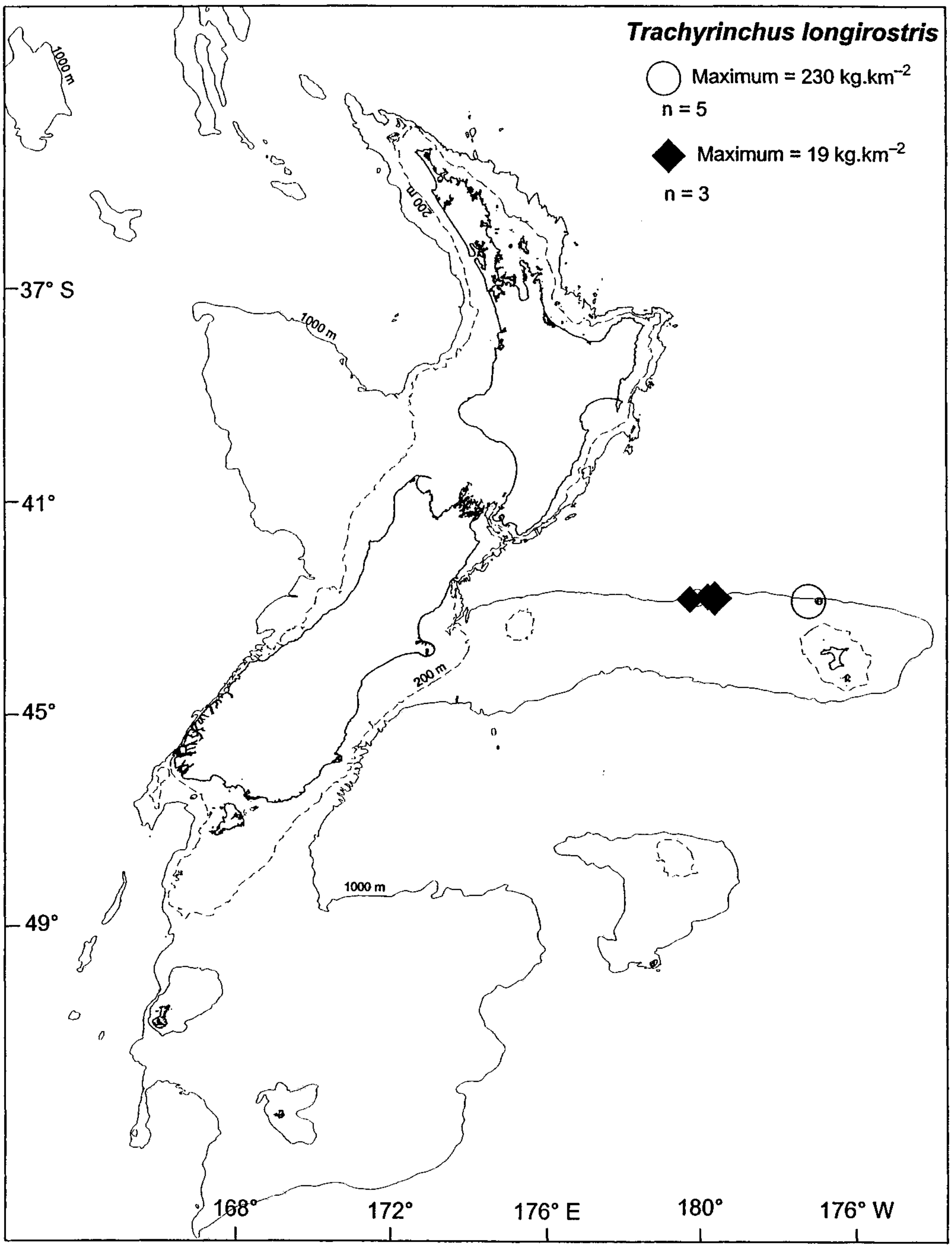
Squalus mitsurkurii
n = 103
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



Squalus mitsurkurii
Maximum = 56 kg.km^{-2}
n = 22
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



Trachyrinchus longirostris
n = 1204
n = 1115
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W
1000 m
200 m



Trachyrinchus longirostris
Maximum = 230 kg.km−2
n = 5
Maximum = 19 kg.km−2
n = 3
1000 m
200 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W

1.2.2 Deepwater fish juvenile abundance

Inshore surveys

Key to symbols and interpretation of inshore abundance plots

Left-hand pages are reference plots of where the species was caught in the trawl survey series (see Table 3); n, number of stations.

Right-hand pages show catch rates of juveniles. Symbol size is proportional to the maximum catch rate indicated; n, number of stations with juveniles.

North Island

Solid circles, *Kaharoa* time series with high opening bottom trawl, 40 mm codend

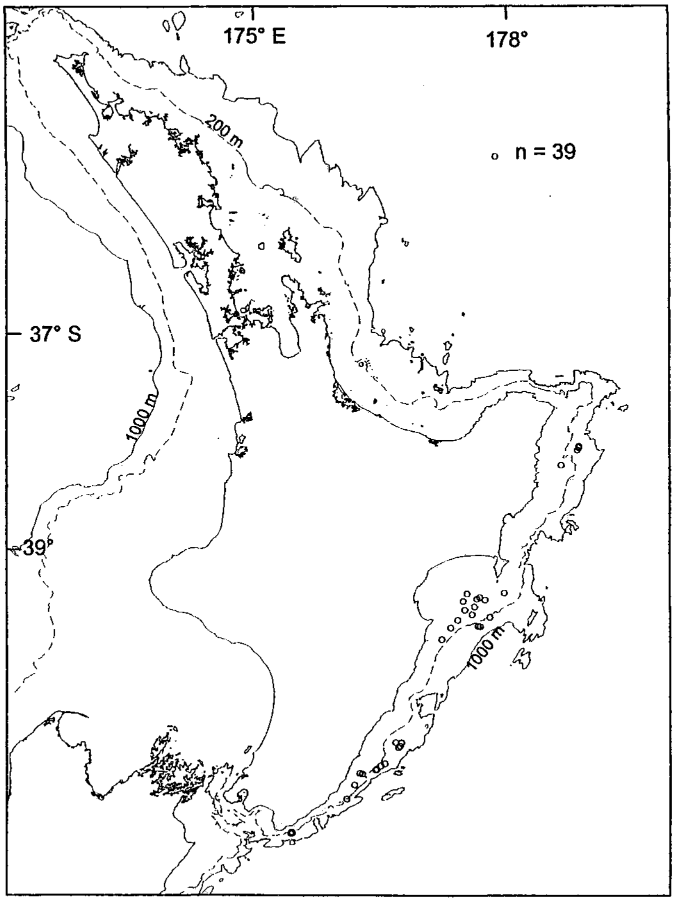
Open circles, *Kaharoa* time series with high lift bottom wing trawl, 80 mm codend

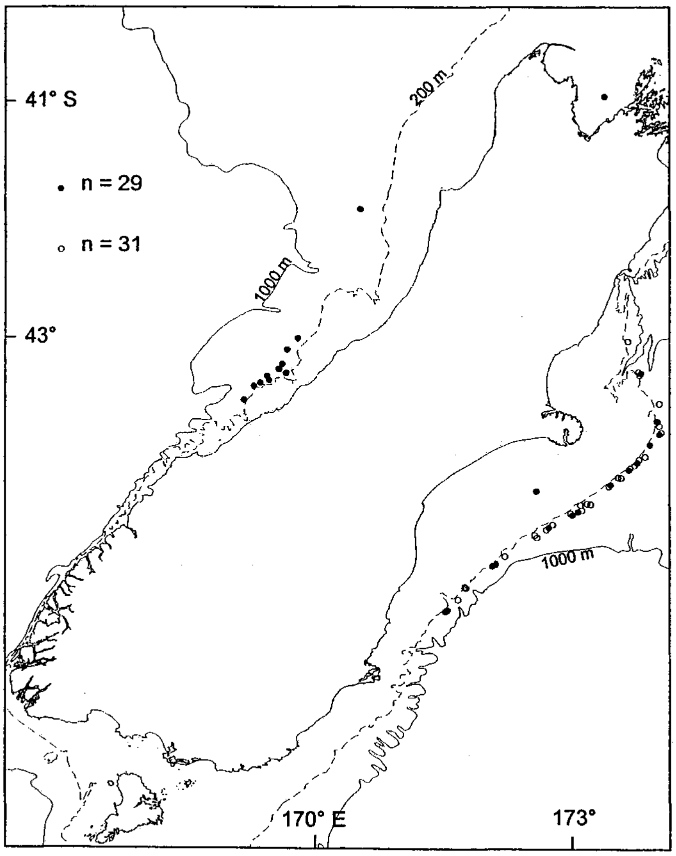
South Island

Solid circles, *Kaharoa* time series with two panel, Alfredo design trawl, 74 mm codend

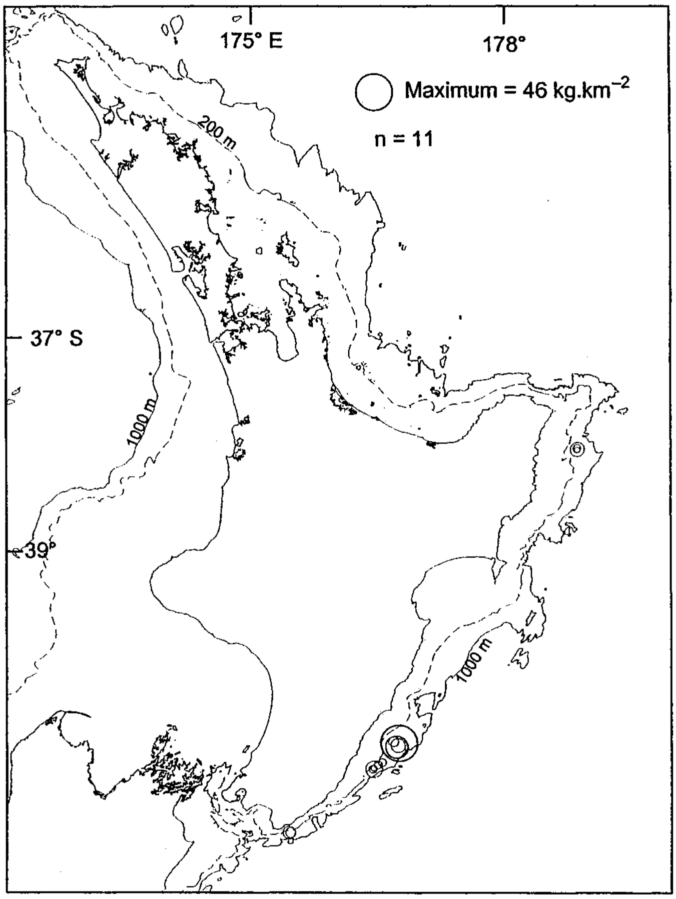
Open circles, *Kaharoa* time series with two panel, Alfredo design trawl, 28 mm codend

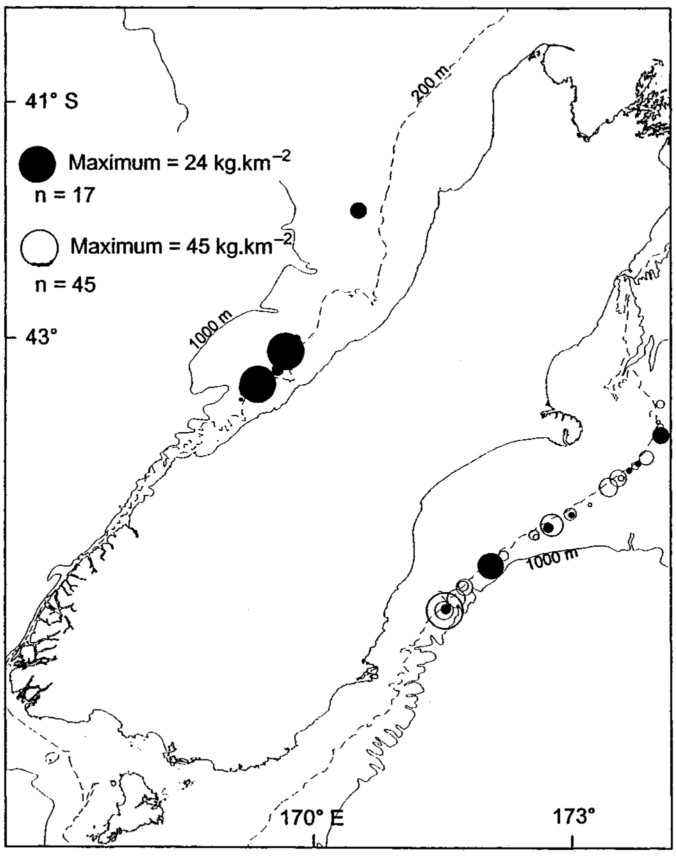
Cyttus traversi



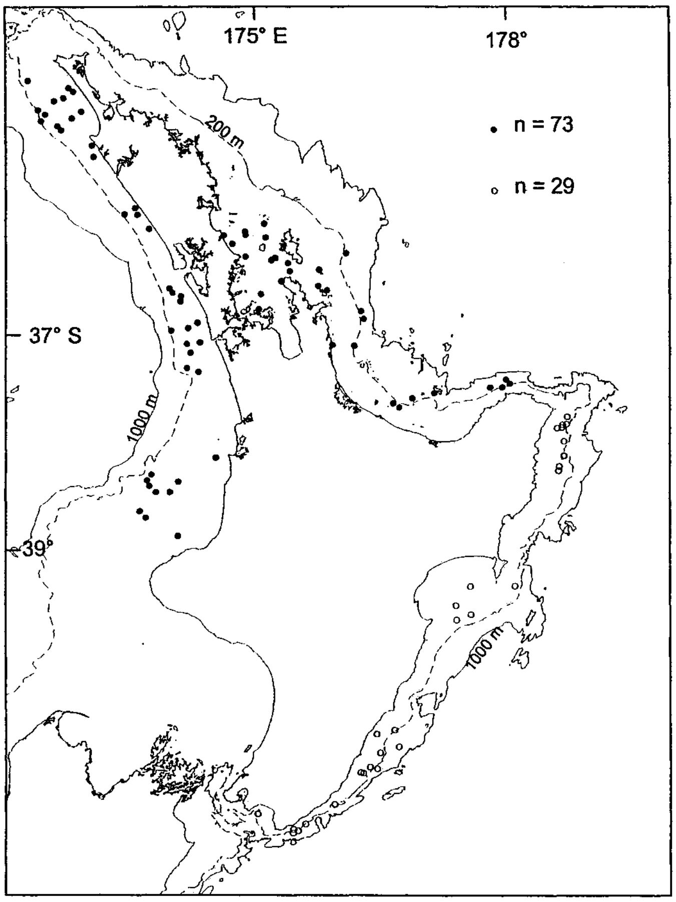


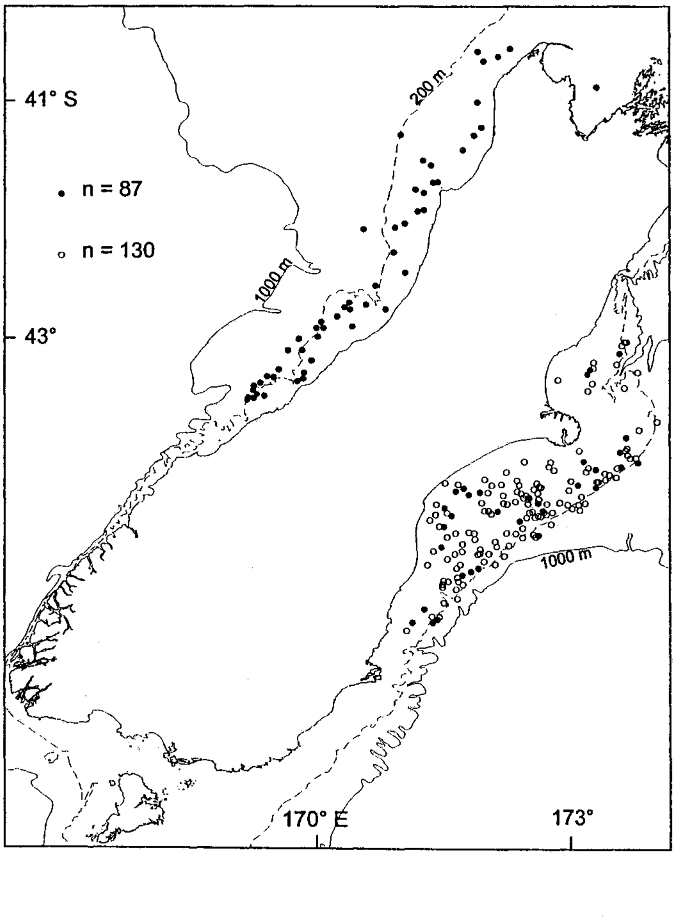
Cyttus traversi



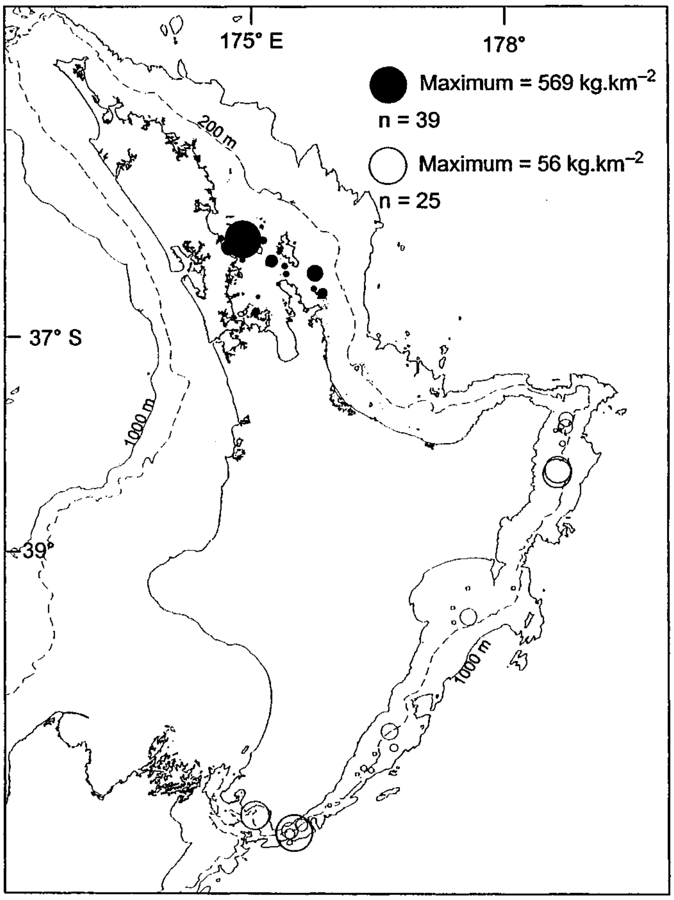


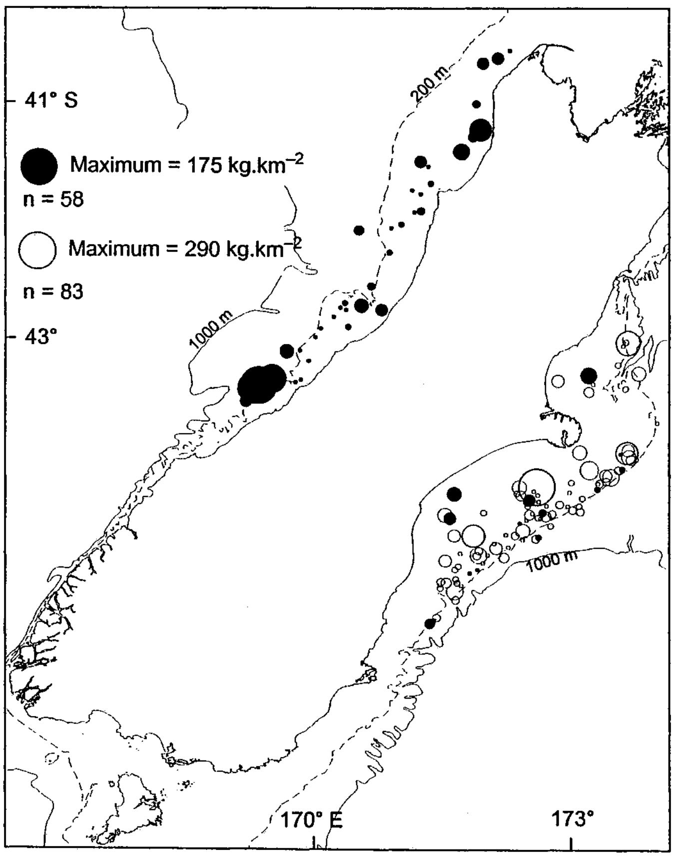
Dipturus innominatus



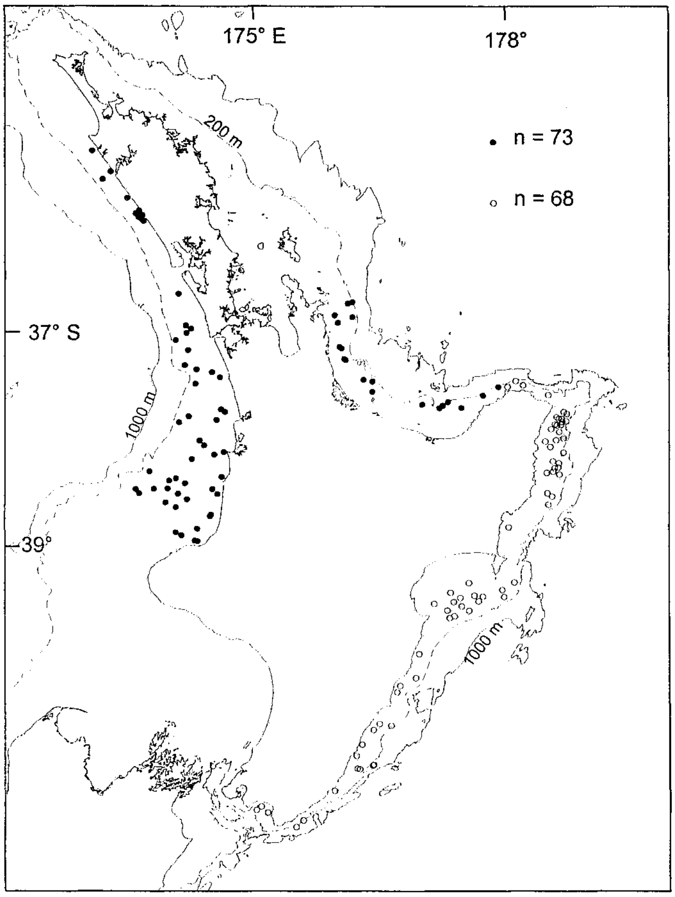


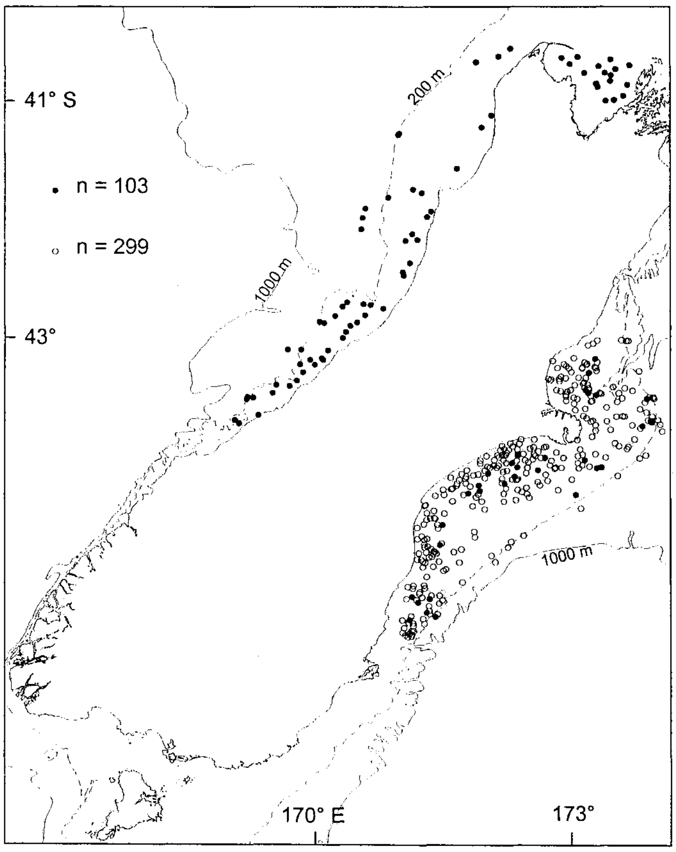
Dipturus innominatus



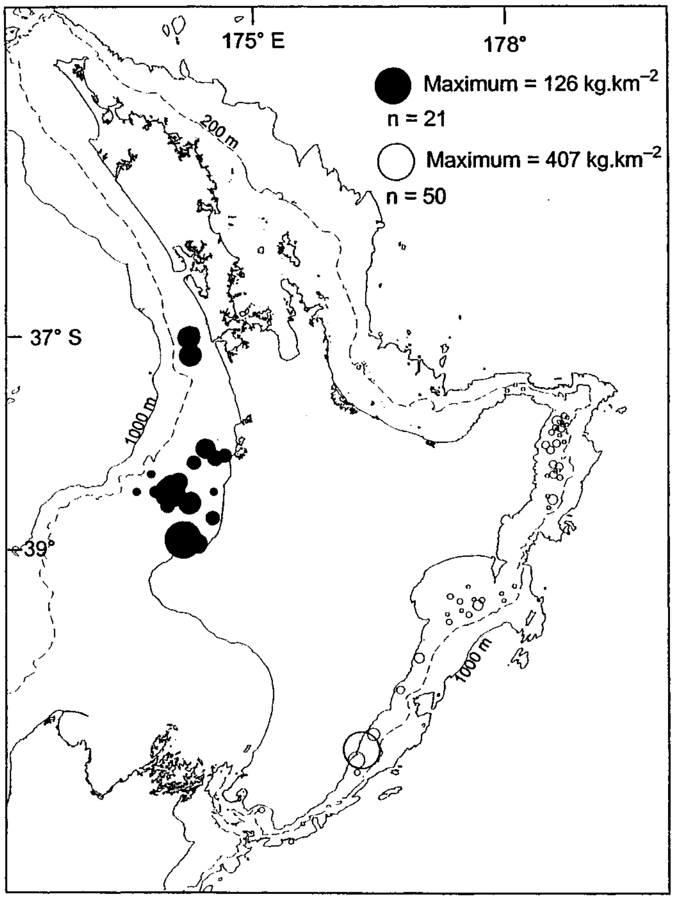


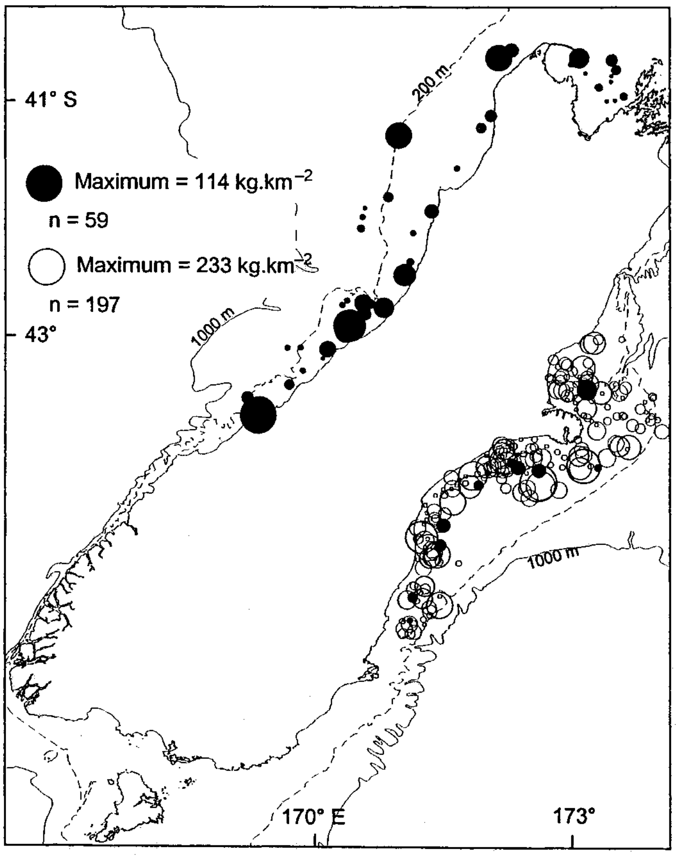
Dipturus nasutus



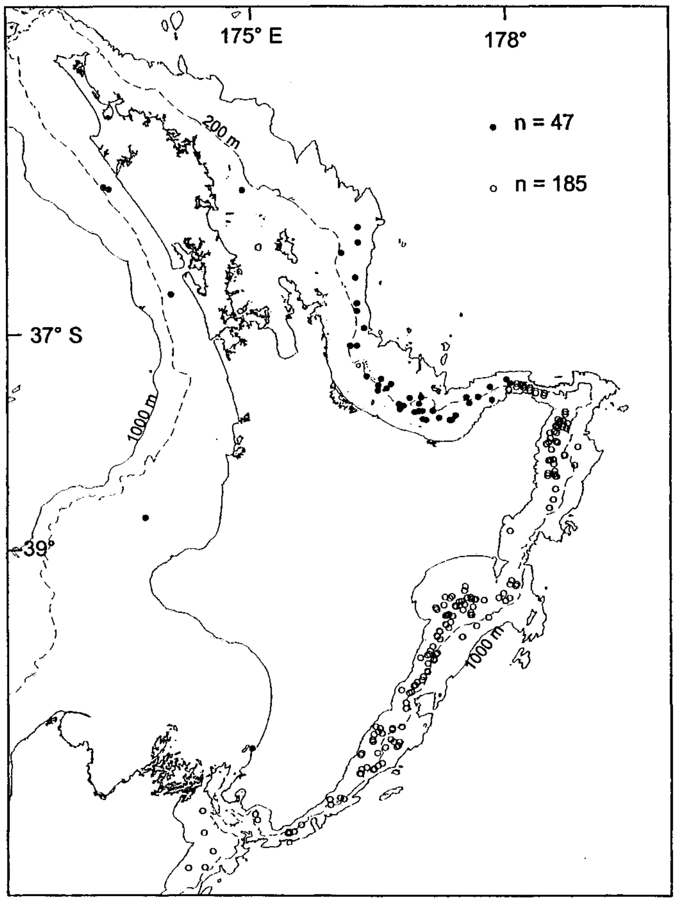


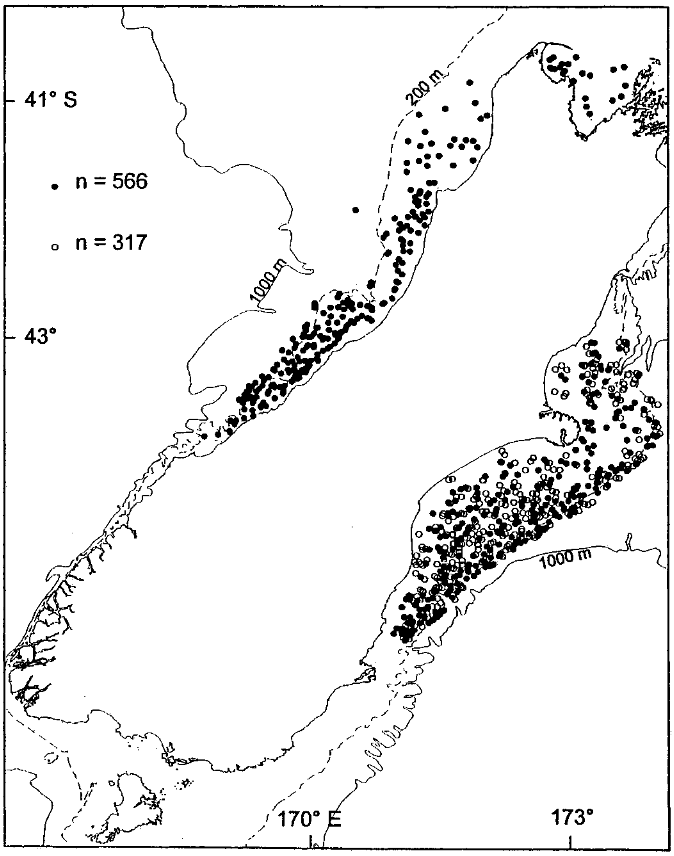
Dipturus nasutus



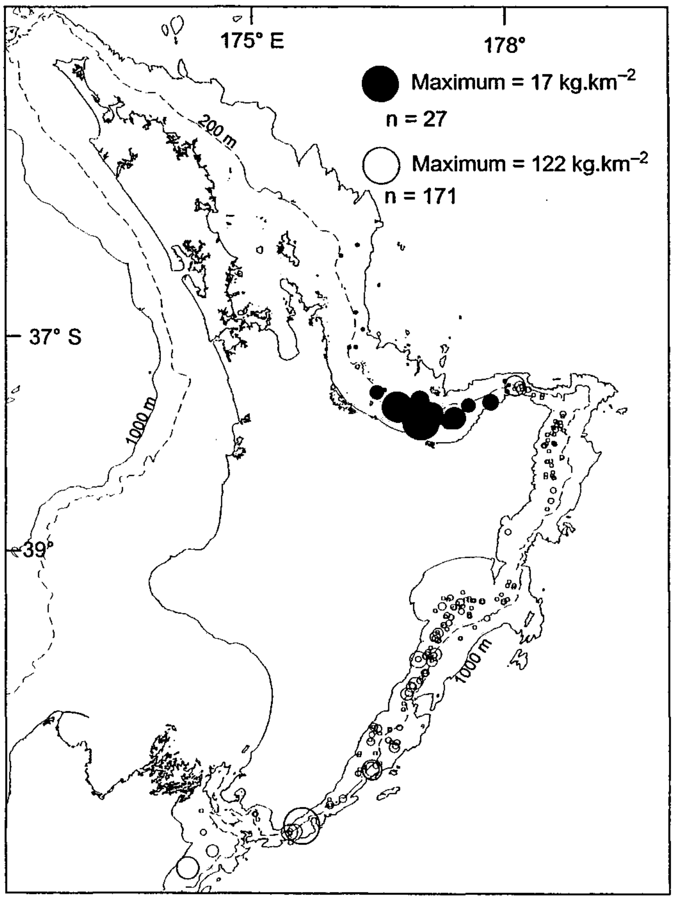


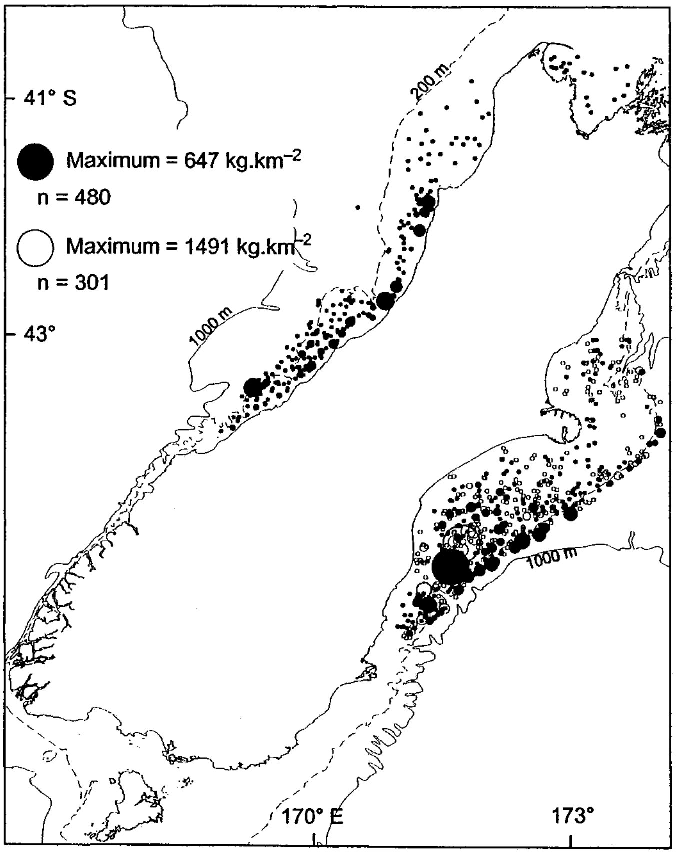
Genypterus blacodes



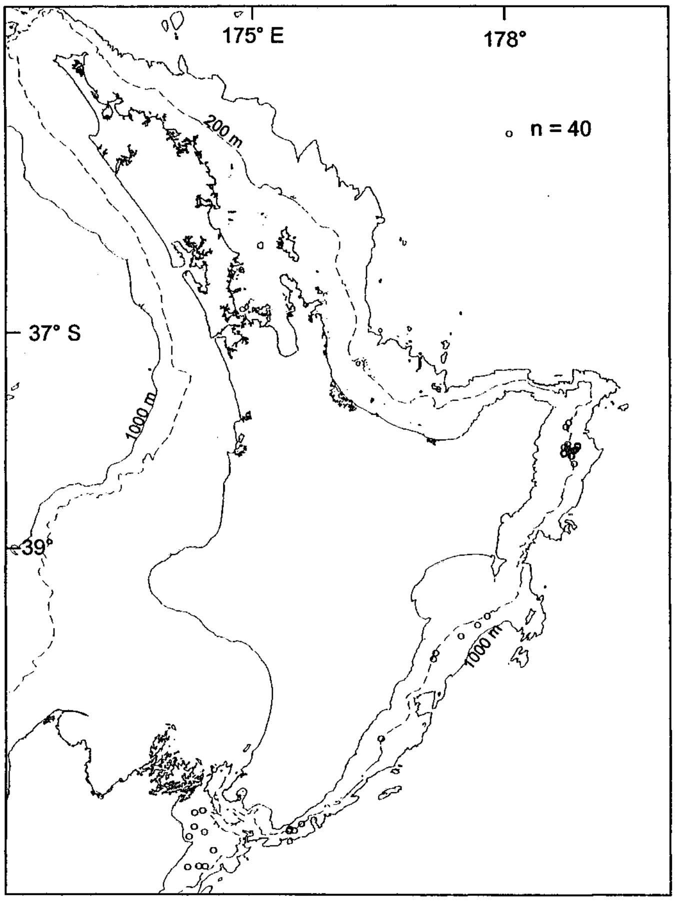


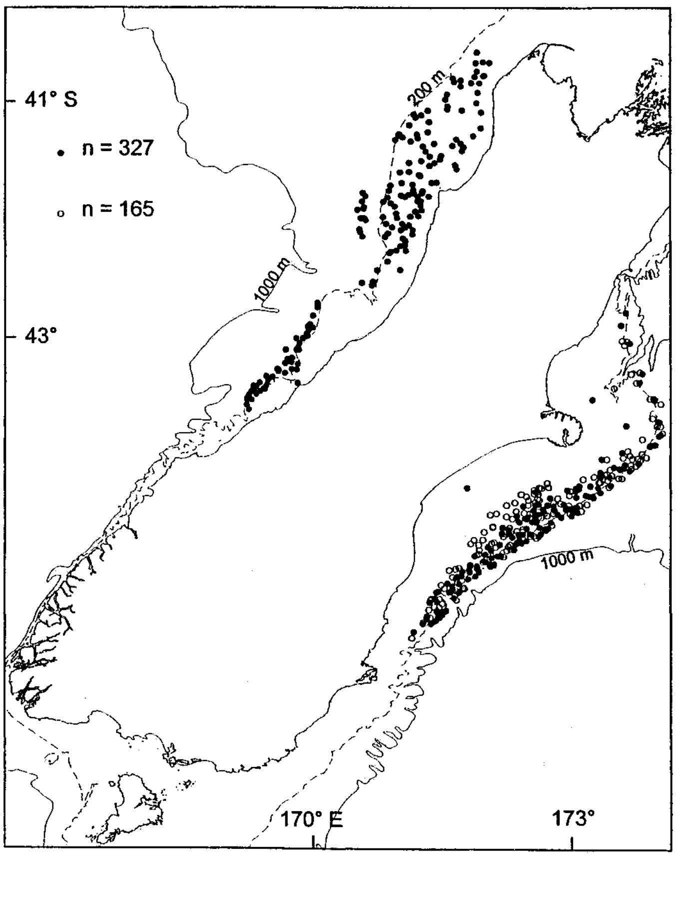
Genypterus blacodes



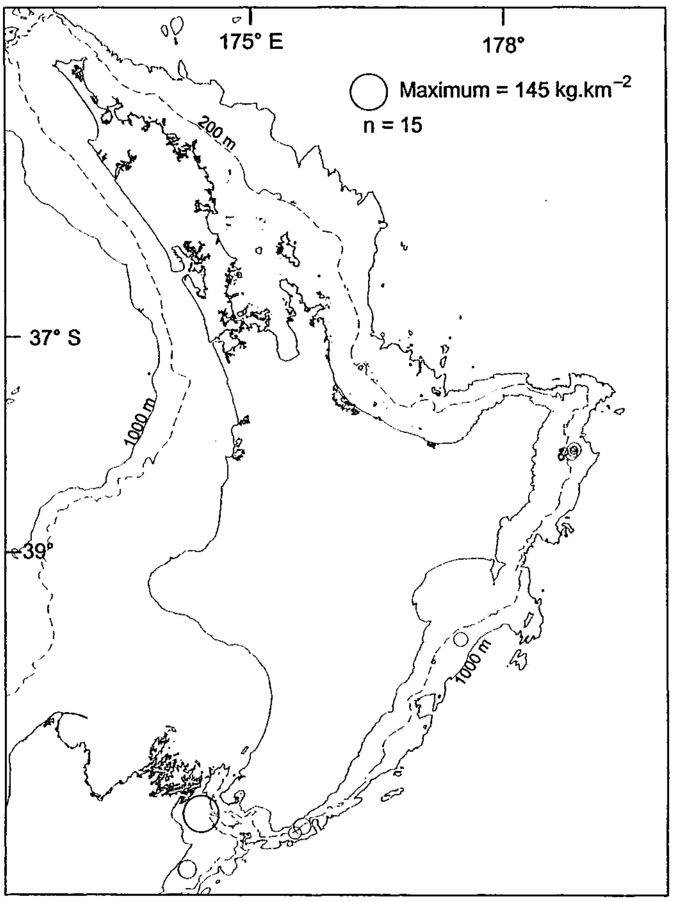


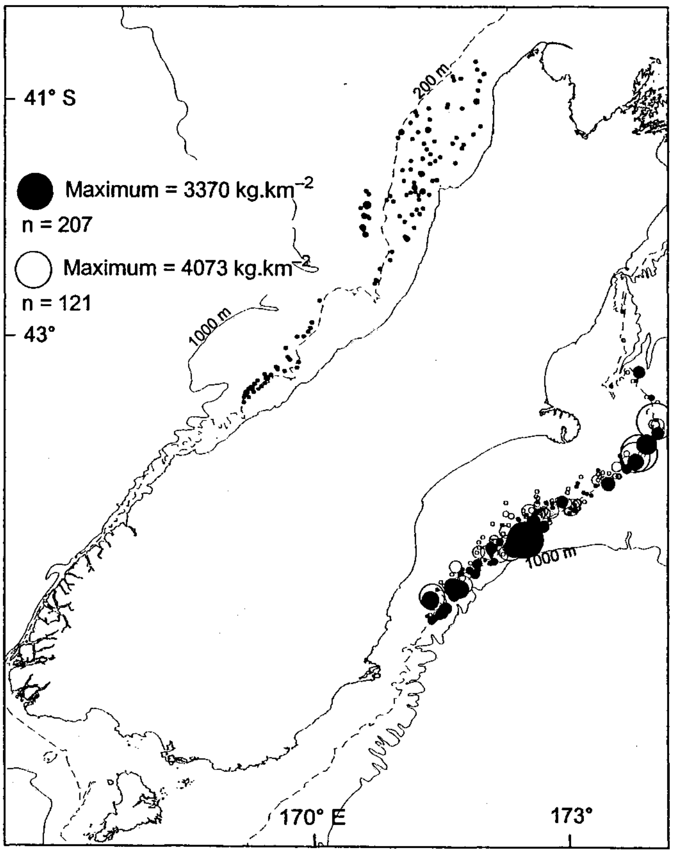
Hydrolagus novaezealandiae



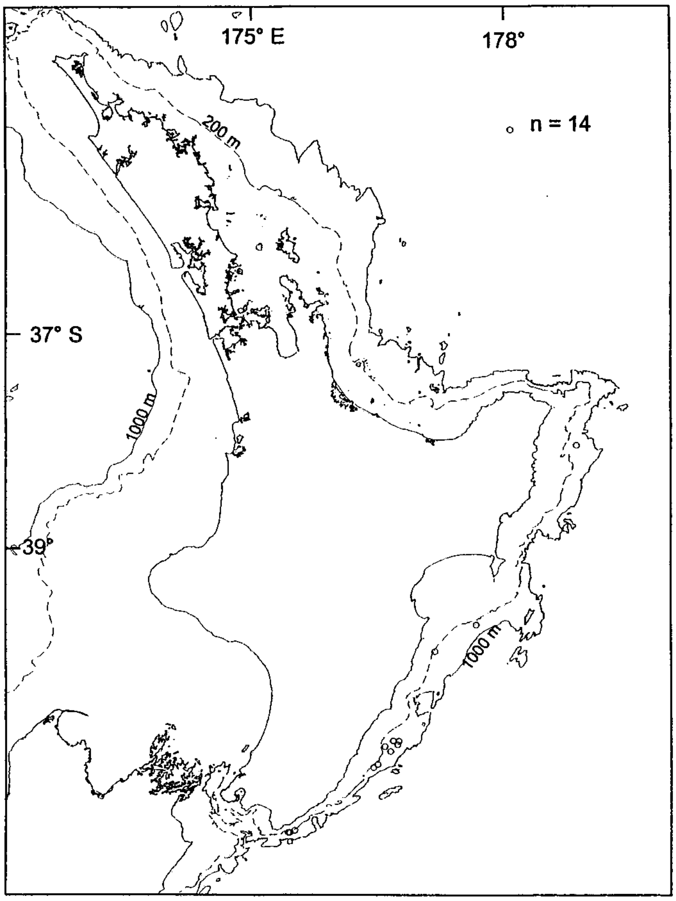


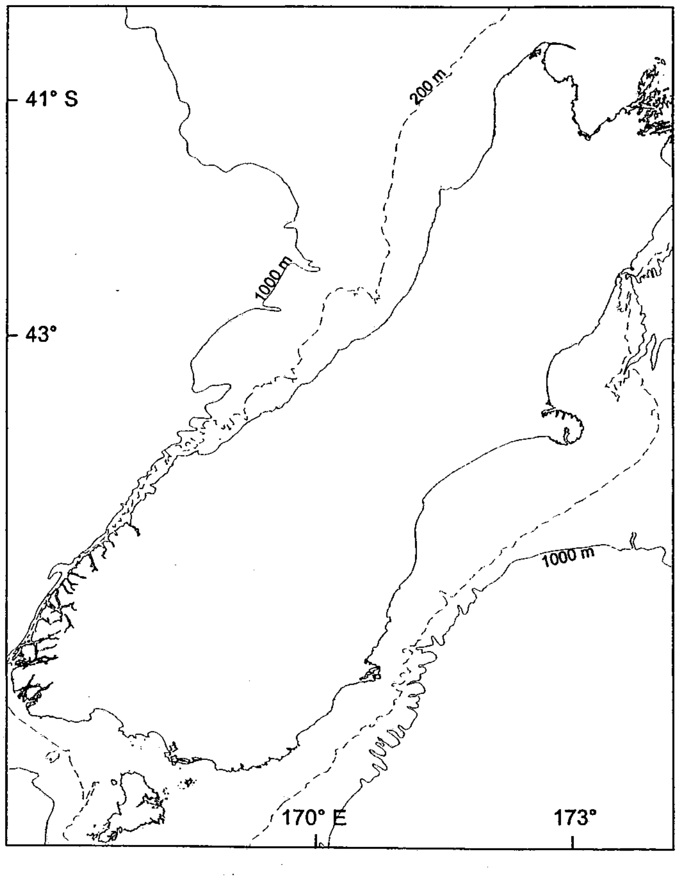
Hydrolagus novaezealandiae



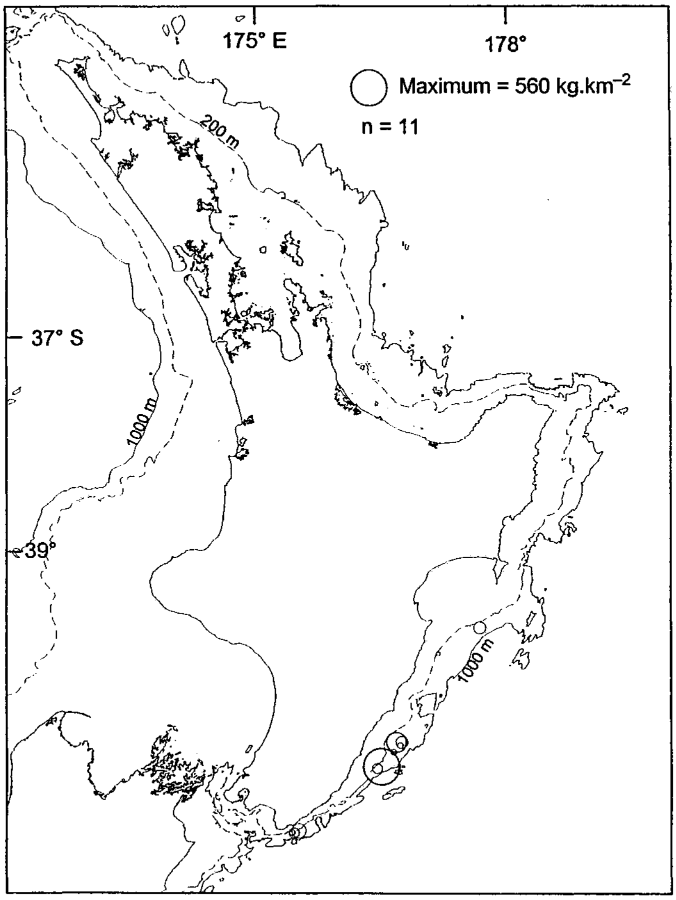


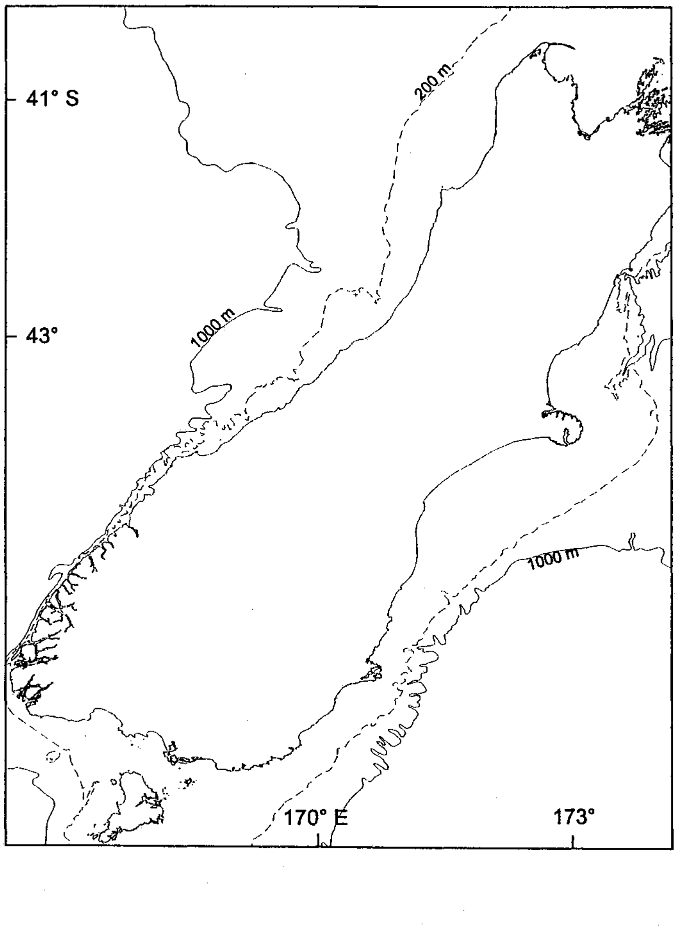
Hyperoglyphe antarctica



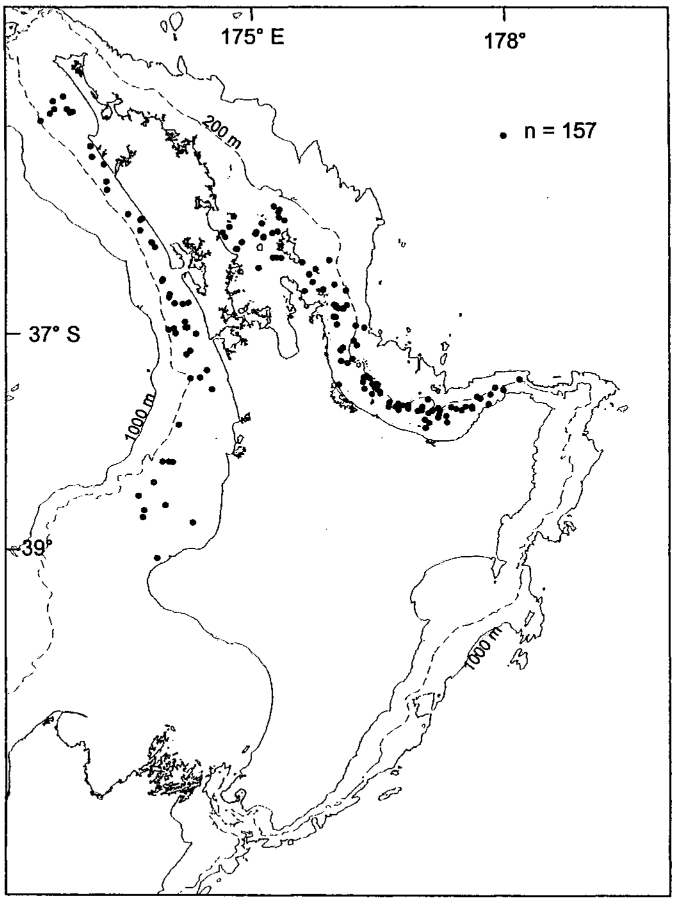


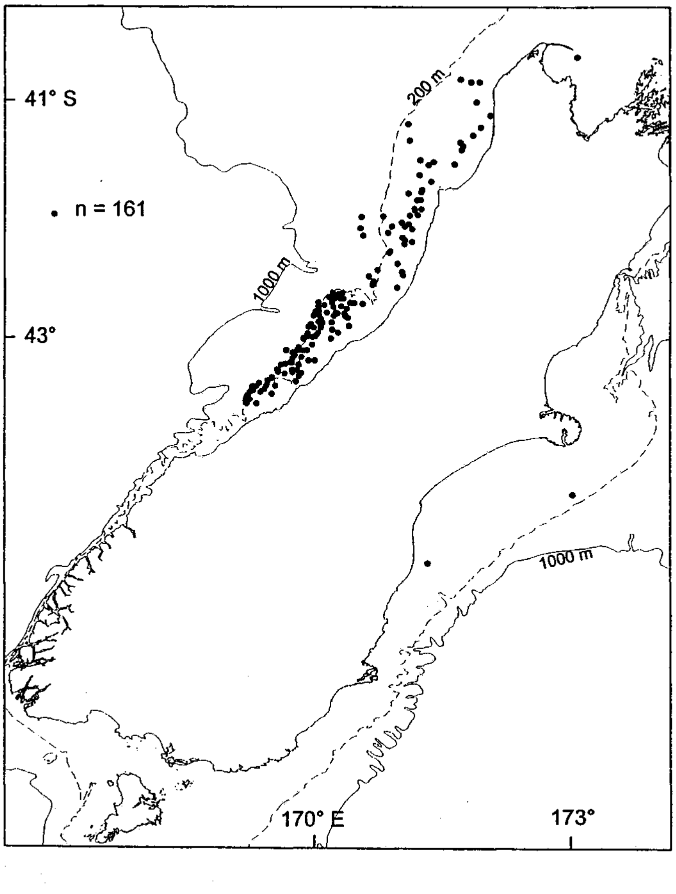
Hyperoglyphe antarctica



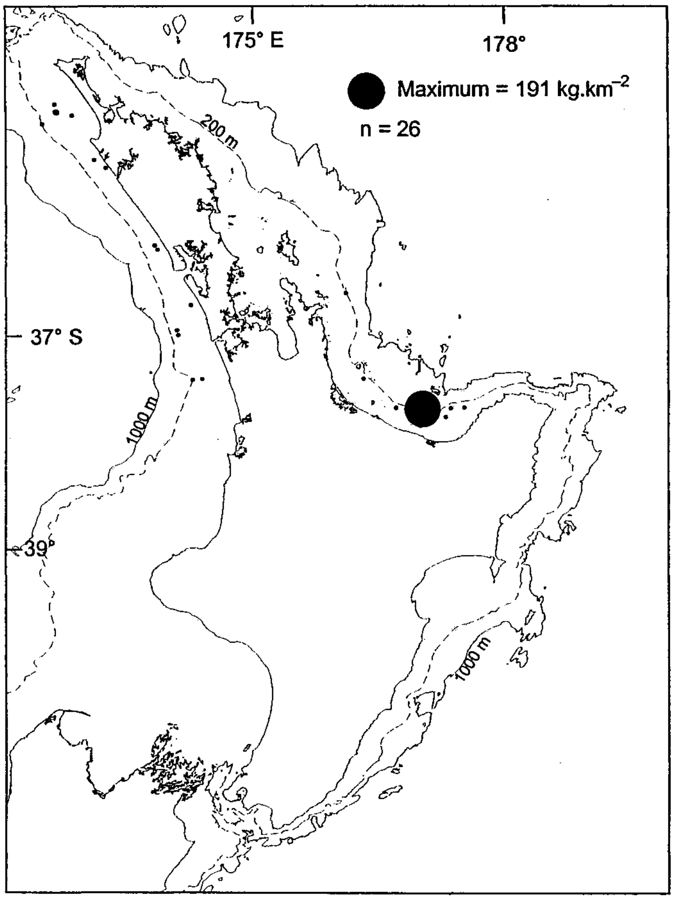


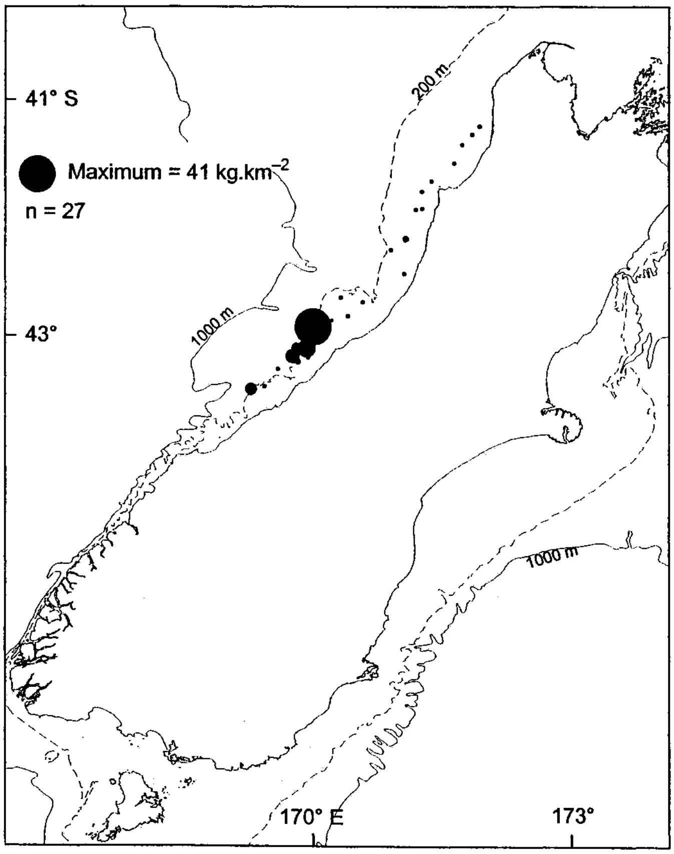
Lepidopus caudatus



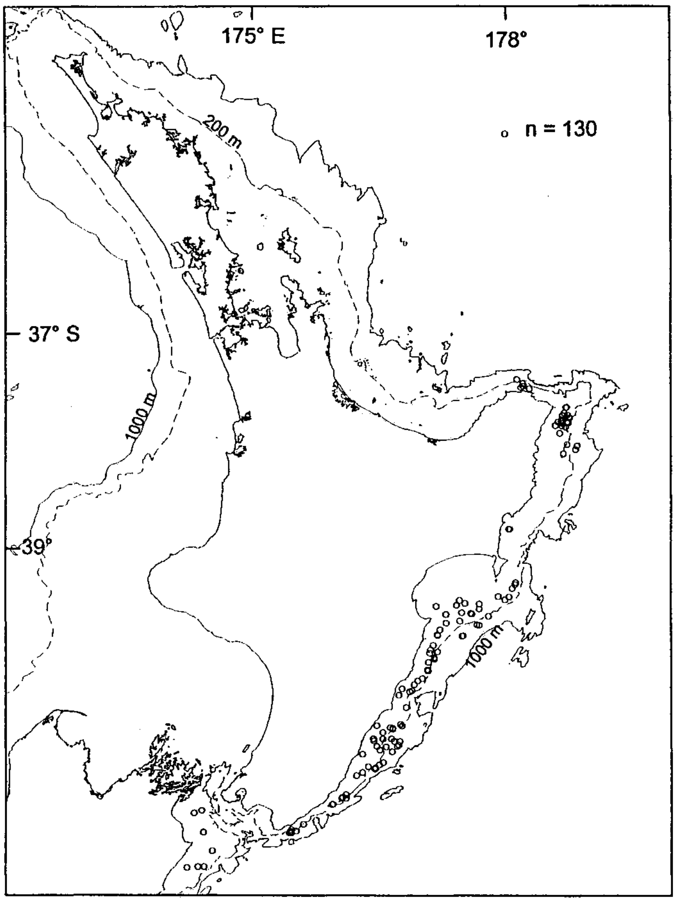


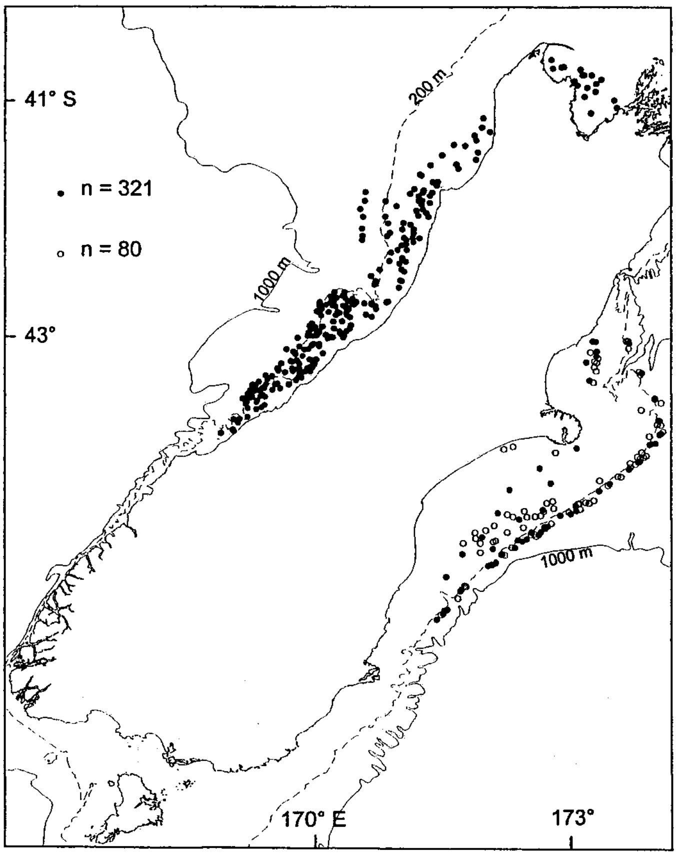
Lepidopus caudatus



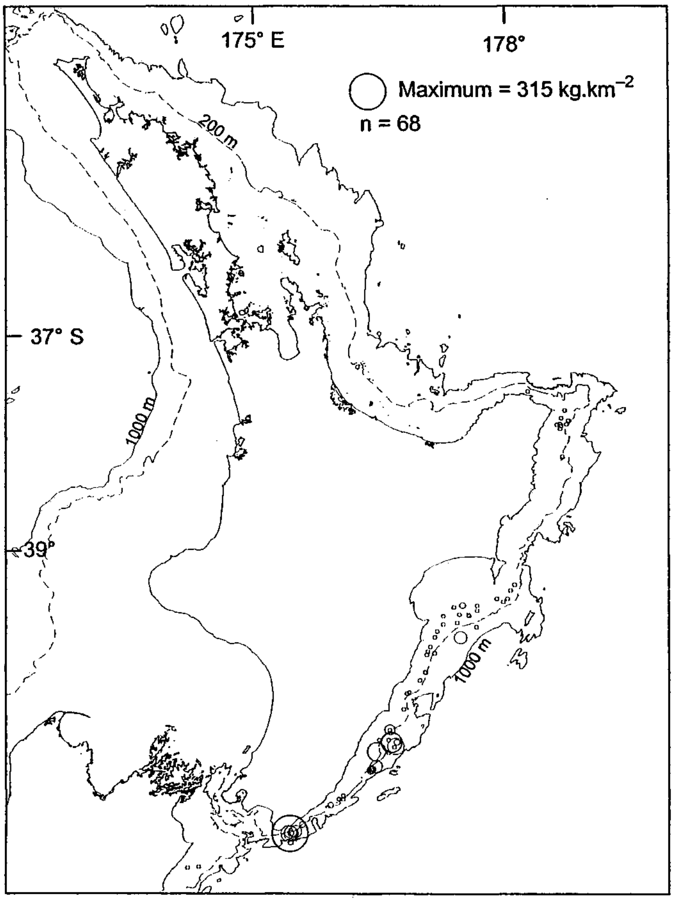


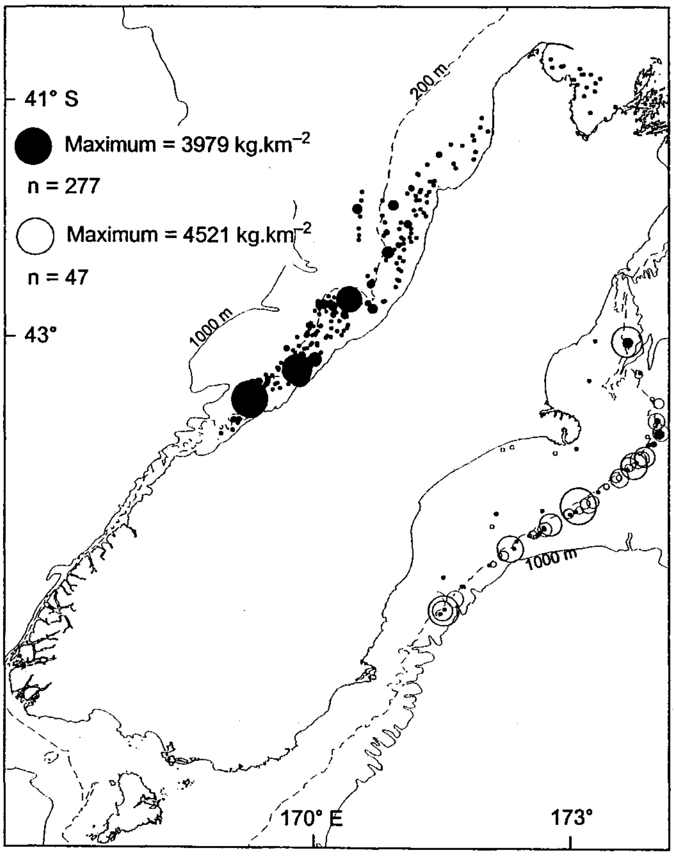
Macruronus novaezelandiae



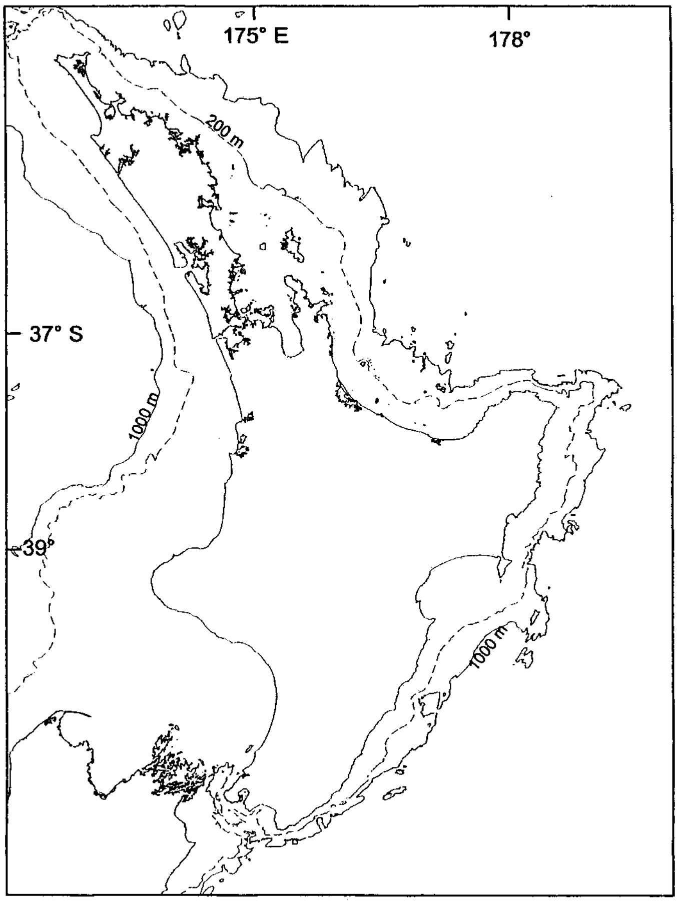


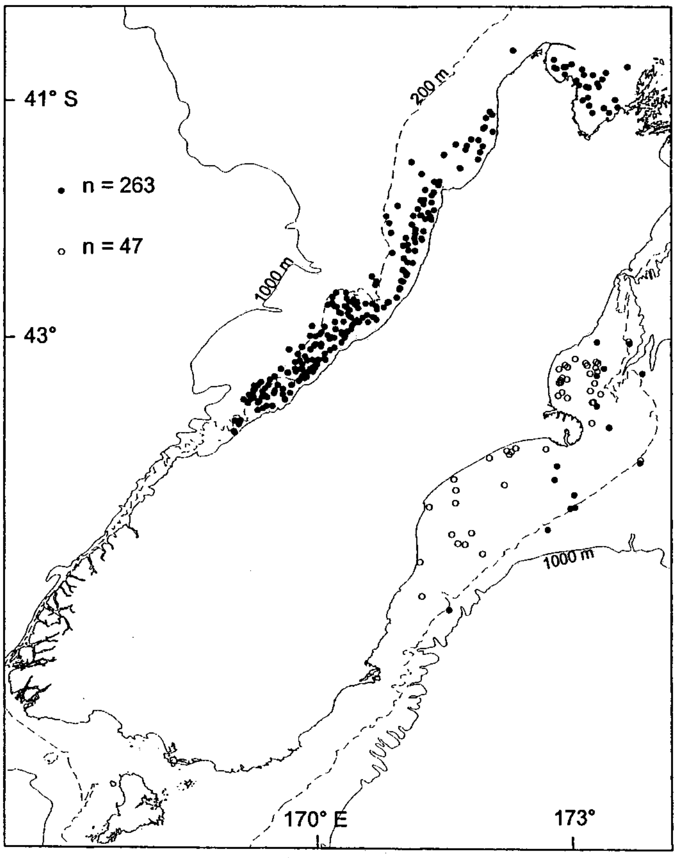
Macruronus novaezelandiae



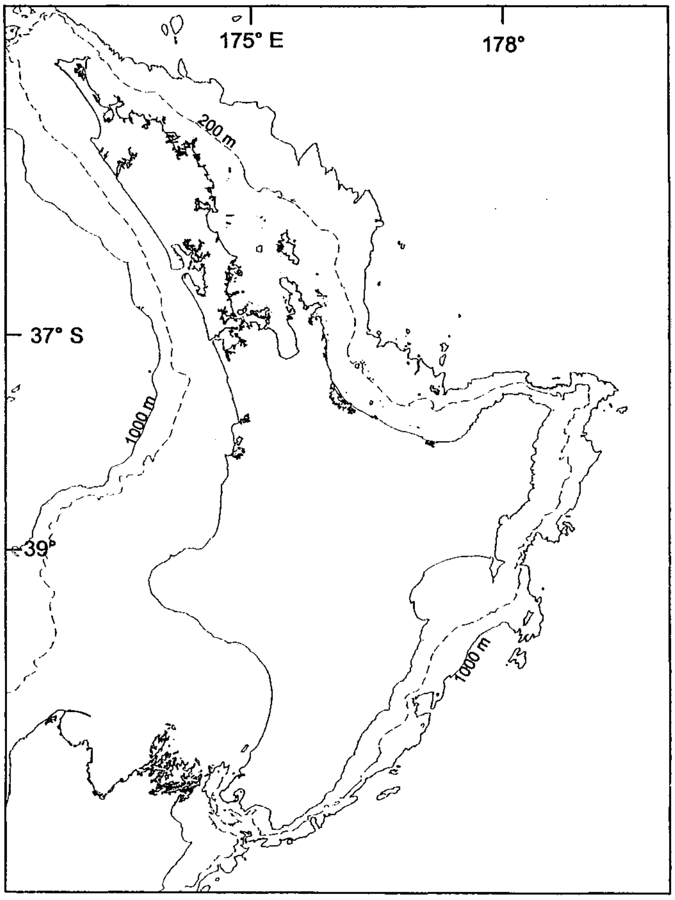


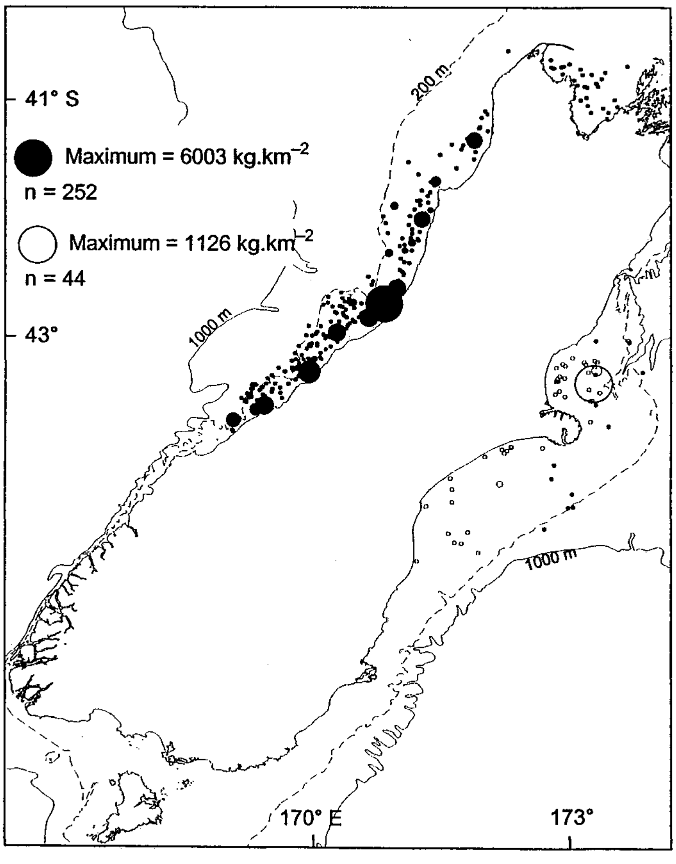
Merluccius australis



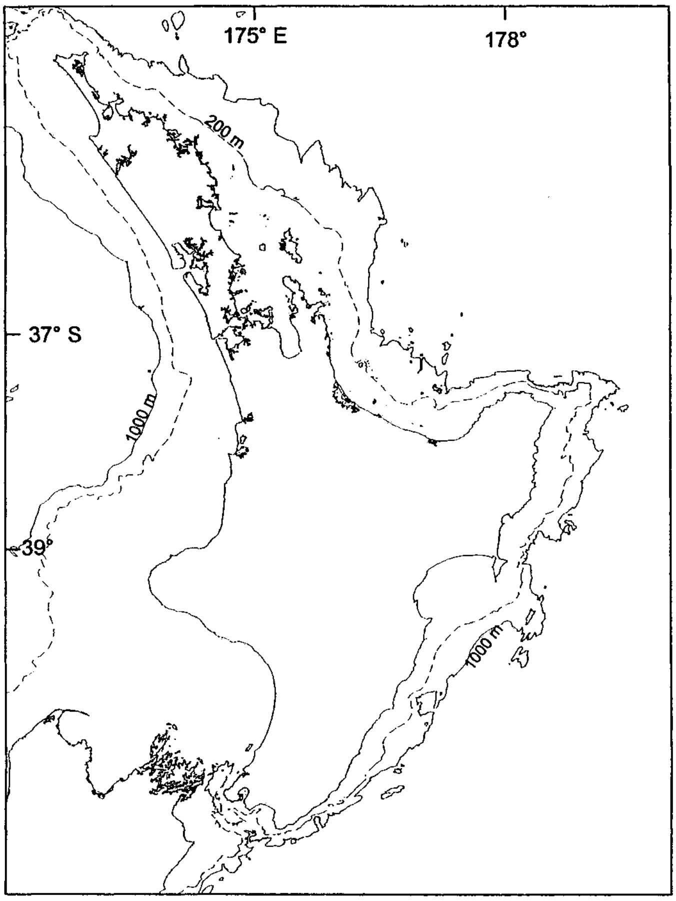


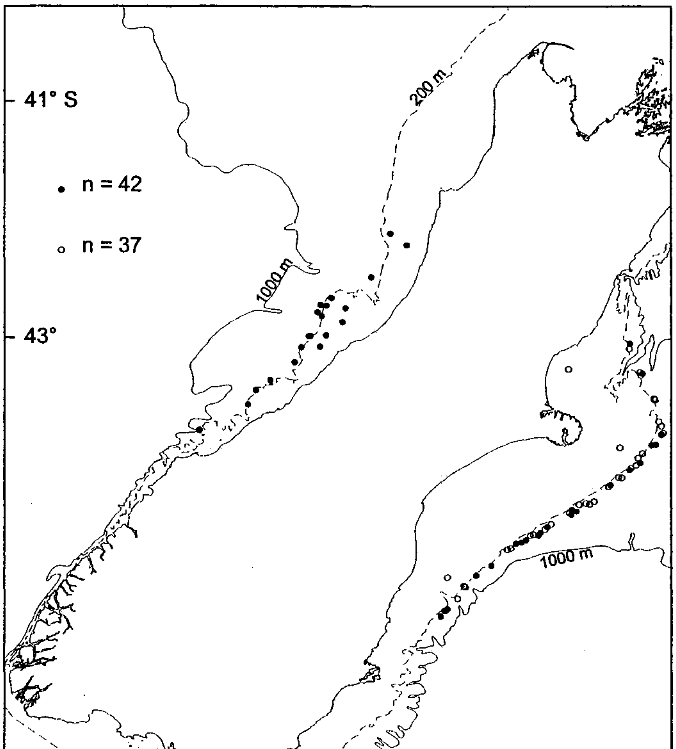
Merluccius australis



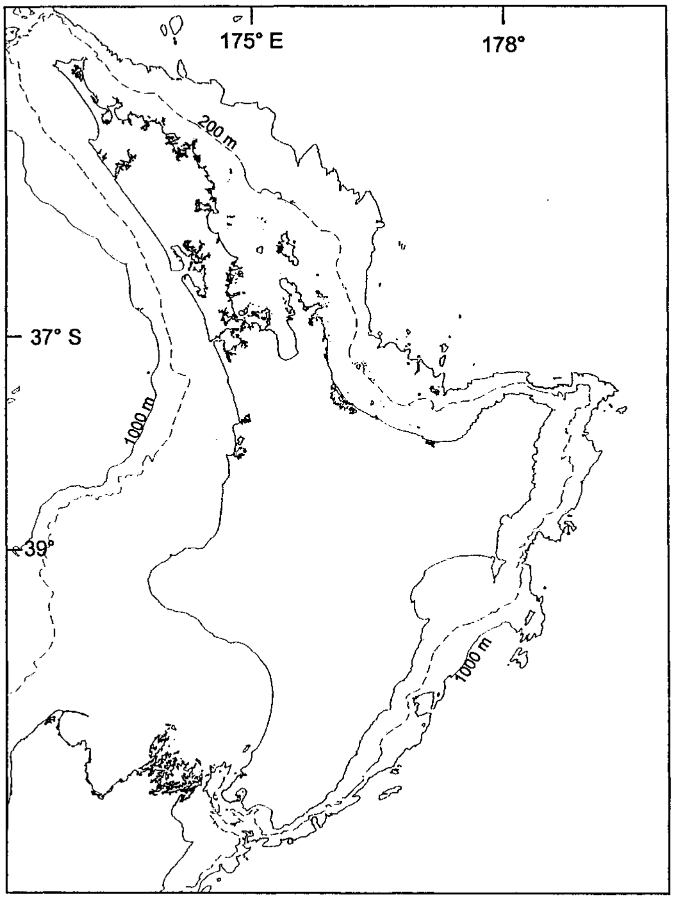


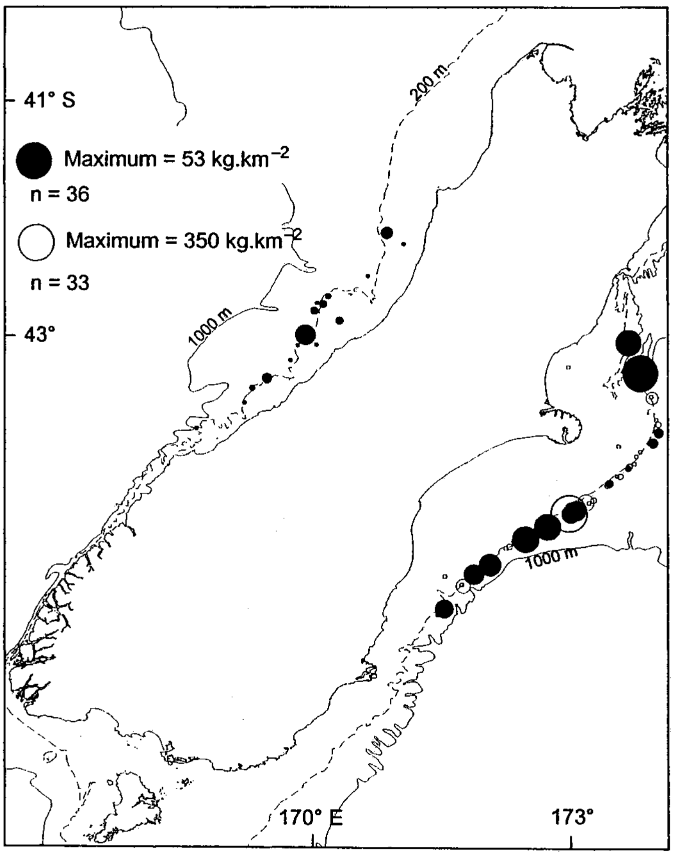
Seriolella caerulea



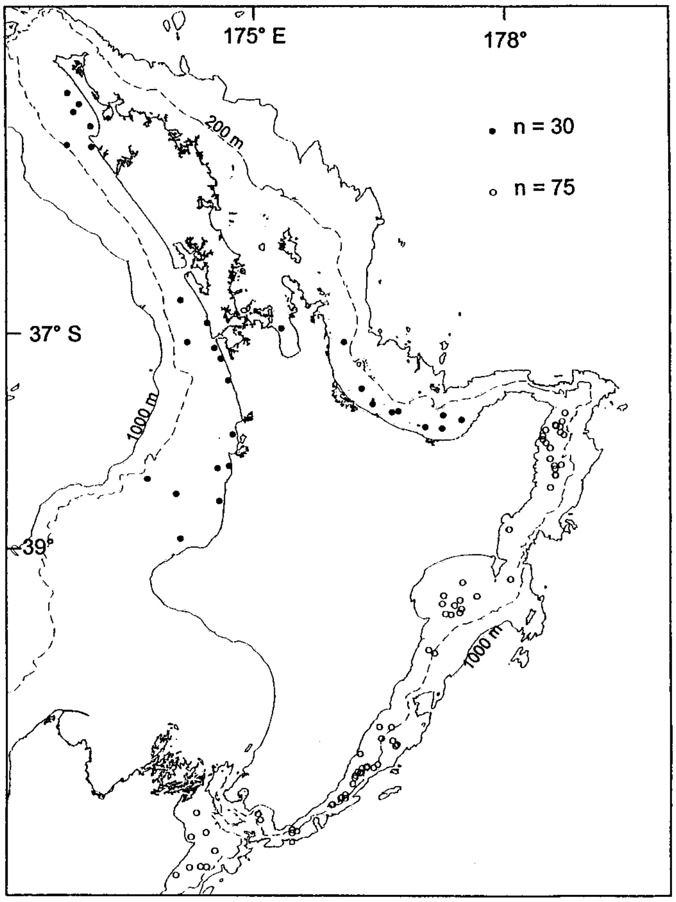


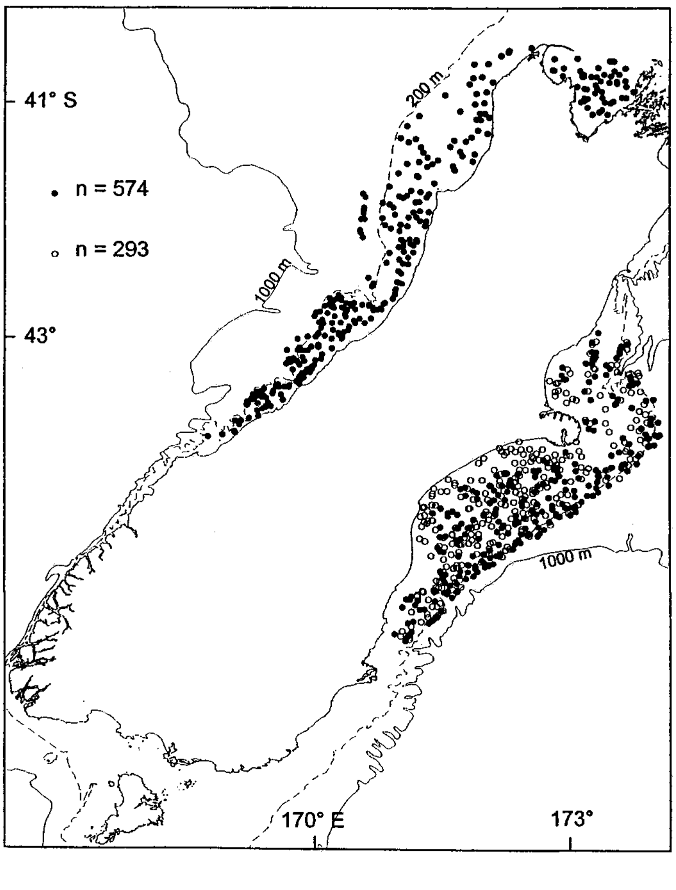
Seriolella caerulea



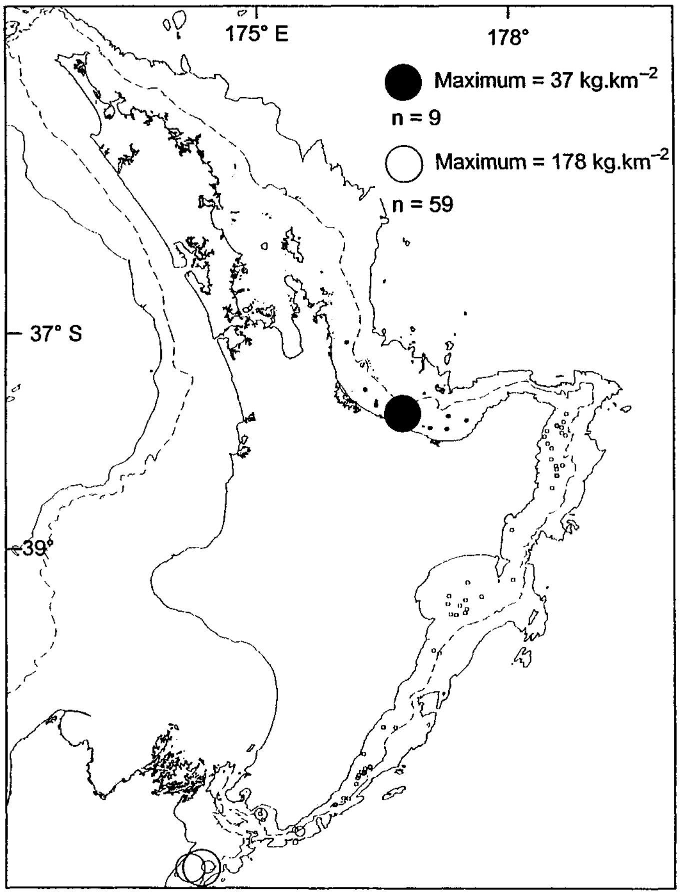


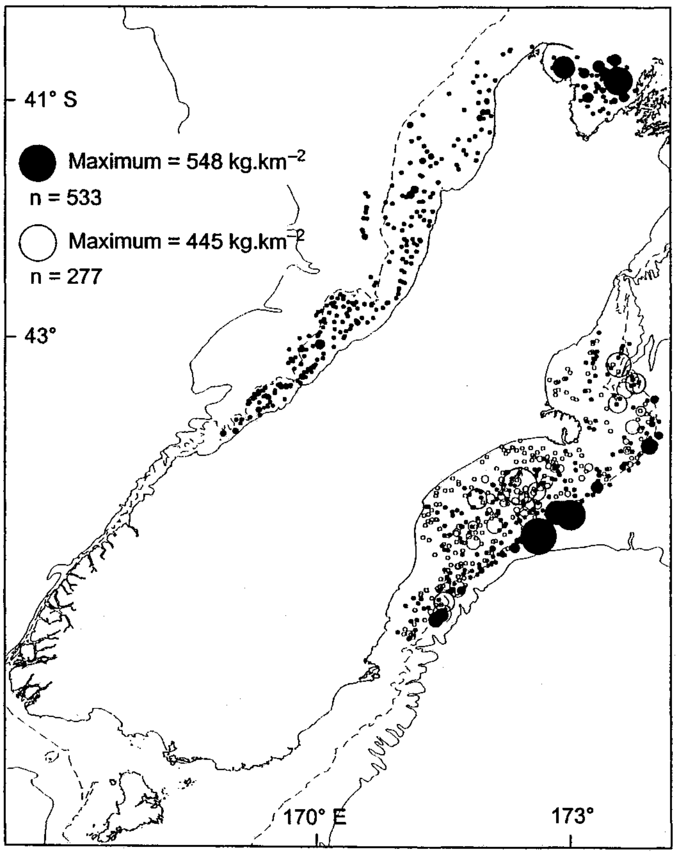
Seriolella punctata



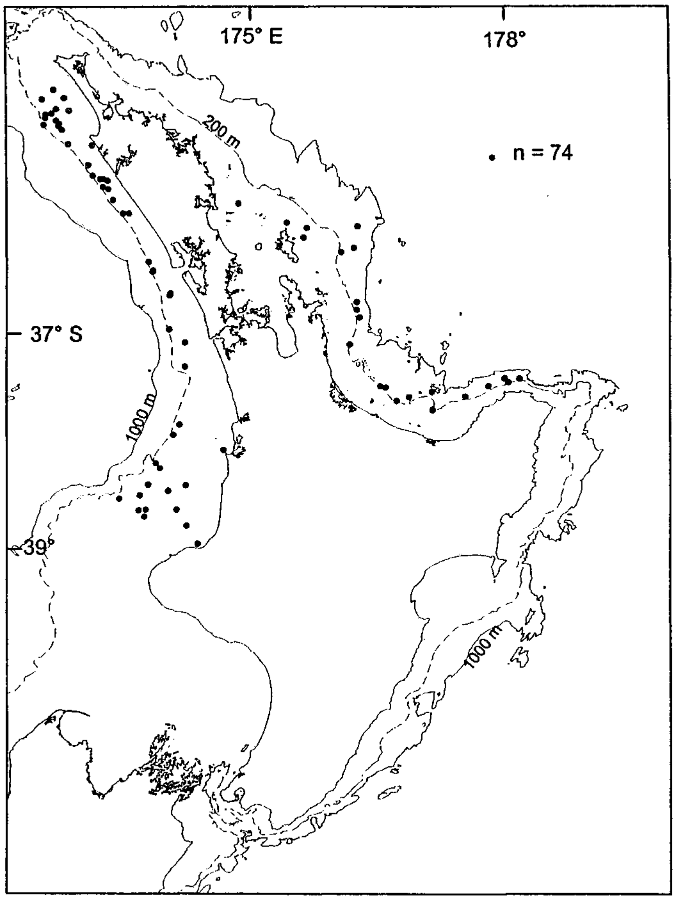


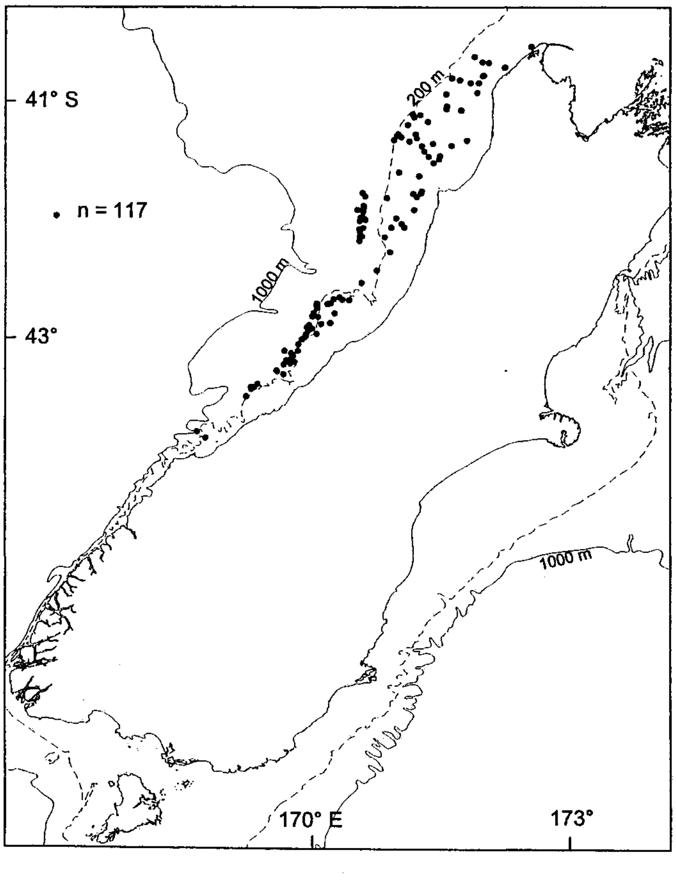
Seriollela punctata



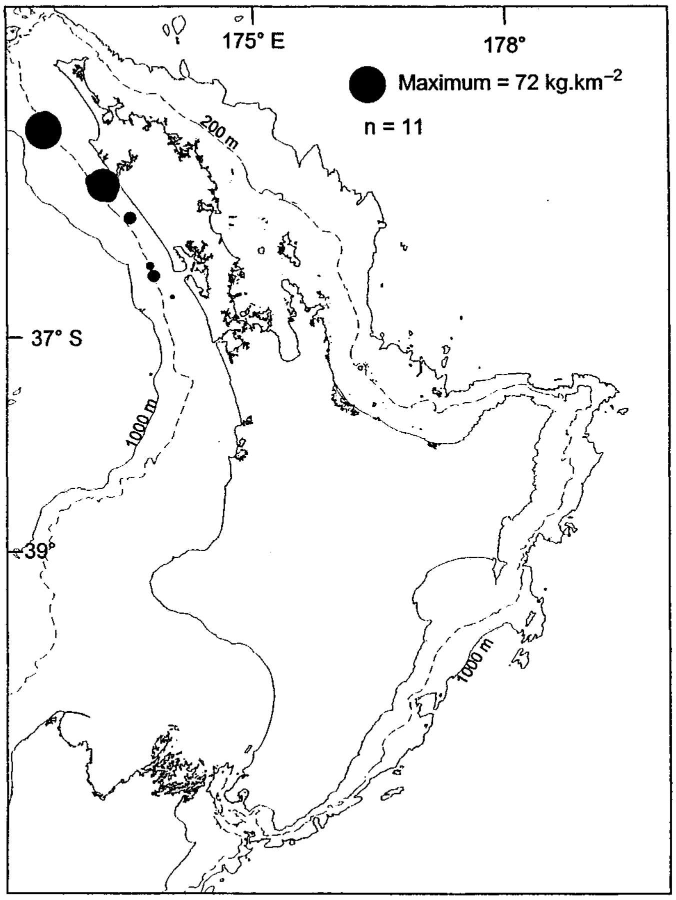


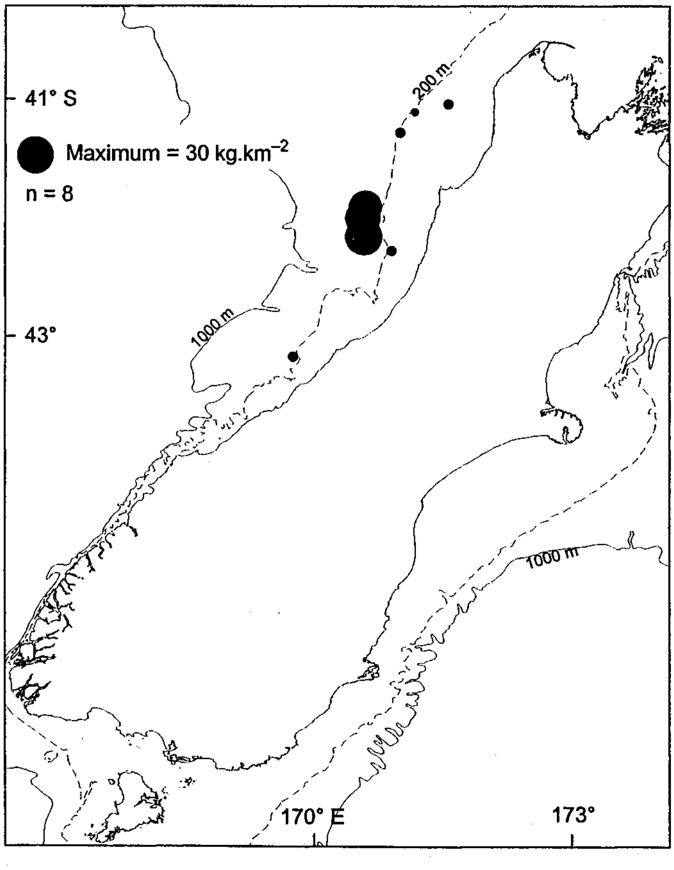
Squalus mitsukurii



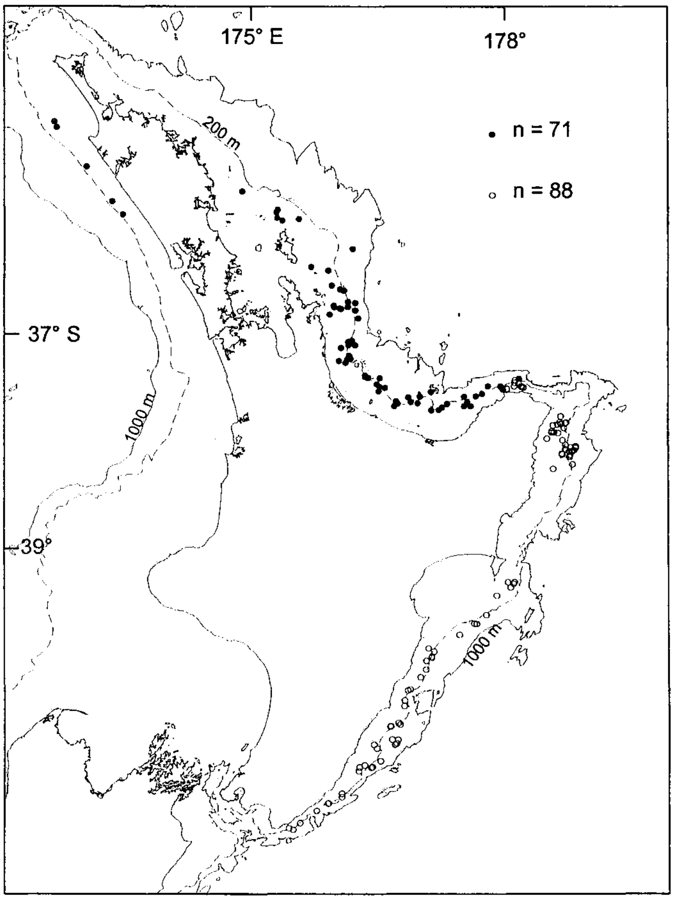


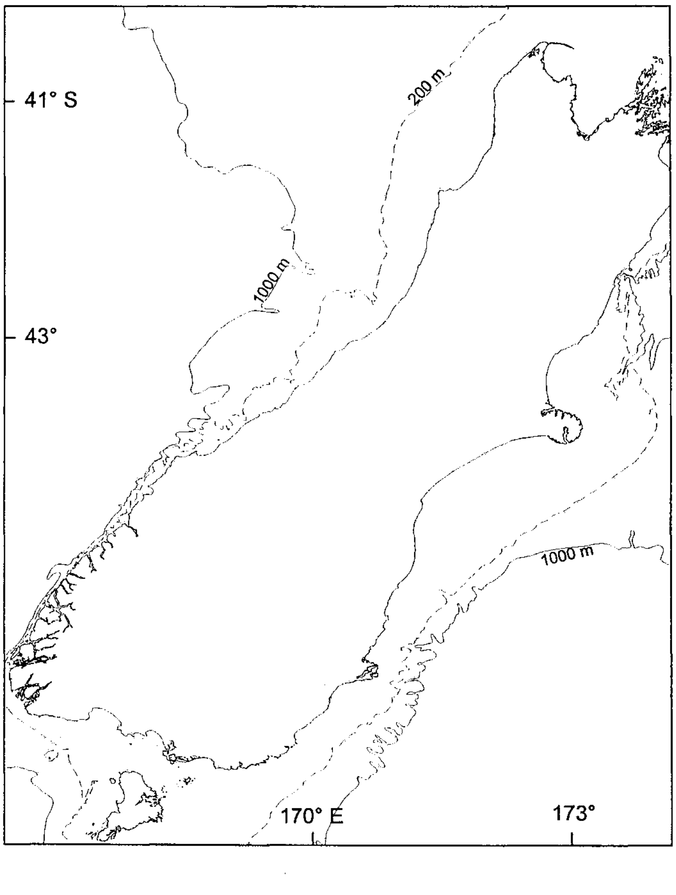
Squalus mitsukurii



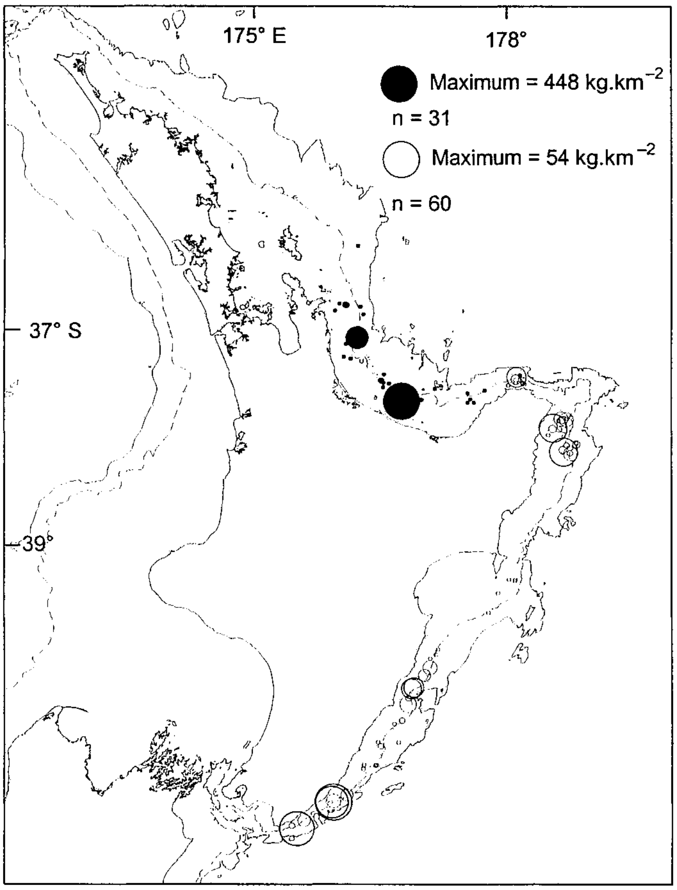


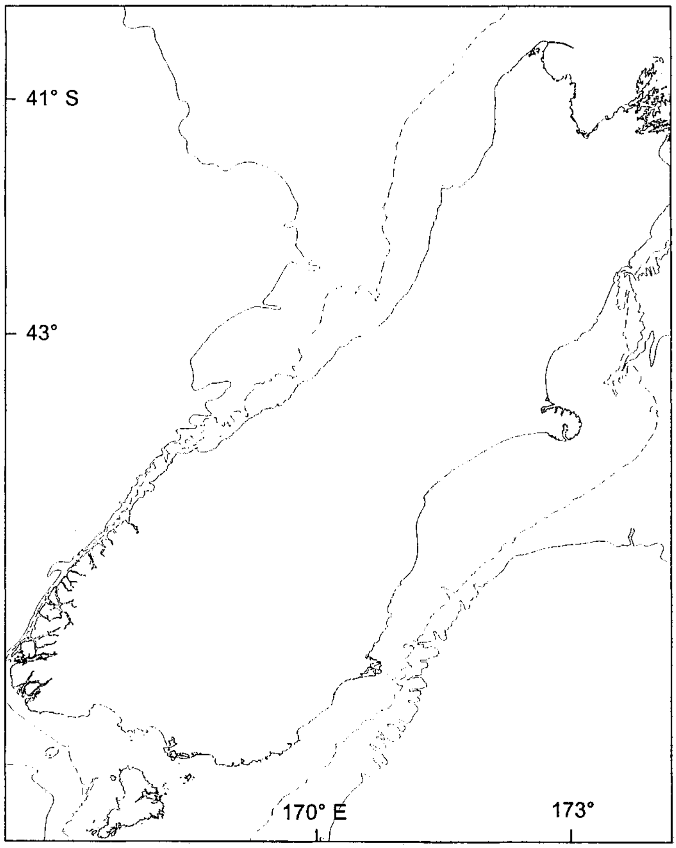
Zenopsis nebulosus





Zenopsis nebulosus





2 Deepwater fish spawning areas

Key to symbols and shading in spawning distribution plots

Left-hand pages show distribution of females in spawning condition. Symbols indicate positions where fish of each maturity stage occurred.

N, number of stations with females at this stage

Solid circles, research stations

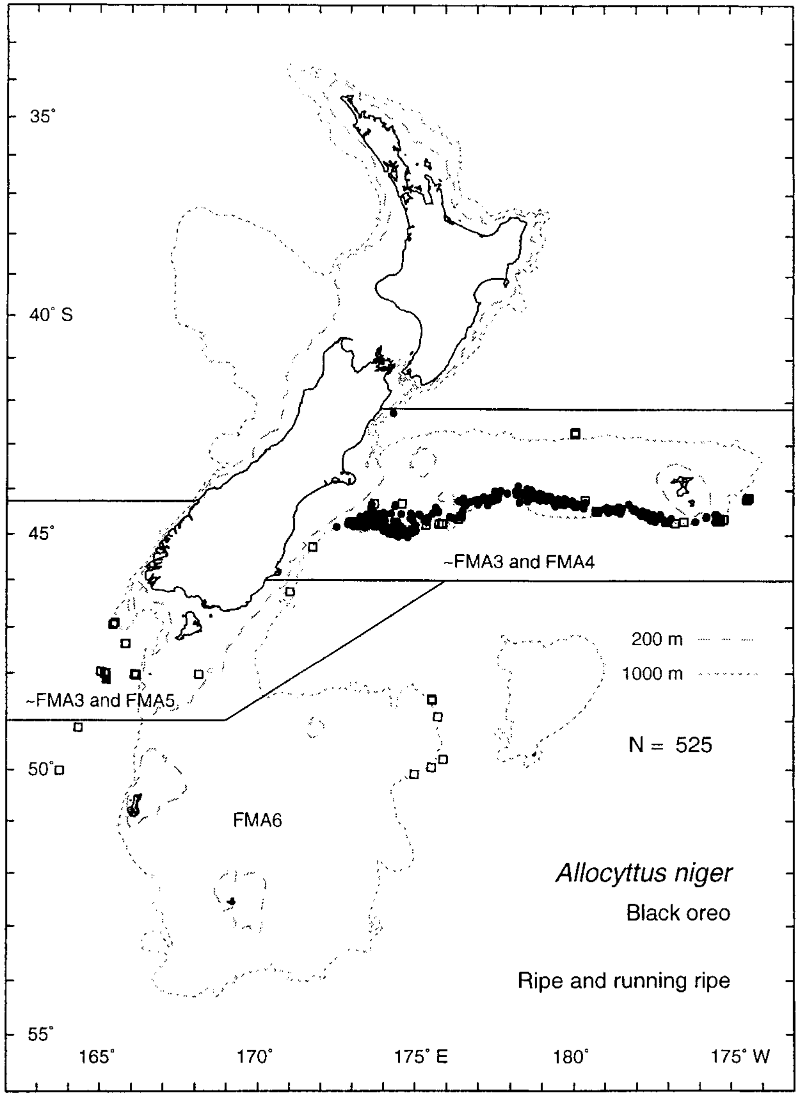
Open squares, scientific observer stations

Grey shading in spent plots shows all positions where gonad stage information has been recorded in research or commercial trawls.

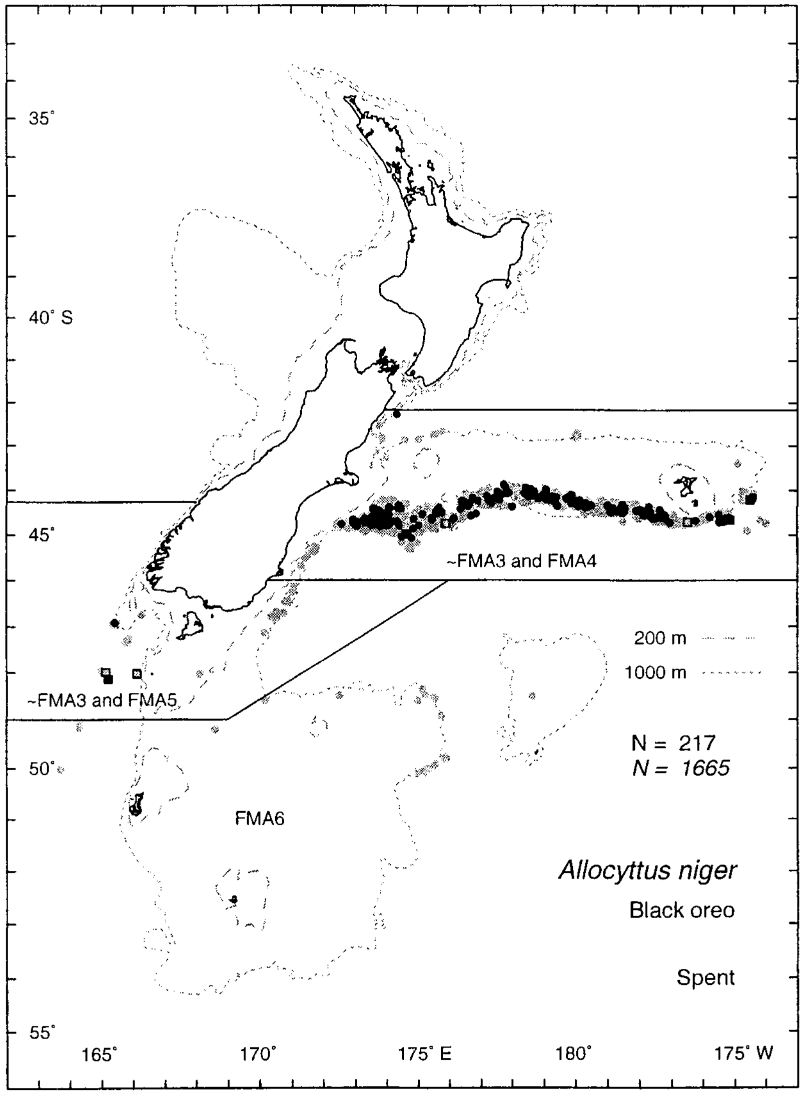
N, total number of stations

FMA, Fisheries Management Area
~, indicates FMA boundaries are approximated

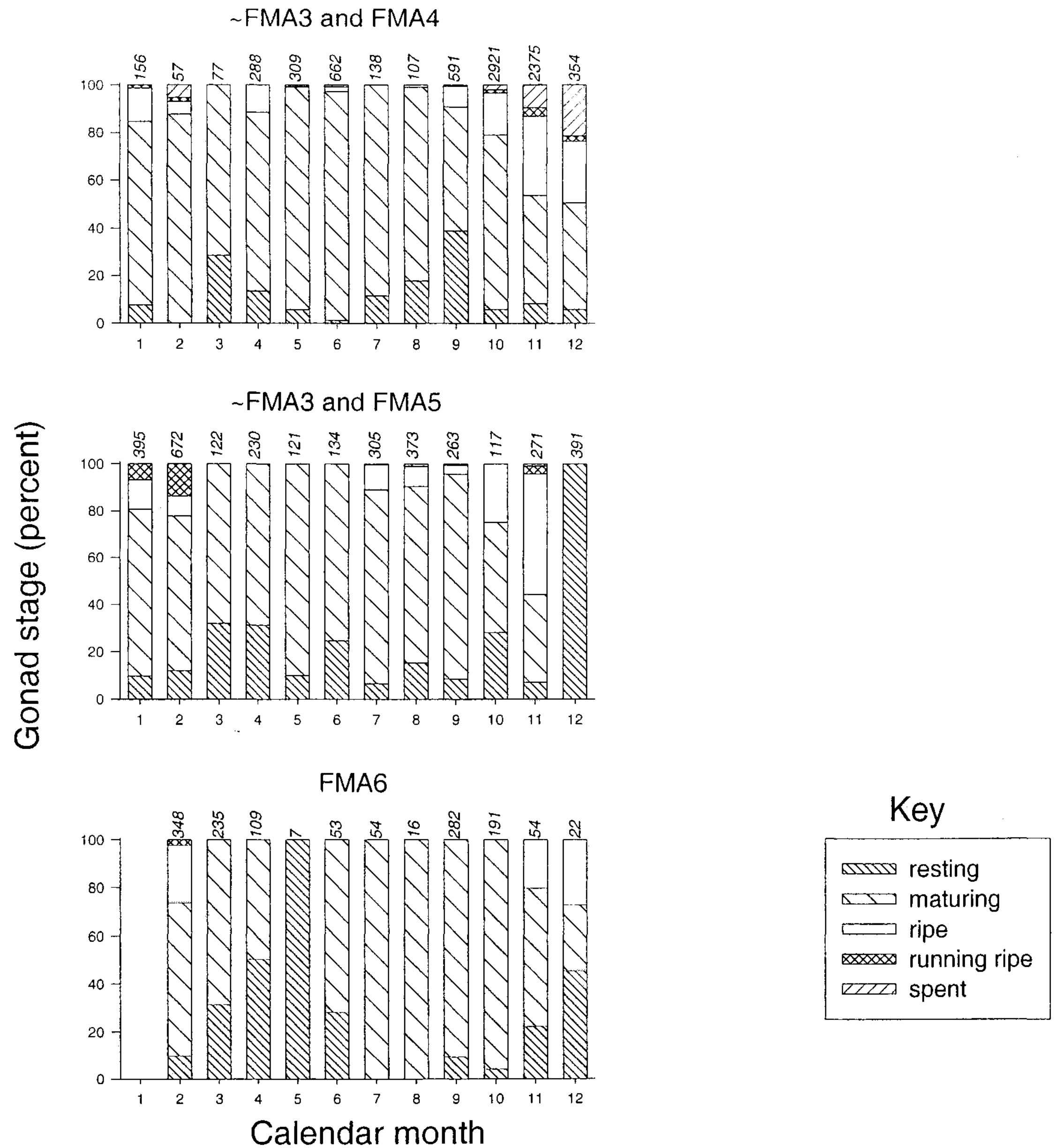
Right-hand pages show female gonad stages by area and month.



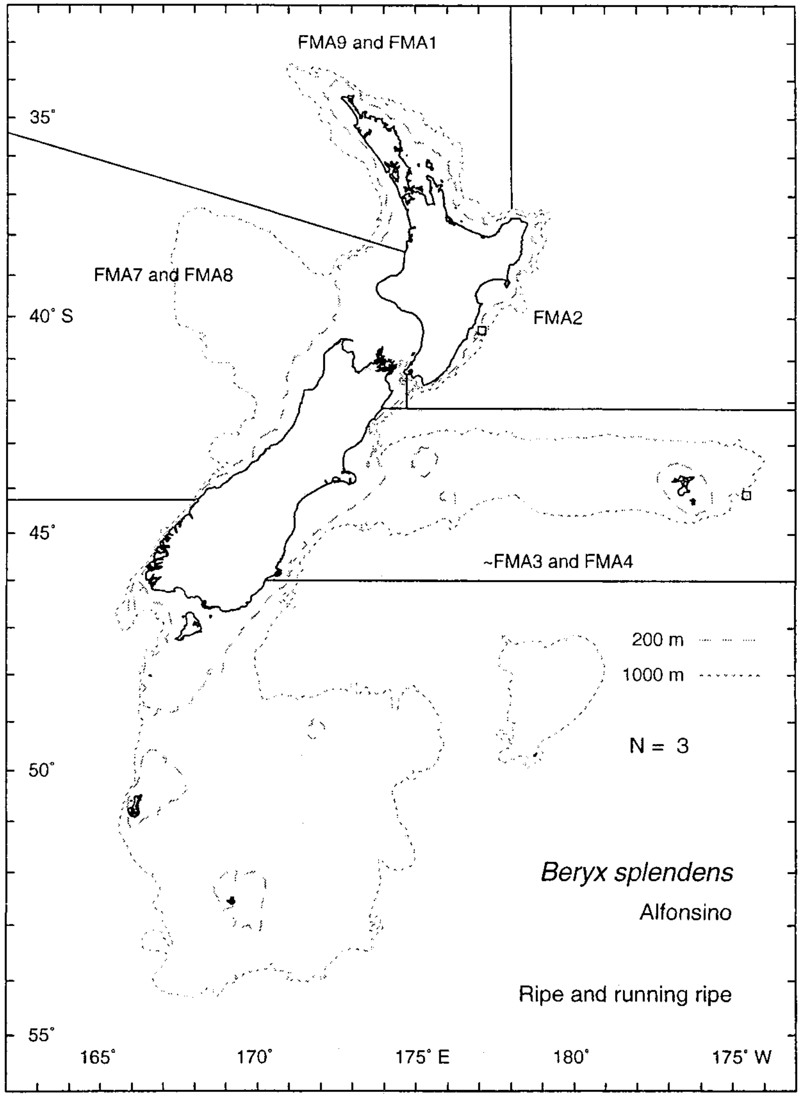
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
~FMA3 and FMA4
~FMA3 and FMA5
FMA6
200 m
1000 m
N = 525
Allocyttus niger
Black oreo
Ripe and running ripe

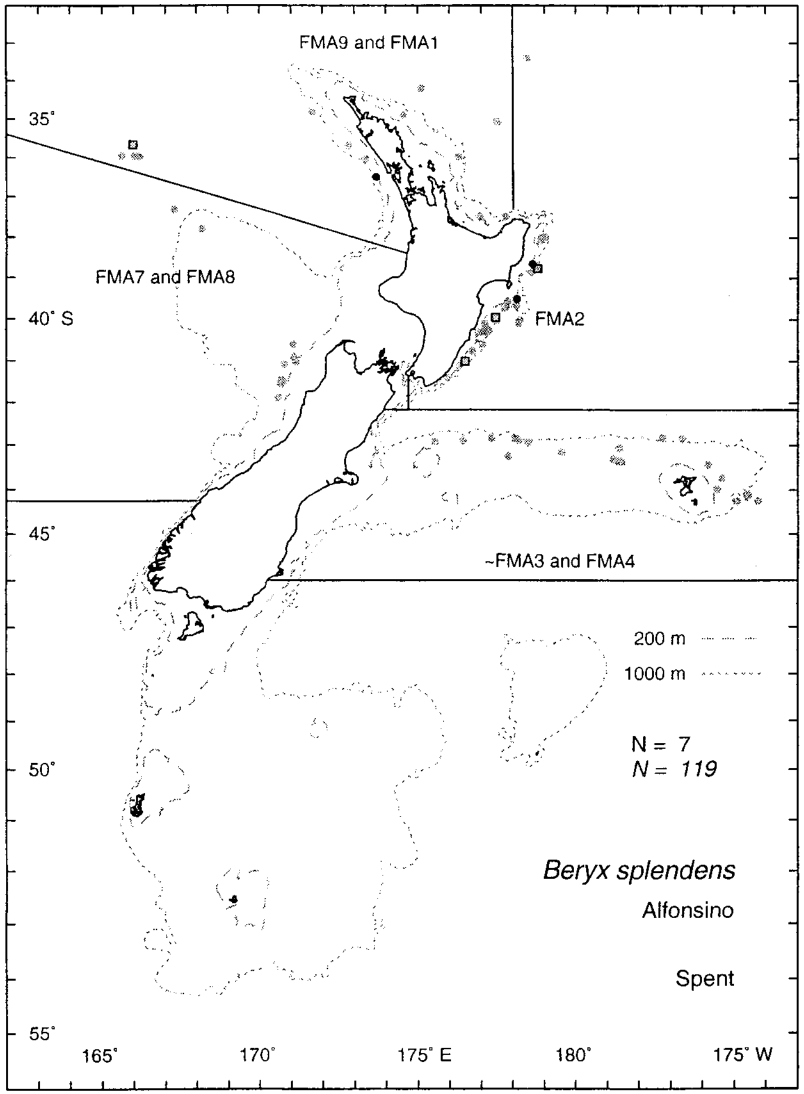


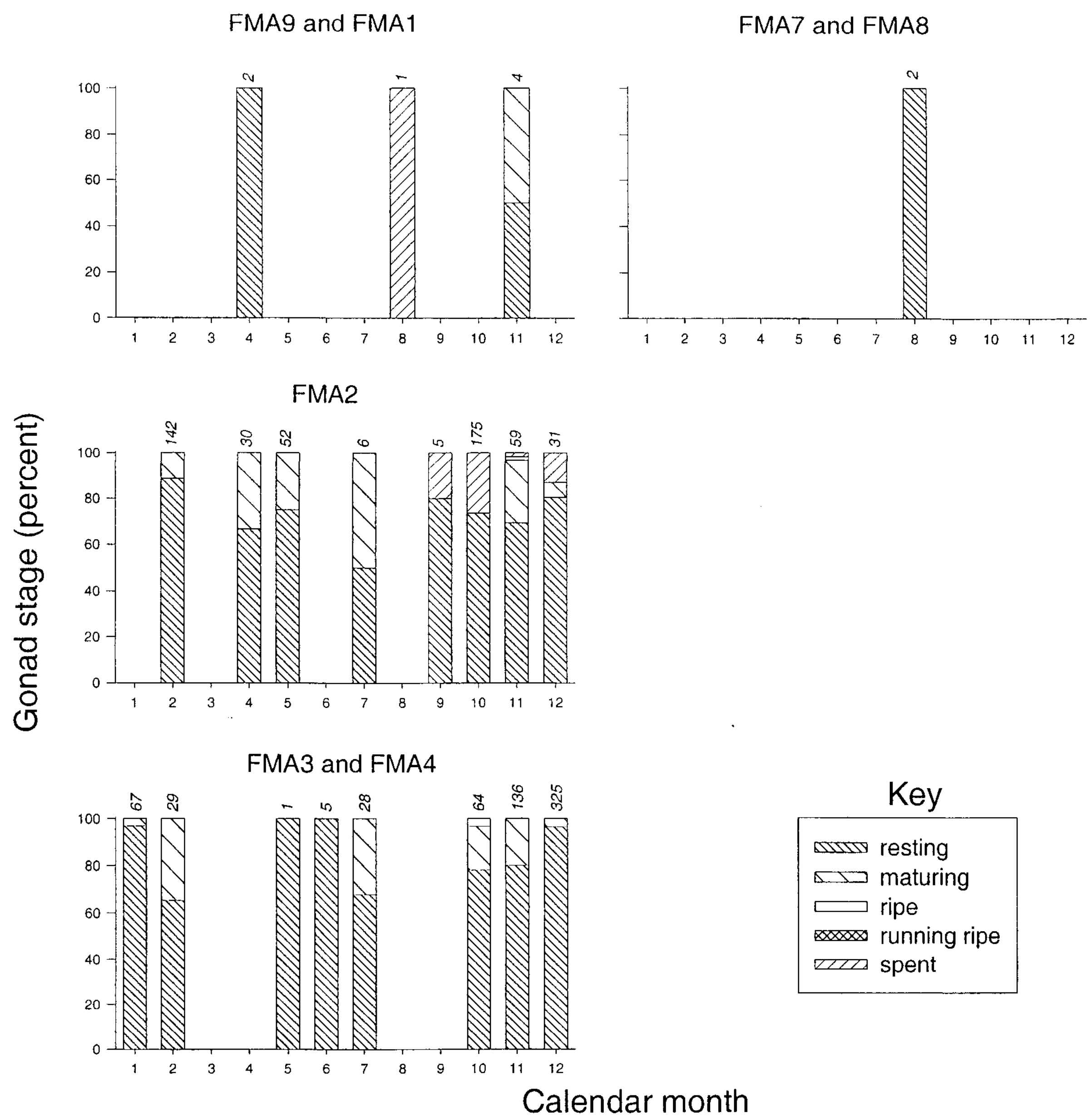
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
~FMA3 and FMA4
~FMA3 and FMA5
FMA6
200 m
1000 m
N = 217
N = 1665
Allocyttus niger
Black oreo
Spent



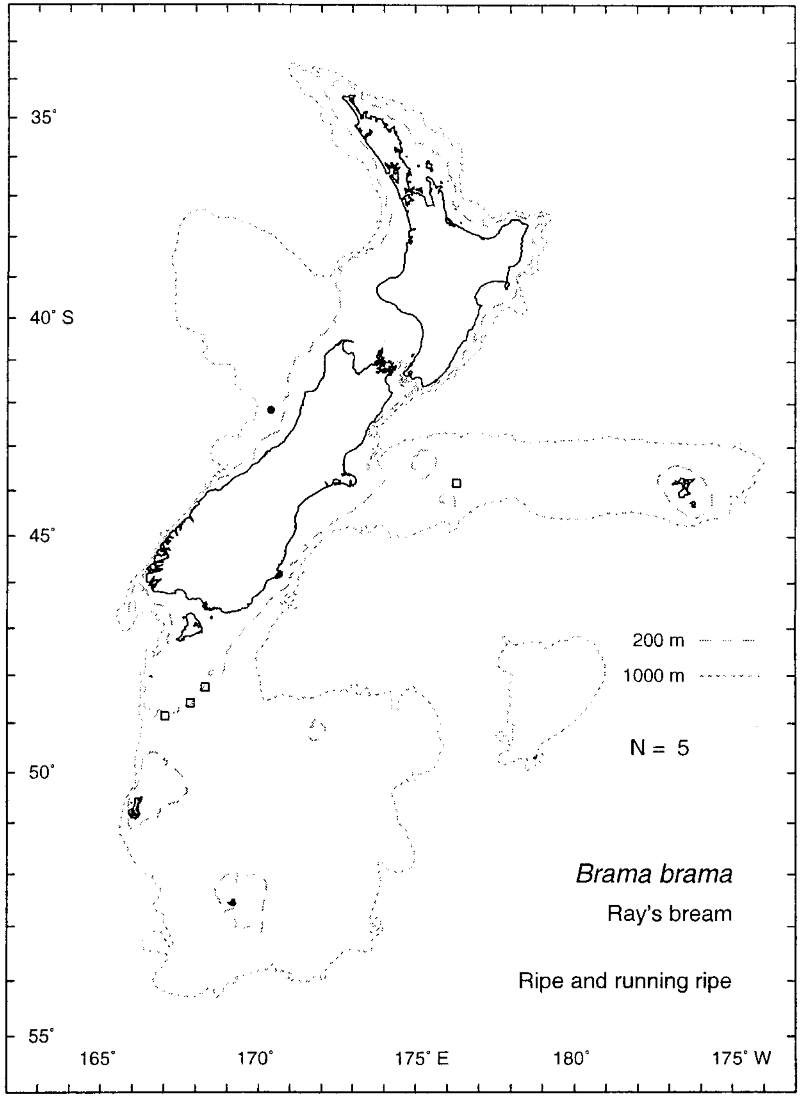
Black oreo female gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized female fish staged per month.

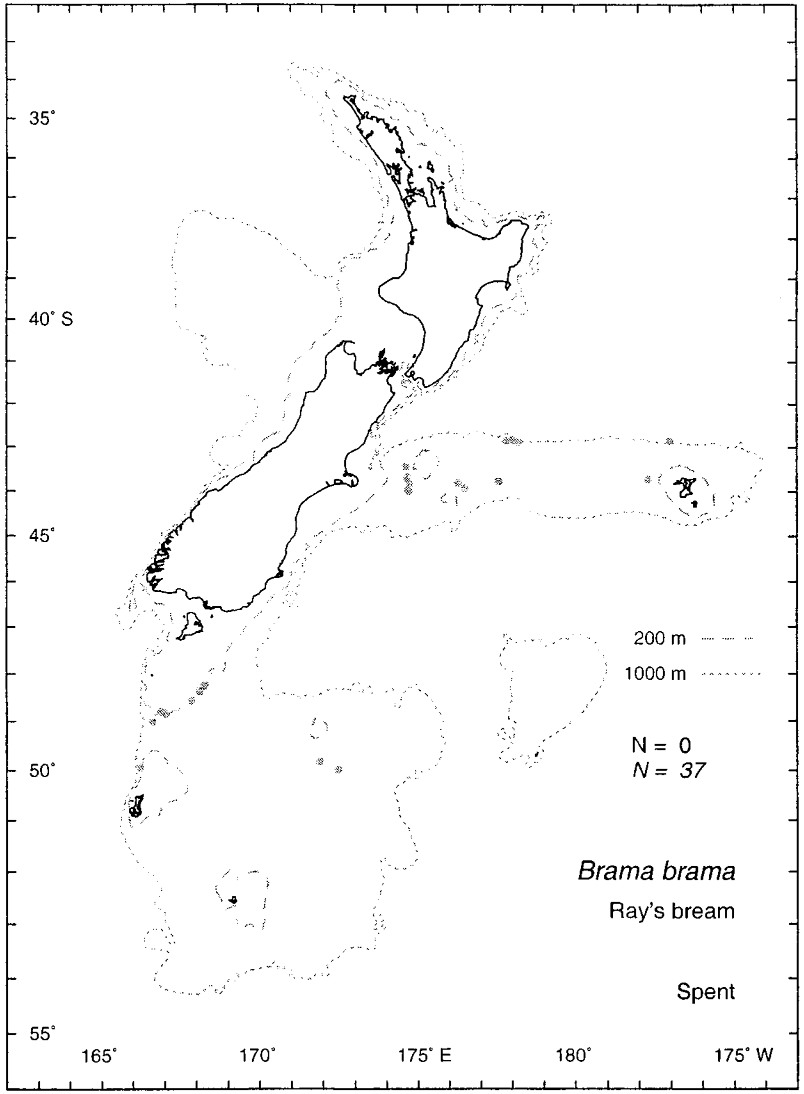

FMA9 and FMA1
35°
FMA7 and FMA8
40° S
FMA2
45°
~FMA3 and FMA4
200 m
1000 m
N = 3
50°
Beryx splendens
Alfonsino
Ripe and running ripe
55°
165°
170°
175° E
180°
175° W

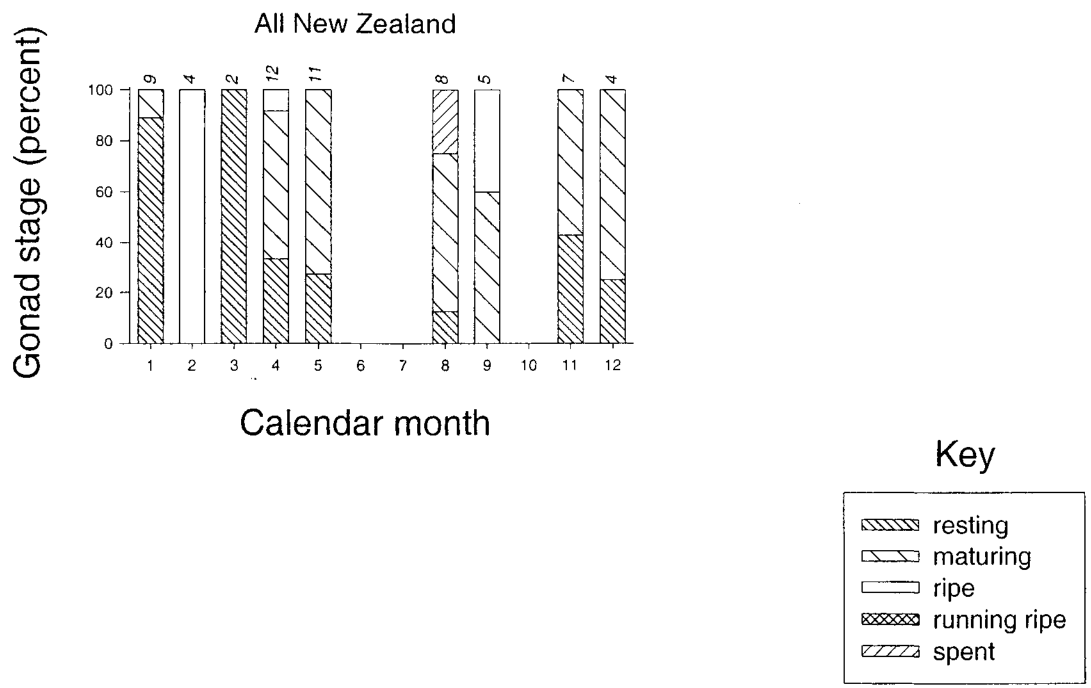

FMA9 and FMA1
35°
FMA7 and FMA8
40° S
FMA2
45°
~FMA3 and FMA4
200 m
1000 m
N = 7
N = 119
50°
Beryx splendens
Alfonsino
Spent
55°
165°
170°
175° E
180°
175° W



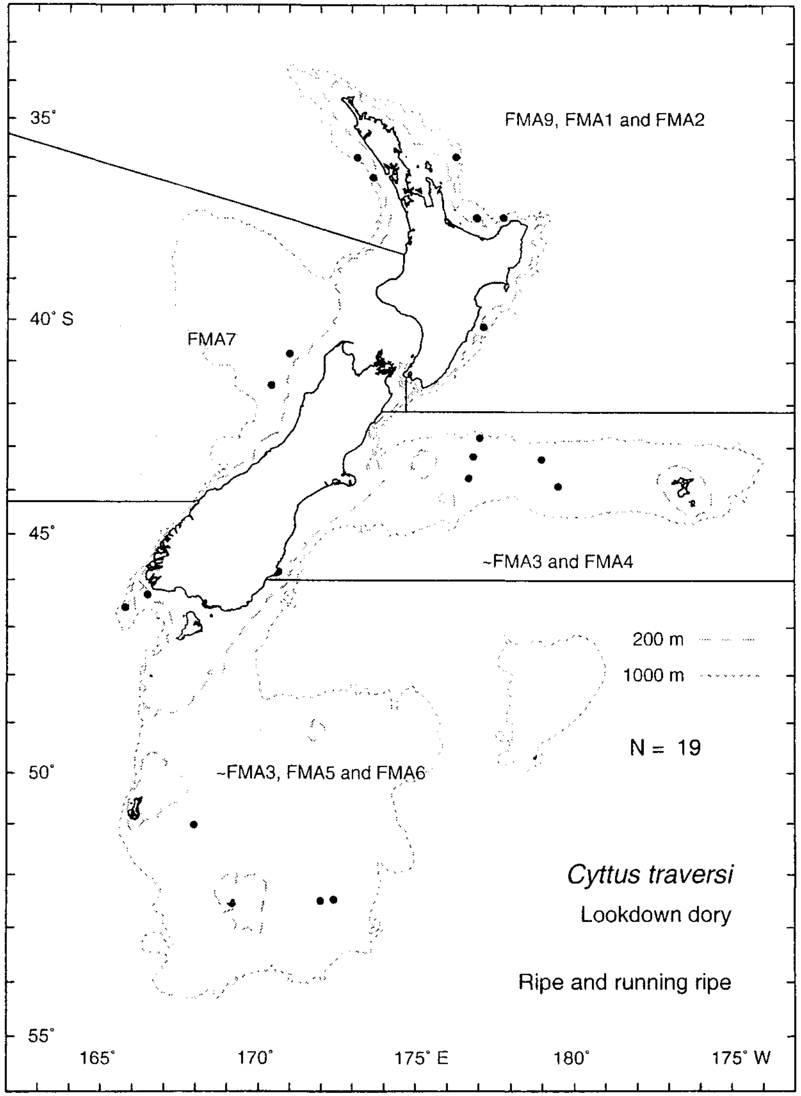
Alfonsino gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized fish staged per month.

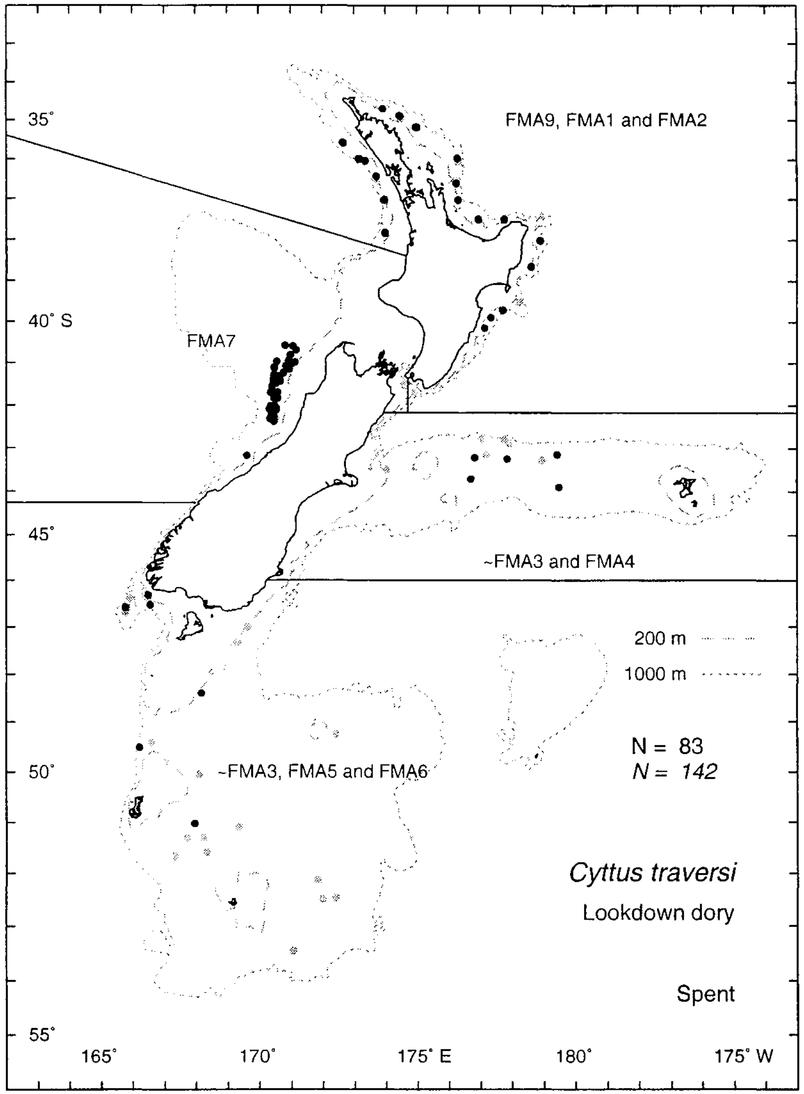

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 5
Brama brama
Ray's bream
Ripe and running ripe

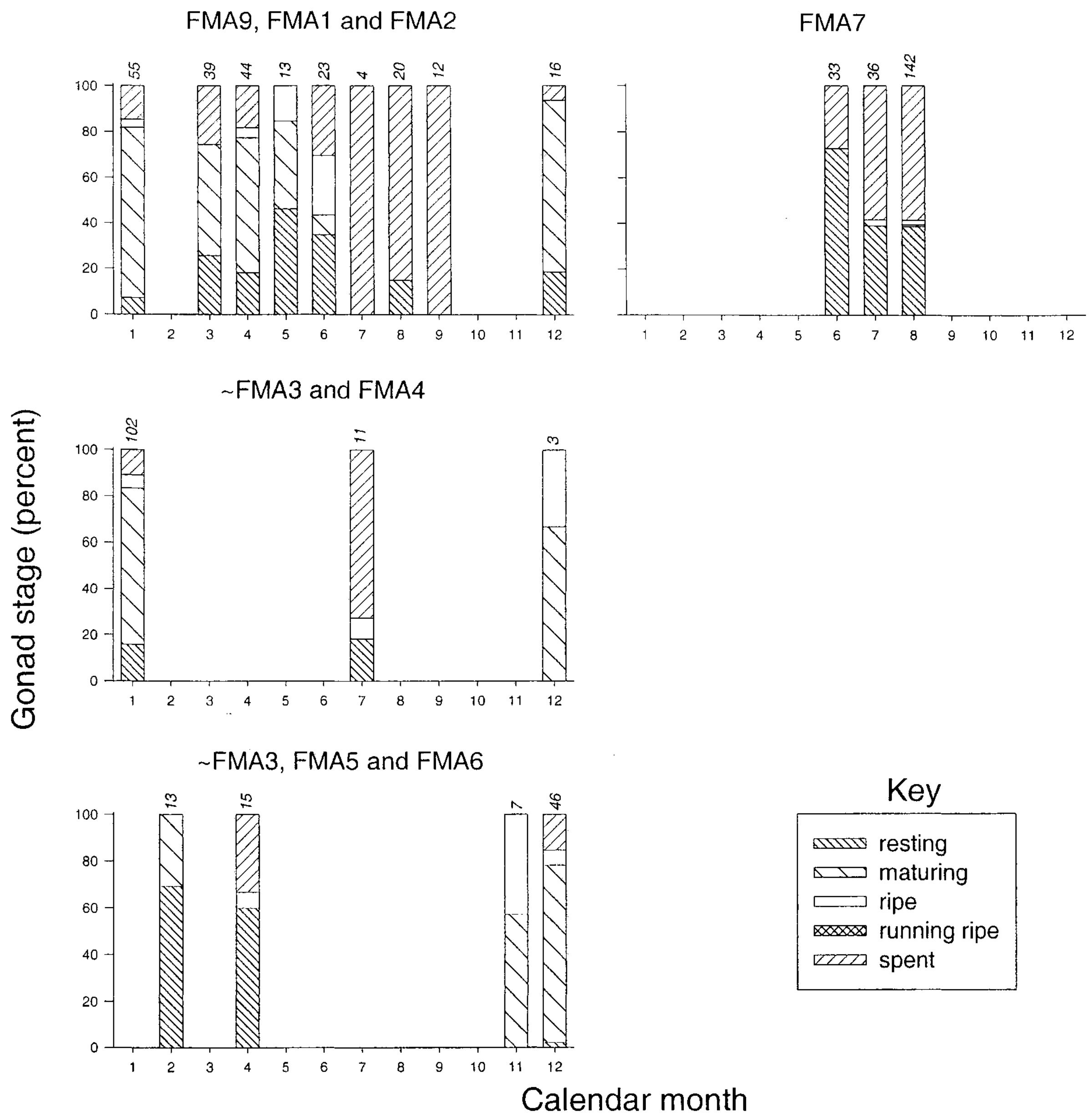

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 0
N = 37
Brama brama
Ray's bream
Spent



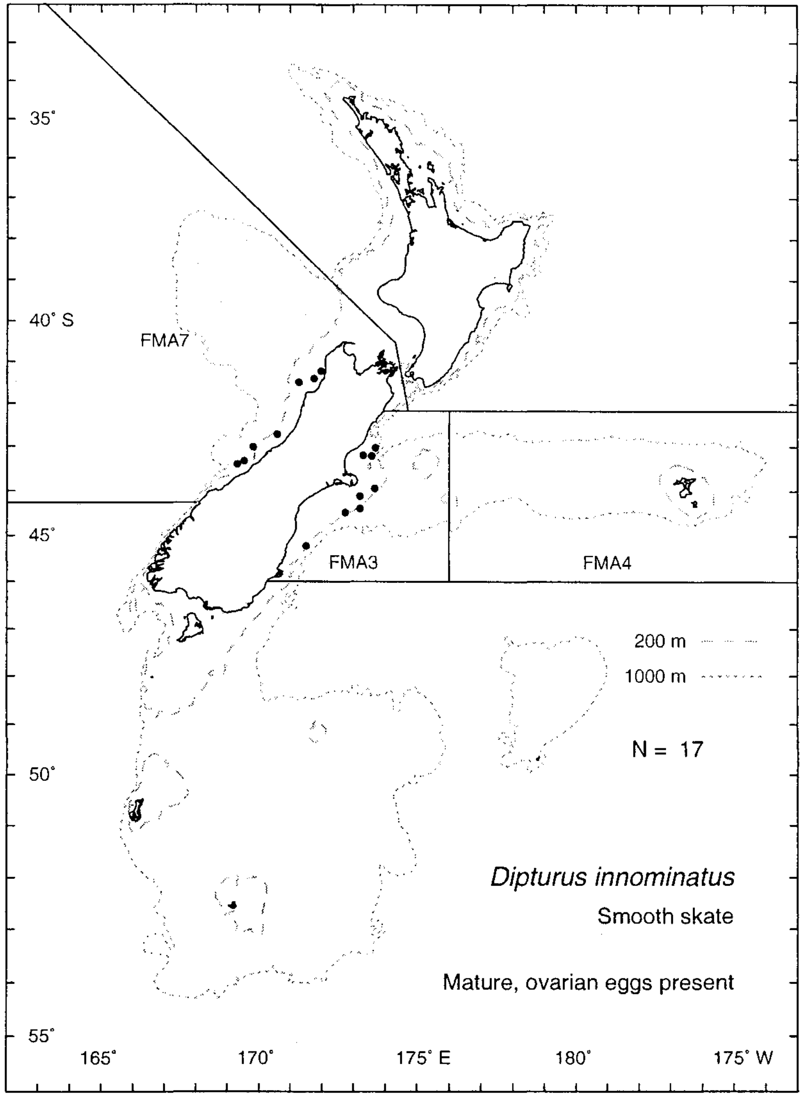
Ray's bream female gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized female fish staged per month.

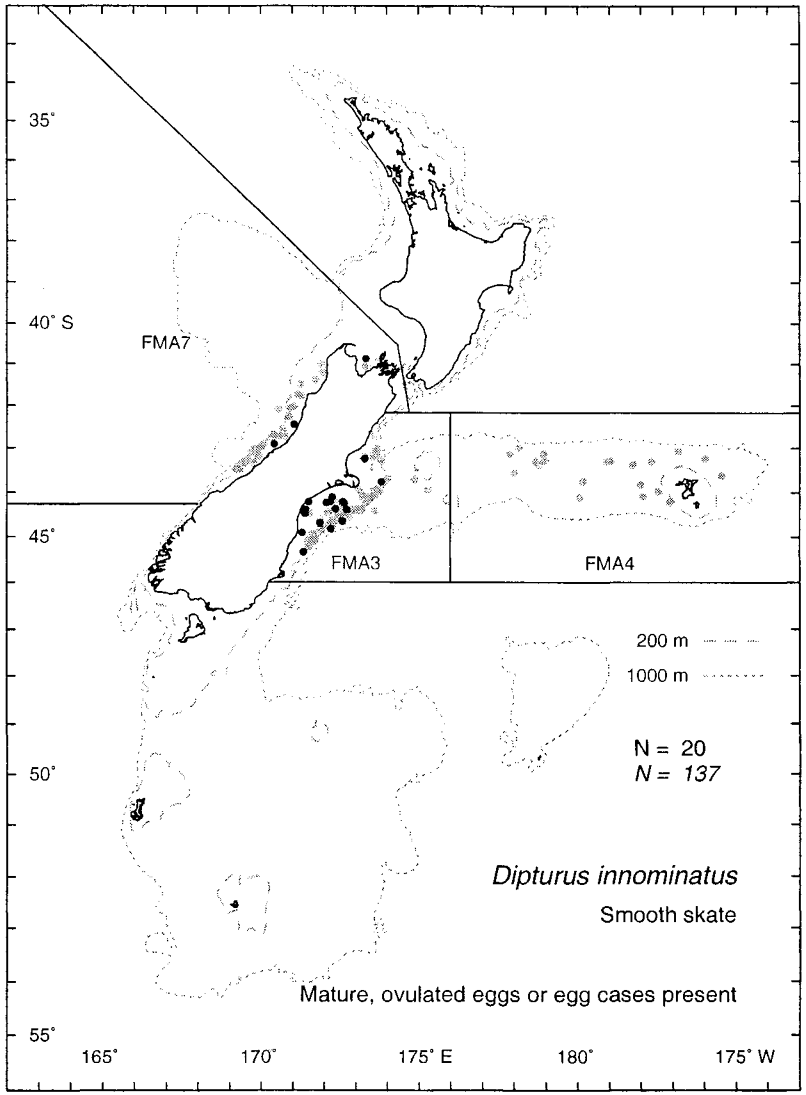

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
FMA9, FMA1 and FMA2
FMA7
~FMA3 and FMA4
~FMA3, FMA5 and FMA6
200 m
1000 m
N = 19
Cyttus traversi
Lookdown dory
Ripe and running ripe

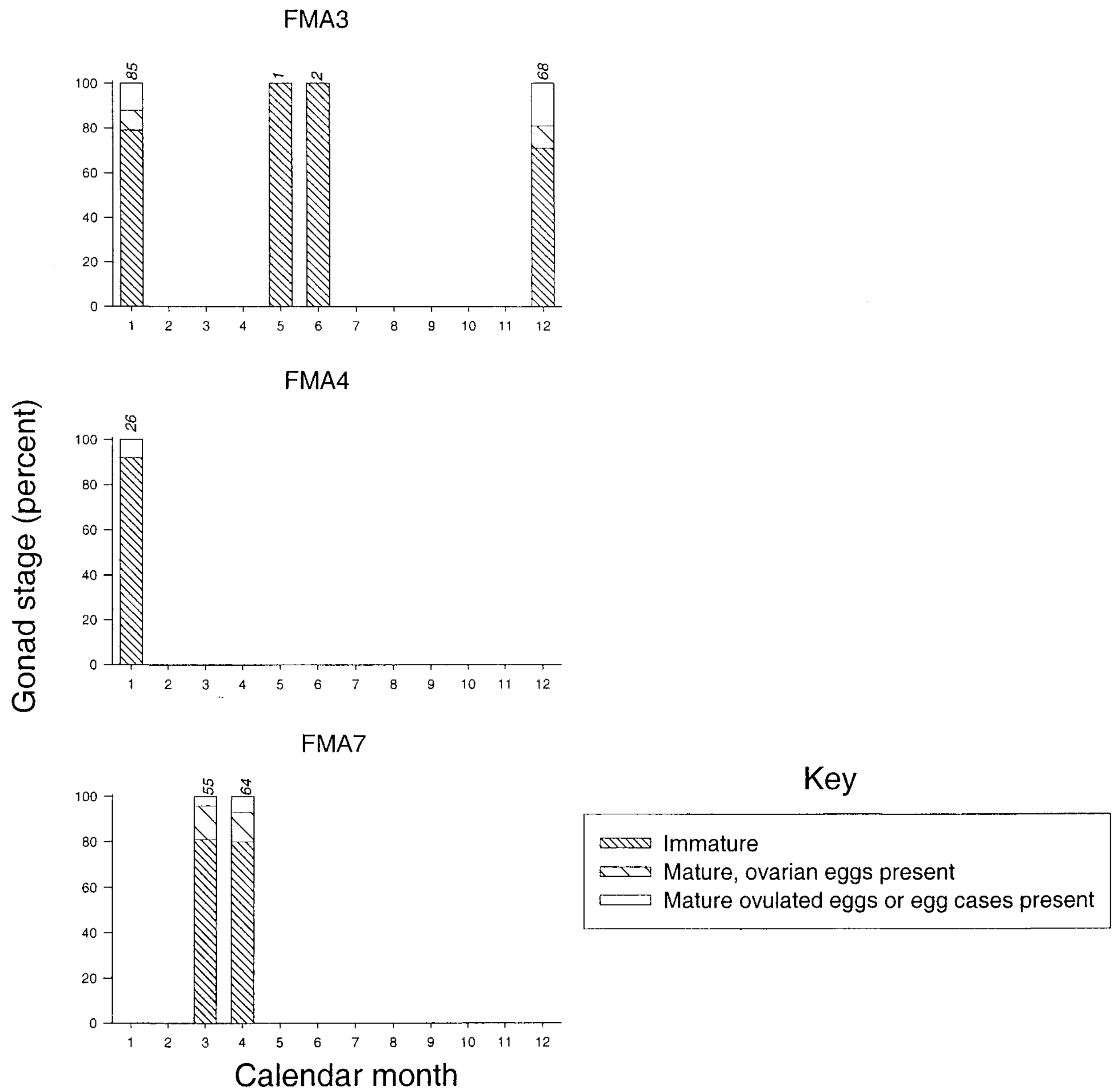

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
FMA9, FMA1 and FMA2
FMA7
~FMA3 and FMA4
~FMA3, FMA5 and FMA6
200 m
1000 m
N = 83
N = 142
Cyttus traversi
Lookdown dory
Spent



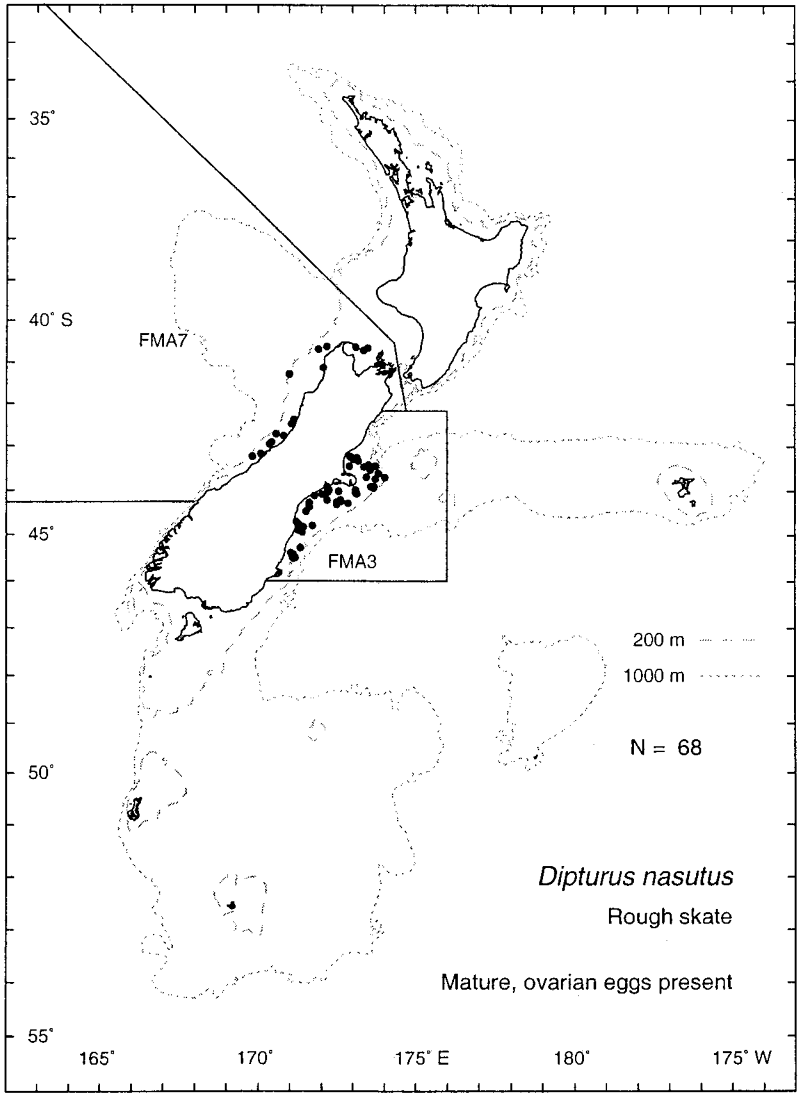
Lookdown dory gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized fish staged per month.

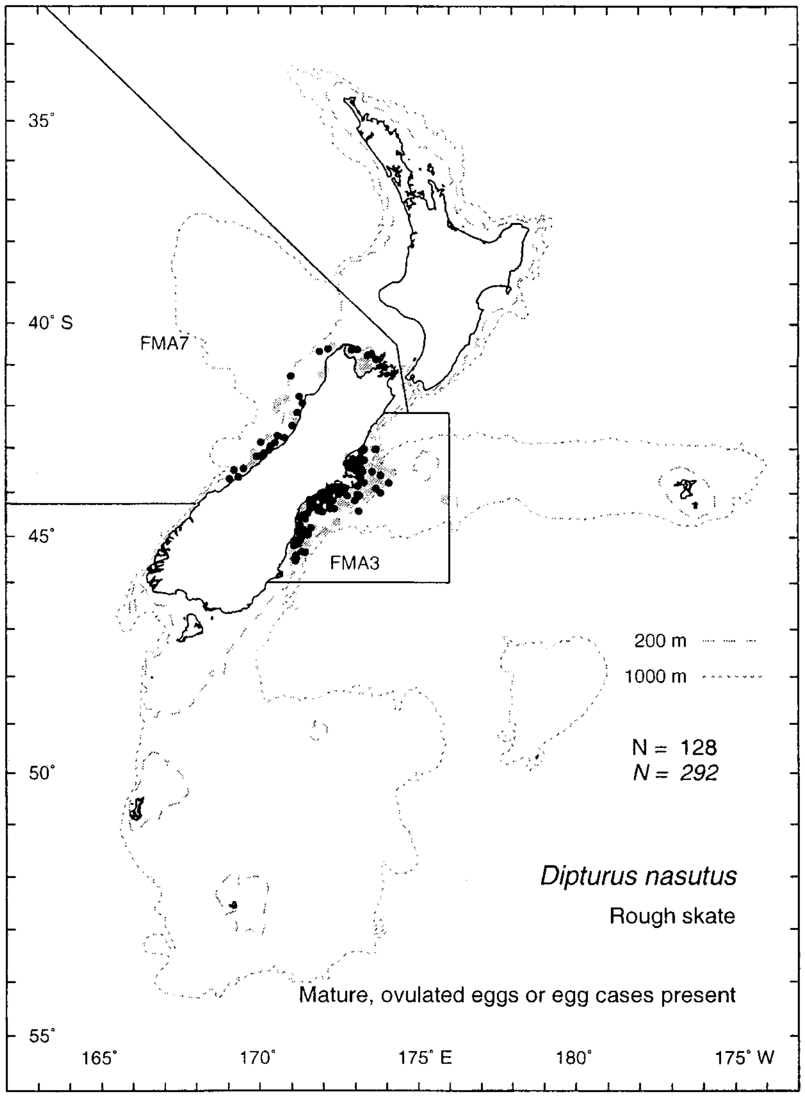

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
FMA7
FMA3
FMA4
200 m
1000 m
N = 17
Dipturus innominatus
Smooth skate
Mature, ovarian eggs present

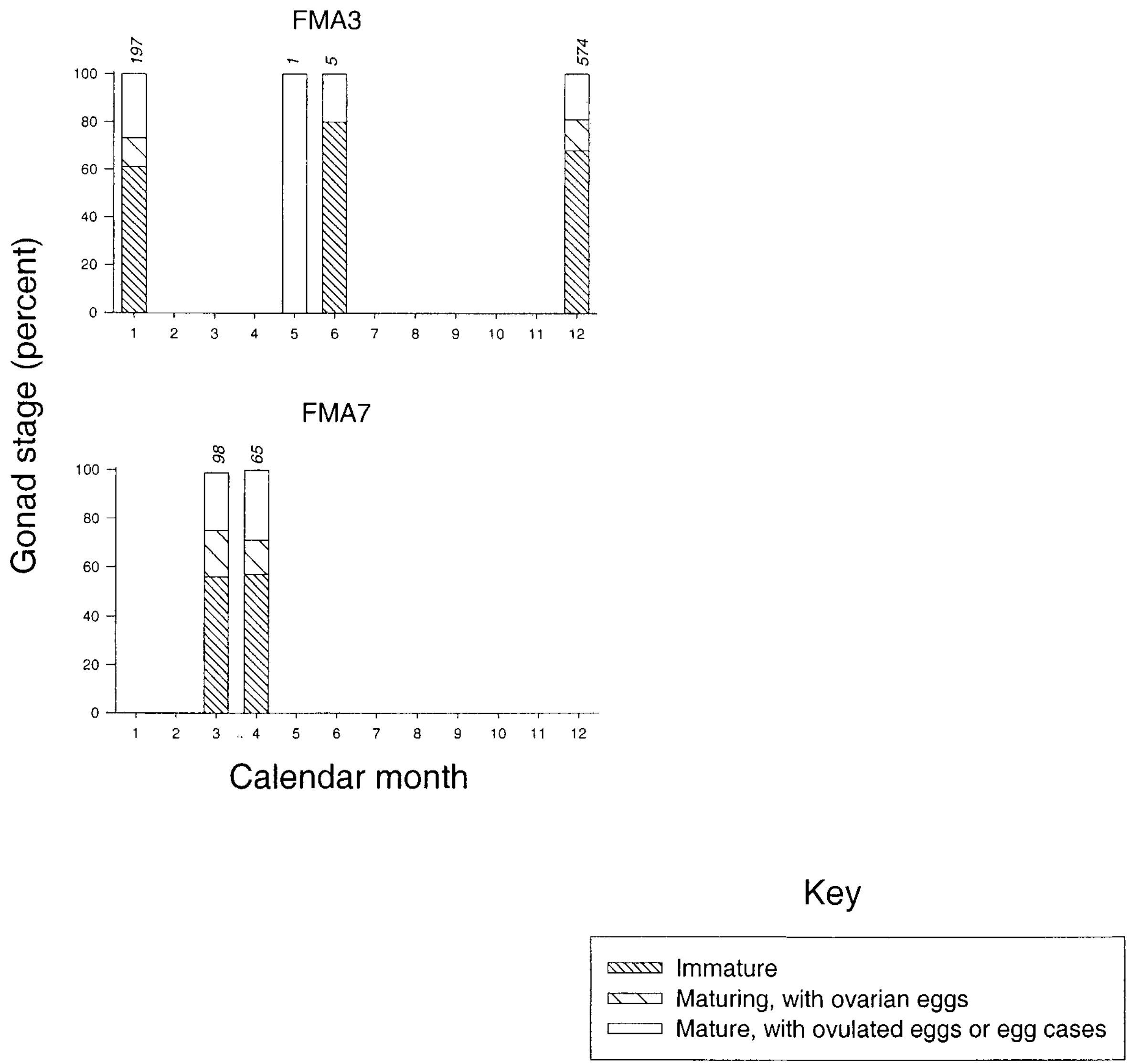

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
FMA7
FMA3
FMA4
200 m
1000 m
N = 20
N = 137
Dipturus innominatus
Smooth skate
Mature, ovulated eggs or egg cases present



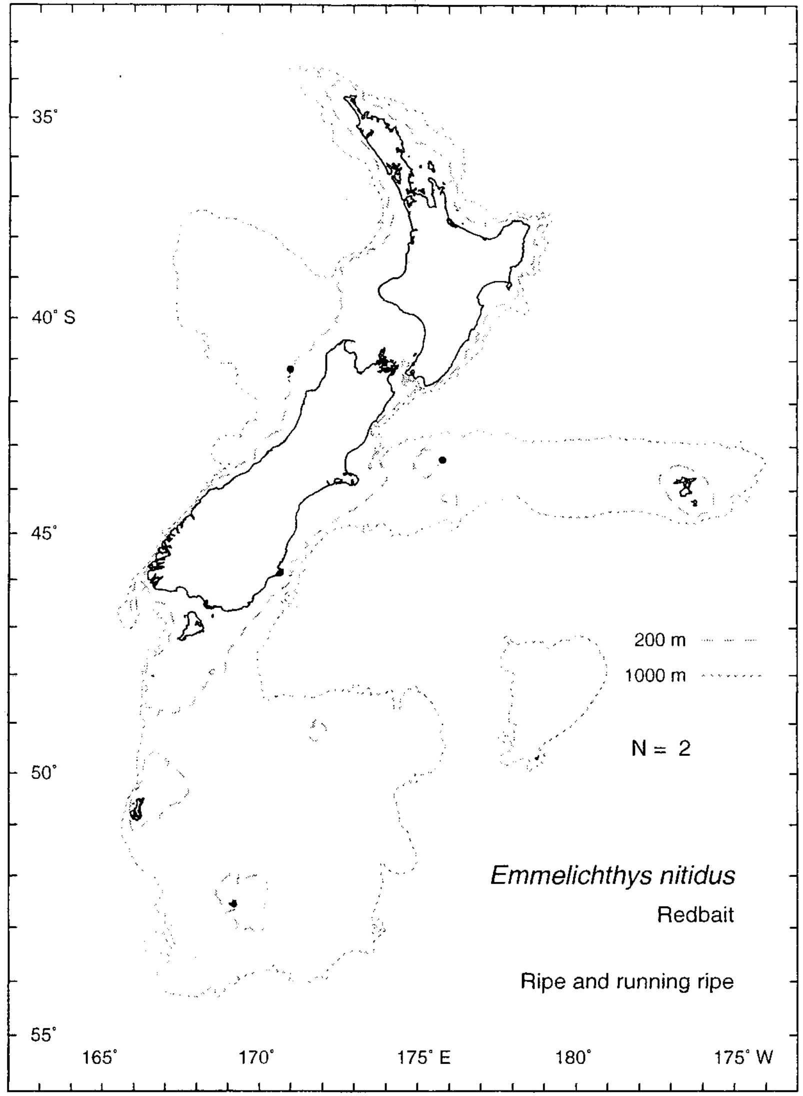
Smooth skate female gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of female fish staged per month.

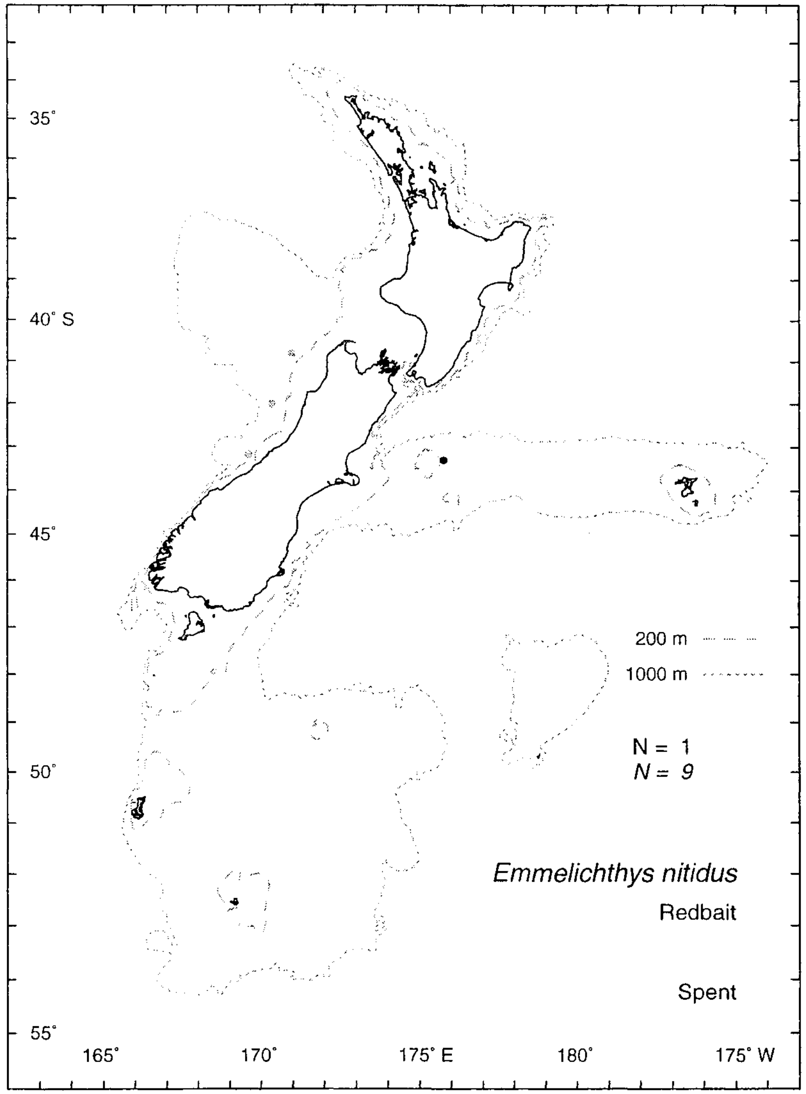

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
FMA7
FMA3
200 m
1000 m
N = 68
Dipturus nasutus
Rough skate
Mature, ovarian eggs present

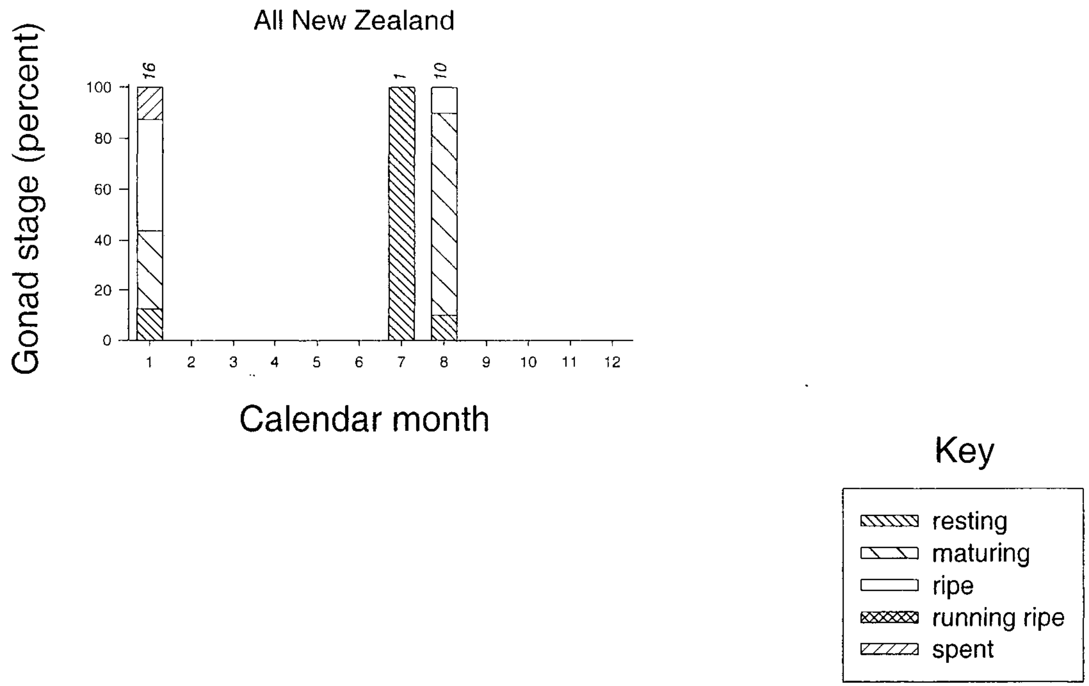

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
FMA7
FMA3
200 m
1000 m
N = 128
N = 292
Dipturus nasutus
Rough skate
Mature, ovulated eggs or egg cases present



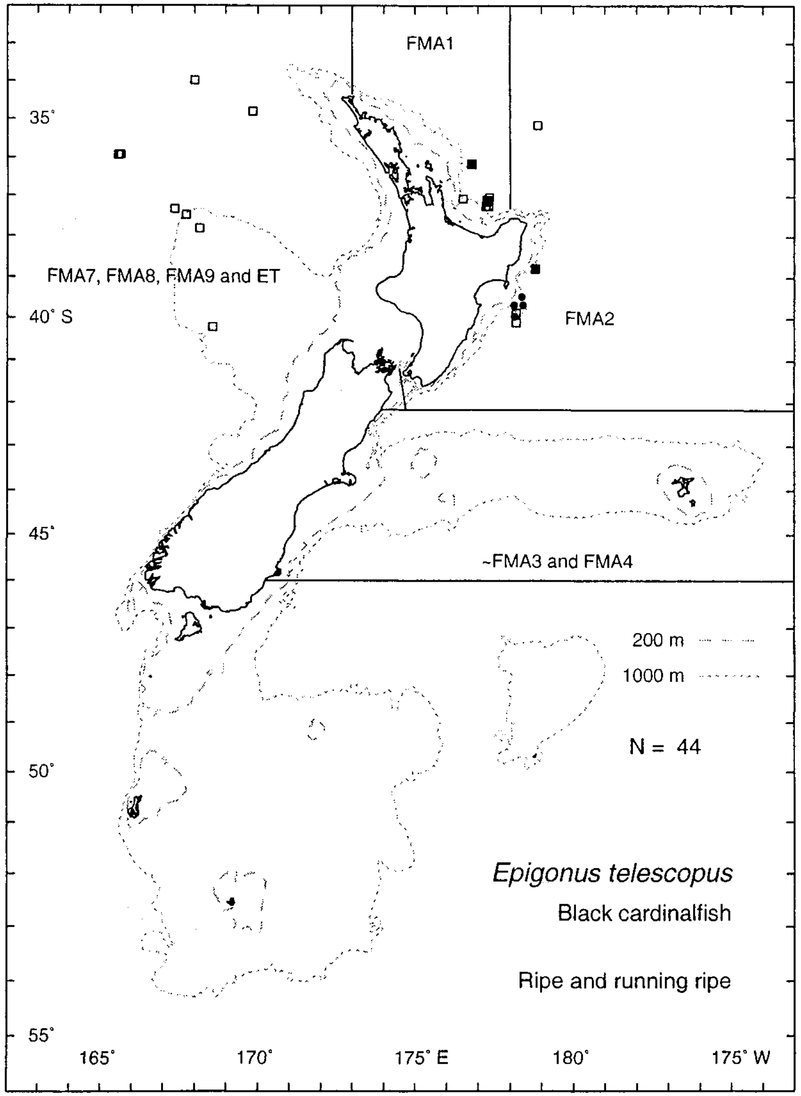
Rough skate female gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of female fish staged per month.

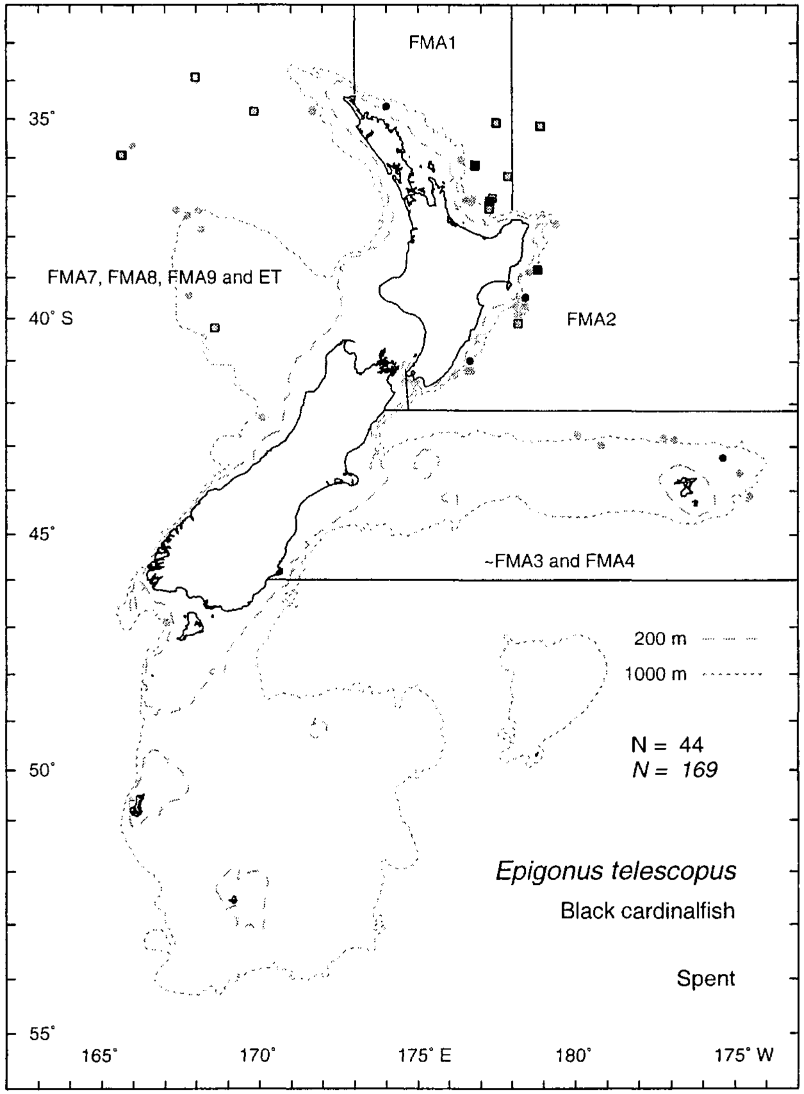

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 2
Emmelichthys nitidus
Redbait
Ripe and running ripe

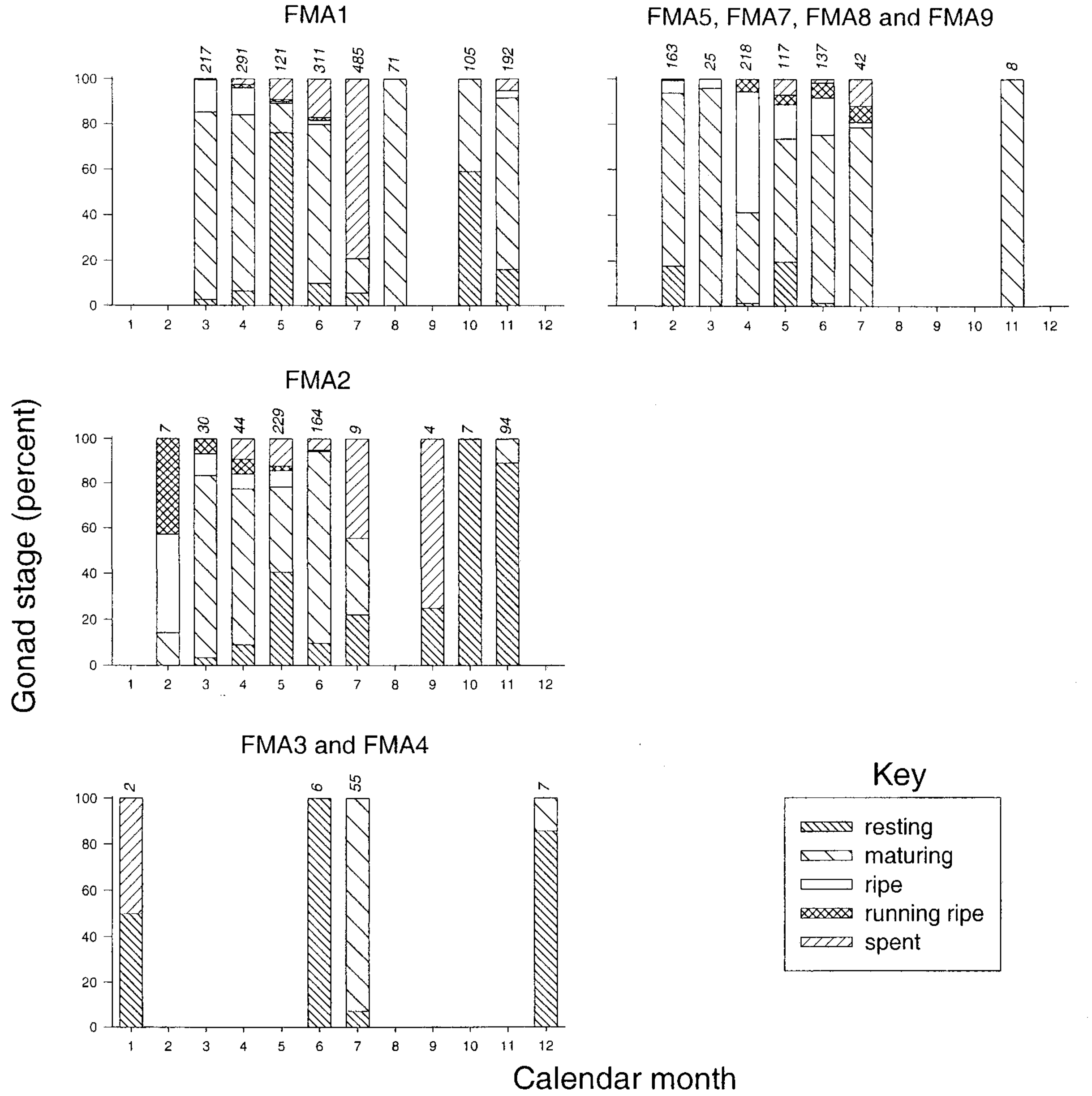

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 1
N = 9
Emmelichthys nitidus
Redbait
Spent



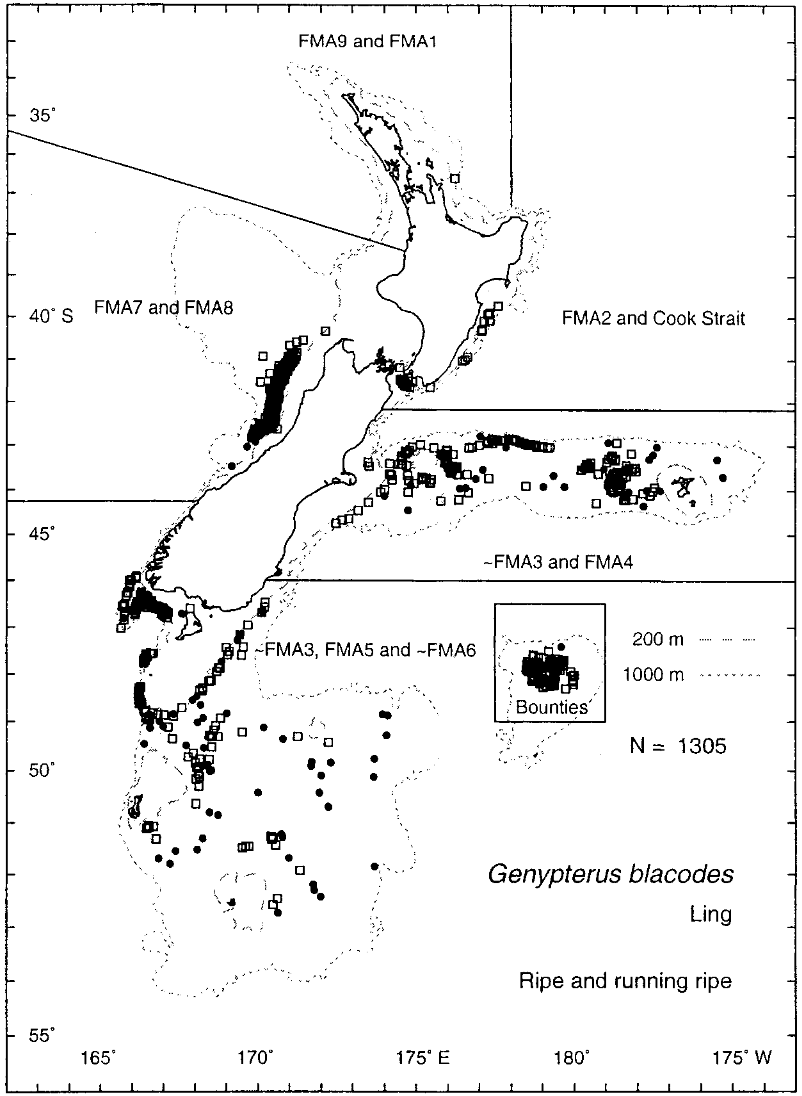
Redbait female gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized female fish staged per month.

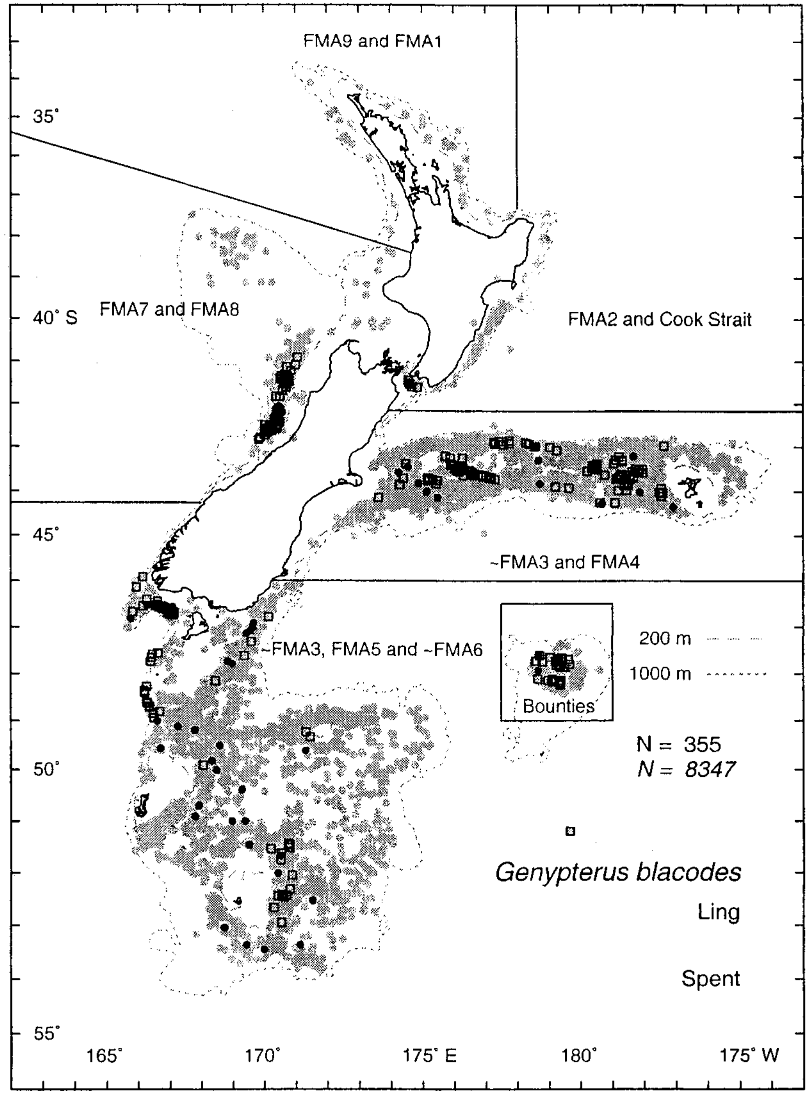

FMA1
FMA7, FMA8, FMA9 and ET
FMA2
~FMA3 and FMA4
200 m
1000 m
N = 44
Epigonus telescopus
Black cardinalfish
Ripe and running ripe
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W

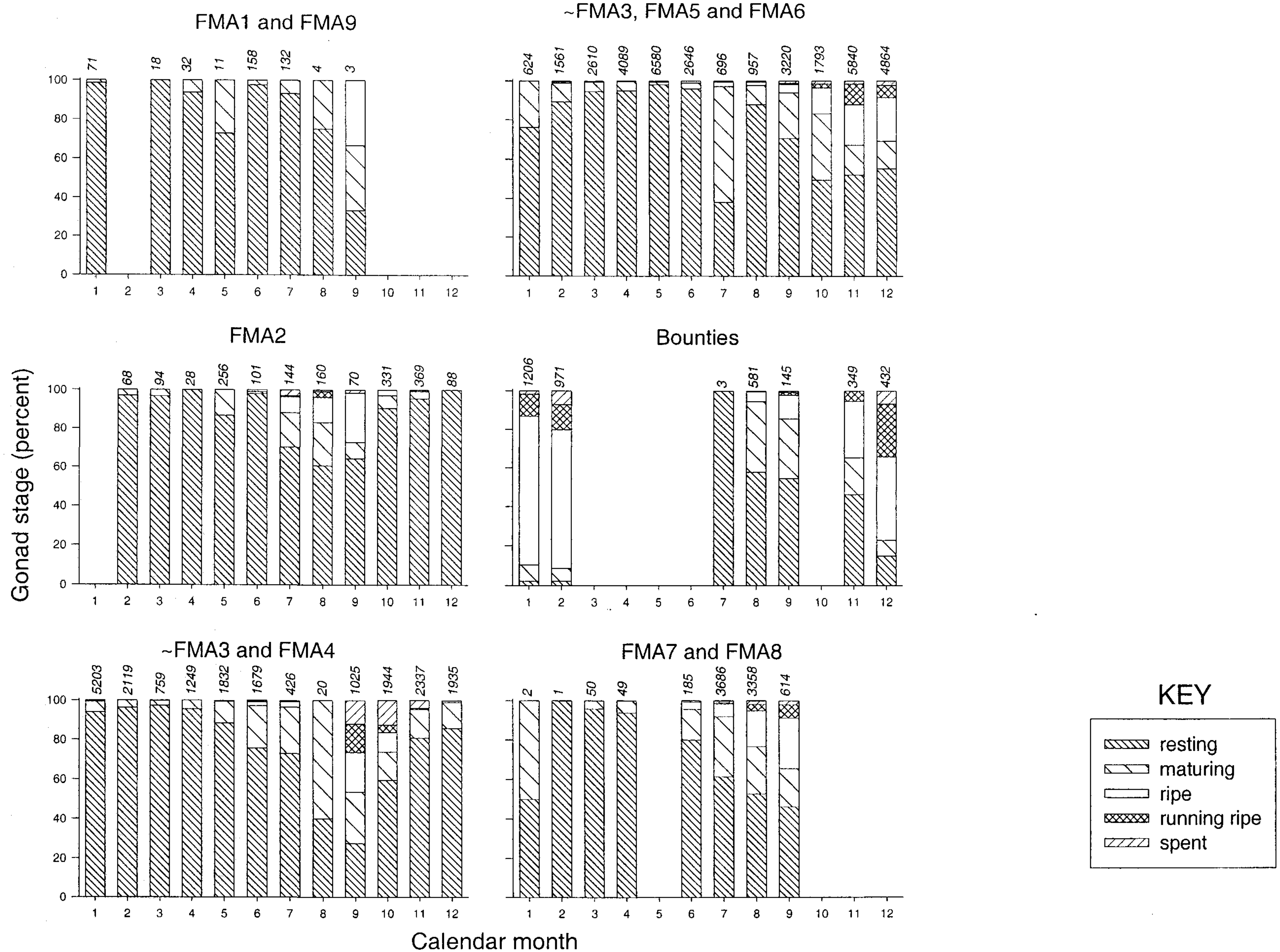

FMA1
FMA7, FMA8, FMA9 and ET
FMA2
~FMA3 and FMA4
200 m
1000 m
N = 44
N = 169
Epigonus telescopus
Black cardinalfish
Spent
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W



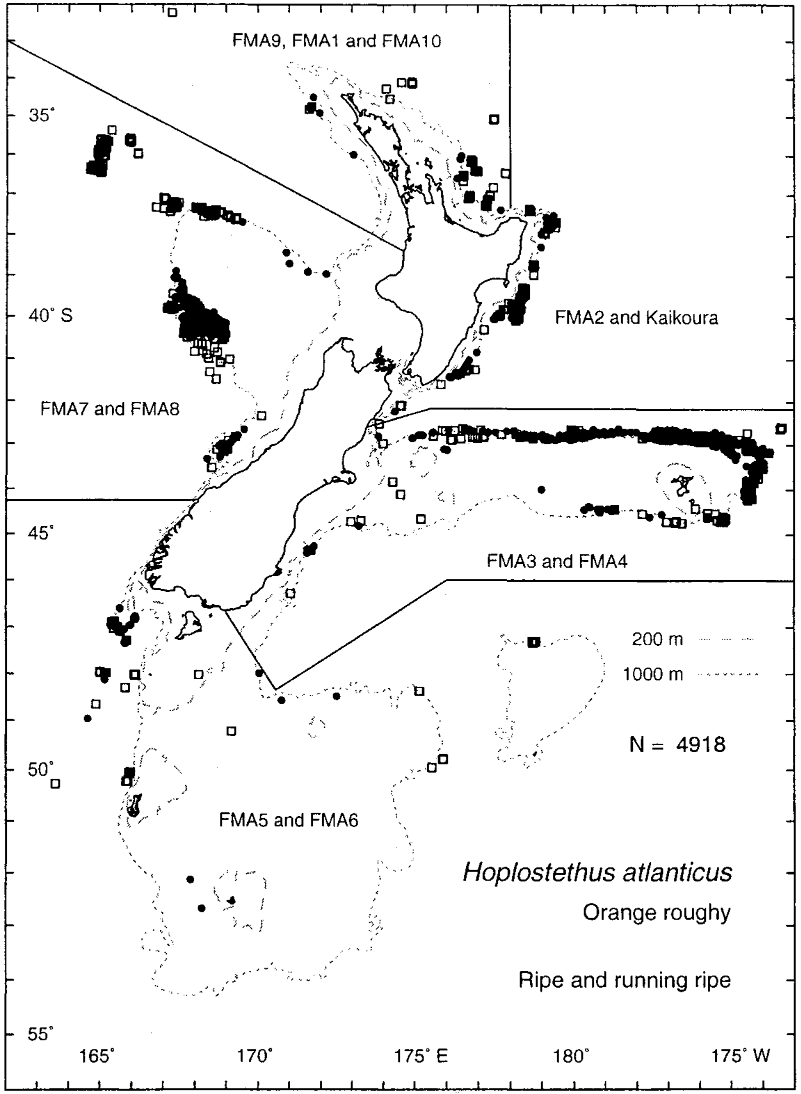
Black cardinalfish gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized fish staged per month.

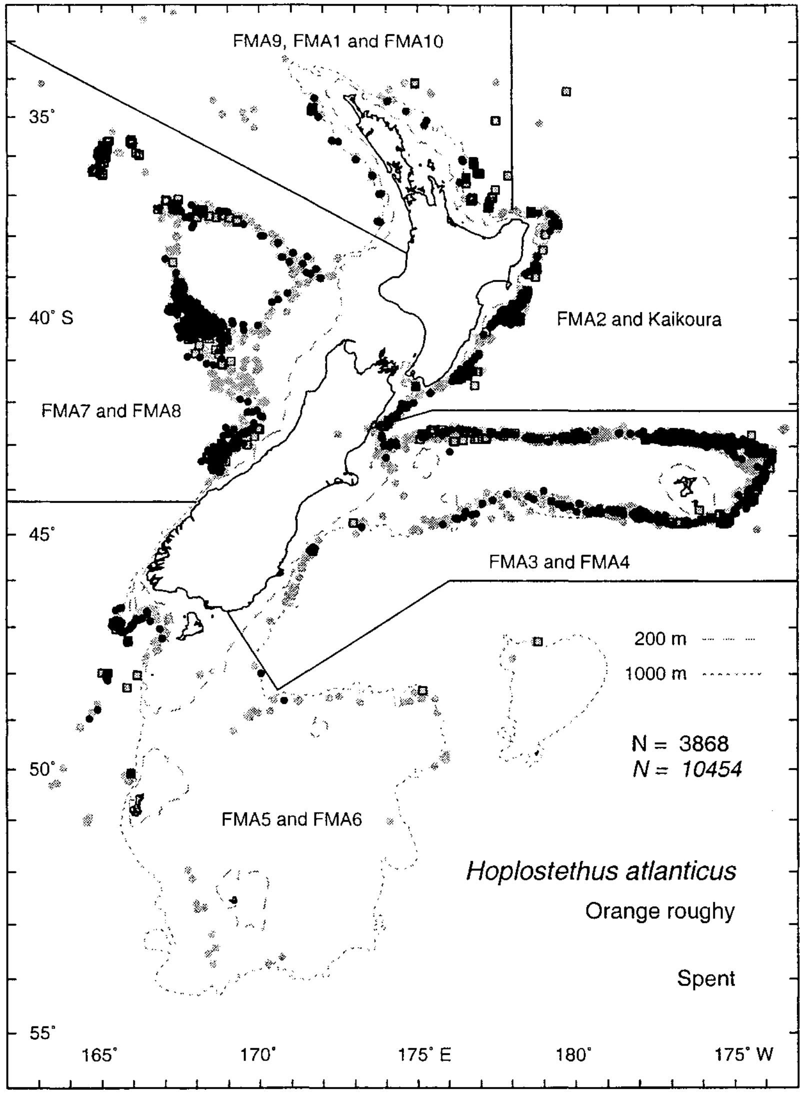

FMA9 and FMA1
35°
40° S
FMA7 and FMA8
FMA2 and Cook Strait
45°
~FMA3 and FMA4
~FMA3, FMA5 and ~FMA6
200 m
1000 m
Bounties
N = 1305
50°
Genypterus blacodes
Ling
Ripe and running ripe
55°
165°
170°
175° E
180°
175° W

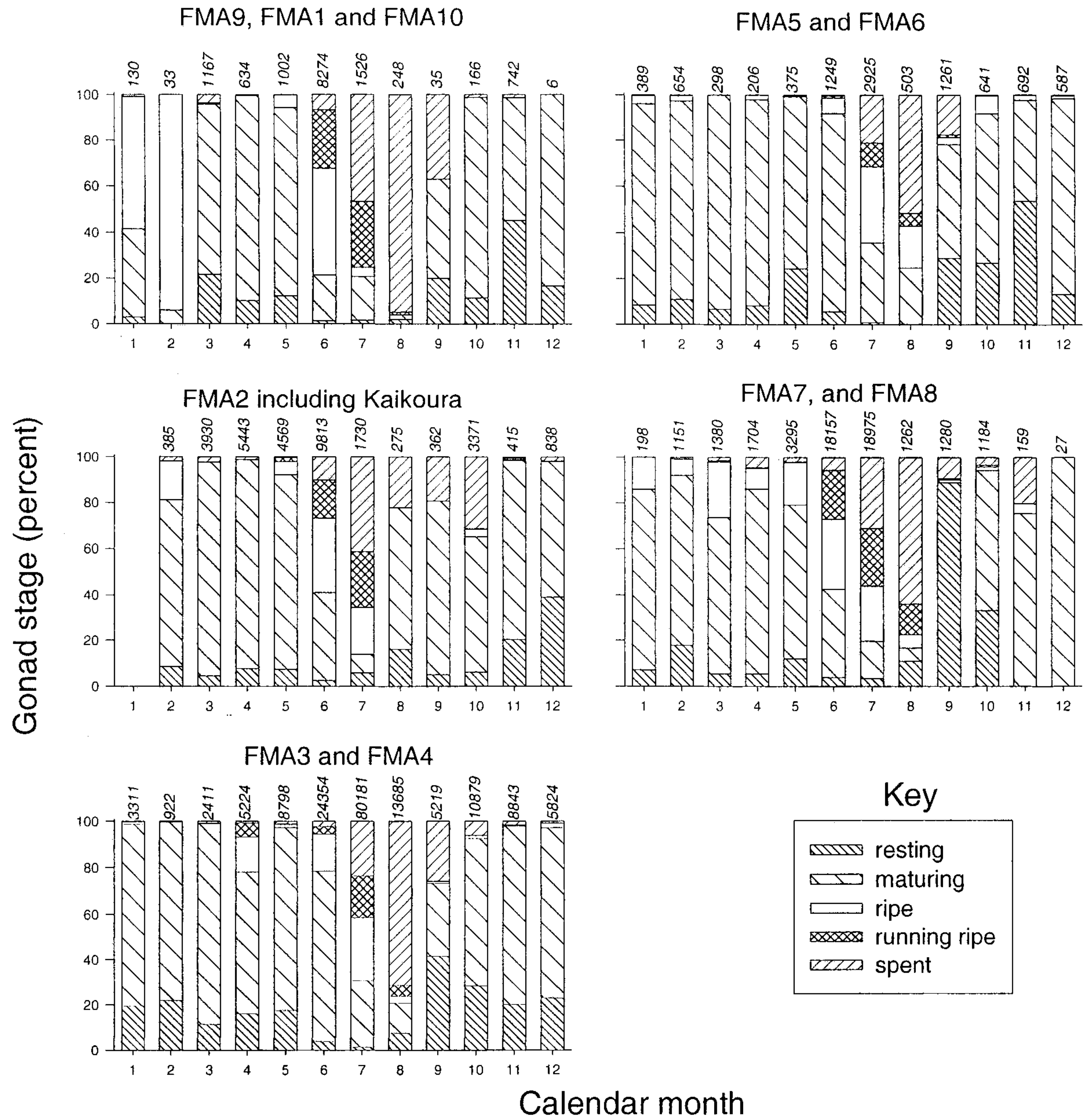

FMA9 and FMA1
35°
40° S
FMA7 and FMA8
FMA2 and Cook Strait
45°
~FMA3 and FMA4
~FMA3, FMA5 and ~FMA6
200 m
1000 m
Bounties
N = 355
N = 8347
50°
Genypterus blacodes
Ling
Spent
55°
165°
170°
175° E
180°
175° W



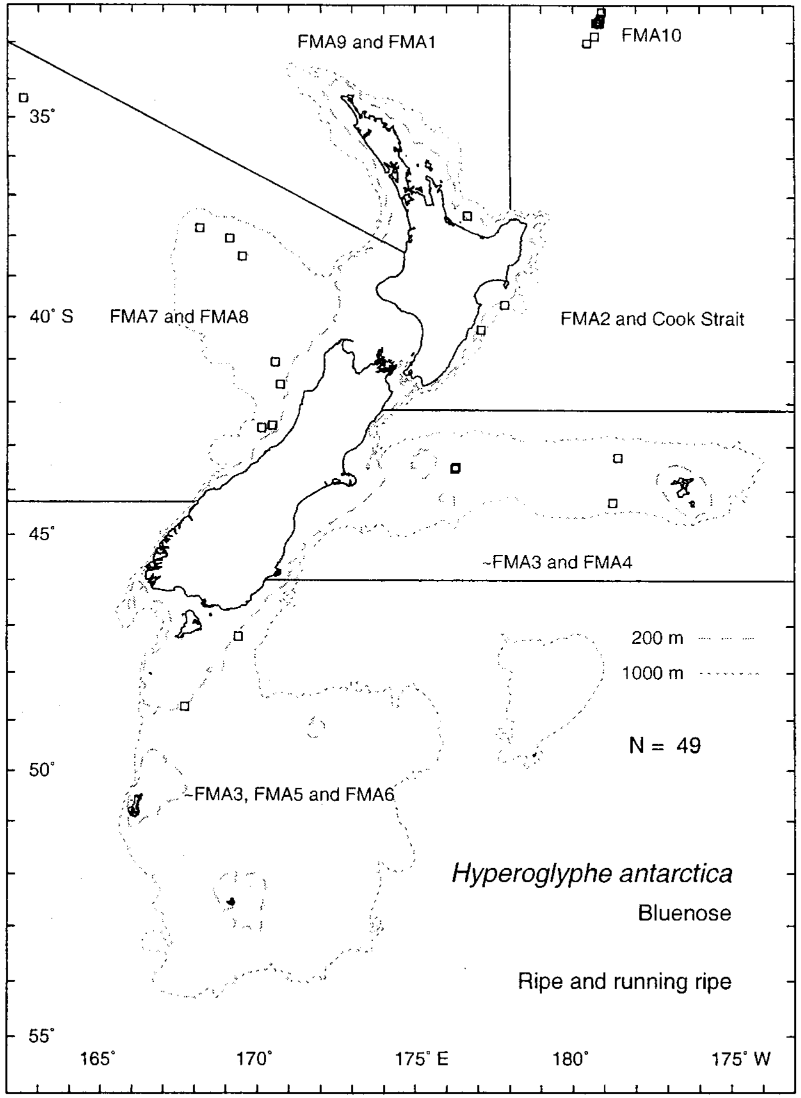
Ling gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized fish staged per month. ET refers to out of EEZ trips.

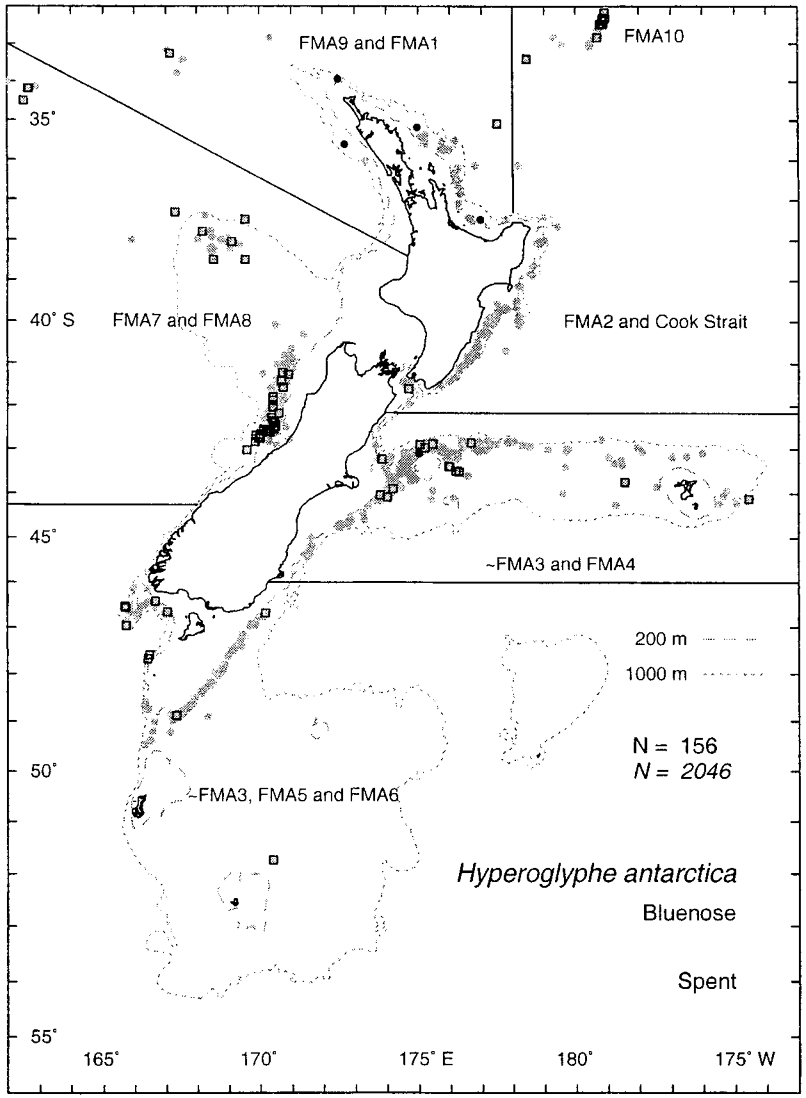

FMA9, FMA1 and FMA10
FMA2 and Kaikoura
FMA7 and FMA8
FMA3 and FMA4
FMA5 and FMA6
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 4918
Hoplostethus atlanticus
Orange roughy
Ripe and running ripe

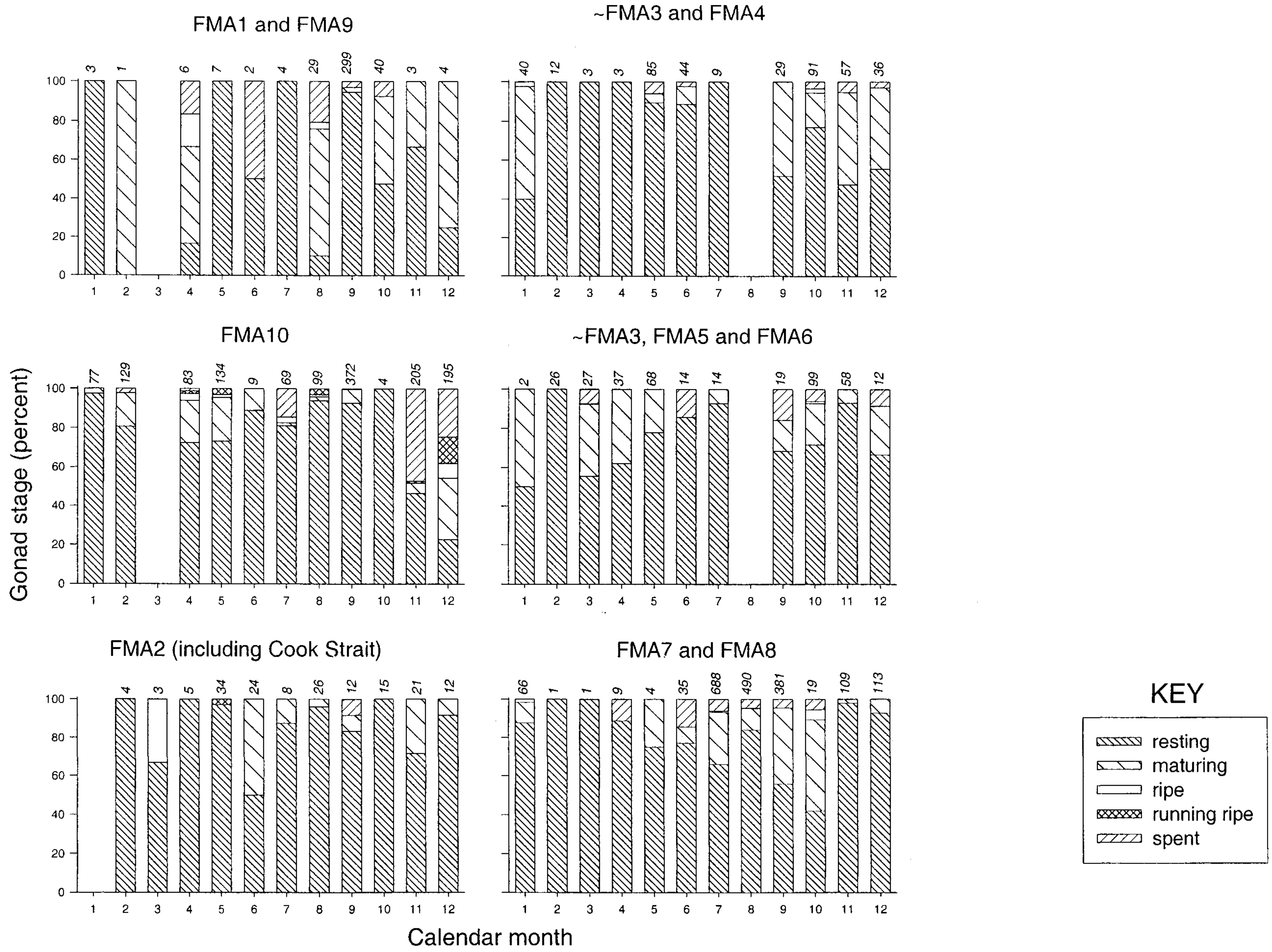

FMA9, FMA1 and FMA10
FMA2 and Kaikoura
FMA7 and FMA8
FMA3 and FMA4
FMA5 and FMA6
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 3868
N = 10454
Hoplostethus atlanticus
Orange roughy
Spent



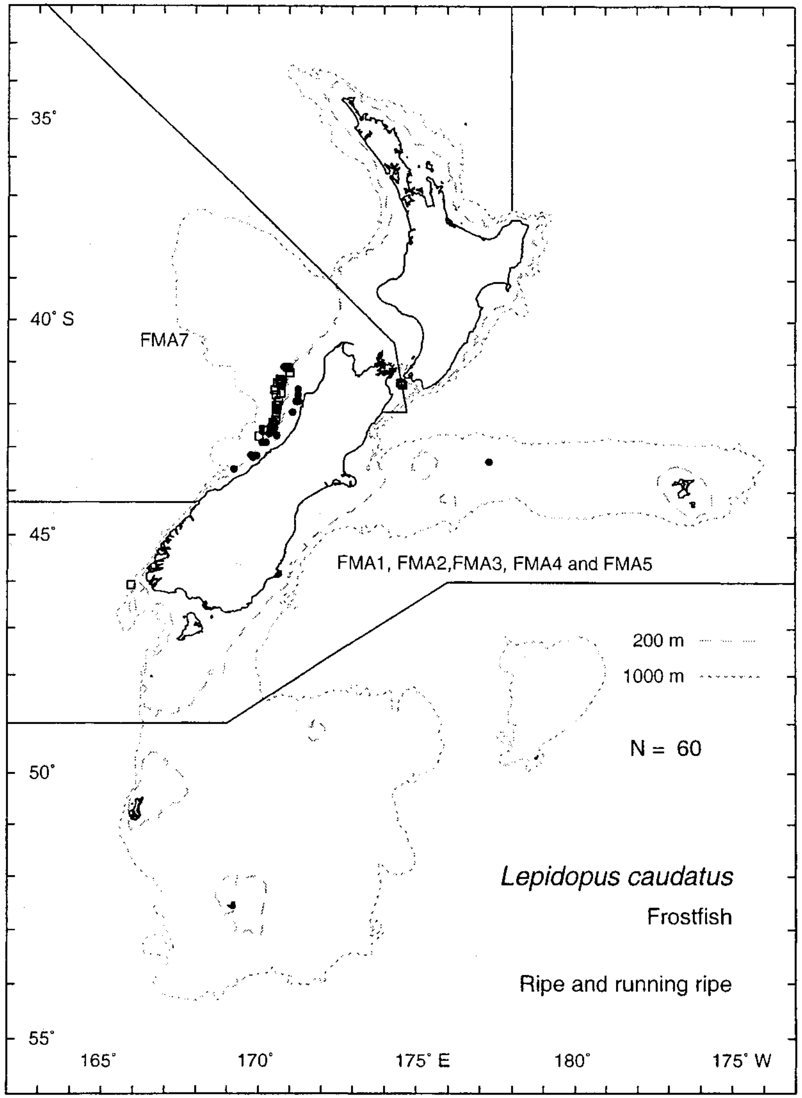
Orange roughy gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized fish staged per month.

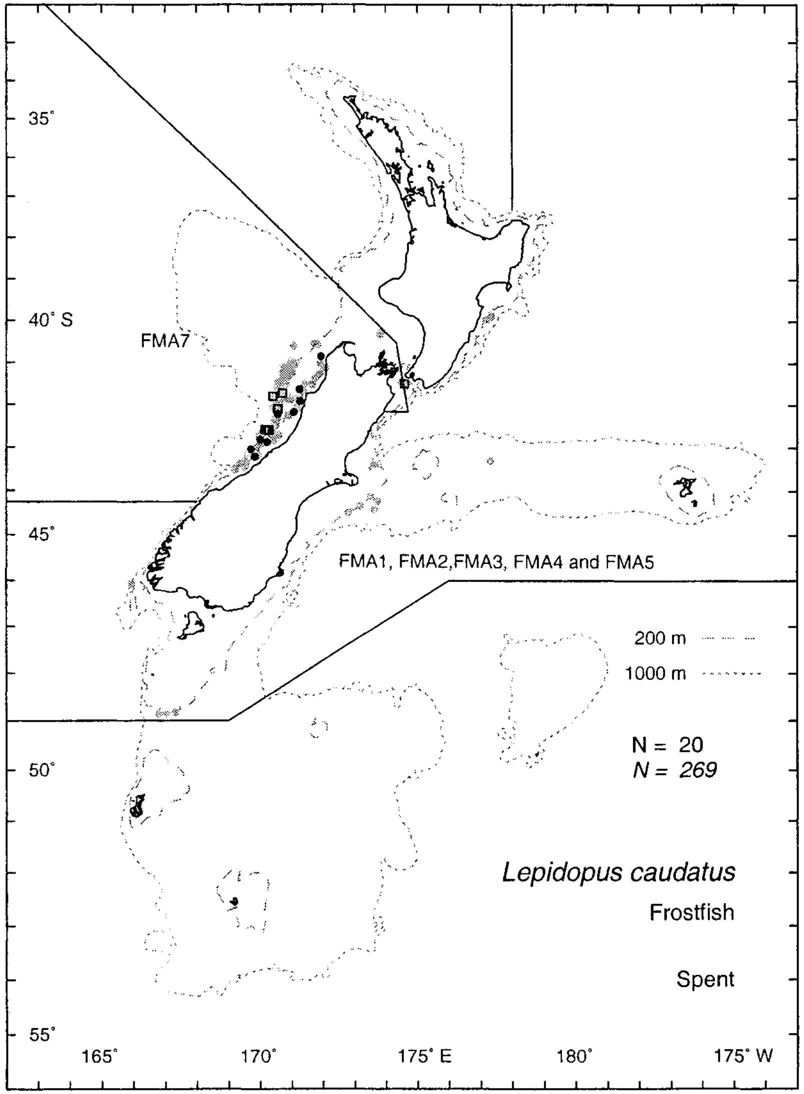

FMA9 and FMA1
FMA10
FMA7 and FMA8
FMA2 and Cook Strait
~FMA3 and FMA4
~FMA3, FMA5 and FMA6
200 m
1000 m
N = 49
Hyperoglyphe antarctica
Bluenose
Ripe and running ripe
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W

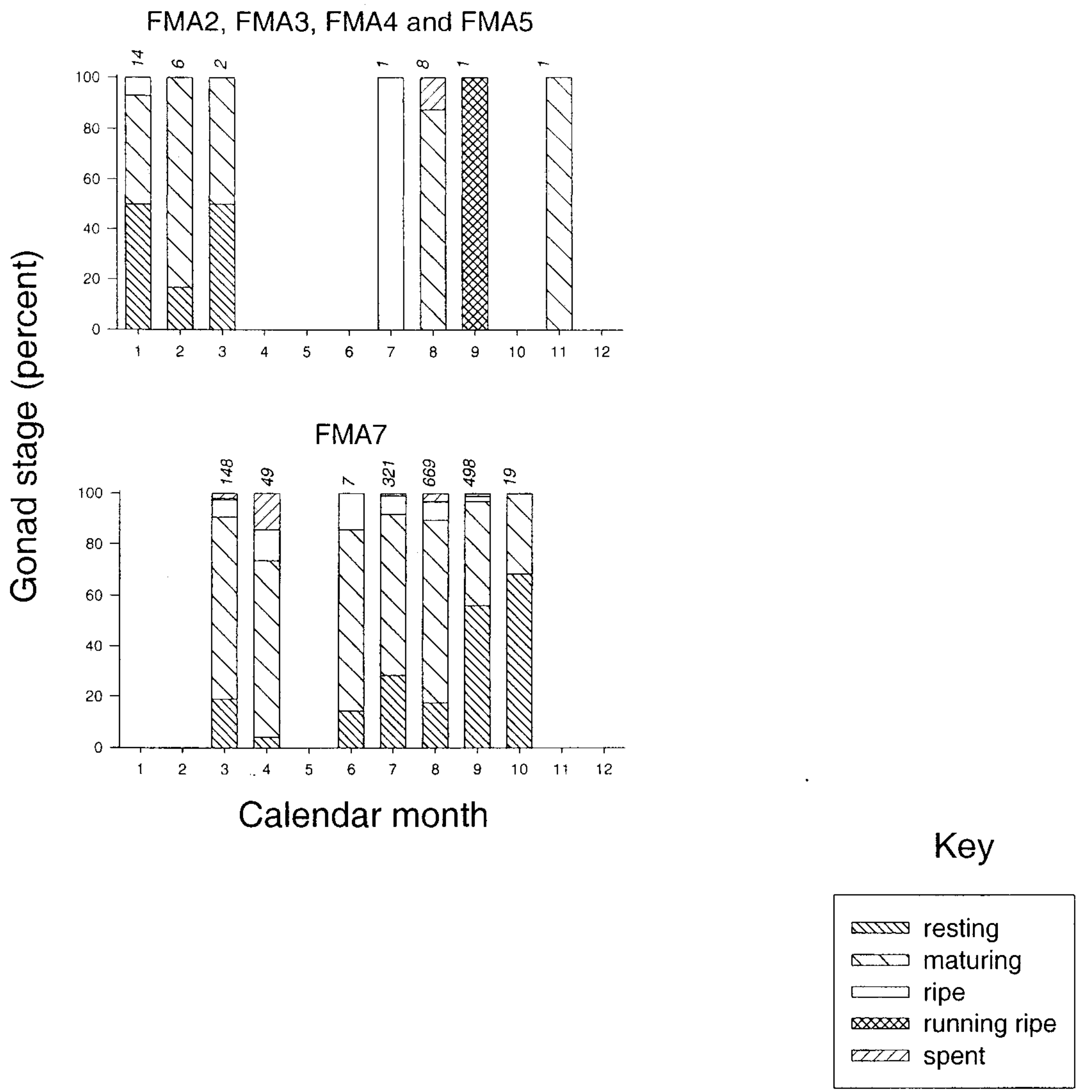

FMA9 and FMA1
FMA10
FMA7 and FMA8
FMA2 and Cook Strait
~FMA3 and FMA4
~FMA3, FMA5 and FMA6
200 m
1000 m
N = 156
N = 2046
Hyperoglyphe antarctica
Bluenose
Spent
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W



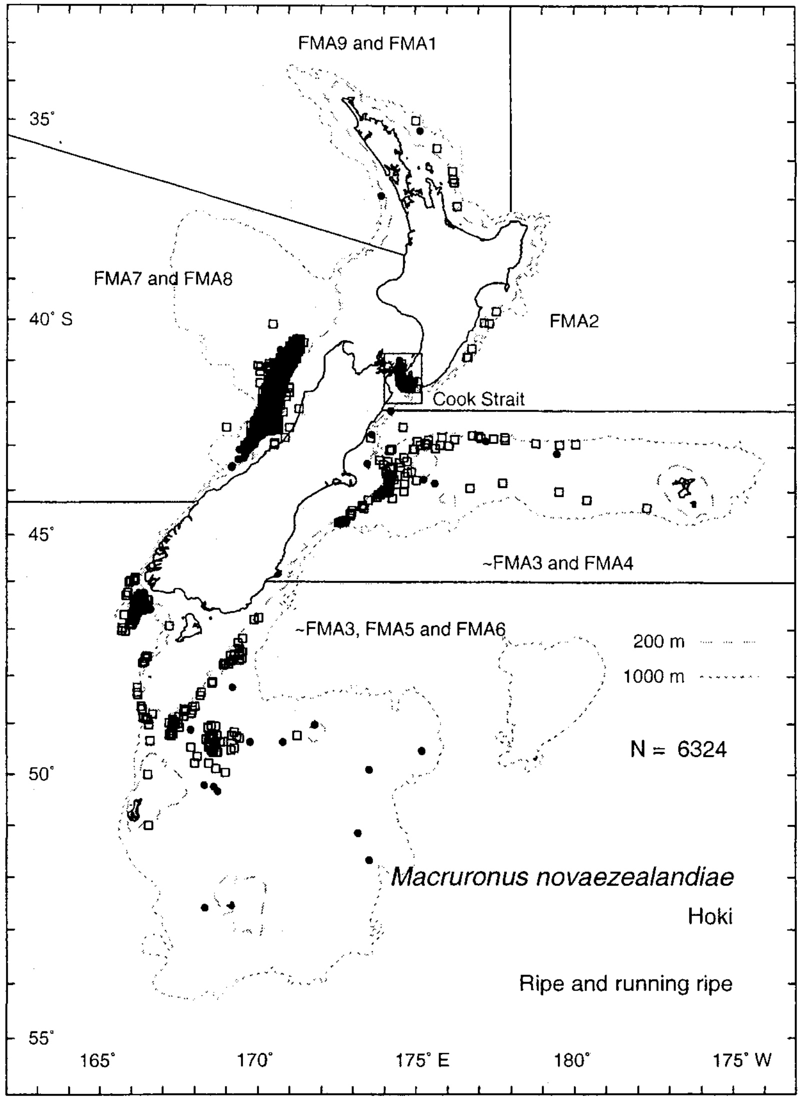
Bluenose gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized fish staged per month. ET refers to out of EEZ trips.

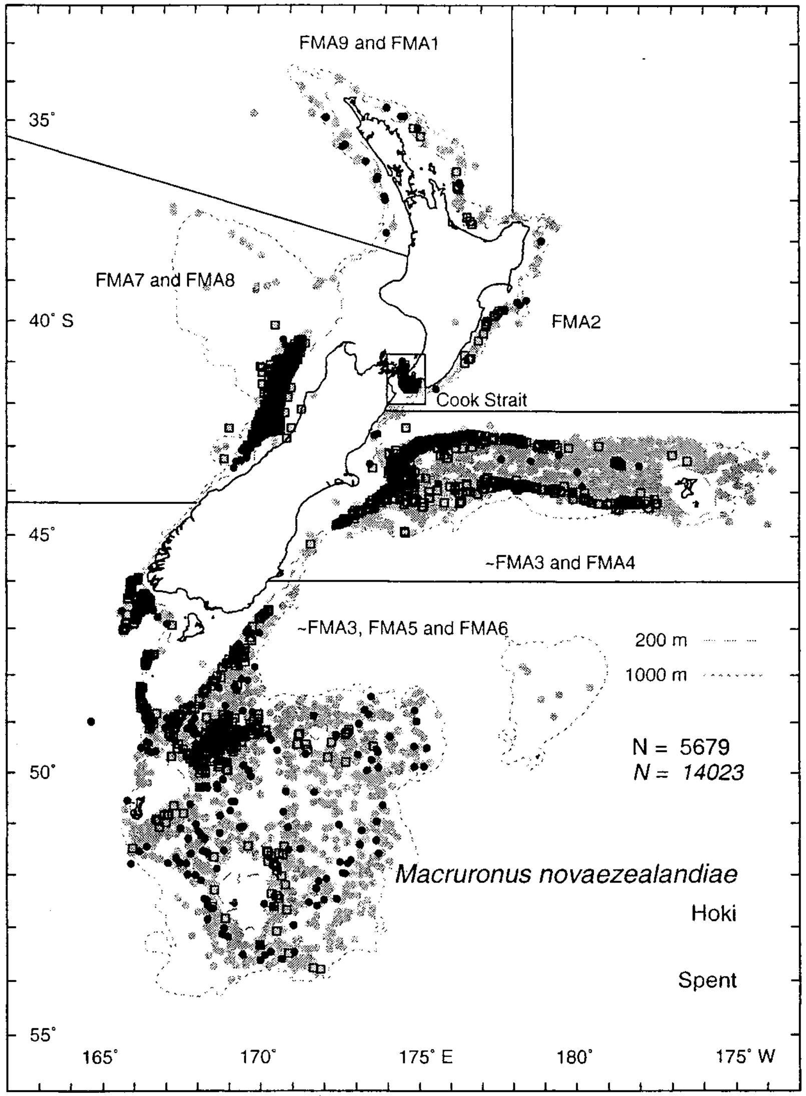

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
FMA7
FMA1, FMA2,FMA3, FMA4 and FMA5
200 m
1000 m
N = 60
Lepidopus caudatus
Frostfish
Ripe and running ripe

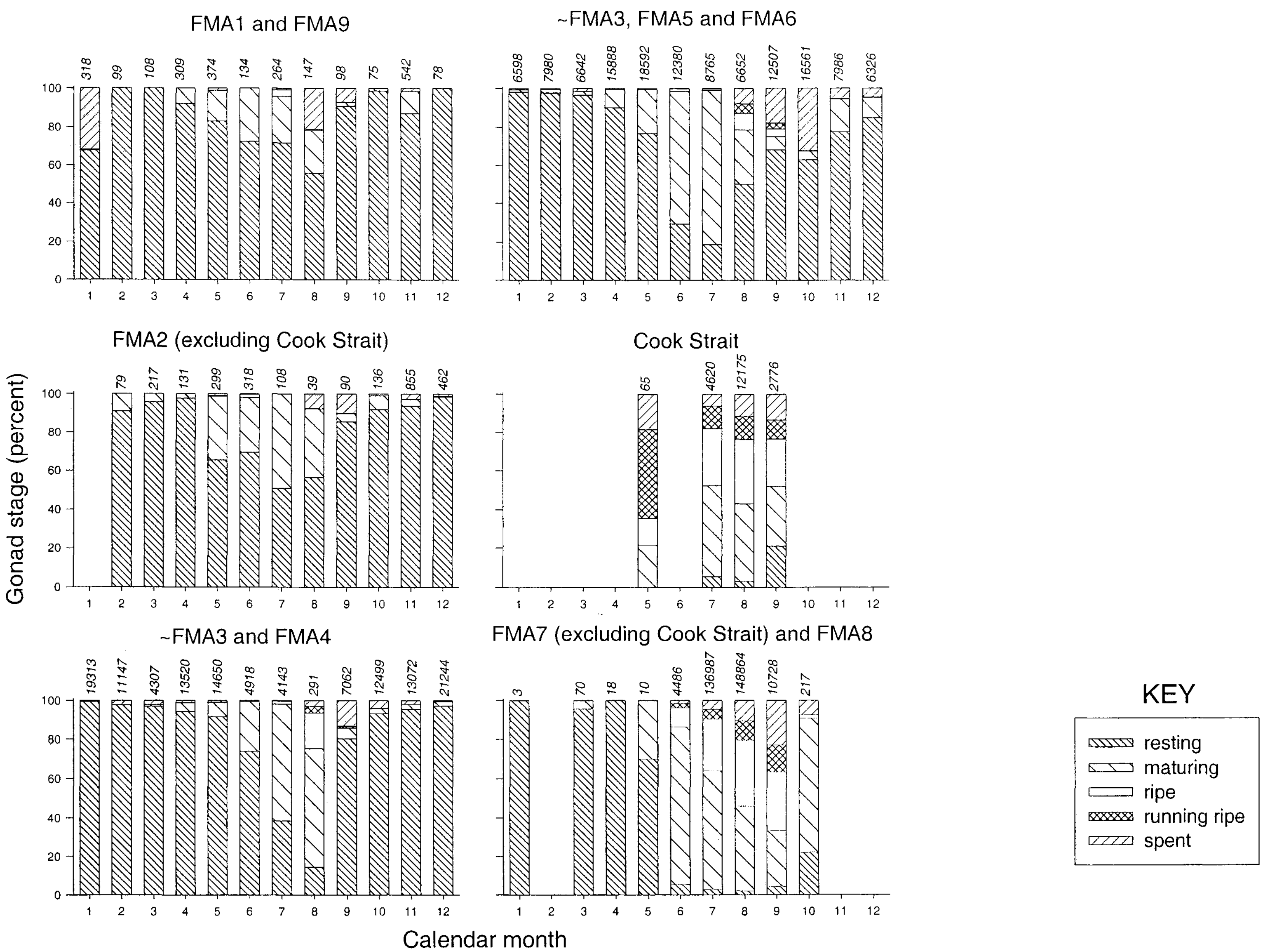

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
FMA7
FMA1, FMA2,FMA3, FMA4 and FMA5
200 m
1000 m
N = 20
N = 269
Lepidopus caudatus
Frostfish
Spent



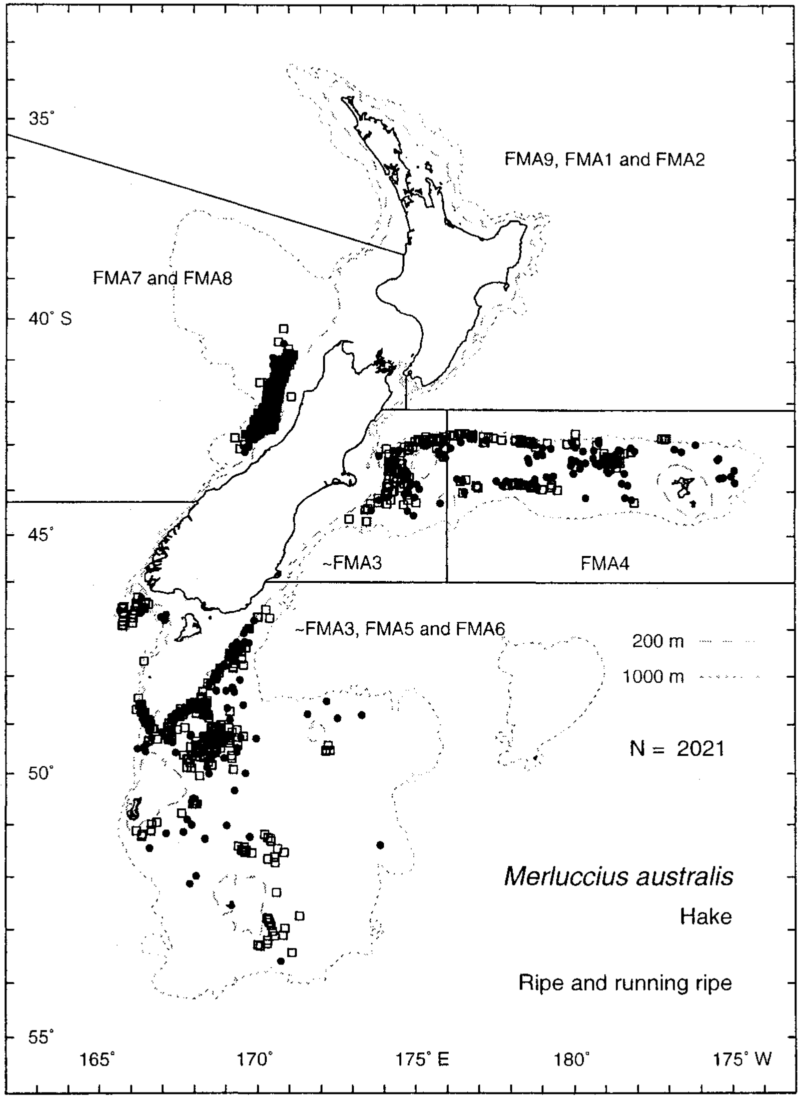
Frostfish female gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized female fish staged per month.

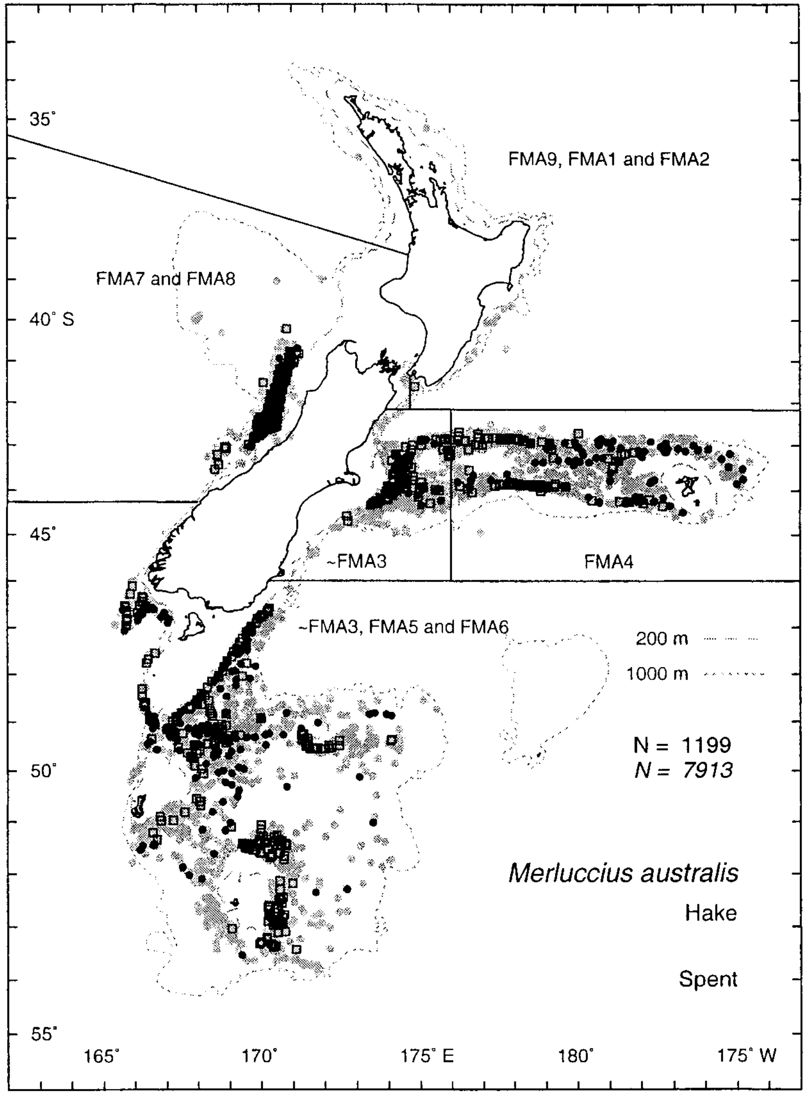

FMA9 and FMA1
35°
FMA7 and FMA8
40° S
FMA2
Cook Strait
45°
~FMA3 and FMA4
~FMA3, FMA5 and FMA6
200 m
1000 m
N = 6324
50°
Macruronus novaezealandiae
Hoki
Ripe and running ripe
55°
165°
170°
175° E
180°
175° W

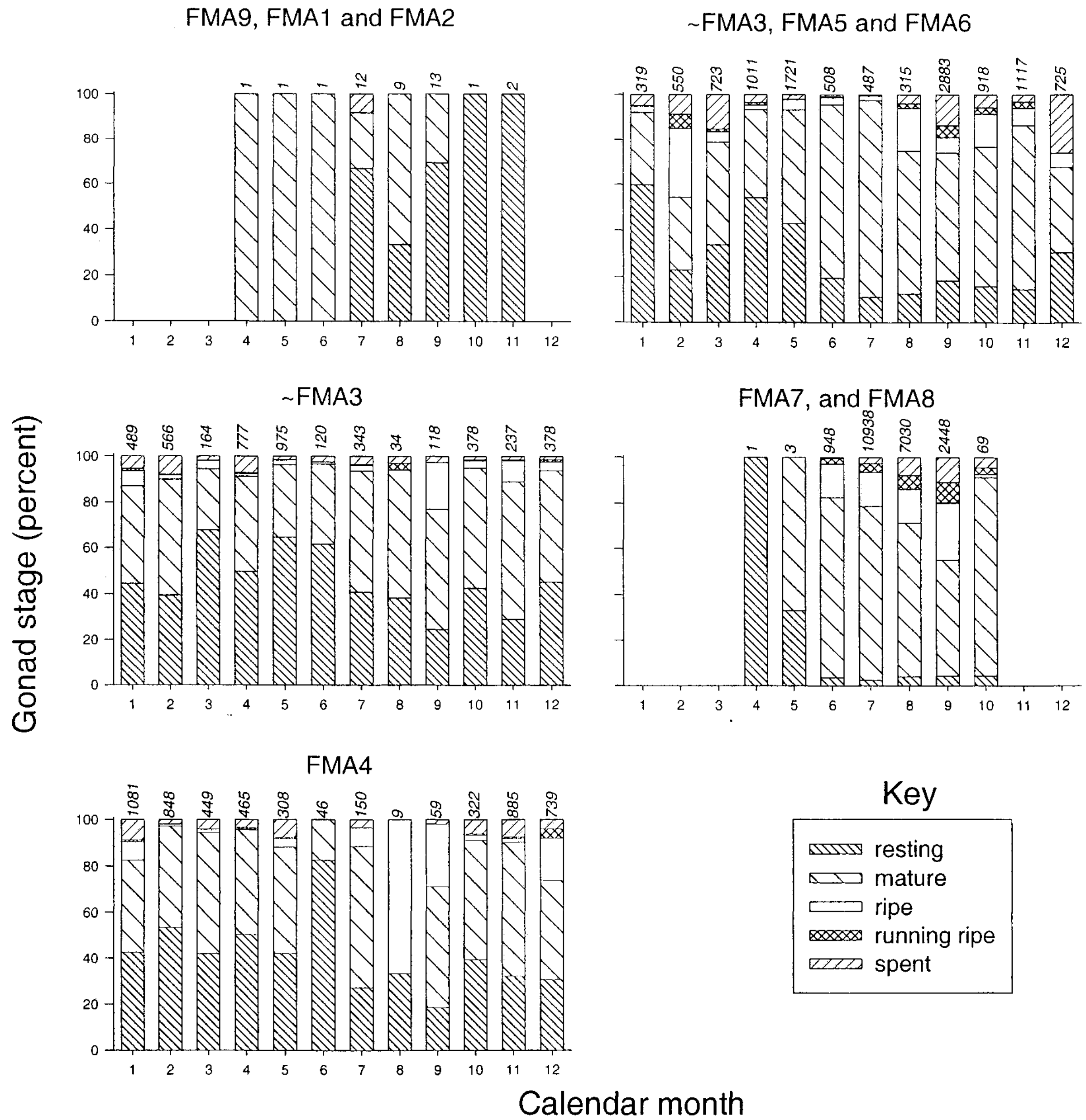

FMA9 and FMA1
35°
FMA7 and FMA8
40° S
FMA2
Cook Strait
45°
~FMA3 and FMA4
~FMA3, FMA5 and FMA6
200 m
1000 m
N = 5679
N = 14023
50°
Macruronus novaezealandiae
Hoki
Spent
55°
165°
170°
175° E
180°
175° W



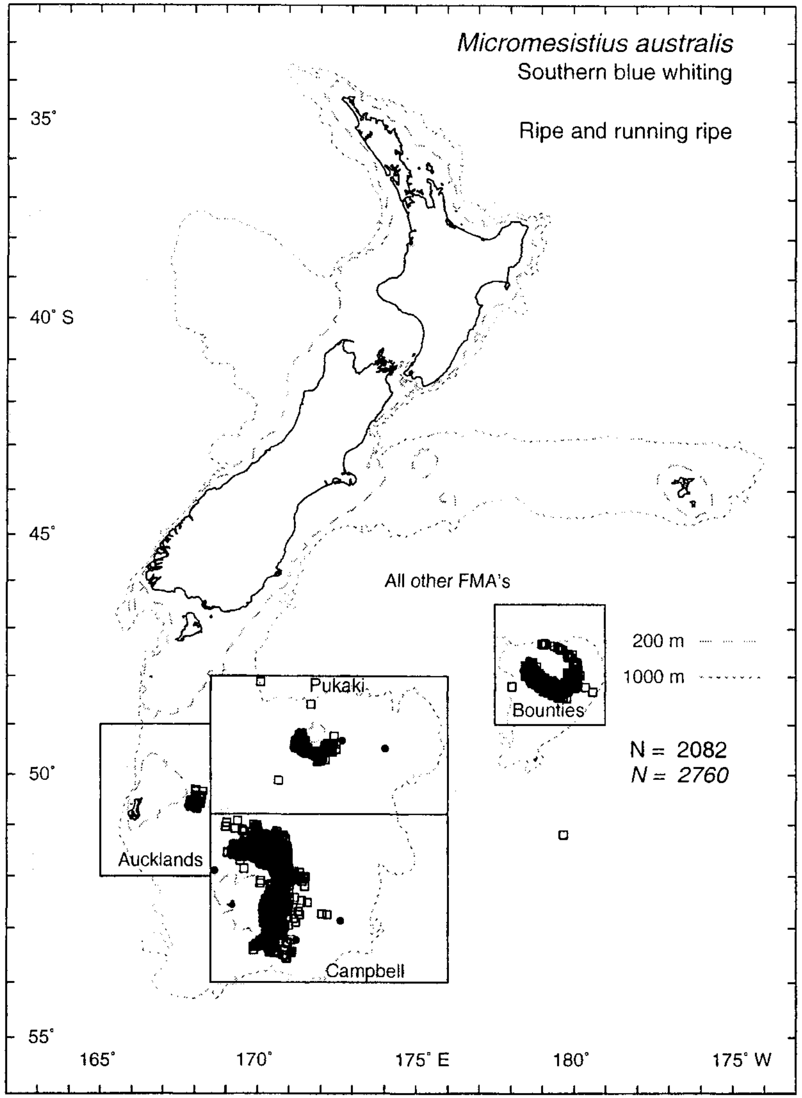
Hoki gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized fish staged per month. ET refers to out of EEZ trips.

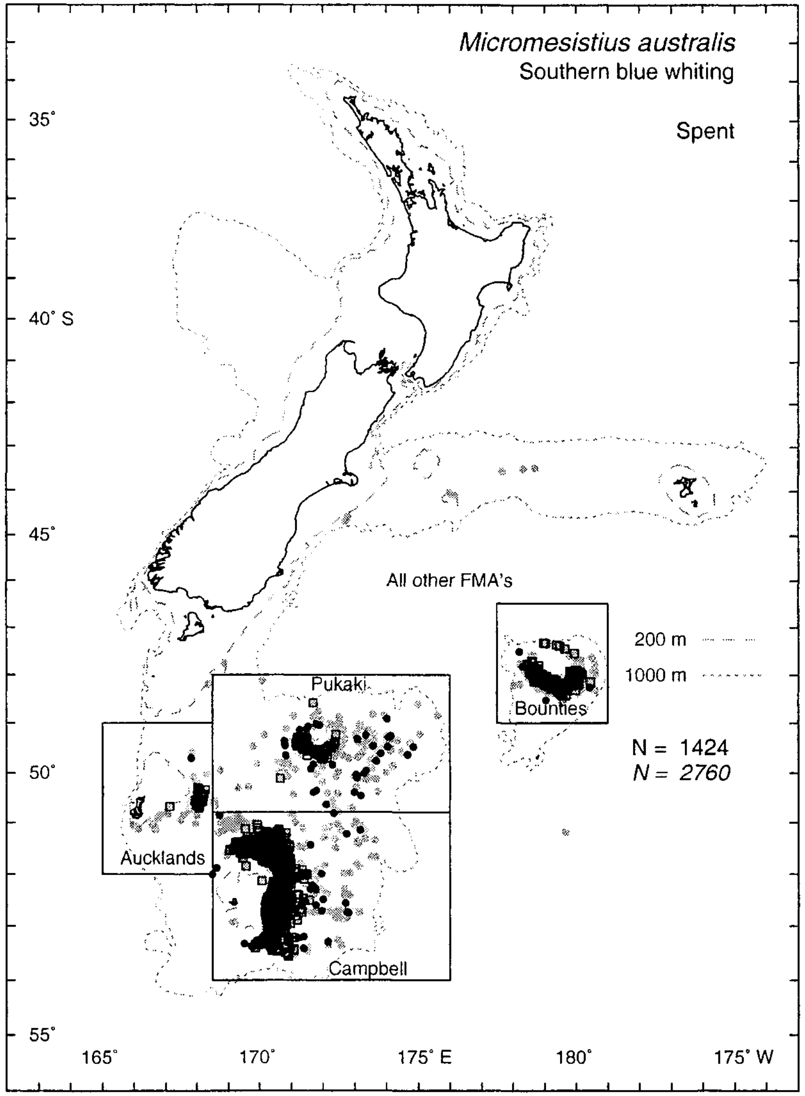

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
FMA9, FMA1 and FMA2
FMA7 and FMA8
~FMA3
FMA4
~FMA3, FMA5 and FMA6
200 m
1000 m
N = 2021
Merluccius australis
Hake
Ripe and running ripe

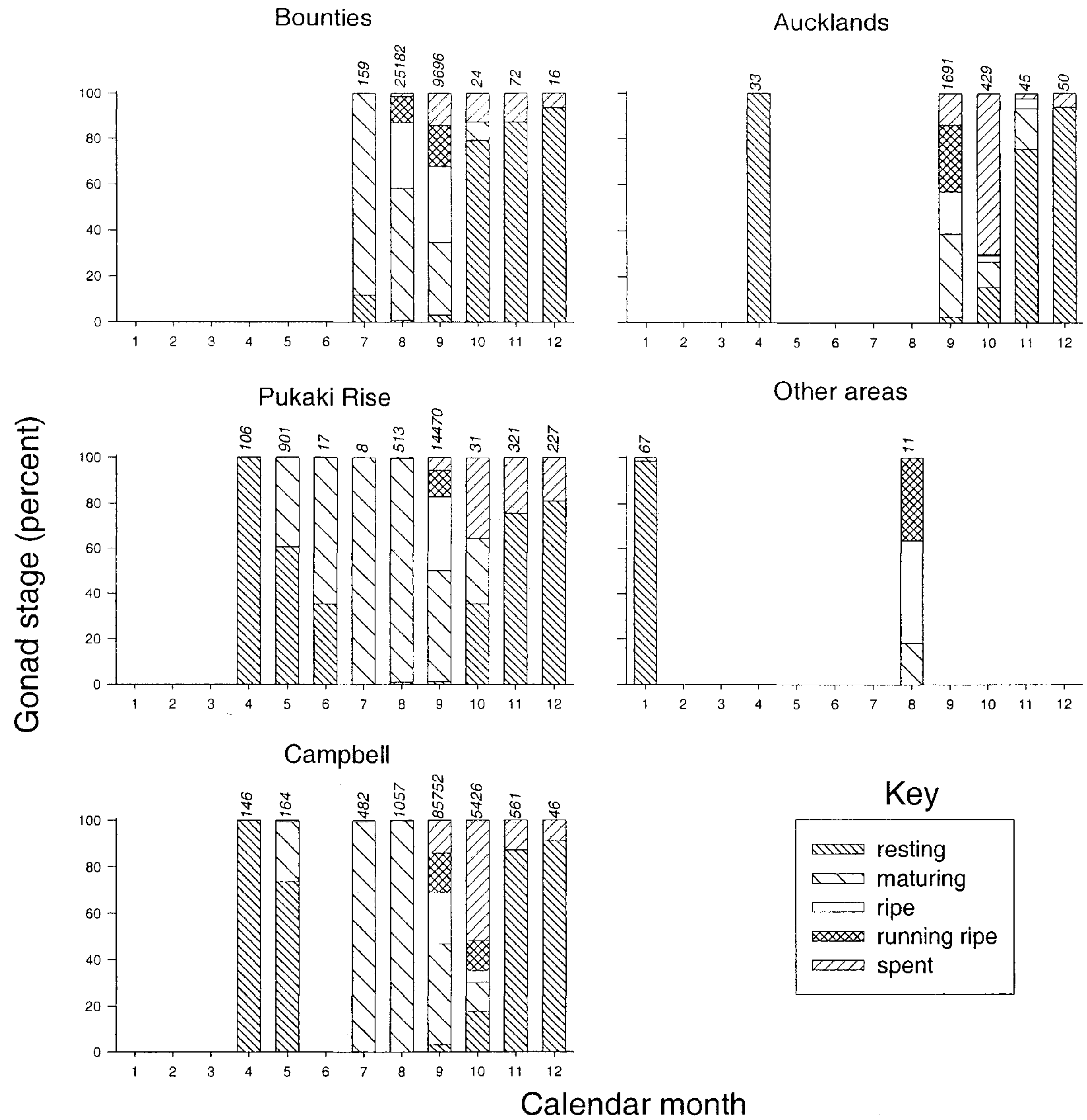

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
FMA9, FMA1 and FMA2
FMA7 and FMA8
~FMA3
FMA4
~FMA3, FMA5 and FMA6
200 m
1000 m
N = 1199
N = 7913
Merluccius australis
Hake
Spent



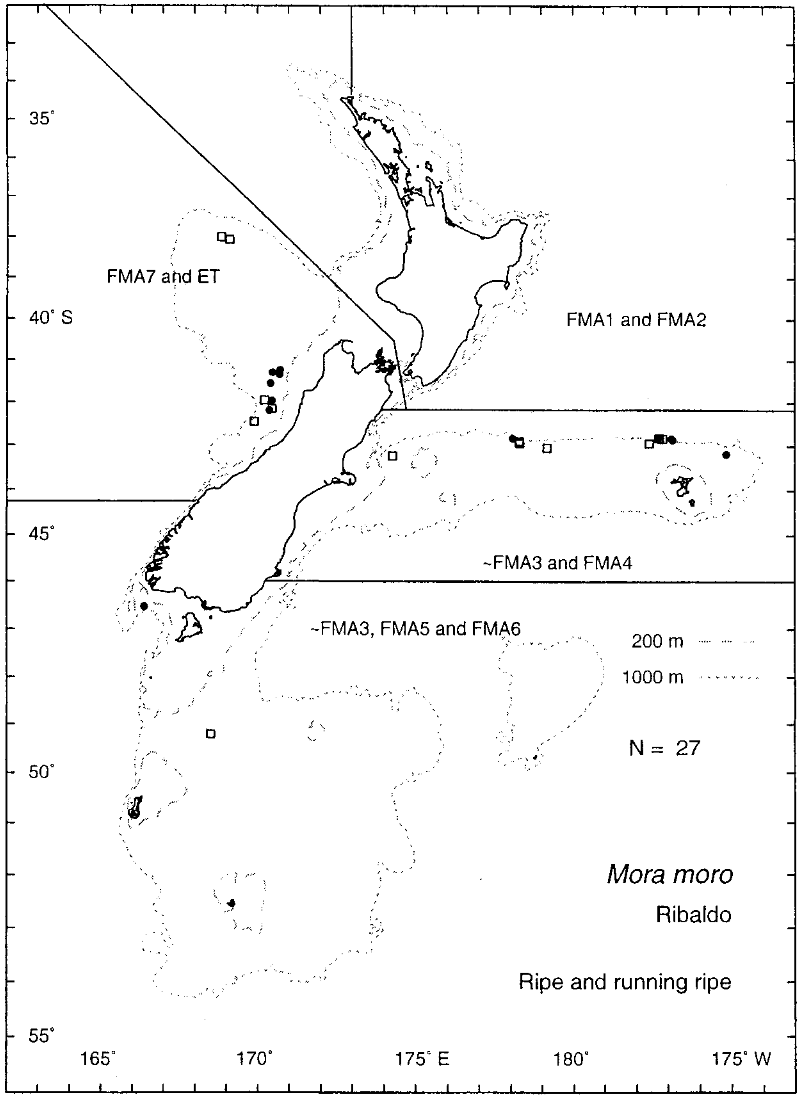
Hake gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized fish staged per month.

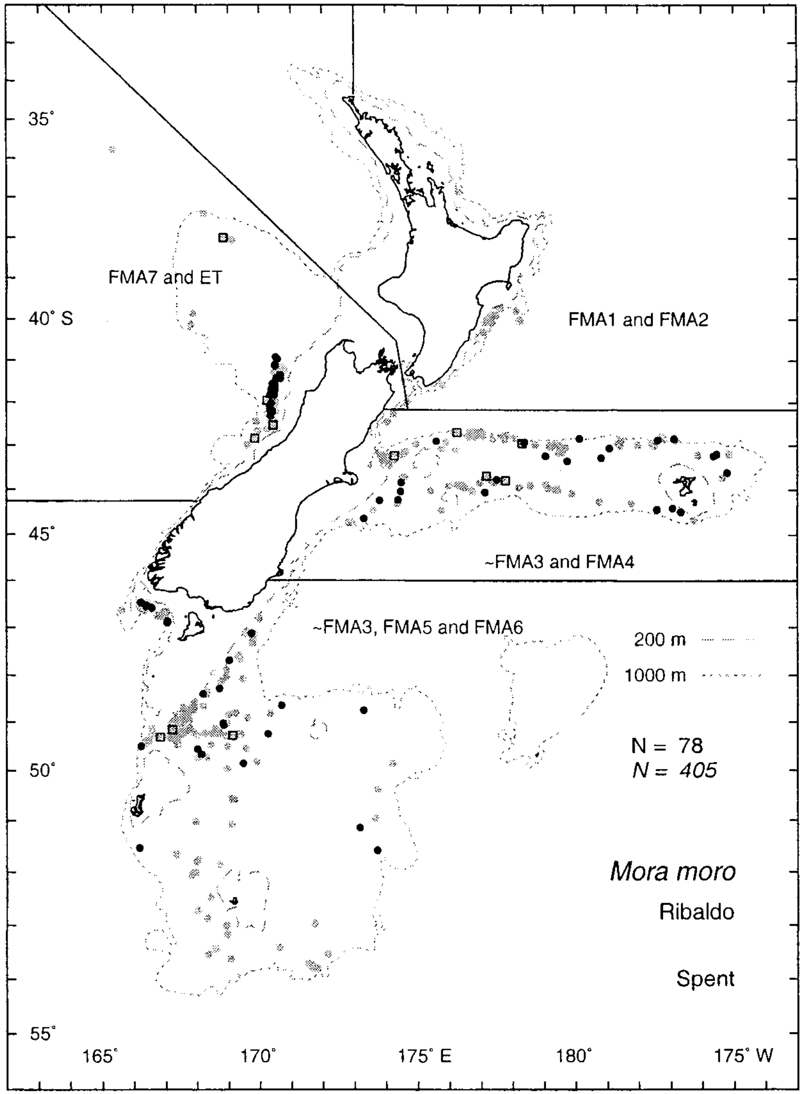

Micromesistius australis
Southern blue whiting
Ripe and running ripe
All other FMA's
200 m
1000 m
Pukaki
Bounties
Aucklands
Campbell
N = 2082
N = 2760
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W

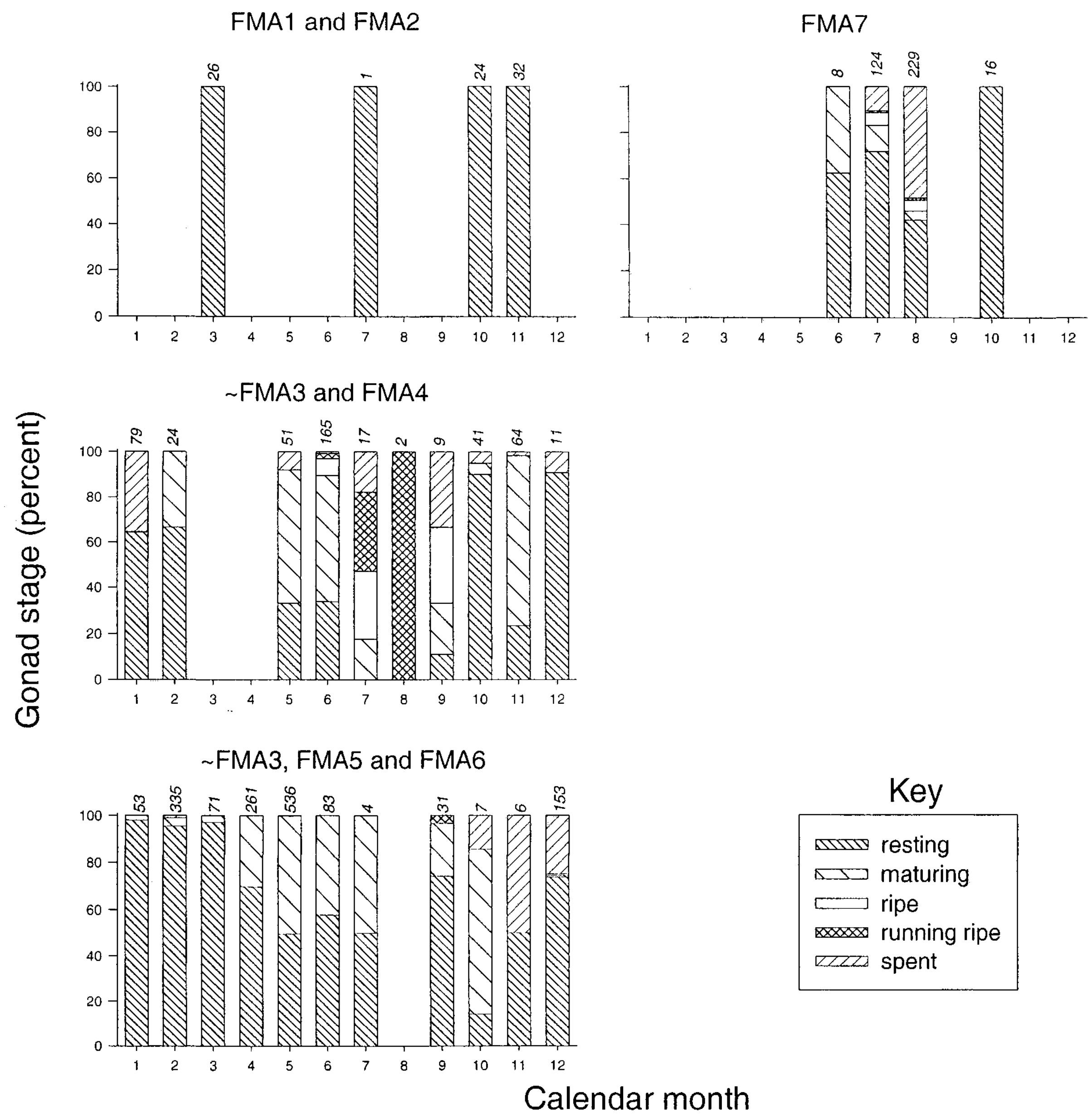

Micromesistius australis
Southern blue whiting
Spent
All other FMA's
200 m
1000 m
Pukaki
Bounties
Aucklands
Campbell
N = 1424
N = 2760
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W



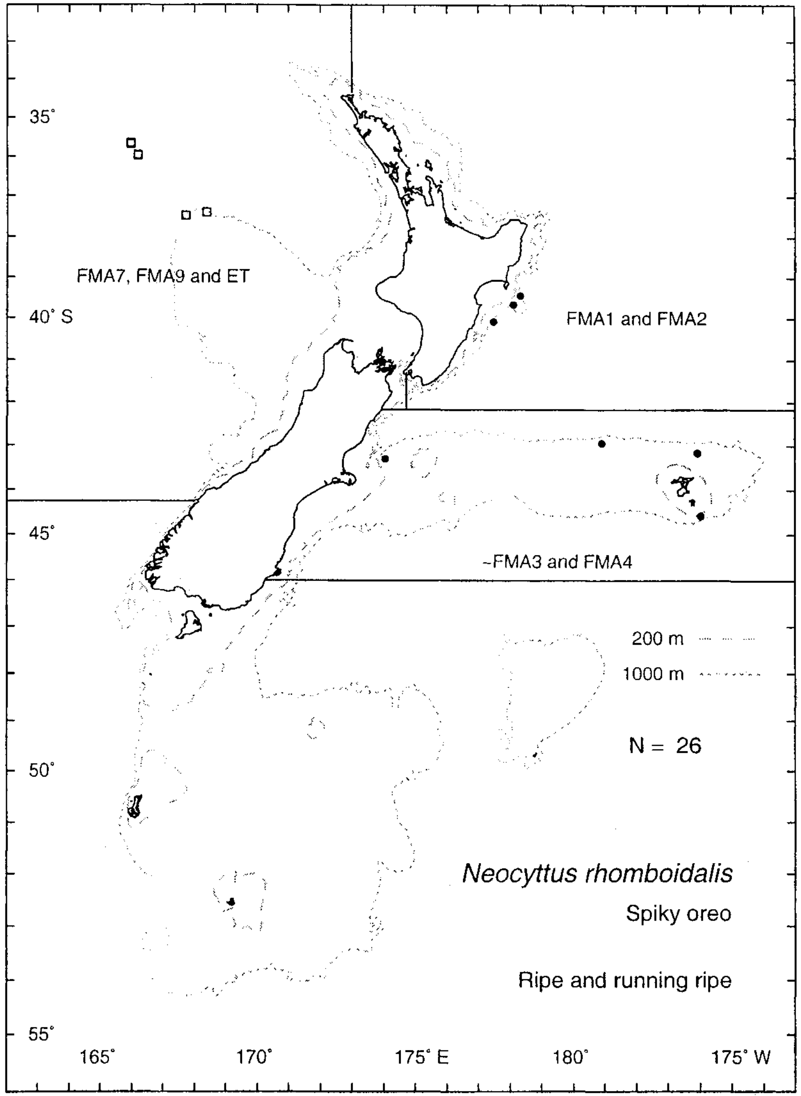
Southern blue whiting gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized fish staged per month.

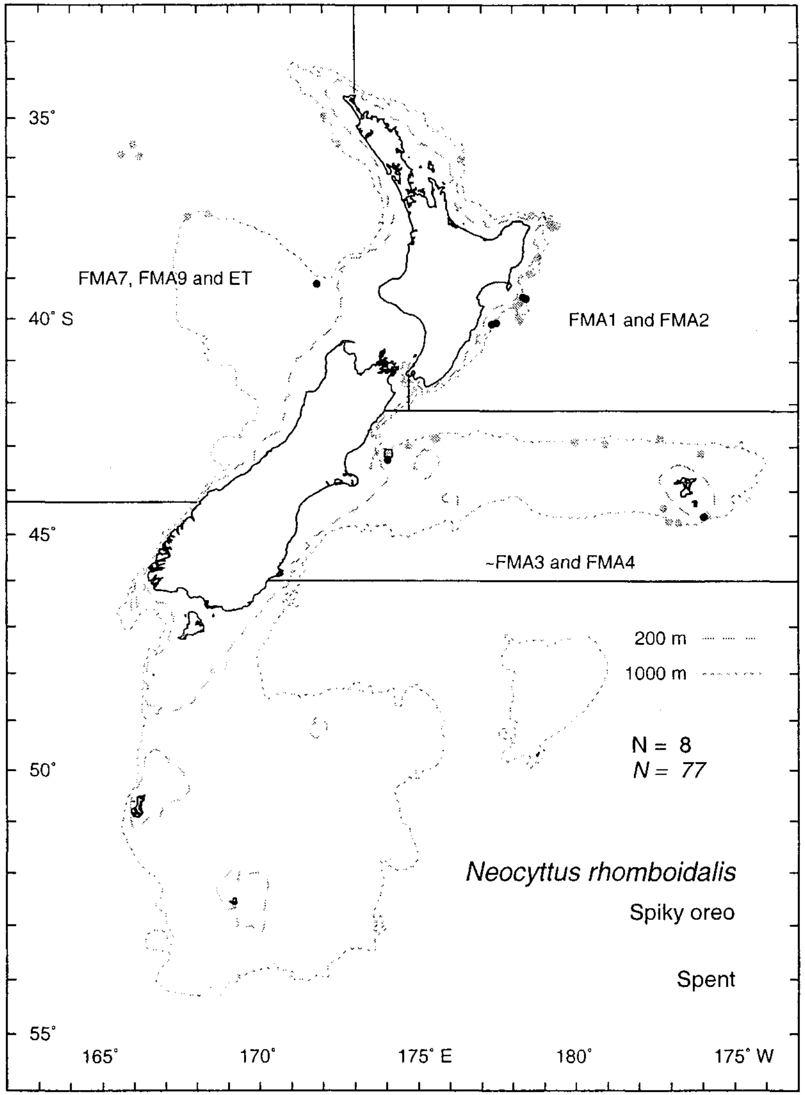

FMA7 and ET
FMA1 and FMA2
~FMA3 and FMA4
~FMA3, FMA5 and FMA6
200 m
1000 m
N = 27
Mora moro
Ribaldo
Ripe and running ripe
35˚
40˚ S
45˚
50˚
55˚
165˚
170˚
175˚ E
180˚
175˚ W

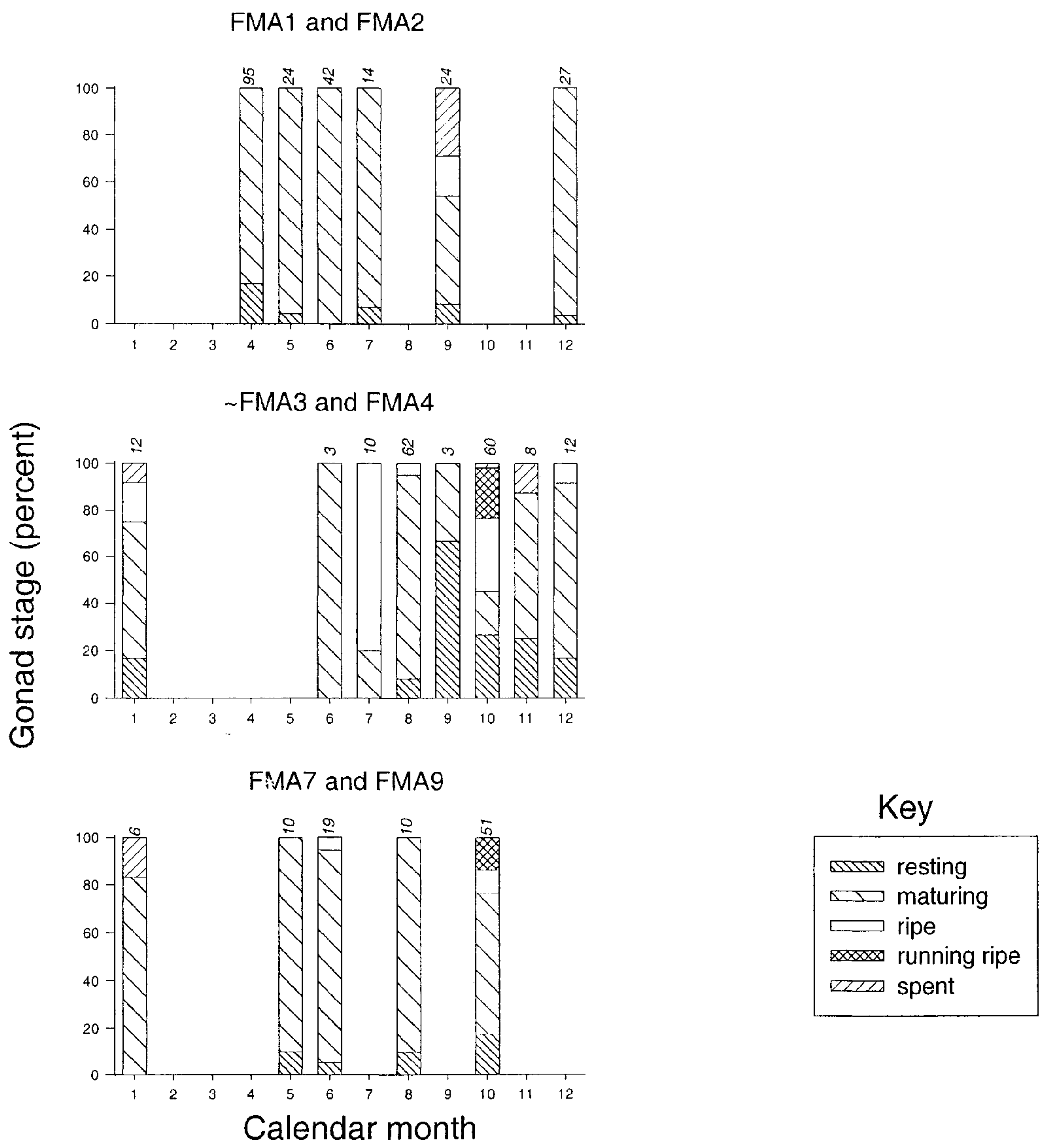

FMA7 and ET
FMA1 and FMA2
~FMA3 and FMA4
~FMA3, FMA5 and FMA6
200 m
1000 m
N = 78
N = 405
Mora moro
Ribaldo
Spent
35˚
40˚ S
45˚
50˚
55˚
165˚
170˚
175˚ E
180˚
175˚ W



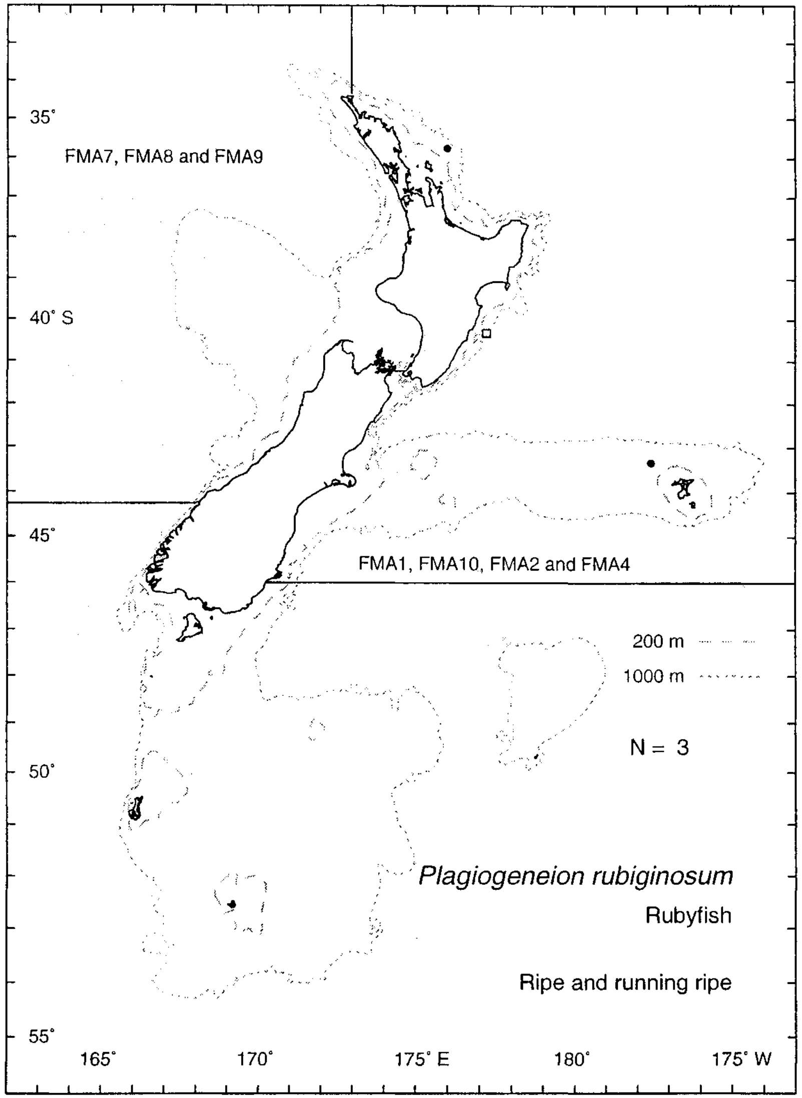
Ribaldo gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized fish staged per month.

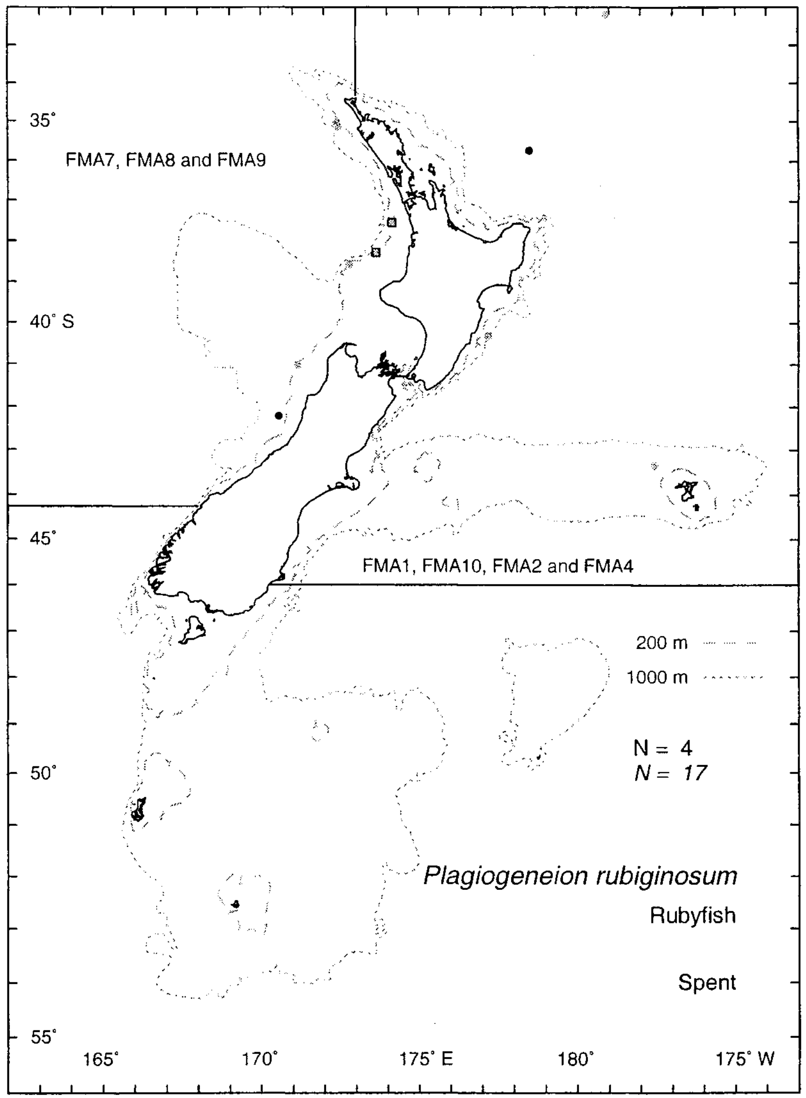

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
FMA7, FMA9 and ET
FMA1 and FMA2
~FMA3 and FMA4
200 m
1000 m
N = 26
Neocyttus rhomboidalis
Spiky oreo
Ripe and running ripe

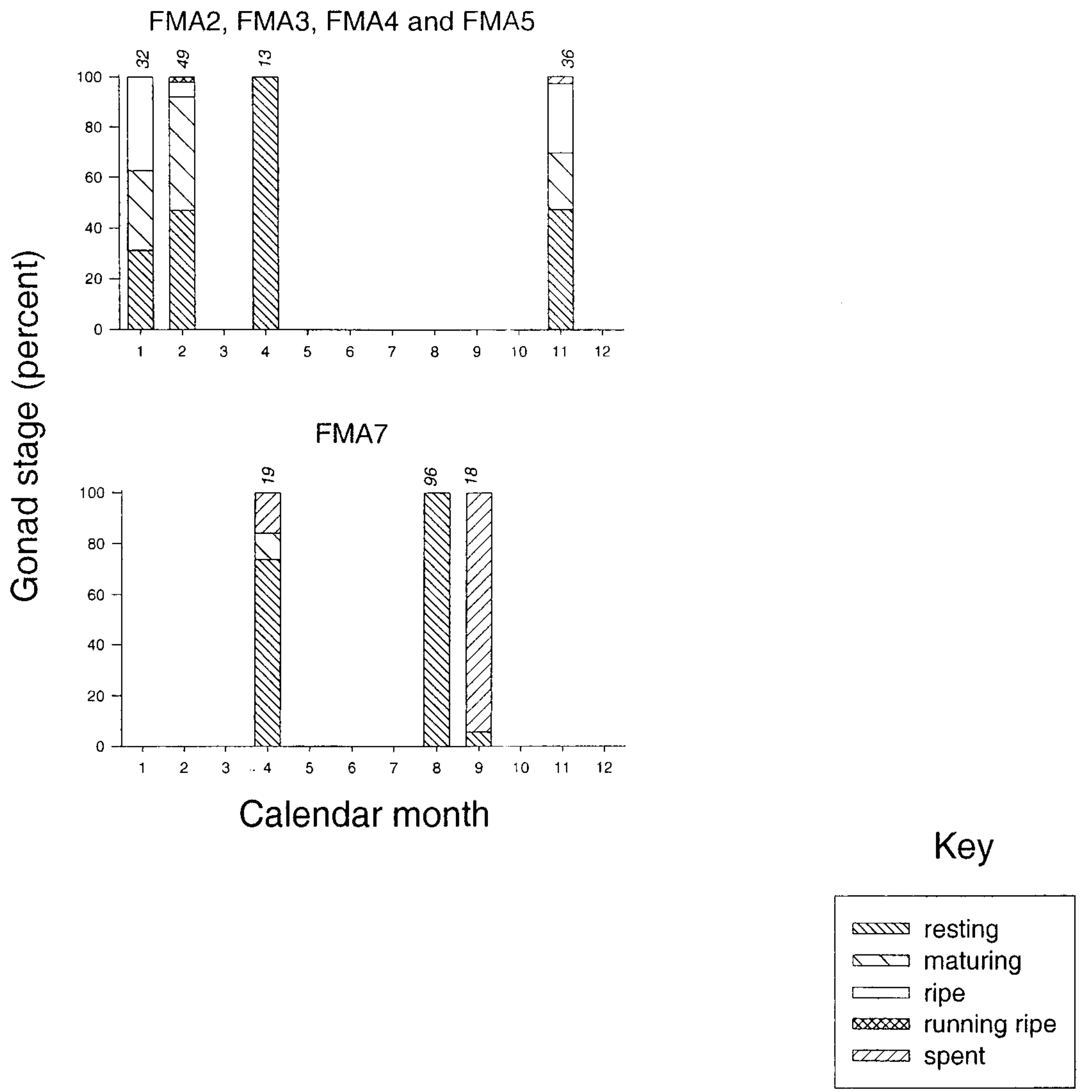

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
FMA7, FMA9 and ET
FMA1 and FMA2
~FMA3 and FMA4
200 m
1000 m
N = 8
N = 77
Neocyttus rhomboidalis
Spiky oreo
Spent



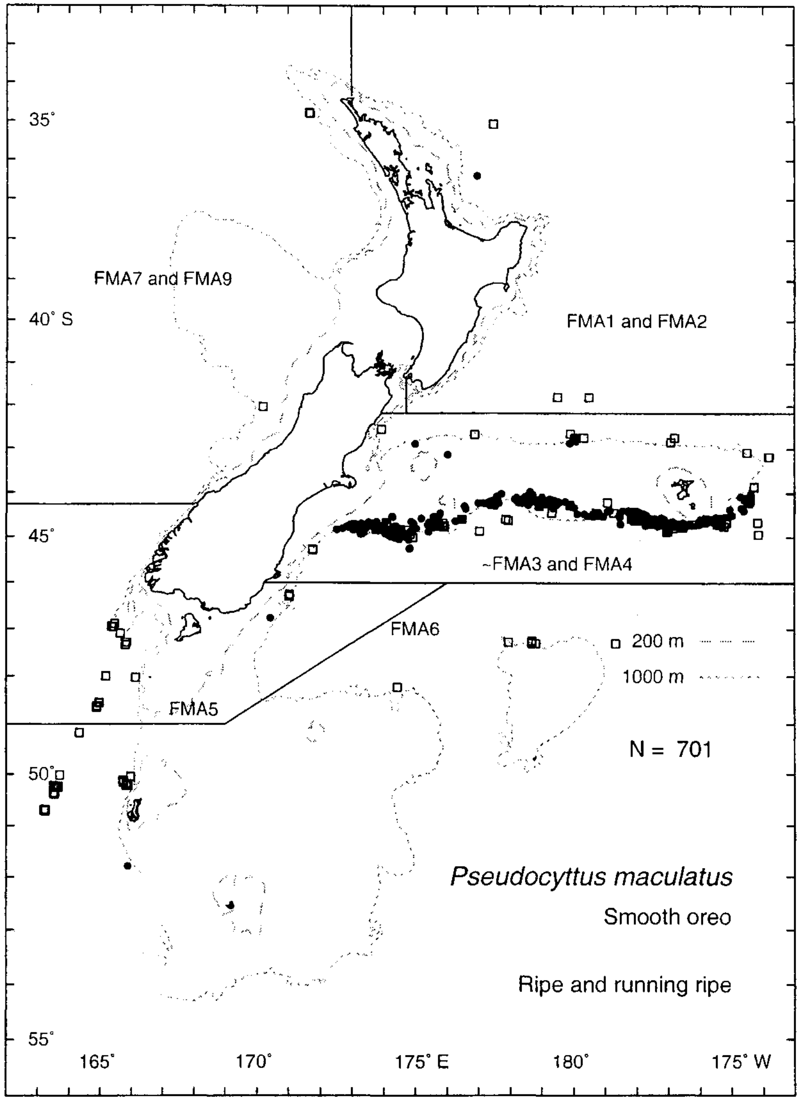
Spiky oreo female gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized female fish staged per month.

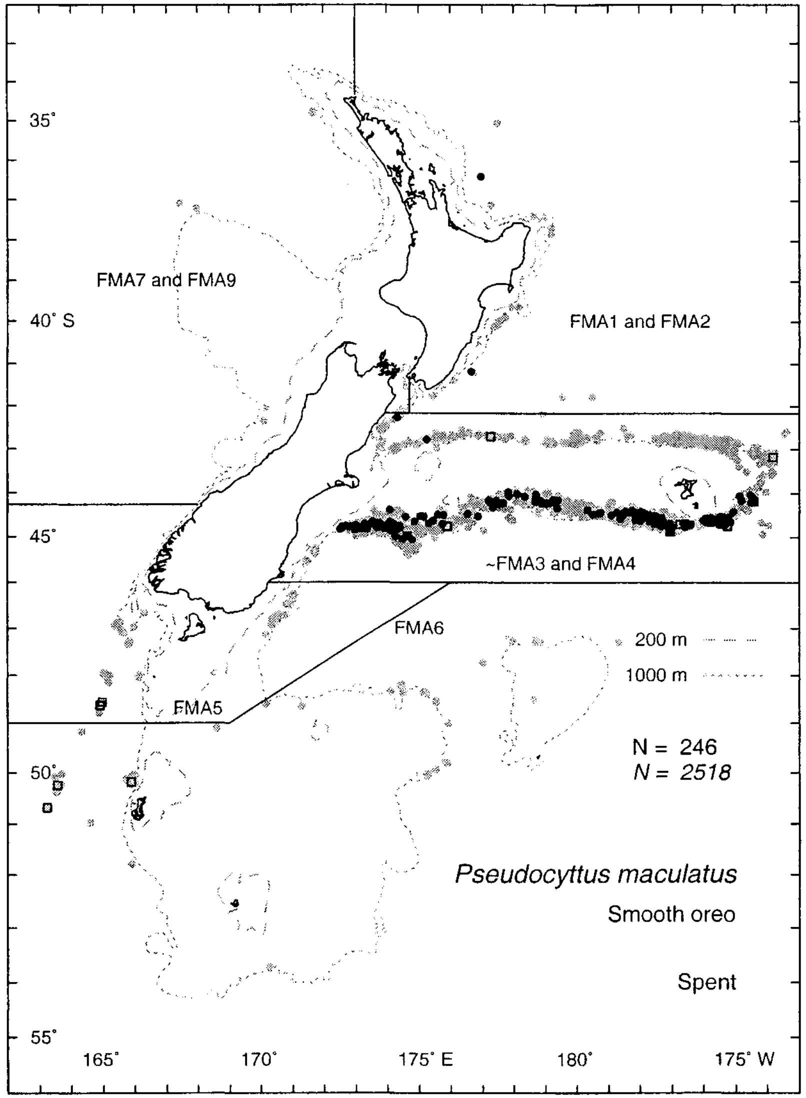

35°
FMA7, FMA8 and FMA9
40° S
45°
FMA1, FMA10, FMA2 and FMA4
200 m
1000 m
N = 3
50°
Plagiogeneion rubiginosum
Rubyfish
Ripe and running ripe
55°
165°
170°
175° E
180°
175° W

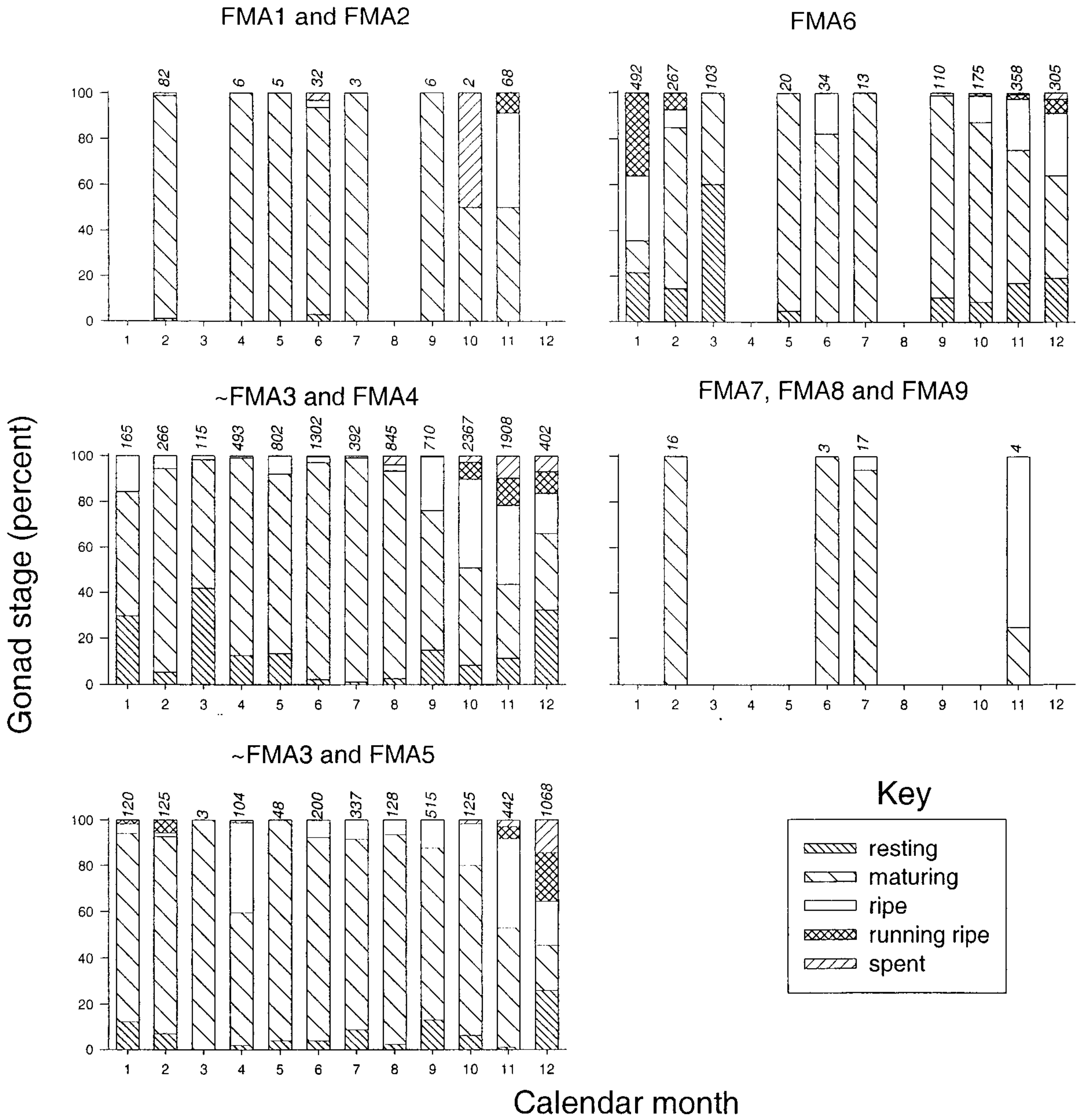

35°
FMA7, FMA8 and FMA9
40° S
45°
FMA1, FMA10, FMA2 and FMA4
200 m
1000 m
N = 4
N = 17
50°
Plagiogeneion rubiginosum
Rubyfish
Spent
55°
165°
170°
175° E
180°
175° W



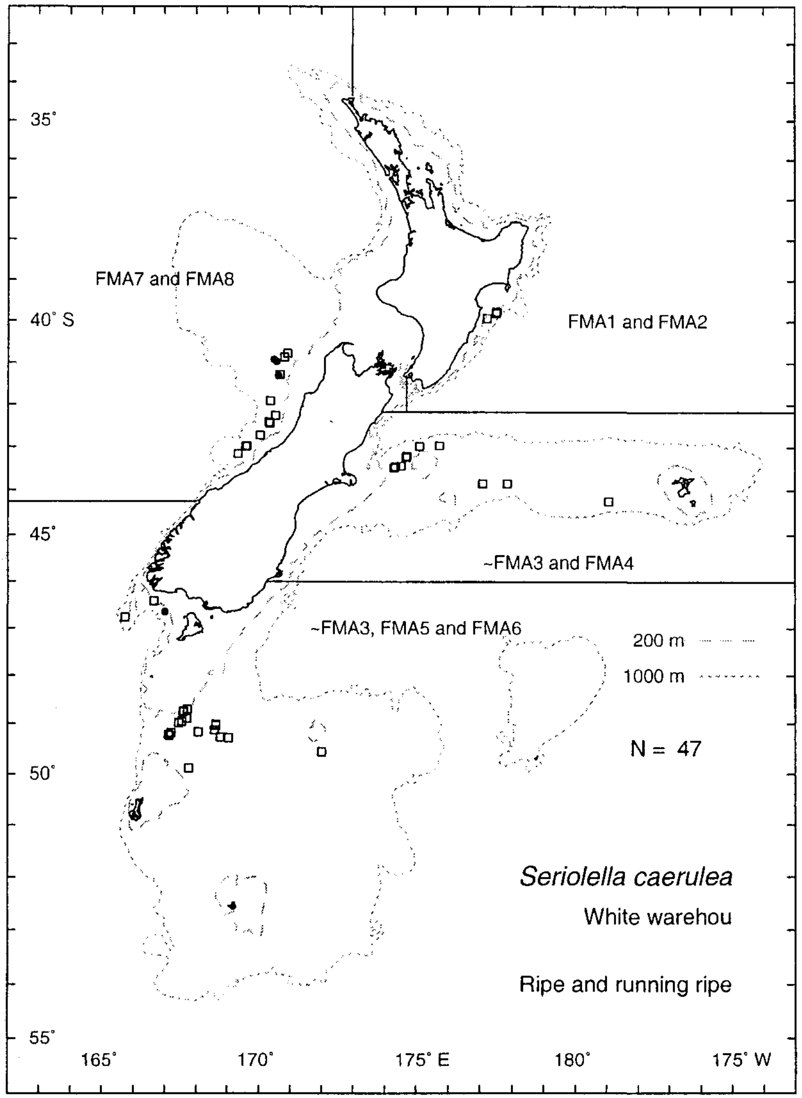
Rubyfish female gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized female fish staged per month.

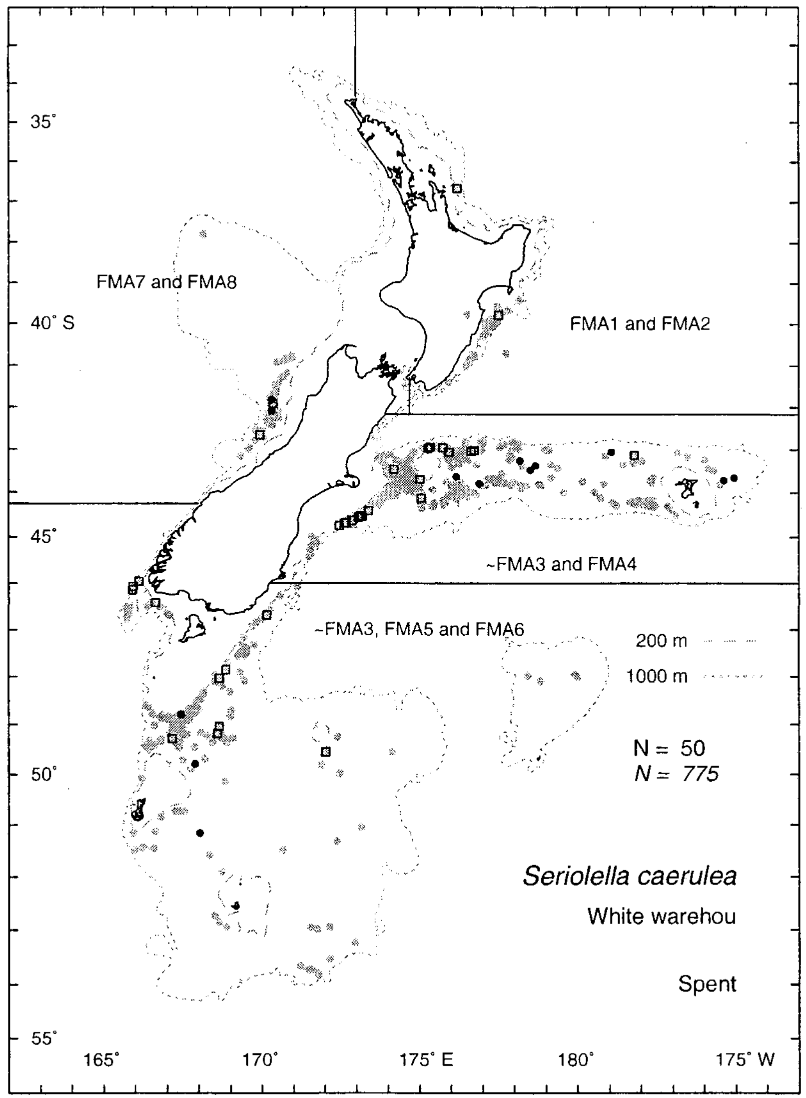

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
FMA7 and FMA9
FMA1 and FMA2
~FMA3 and FMA4
FMA6
FMA5
200 m
1000 m
N = 701
Pseudocyttus maculatus
Smooth oreo
Ripe and running ripe

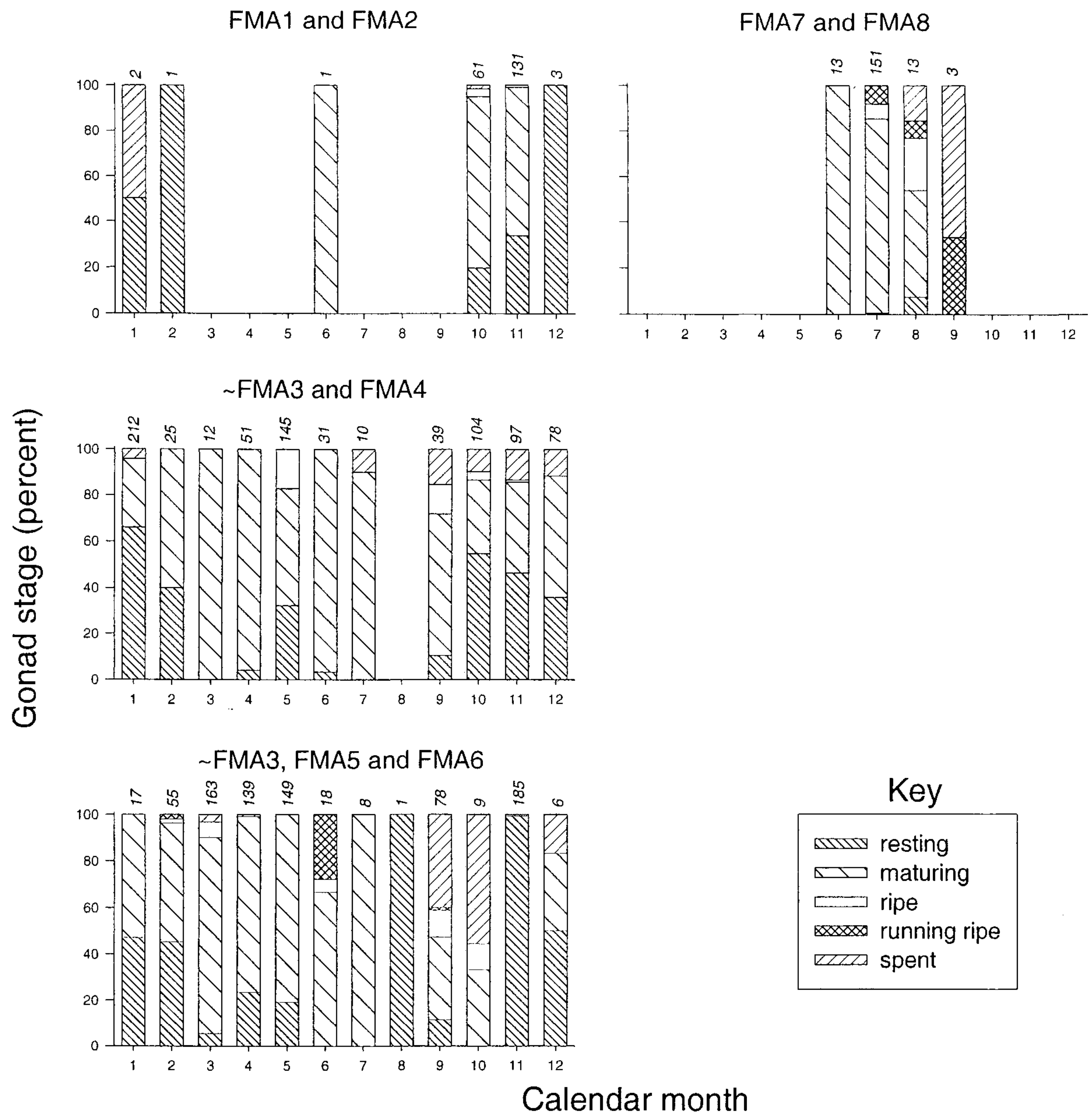

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
FMA7 and FMA9
FMA1 and FMA2
~FMA3 and FMA4
FMA6
FMA5
200 m
1000 m
N = 246
N = 2518
Pseudocyttus maculatus
Smooth oreo
Spent



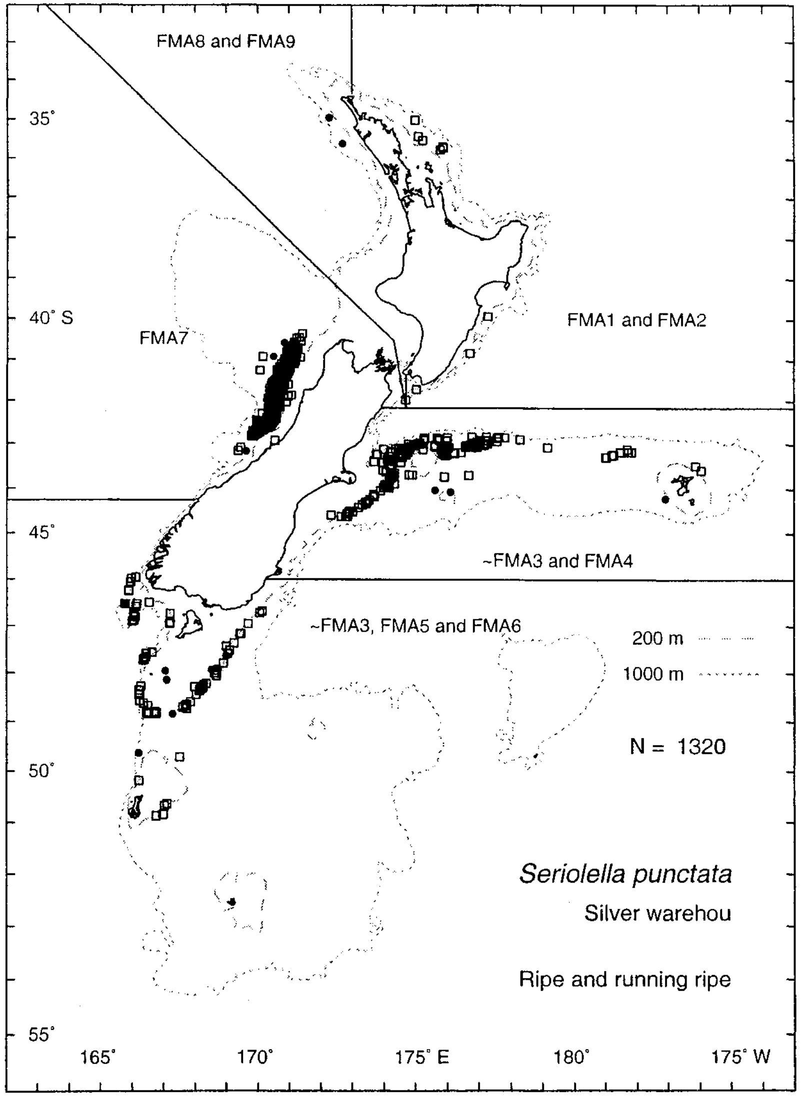
Smooth oreo gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized fish staged per month.

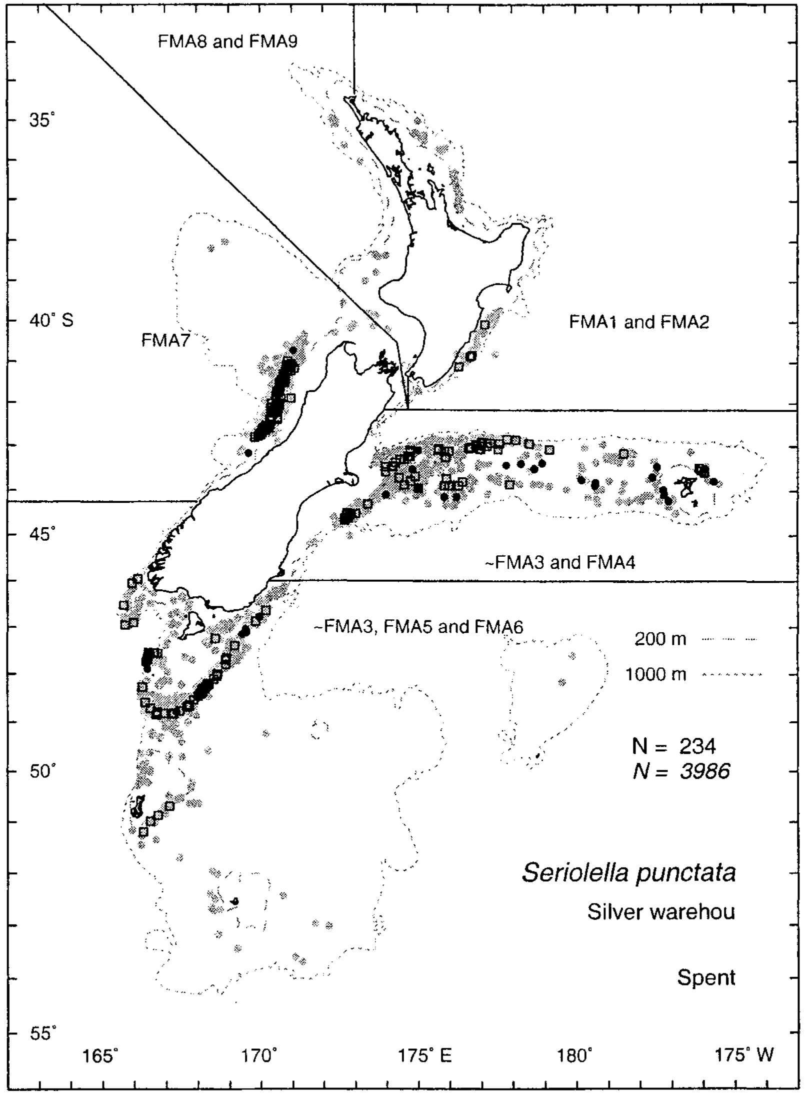

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
FMA7 and FMA8
FMA1 and FMA2
~FMA3 and FMA4
~FMA3, FMA5 and FMA6
200 m
1000 m
N = 47
Seriolella caerulea
White warehou
Ripe and running ripe

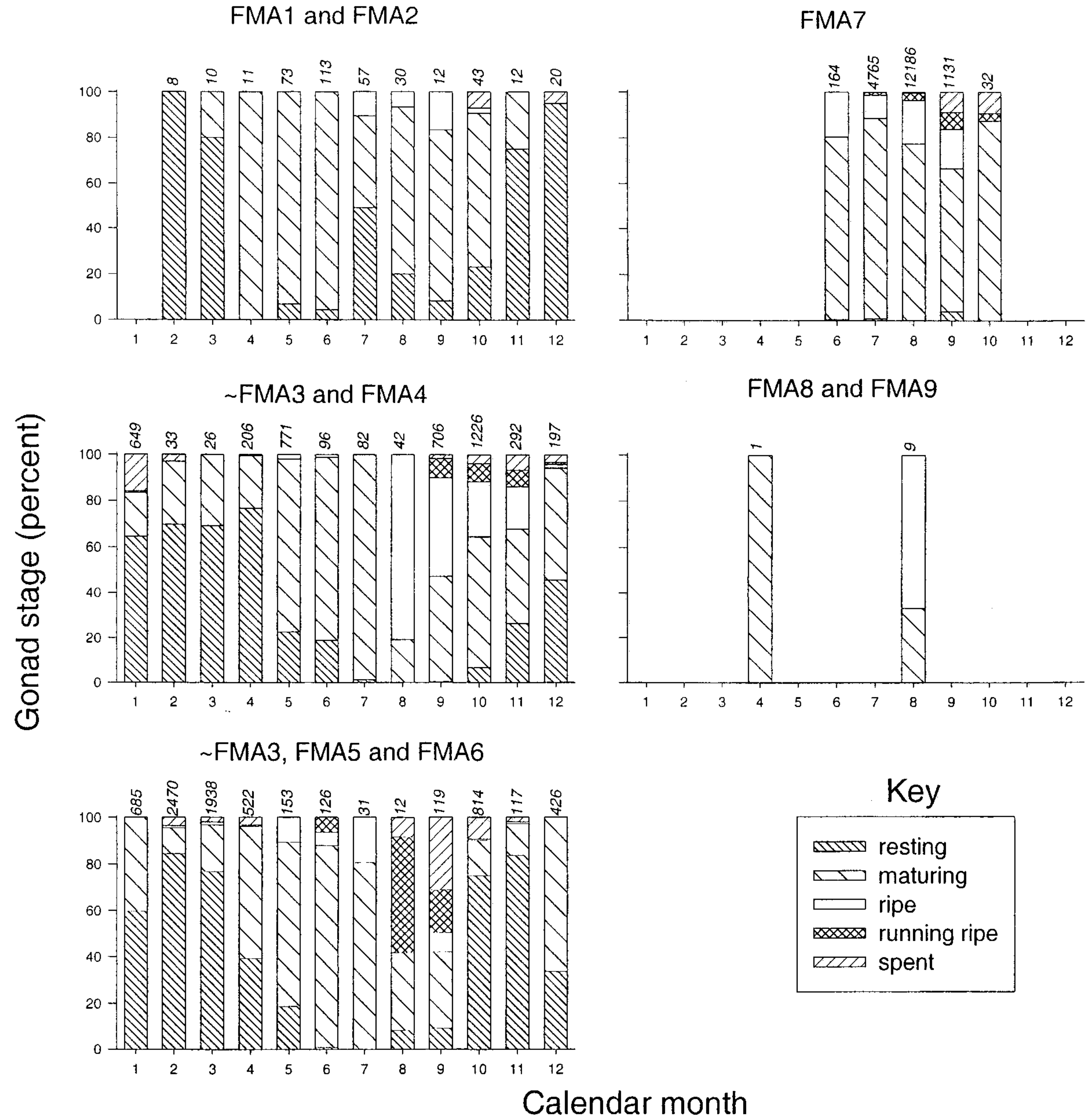

35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
FMA7 and FMA8
FMA1 and FMA2
~FMA3 and FMA4
~FMA3, FMA5 and FMA6
200 m
1000 m
N = 50
N = 775
Seriolella caerulea
White warehou
Spent



White warehou gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized fish staged per month.


FMA8 and FMA9
FMA1 and FMA2
FMA7
~FMA3 and FMA4
~FMA3, FMA5 and FMA6
200 m
1000 m
N = 1320
Seriolella punctata
Silver warehou
Ripe and running ripe
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W


FMA8 and FMA9
FMA1 and FMA2
FMA7
~FMA3 and FMA4
~FMA3, FMA5 and FMA6
200 m
1000 m
N = 234
N = 3986
Seriolella punctata
Silver warehou
Spent
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W



Silver warehou gonad stages by area by month. See distribution figure on page opposite for definition of areas. Numbers in italics are the numbers of mature sized fish staged per month.

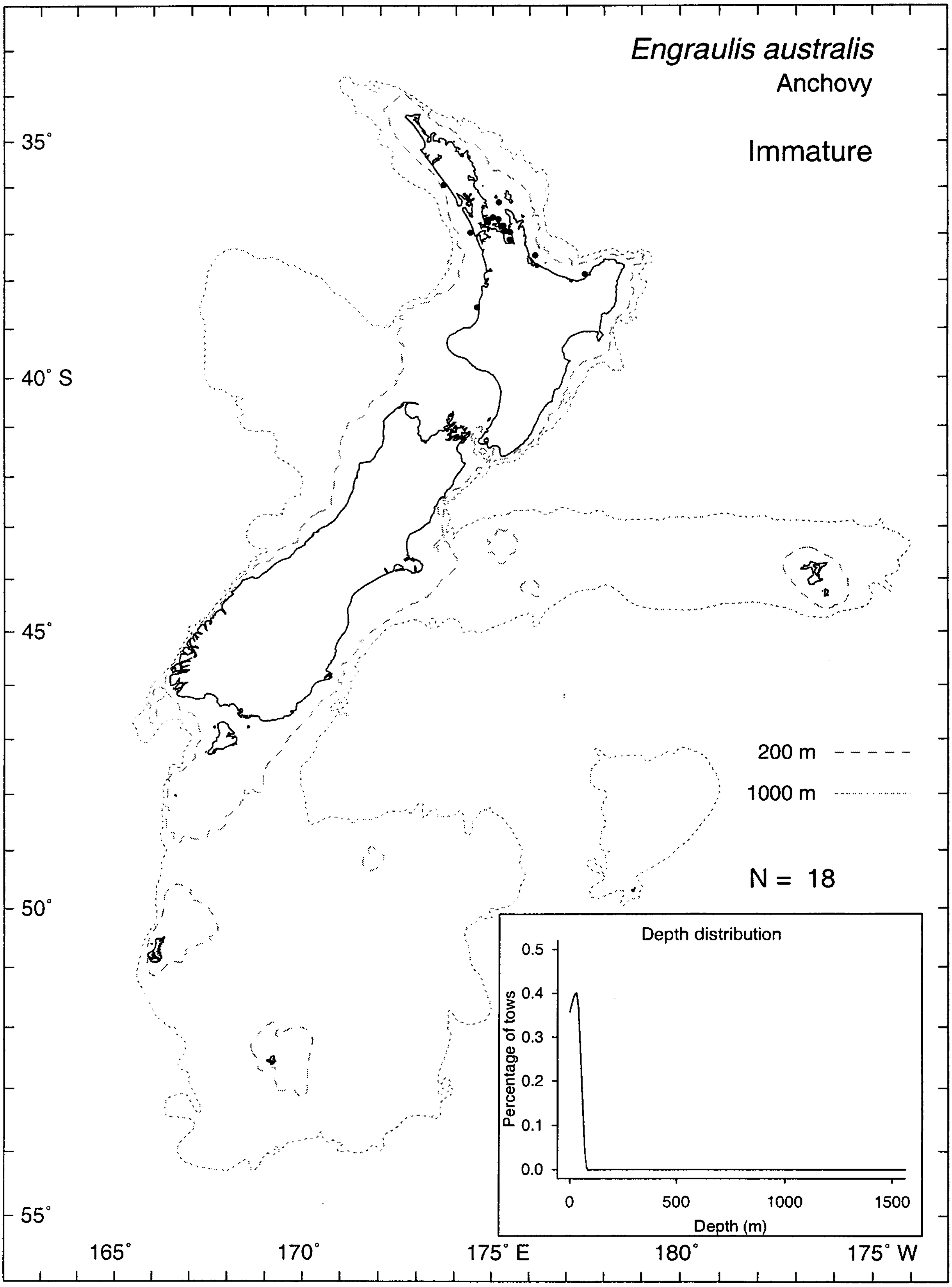
3.1 Pelagic fish juvenile distributions

Key to symbols and shading in the distribution plots

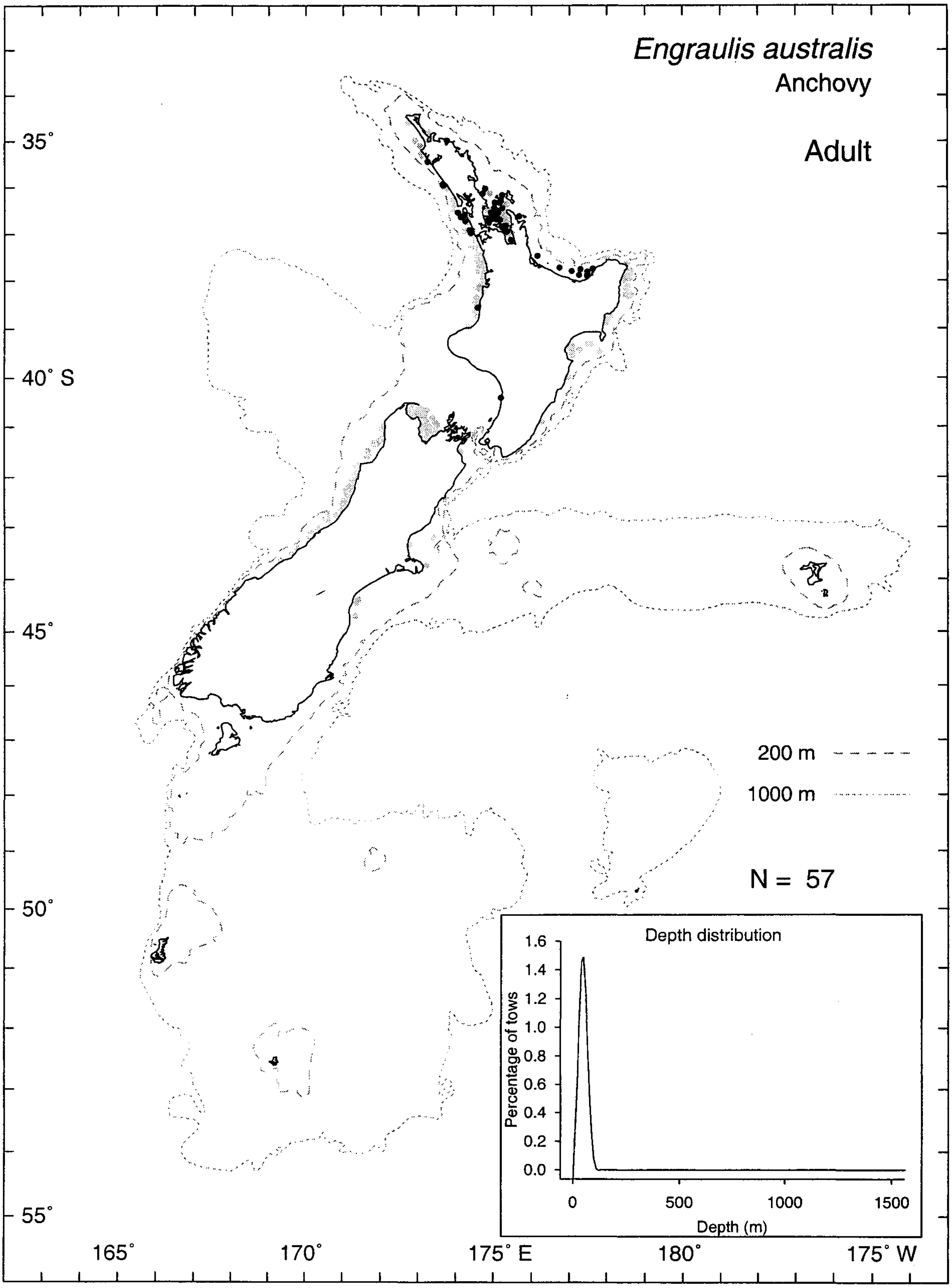
Symbols indicate positions where life history stage occurred.

N, number of stations

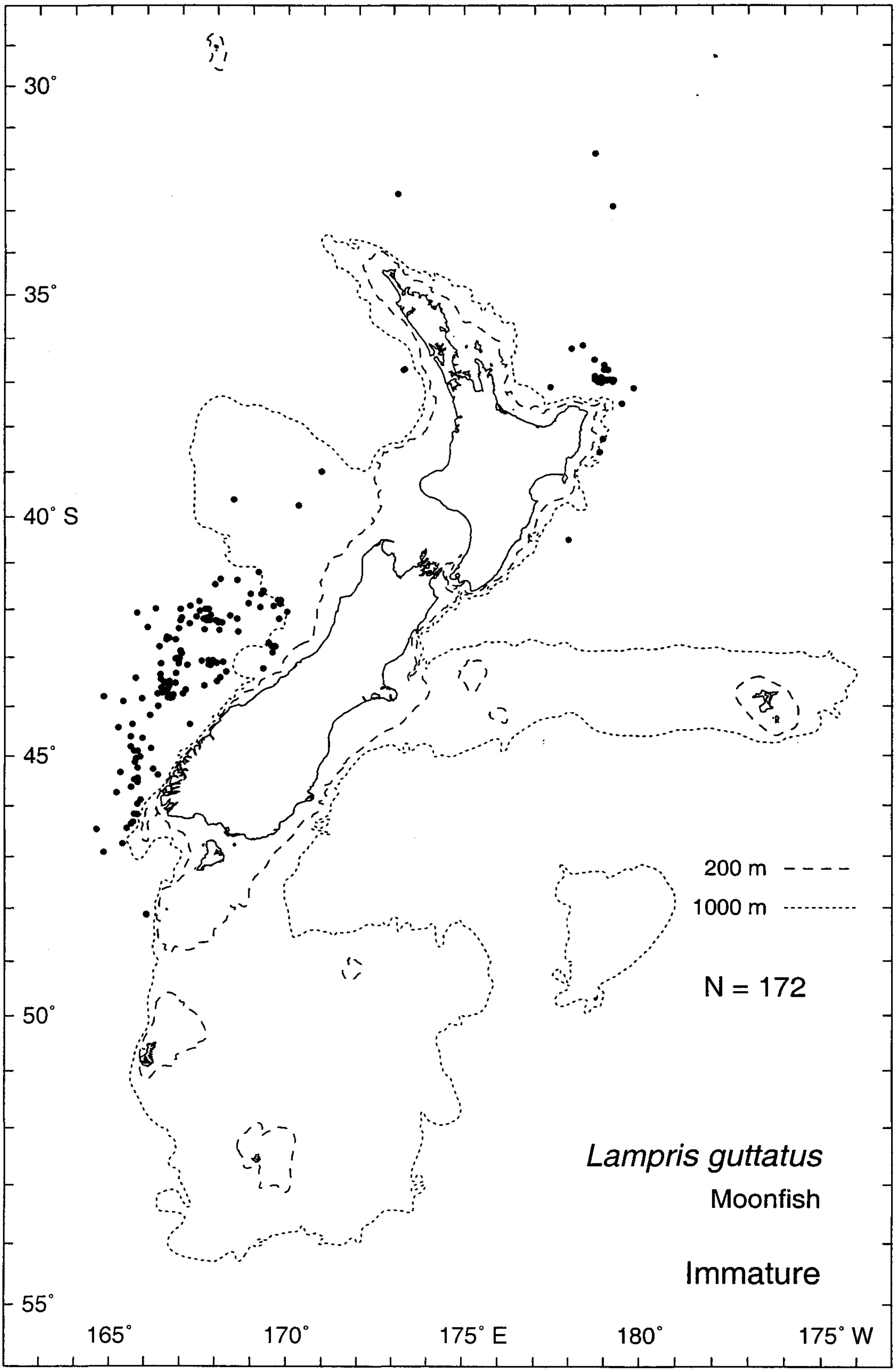
Grey shading in adult plots shows all positions where the species has been recorded in research or commercial databases.



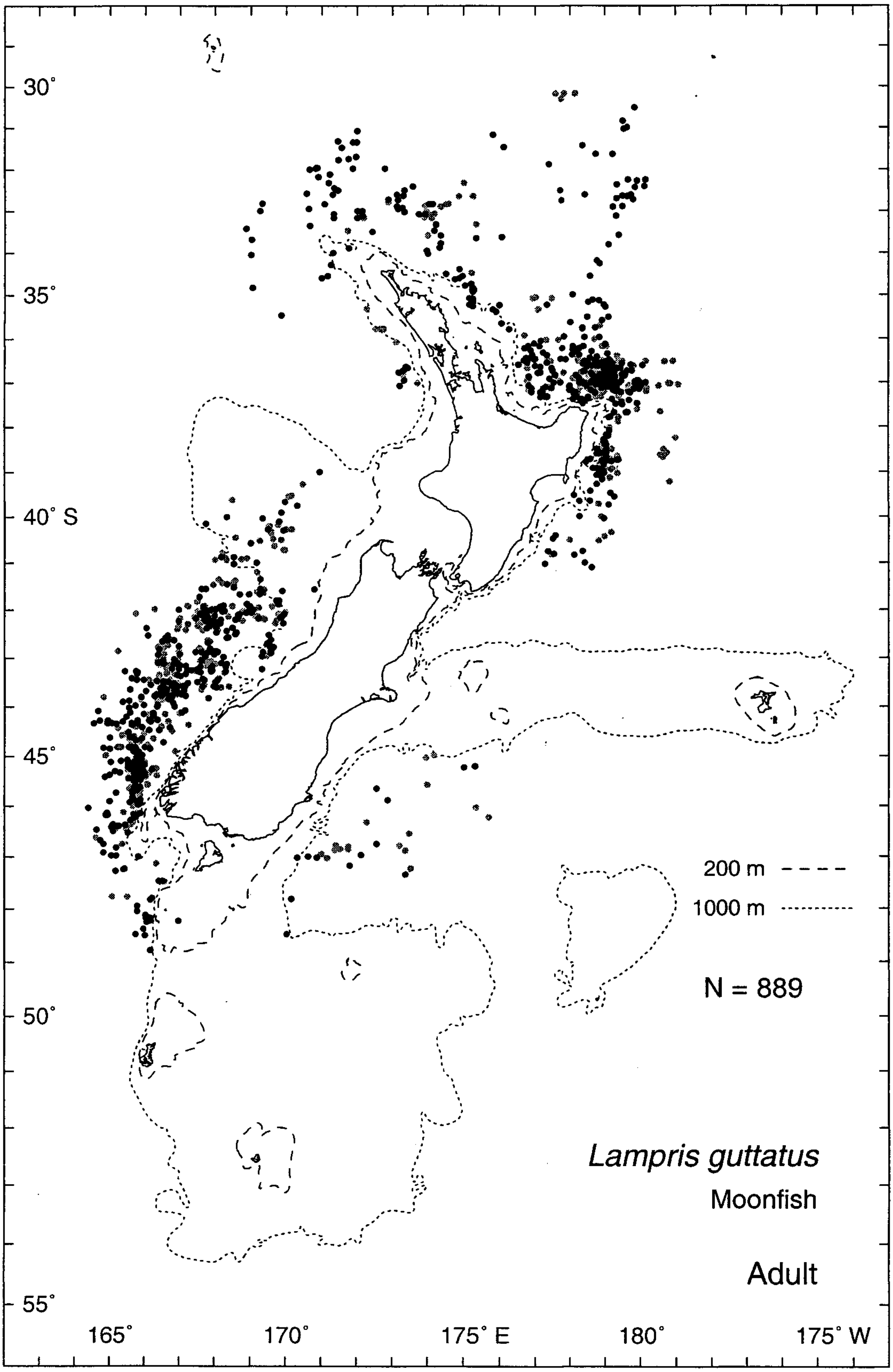
Engraulis australis
Anchovy
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 18
Depth distribution
Percentage of tows
0.5
0.4
0.3
0.2
0.1
0.0
0
500
1000
1500
Depth (m)



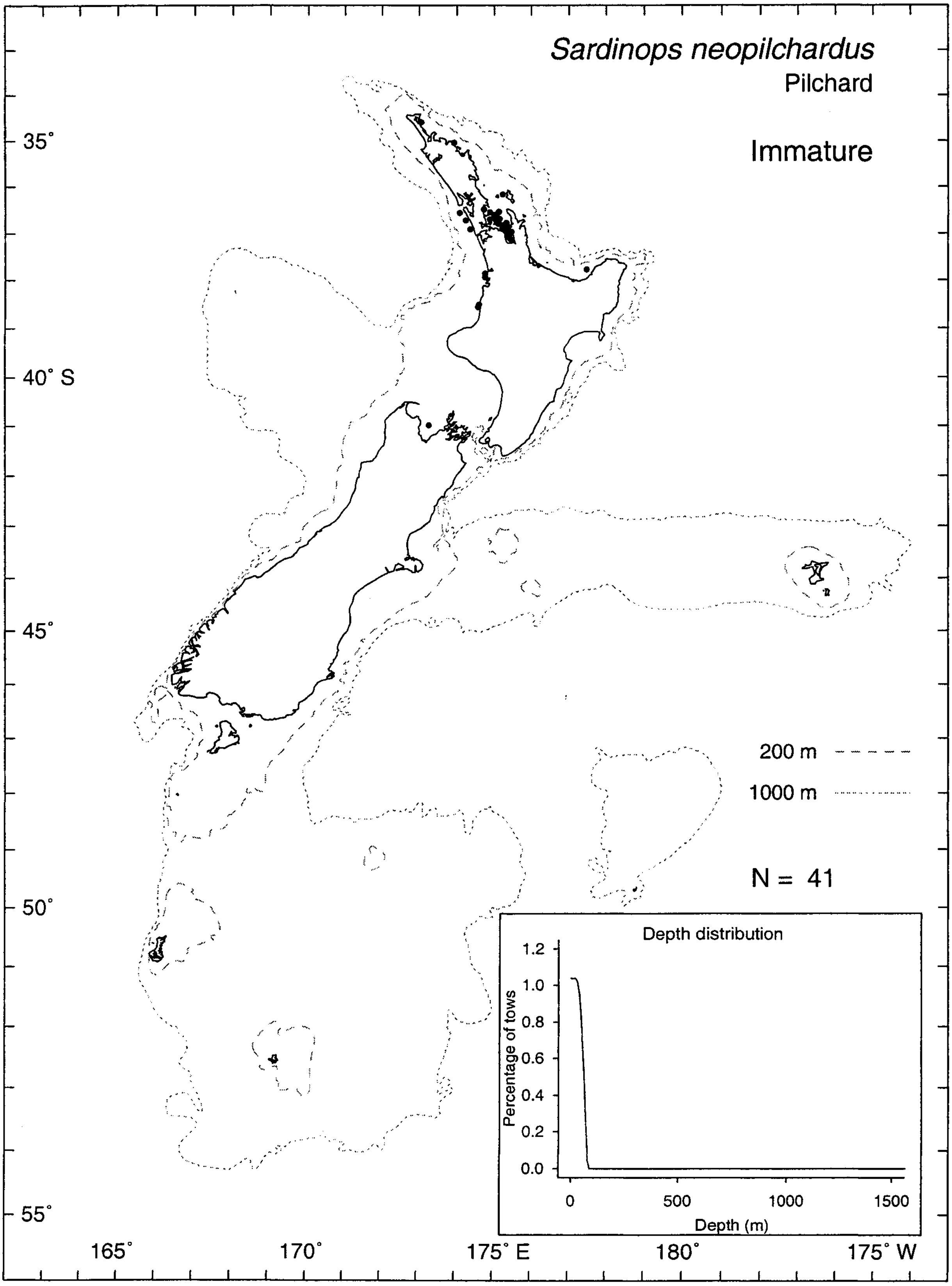
Engraulis australis
Anchovy
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 57
Depth distribution
Percentage of tows
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
Depth (m)



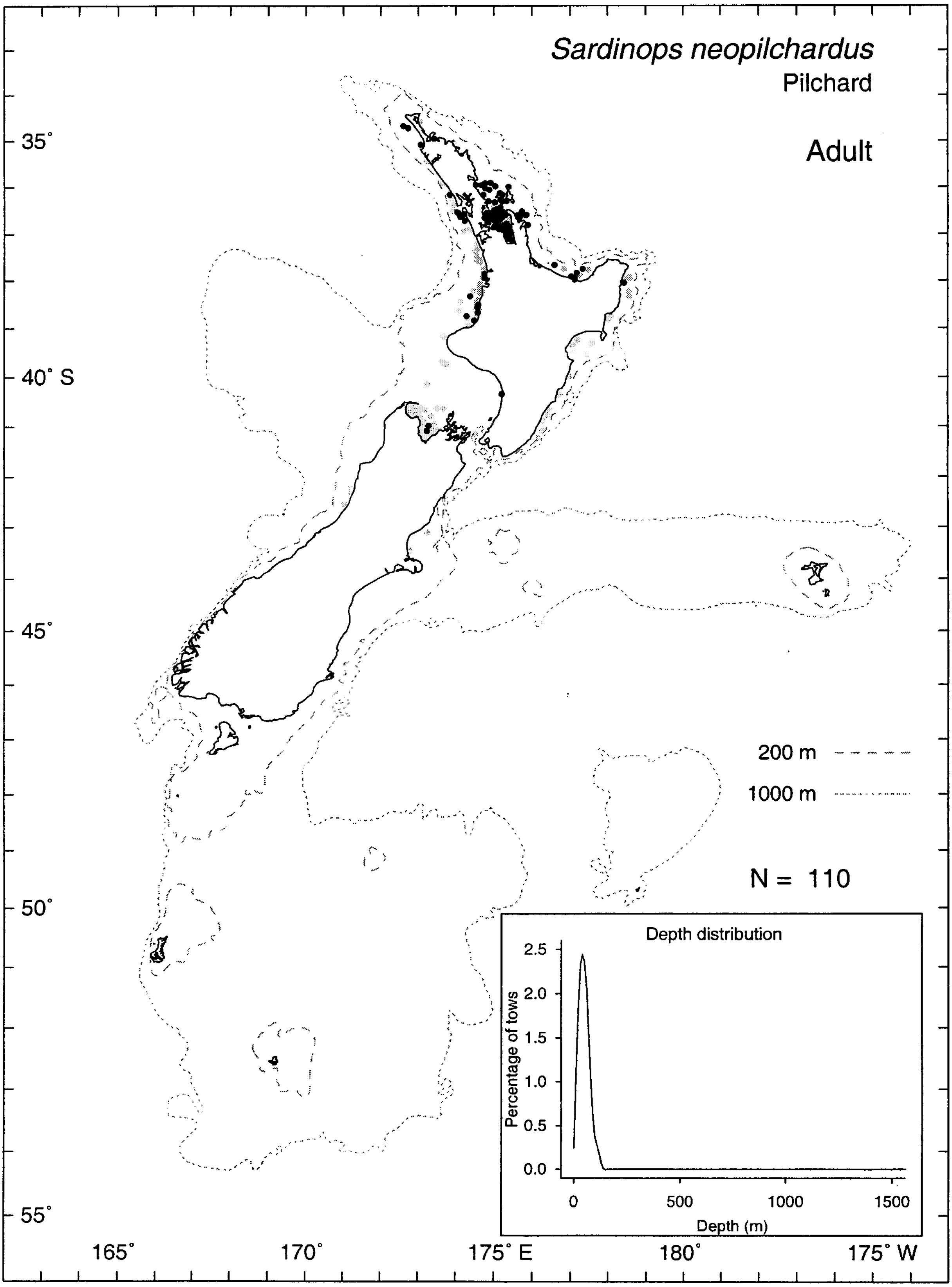
30°
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 172
Lampris guttatus
Moonfish
Immature



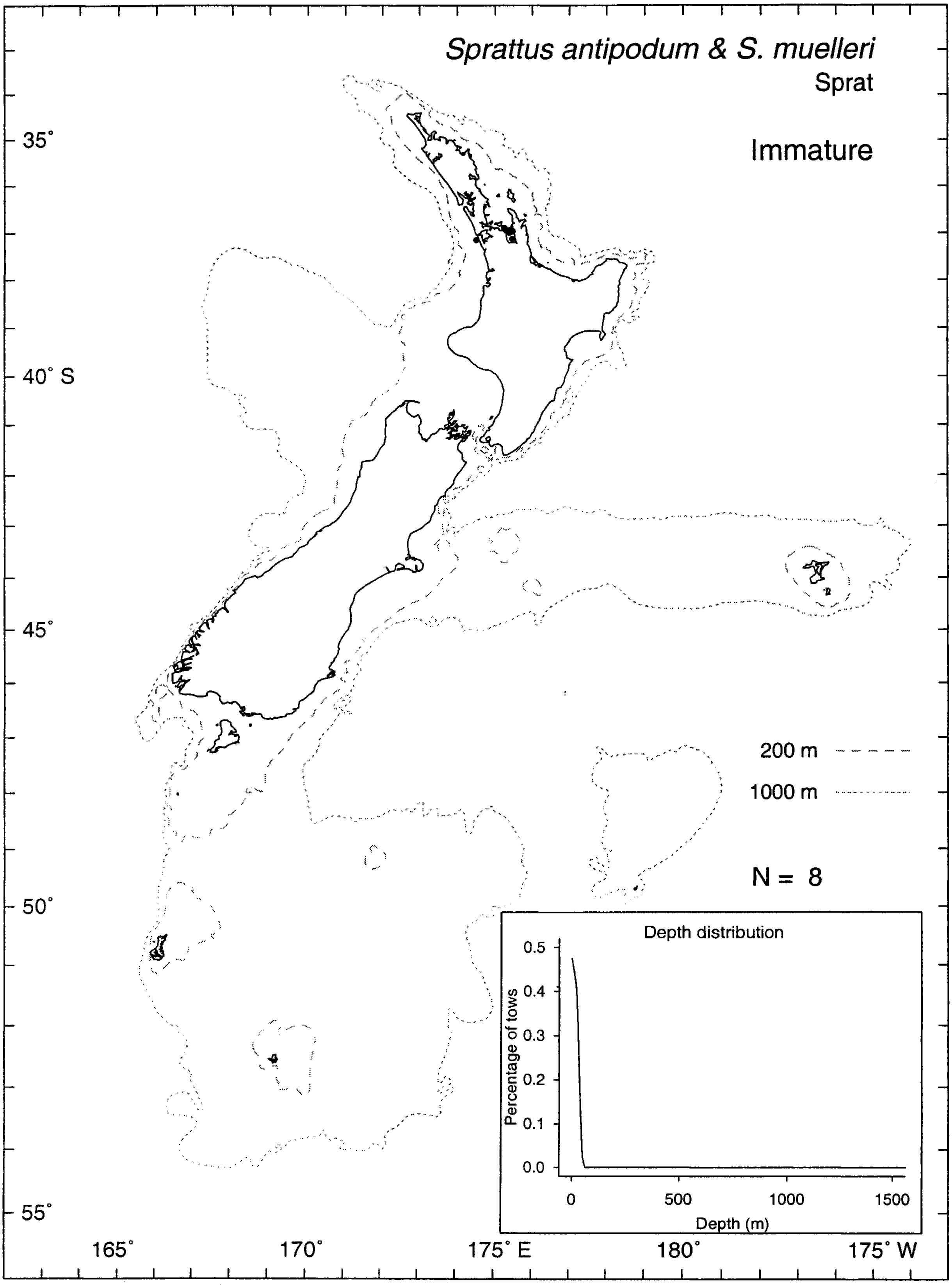
30°
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 889
Lampris guttatus
Moonfish
Adult



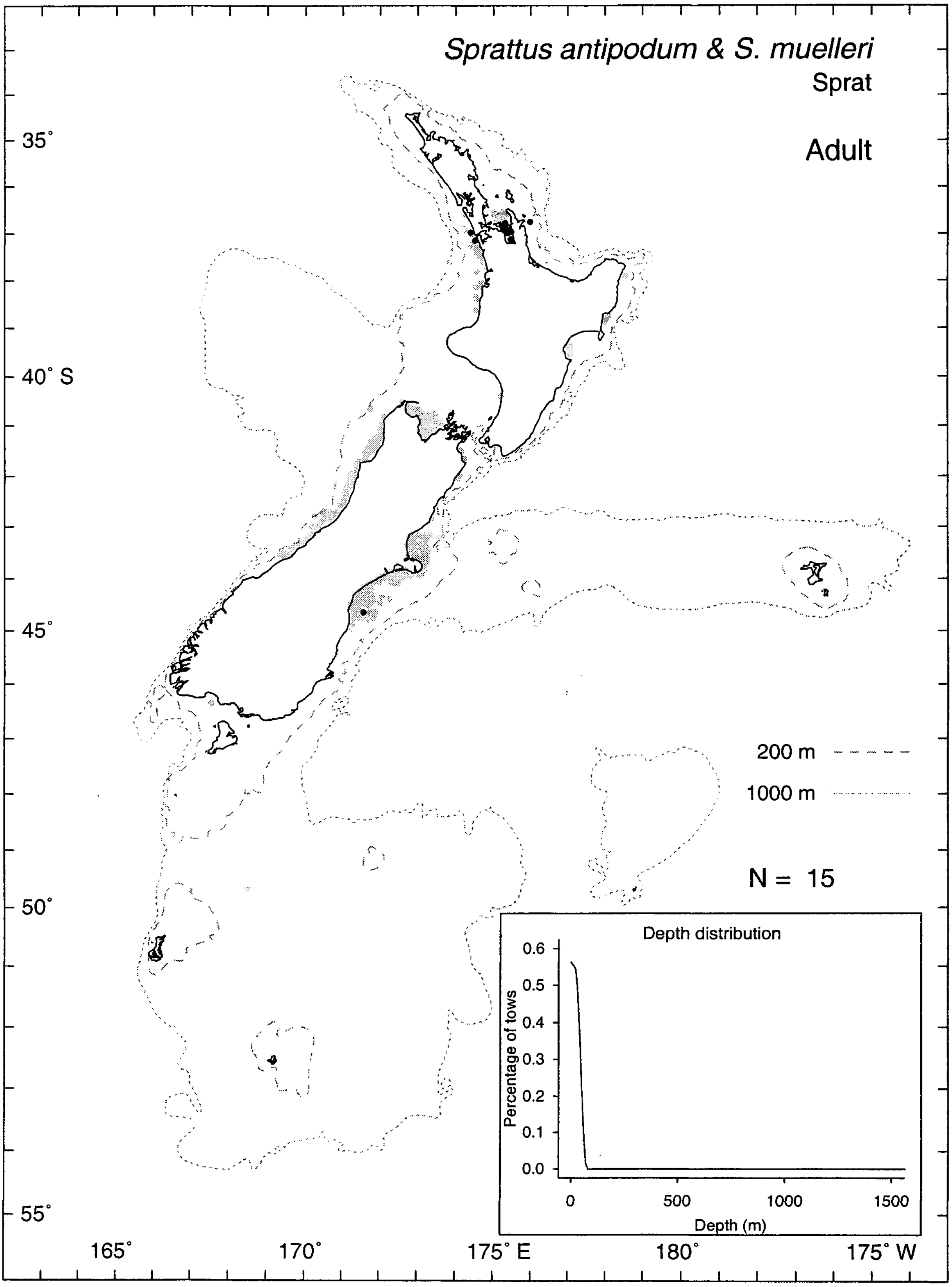
Sardinops neopilchardus
Pilchard
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 41
Depth distribution
Percentage of tows
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
Depth (m)



Sardinops neopilchardus
Pilchard
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 110
Depth distribution
Percentage of tows
2.5
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Depth (m)



Sprattus antipodum & S. muelleri
Sprat
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 8
Depth distribution
Percentage of tows
0.5
0.4
0.3
0.2
0.1
0.0
0
500
1000
1500
Depth (m)



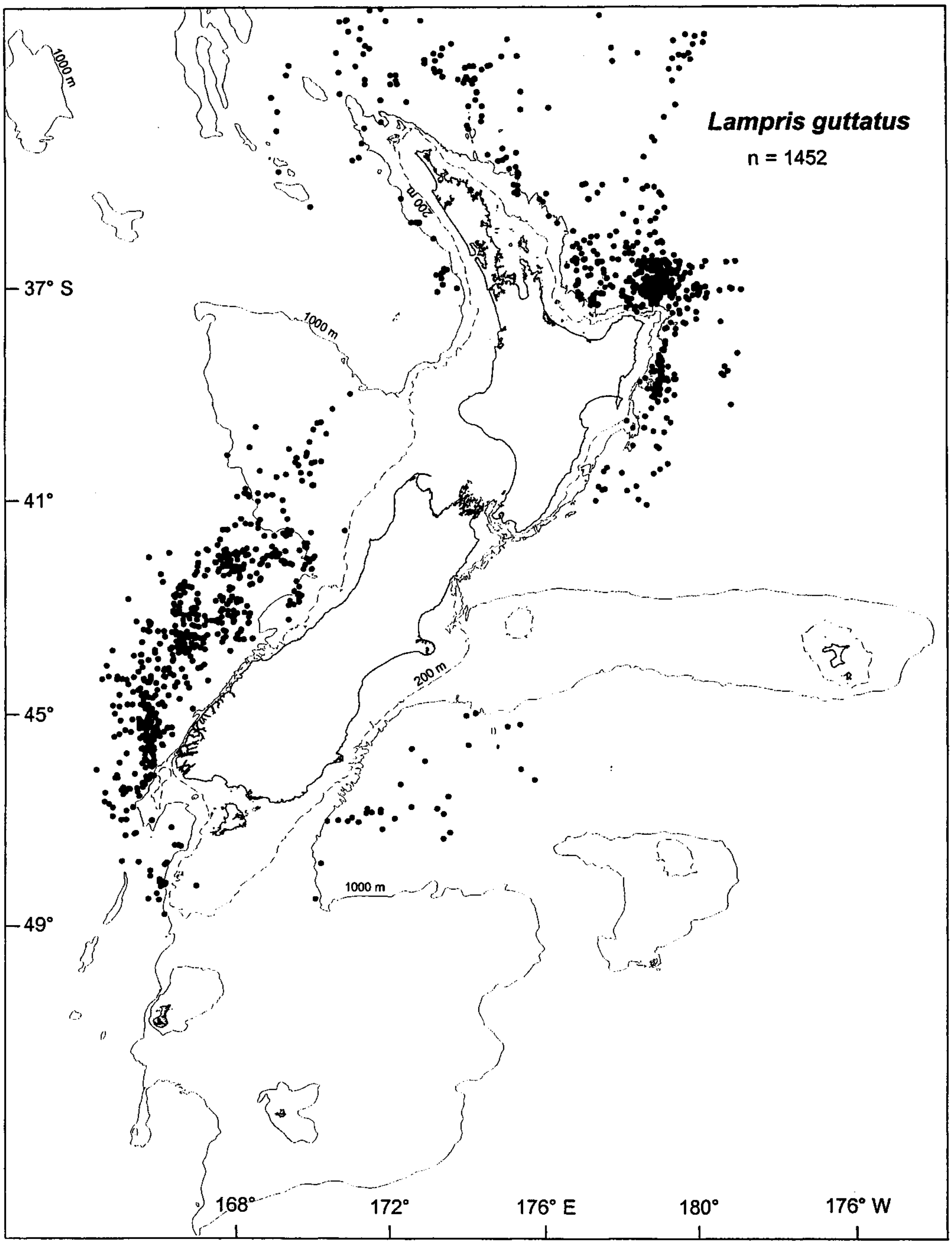
Spratus antipodum & S. muelleri
Sprat
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 15
Depth distribution
Percentage of tows
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0
500
1000
1500
Depth (m)

3.2 Moonfish juvenile abundance

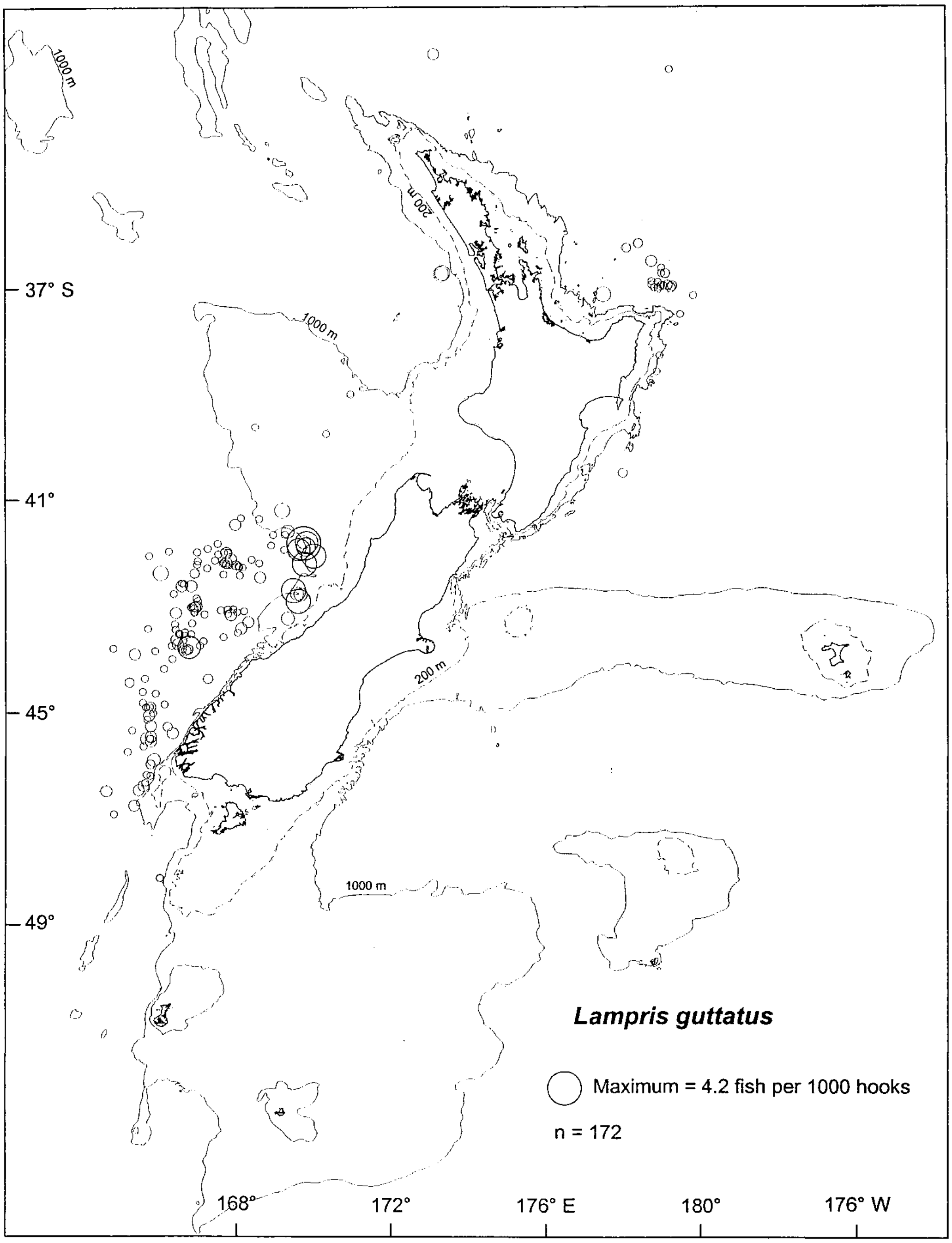
Key to interpretation of moonfish abundance plots

Left-hand page is reference plot of positions where moonfish were caught in observed commercial longline sets; n, number of sets.

Right-hand page shows catch rate of juveniles. Symbol size is proportional to the maximum catch rate indicated; n, number of sets with juveniles.



Lampris guttatus
n = 1452
1000 m
200 m
1000 m
200 m
1000 m
37° S
41°
45°
49°
168°
172°
176° E
180°
176° W



1000 m
200 m
37° S
1000 m
41°
200 m
45°
1000 m
49°
Lampris guttatus
Maximum = 4.2 fish per 1000 hooks
n = 172
168°
172°
176° E
180°
176° W

4 Area and species summaries

Table 4.1: **Summary of juvenile distributions from the North Island. CP, Challenger Plateau; SW, southwest; Nth, north of Auckland; HG, Hauraki Gulf; BoP, Bay of Plenty; EC, East Cape; HB, Hawke Bay; Wair, Wairarapa. + indicates presence (from literature or trawl data) where abundance not determined because of insufficient records. ? indicates possible occurrence where no fish measured.**

	CP	SW	Nth	HG	BoP	EC	HB	Wair
Deepwater species								
Allocyttus niger		+	+					
Argentina elongata			+		+			
Beryx splendens	+		+		+	Low	Medium	Low
Brama brama								Low
Centroscymnus crepidater	+	?	Low		?	?	?	+
Centroscymnus owstoni	+	?	+		?	?	?	?
Cyttus traversi	+	Medium	Low		Medium	Low	Low	Low
Deania calcea	Low	+	High		Medium	Medium	Medium	?
Dipturus innominatus		+	+	High		Low	Low	Low
Dipturus nasutus		Medium	+			Low	Low	Medium
Emmelichthys nitidus		+	+		+		?	
Epigonus telescopus	+		+		Low	Low	Low	Low
Etmopterus baxteri	+		+			+	?	?
Genypterus blacodes	+	Low	Low		Low	Low	Low	Low
Hoplostethus atlanticus	High	Low	Low		Low	Medium	Low	Low
Hydrolagus novaezealandiae	+	+	+		+	Low	Low	Low
Hydrolagus sp.B2	+					Low	Low	Low
Hyperoglyphe antarctica	+		+		High	High	Medium	High
Lepidoperca aurantia		+			+	?	?	?
Lepidopus caudatus	?	+	+	?	High	?	?	+
Macruronus novaezelandiae	Low	Low	Low		Low	Low	Low	Low
Merluccius australis	Low	Low	Low		+	+	Low	Low
Micromesistius australis								
Mora moro	High	Low	Low		Low	Medium	Low	Low
Neocyttus rhomboidalis	Medium		Low			Low	Low	+
Plagiogeneion rubiginosum		+			+		+	+
Pseudocyttus maculatus	Low				+	Low	Low	Low
Seriolella caerulea								+
Seriolella punctata		+	+	+	Low	Low	Low	Low
Squalus mitsukurii	?	?	Medium	+	+	?	?	?
Trachyrinchus longirostris	?	?	+		?	?	?	+
Zenopsis nebulosus			+		High	Medium	Low	Medium
Pelagic species								
Engraulis australis		+	+	+	+	?	?	?
Lampris guttatus	+		+		+	+	+	
Sardinops neopilchardus		+	+	+	+	?	?	?
S. antipodum, S. muelleri		+		+		+	?	

Survey abundance:

Low Medium High

***Table 4.2*: Summary of juvenile distributions from the South Island. WC, west coast; Ts/Gd, Tasman and Golden Bays; NEC, east coast north of Banks Peninsula; SEC, east coast south of Banks Peninsula; Sth, Southland; SP, Southern Plateau; NCR, north Chatham Rise; SCR, south Chatham Rise. + indicates presence (from literature or trawl data) where abundance not determined because of insufficient records. ? indicates possible occurrence where no fish measured.**

	WC	Ts/Gd	NEC	SEC	Sth	SP	NCR	SCR
Deepwater species								
Allocyttus niger			+	Low	High	Medium	Low	High
Argentina elongata	Medium			Low	+	Low	Medium	Medium
Beryx splendens	Medium		+				High	
Brama brama	Low			Low	Medium	Low	Medium	Medium
Centroscymnus crepidater	?		?	?	?	?	Medium	Low
Centroscymnus owstoni	?		?	?	?	?	+	+
Cyttus traversi	High		+	Low	Low	Low	High	High
Deania calcea	Low		?		Low	?	High	Medium
Dipturus innominatus	Medium		Medium	Medium	Low	Low	Medium	Medium
Dipturus nasutus	Medium	Low	High	High	Low	Low		+
Emmelichthys nitidus	Low	?	?	High	Medium		Low	Low
Epigonus telescopus	Low		+		High		Medium	
Etmopterus baxteri	?		?	?	?	+	High	Low
Genypterus blacodes	Medium	Low	Low	High	Medium	Medium	Medium	High
Hoplostethus atlanticus	Low		Low	Low	Low	Low	High	Medium
Hydrolagus novaezealandiae	Low		Medium	High	Low	Low	Low	Medium
Hydrolagus sp.B2	Low		Low	Low	Low	Medium	Medium	High
Hyperoglyphe antarctica	Medium			+	Low		High	Low
Lepidoperca aurantia	+		?	?	Medium		Low	Low
Lepidopus caudatus	Medium	+	?	?	?		Low	
Macruronus novaezelandiae	High	Low	Medium	High	High	Medium	High	High
Merluccius australis	High	+	Medium	Low	High	Low	Medium	Low
Micromesistius australis	+			Low	Low	High	Low	Low
Mora moro	Low		+		Low	Low	Medium	Low
Neocyttus rhomboidalis	?		?		Low	+	High	High
Plagiogeneion rubiginosum							Low	
Pseudocyttus maculatus	Low		Low	High	Medium	Medium	Medium	High
Seriolella caerulea	Low		Low	Medium	Low	Low	Low	High
Seriolella punctata	Low	Medium	Medium	High	Medium	Low	High	High
Squalus mitsukurii	Medium		?	?			Low	
Trachyrinchus longirostris	?		?	?	?	?	Medium	+
Zenopsis nebulosus	+		?	?			?	
Pelagic species								
Engraulis australis	?	+	?	?				
Lampris guttatus	+			?	+			
Sardinops neopilchardus	?	+	?					
S. antipodum, S. muelleri	+	?	+	+				

Survey abundance:

Low   Medium   High

Table 4.3: **Summary of spawning, pupping or egg-laying distributions from the North Island. CP, Challenger Plateau; SW, southwest; Nth, north of Auckland; HG, Hauraki Gulf; BoP, Bay of Plenty; EC, East Cape; HB, Hawke Bay; Wair, Wairarapa. + indicates presence from literature. ND = no data.**

	CP	SW	Nth	HG	BoP	EC	HB	Wair
Deepwater species								
Allocyttus niger								
Argentina elongata	ND	ND	ND	ND	ND	ND	ND	ND
Beryx splendens								[Rare]
Brama brama								
Centroscymnus crepidater	ND	ND	ND	ND	ND	ND	ND	ND
Centroscymnus owstoni	ND	ND	ND	ND	ND	ND	ND	ND
Cyttus traversi			[Occasional]		[Occasional]		[Rare]	
Deania calcea	+	ND	+	ND	+	+	+	ND
Dipturus innominatus								
Dipturus nasutus								
Emmelichthys nitidus								
Epigonus telescopus	[Occasional]		[Rare]		[Occasional]	[Rare]	[Occasional]	
Etmopterus baxteri	ND	ND	ND	ND	ND	ND	ND	ND
Genypterus blacodes					[Rare]		[Occasional]	[Occasional]
Hoplostethus atlanticus	[Common]		[Occasional]		[Common]	[Common]	[Common]	[Common]
Hydrolagus novaezealandiae	ND	ND	ND	ND	ND	ND	ND	ND
Hydrolagus sp.B2	ND	ND	ND	ND	ND	ND	ND	ND
Hyperoglyphe antarctica	[Occasional]				[Rare]		[Rare]	[Rare]
Lepidoperca aurantia	ND	ND	ND	ND	ND	ND	ND	ND
Lepidopus caudatus			+	+	+	+		
Macruronus novaezelandiae	[Rare]		[Rare]		[Rare]		[Rare]	[Rare]
Merluccius australis								
Micromesistius australis								
Mora moro								
Neocyttus rhomboidalis	[Occasional]						[Occasional]	
Plagiogeneion rubiginosum			[Rare]					[Rare]
Pseudocyttus maculatus			[Rare]		[Rare]			
Seriolella caerulea							[Occasional]	
Seriolella punctata			[Occasional]				[Rare]	[Rare]
Squalus mitsukurii	ND	ND	ND	ND	ND	ND	ND	ND
Trachyrinchus longirostris	ND	ND	ND	ND	ND	ND	ND	ND
Zenopsis nebulosus	ND	ND	ND	ND	ND	ND	ND	ND
Pelagic species								
Engraulis australis	ND	ND	+	+	+	ND	ND	ND
Lampris guttatus	ND	ND	ND	ND	ND	ND	ND	ND
Sardinops neopilchardus	ND	ND	+	+	+	+	ND	ND
S. antipodum, S. muelleri	ND	ND	ND	+	ND	+	ND	ND

Ripe/Running Ripe:

Rare Occasional Common

***Table 4.4*: Summary of spawning, pupping or egg-laying distributions from the South Island. WC, west coast; Ts/Gd, Tasman and Golden Bays; NEC, east coast north of Banks Peninsula; SEC, east coast south of Banks Peninsula; Sth, Southland; SP, Southern Plateau; NCR, north Chatham Rise; SCR, south Chatham Rise. + indicates presence from literature. ND = no data.**

	WC	Ts/Gd	NEC	SEC	Sth	SP	NCR	SCR
Deepwater species								
Allocyttus niger								
Argentina elongata	ND	ND	ND	ND	ND	ND	ND	ND
Beryx splendens								
Brama brama								
Centroscymnus crepidater	ND	ND	ND	ND	ND	ND	ND	ND
Centroscymnus owstoni	ND	ND	ND	ND	ND	ND	ND	ND
Cyttus traversi								
Deania calcea	ND	ND	ND	ND	ND	ND	ND	ND
Dipturus innominatus								
Dipturus nasutus								
Emmelichthys nitidus								
Epigonus telescopus								
Etmopterus baxteri	ND	ND	ND	ND	ND	ND	ND	ND
Genypterus blacodes								
Hoplostethus atlanticus								
Hydrolagus novaezealandiae	ND	ND	ND	ND	ND	ND	ND	ND
Hydrolagus sp.B2	ND	ND	ND	ND	ND	ND	ND	ND
Hyperoglyphe antarctica								
Lepidoperca aurantia	ND	ND	+	ND	ND	ND	ND	ND
Lepidopus caudatus				+				
Macruronus novaezelandiae								
Merluccius australis								
Micromesistius australis								
Mora moro								
Neocyttus rhomboidalis								
Plagiogeneion rubiginosum								
Pseudocyttus maculatus								
Seriolella caerulea			+	+				
Seriolella punctata								
Squalus mitsukurii	ND	ND	ND	ND	ND	ND	ND	ND
Trachyrinchus longirostris	ND	ND	ND	ND	ND	ND	ND	ND
Zenopsis nebulosus	ND	ND	ND	ND	ND	ND	ND	ND
Pelagic species								
Engraulis australis	+	+	ND	ND	ND	ND	ND	ND
Lampris guttatus	ND	ND	ND	ND	ND	ND	ND	ND
Sardinops neopilchardus	+	+	ND	+	ND	ND	ND	ND
S. antipodum, S. muelleri	+	+	+	+	ND	ND	ND	ND

Ripe/Running Ripe:

Rare Occasional Common

5 Invertebrate and seaweed distributions

Key to symbols and shading in the distribution plots

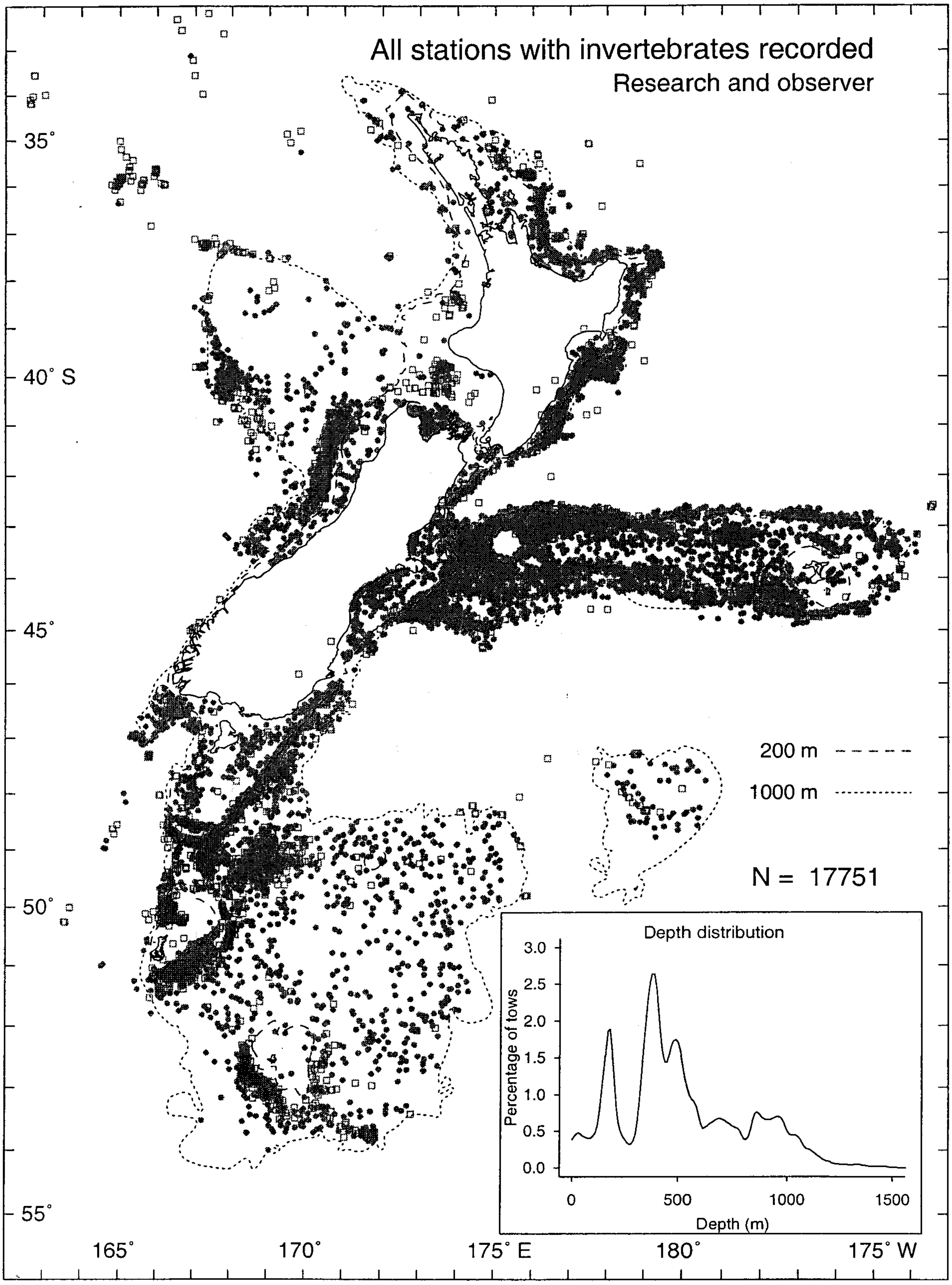
Symbols indicate positions where individuals occurred.

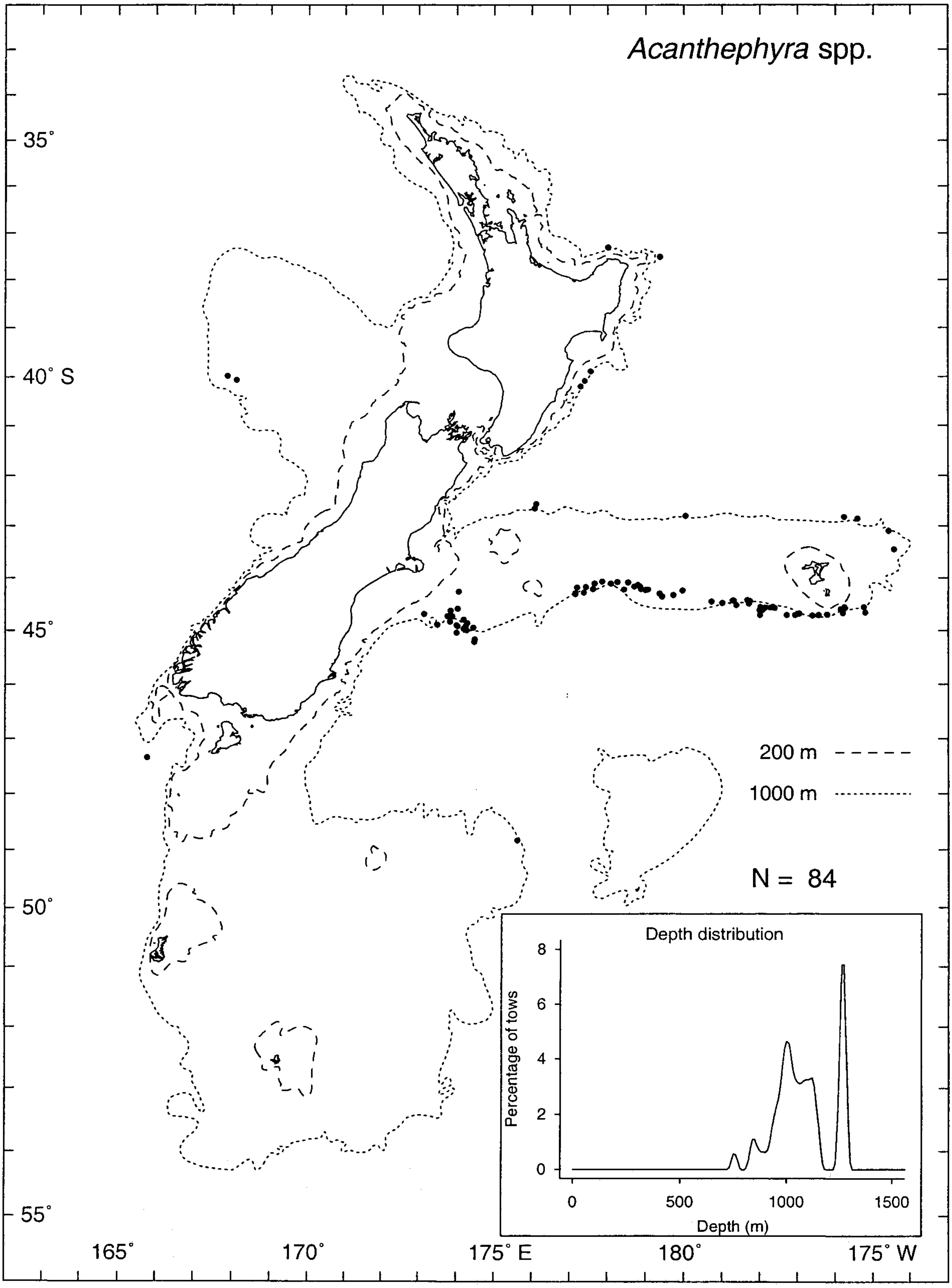
N, number of stations

Solid circles, research bottom trawls

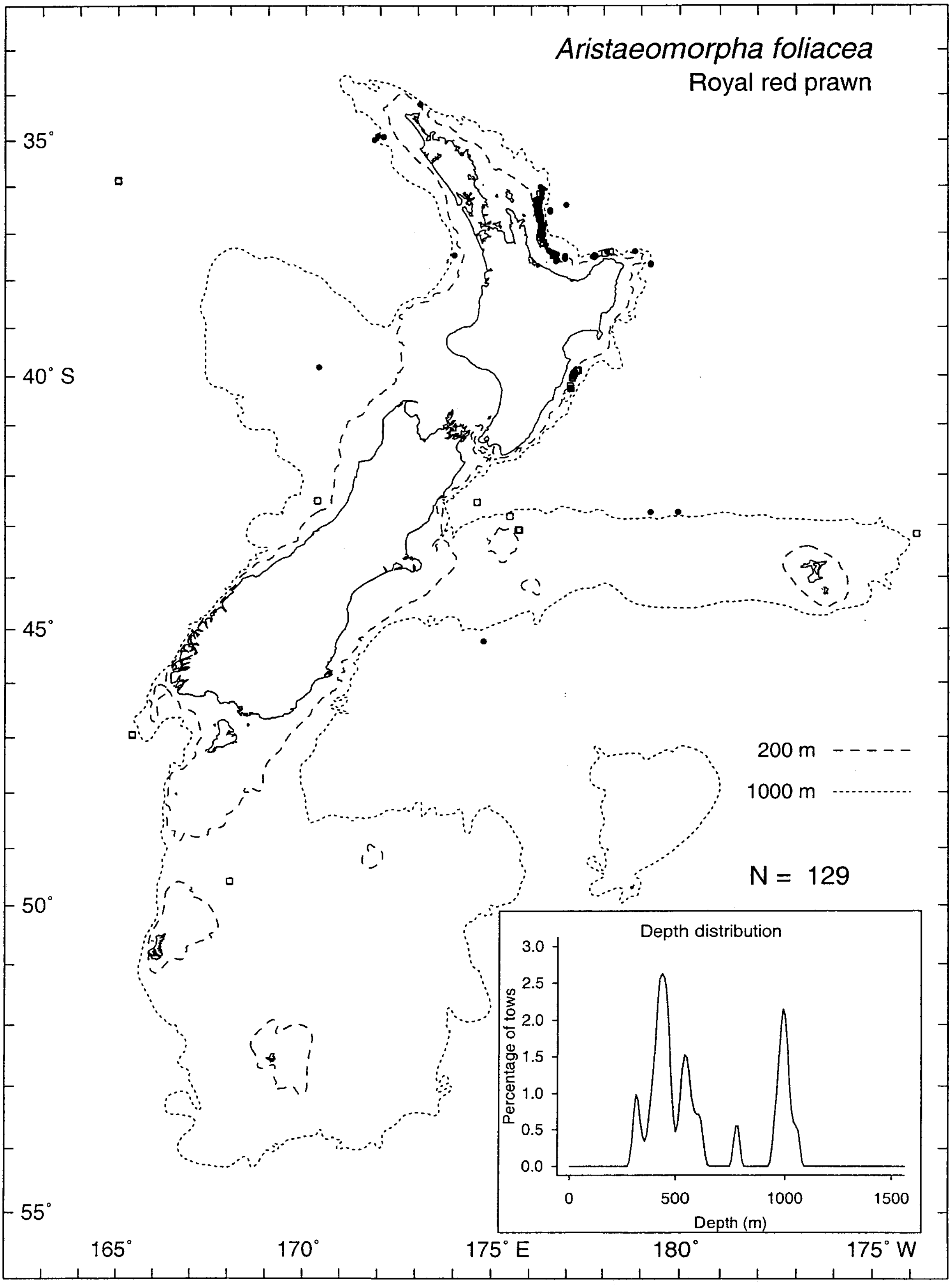
Open squares, scientific observer bottom trawls

The first map shows all positions where invertebrates have been recorded in research or commercial bottom trawls.

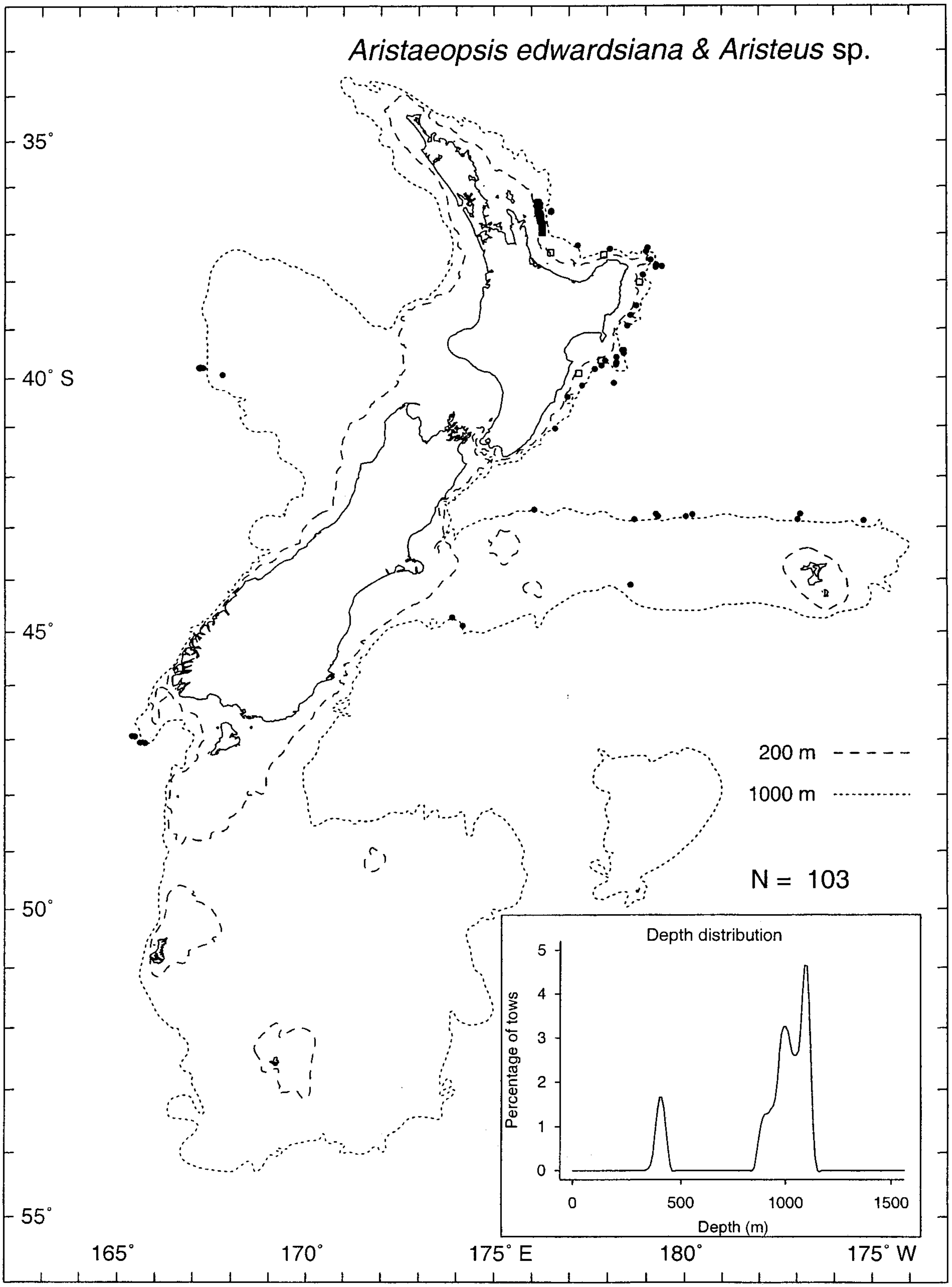

All stations with invertebrates recorded
Research and observer
200 m
1000 m
N = 17751
Depth distribution
Percentage of tows
Depth (m)
0
500
1000
1500
0.0
0.5
1.0
1.5
2.0
2.5
3.0
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W



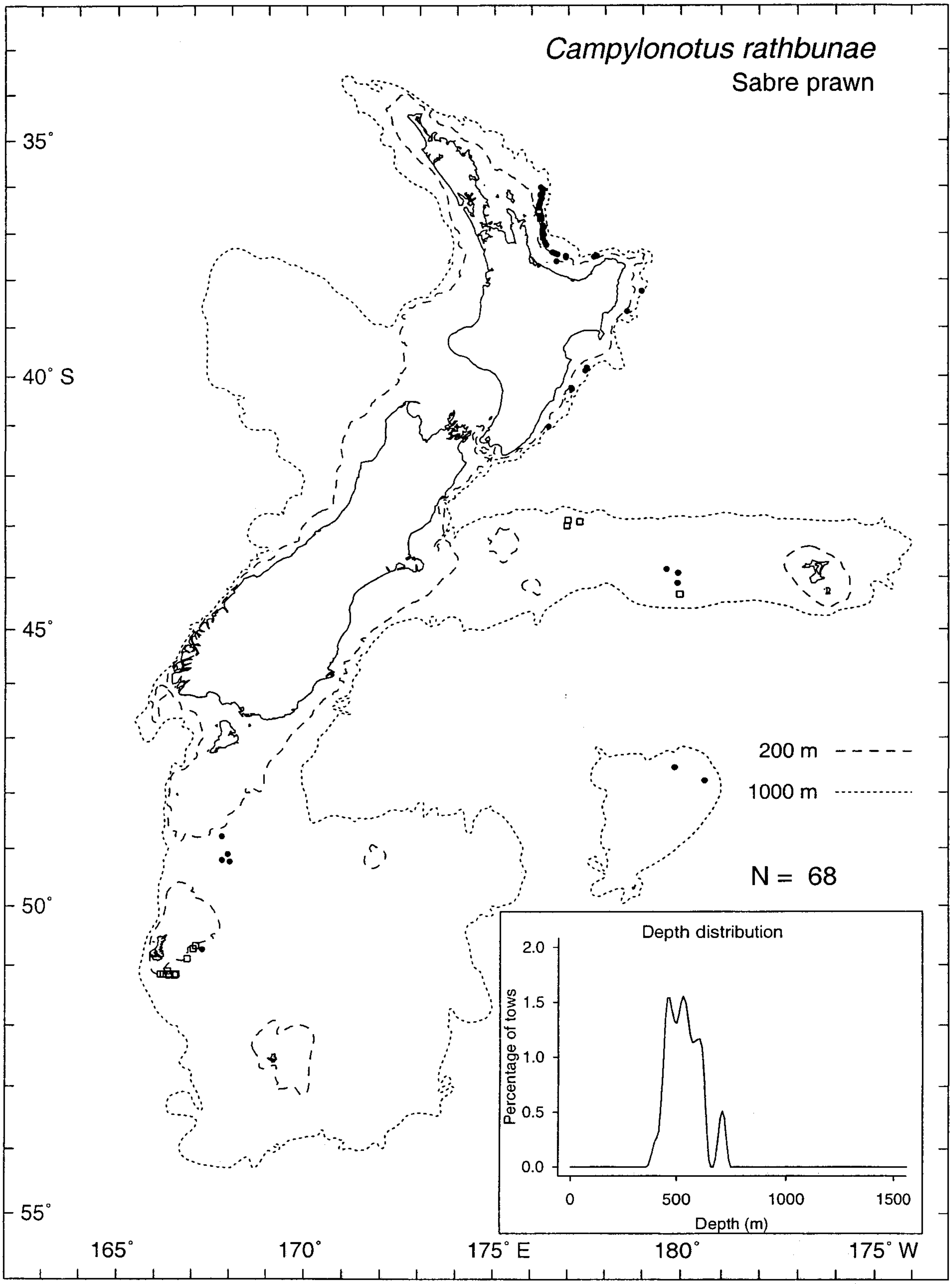
Acanthephyra spp.
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 84
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
0
500
1000
1500



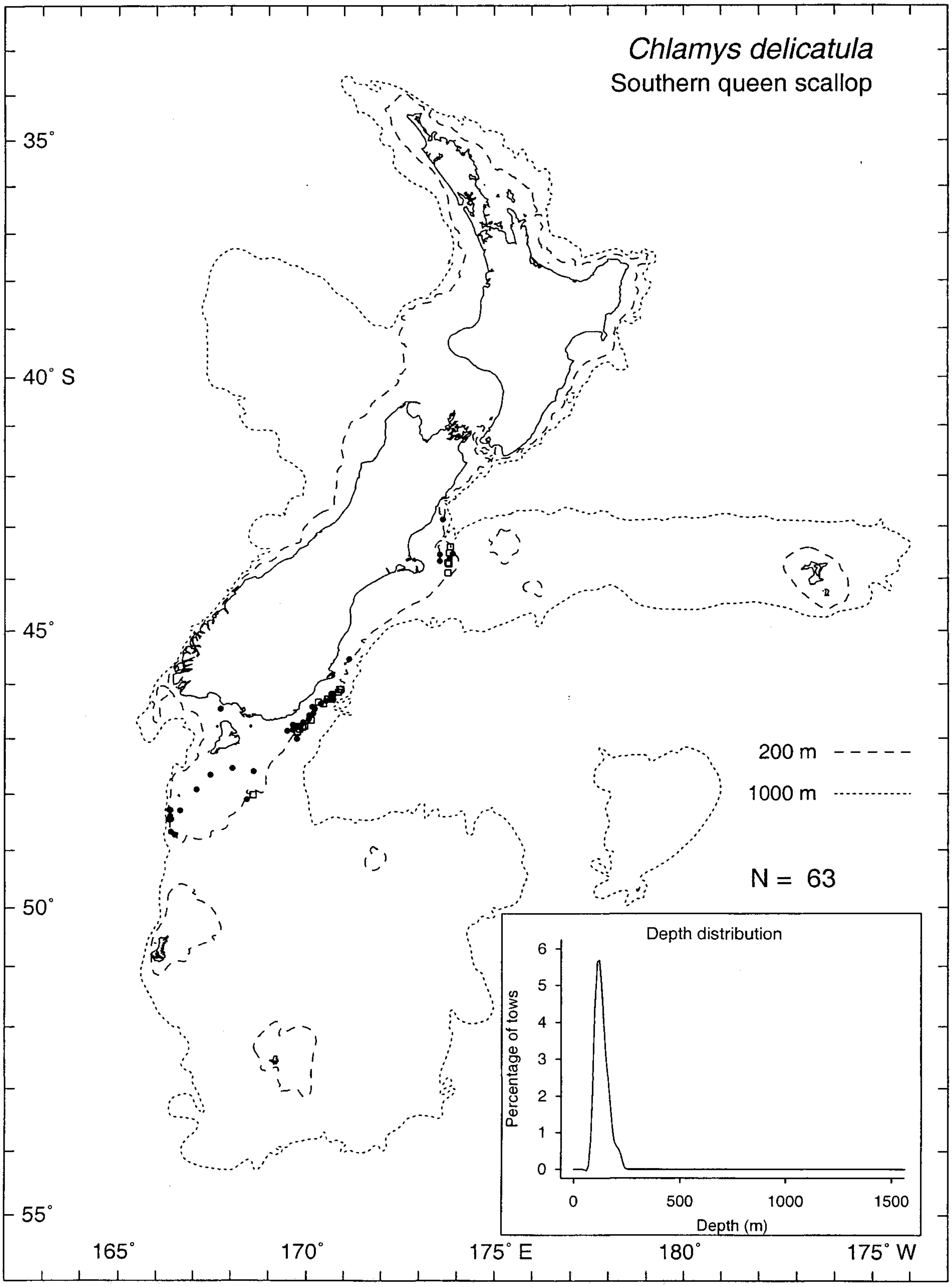
Aristaeomorpha foliacea
Royal red prawn
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 129
Depth distribution
Percentage of tows
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Depth (m)

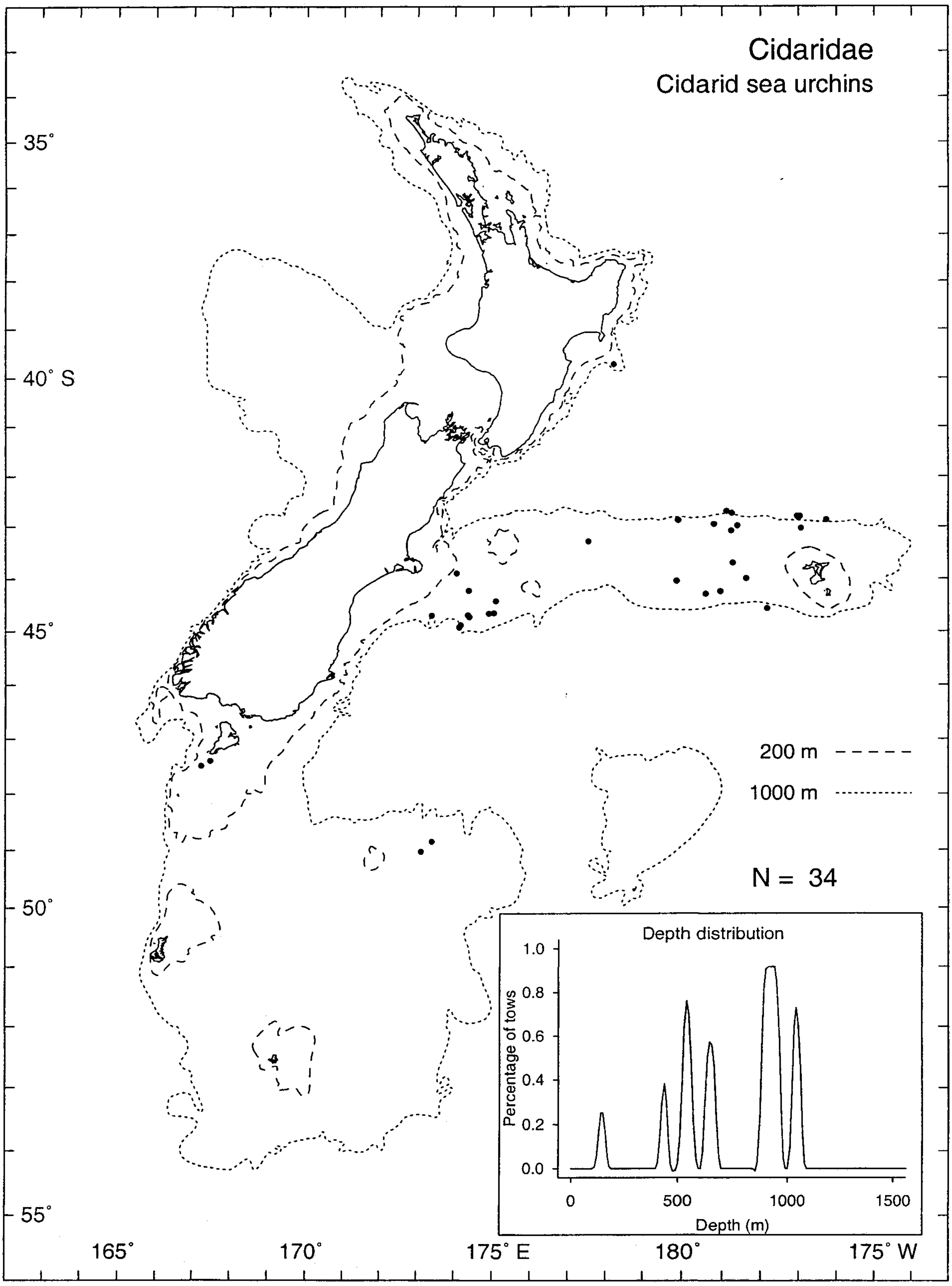


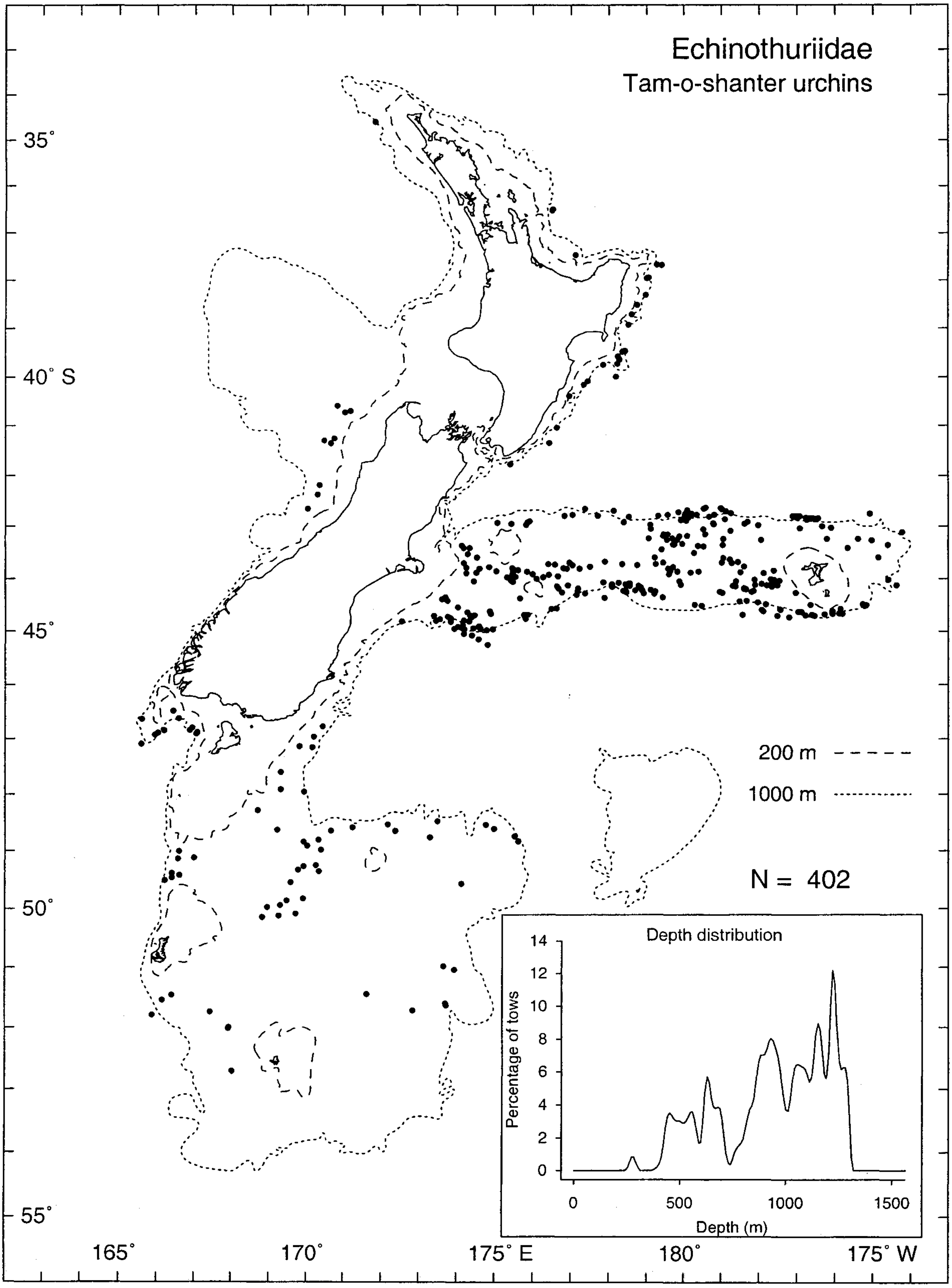
Aristaeopsis edwardsiana & Aristeus sp.
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 103
Depth distribution
Percentage of tows
Depth (m)
0
1
2
3
4
5
0
500
1000
1500



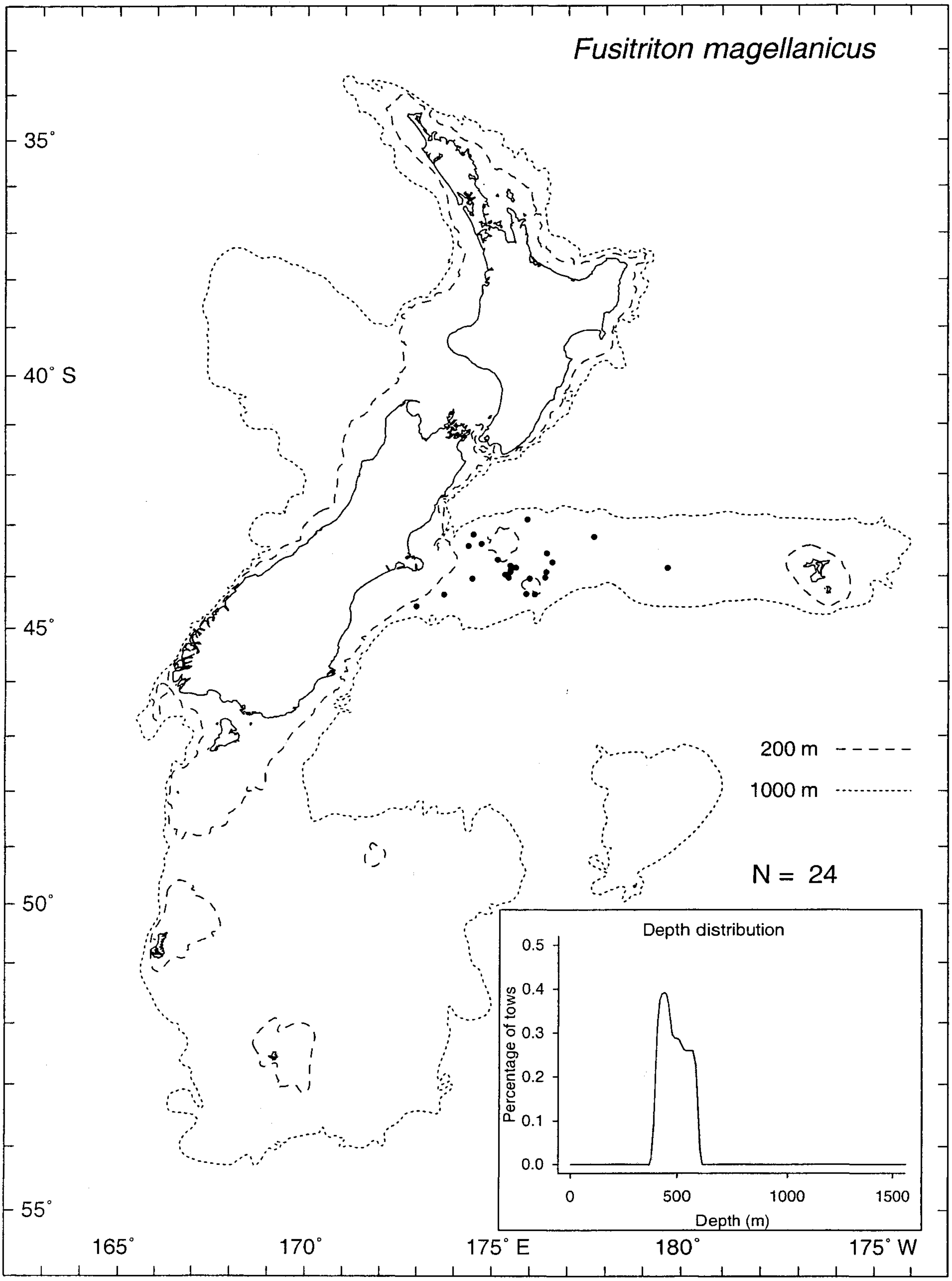
Campylonotus rathbunae
Sabre prawn
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 68
Depth distribution
Percentage of tows
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Depth (m)


Chlamys delicatula
Southern queen scallop
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 63
Depth distribution
Percentage of tows
0
1
2
3
4
5
6
0
500
1000
1500
Depth (m)

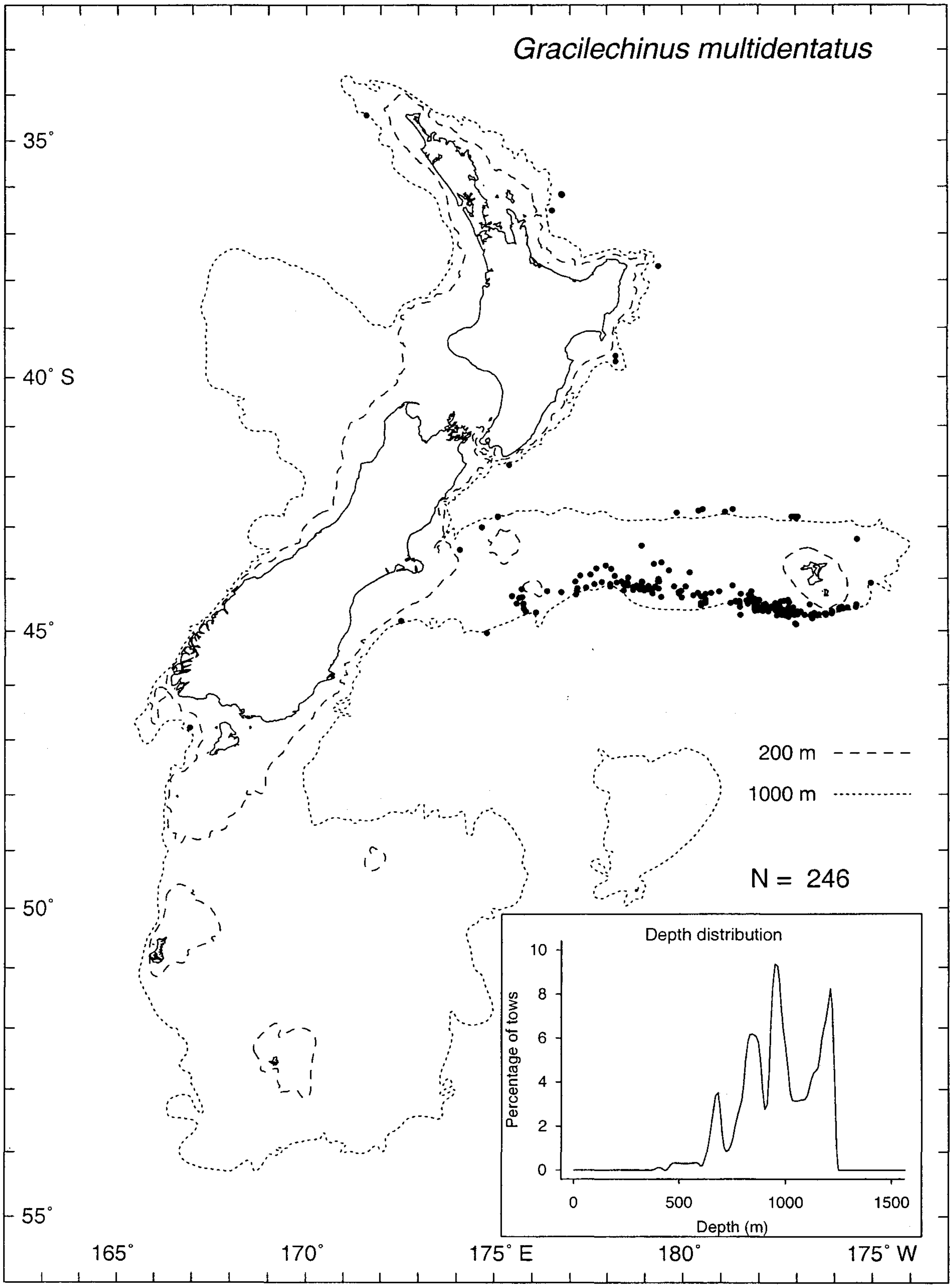

Cidaridae
Cidarid sea urchins
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 34
Depth distribution
Percentage of tows
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
Depth (m)



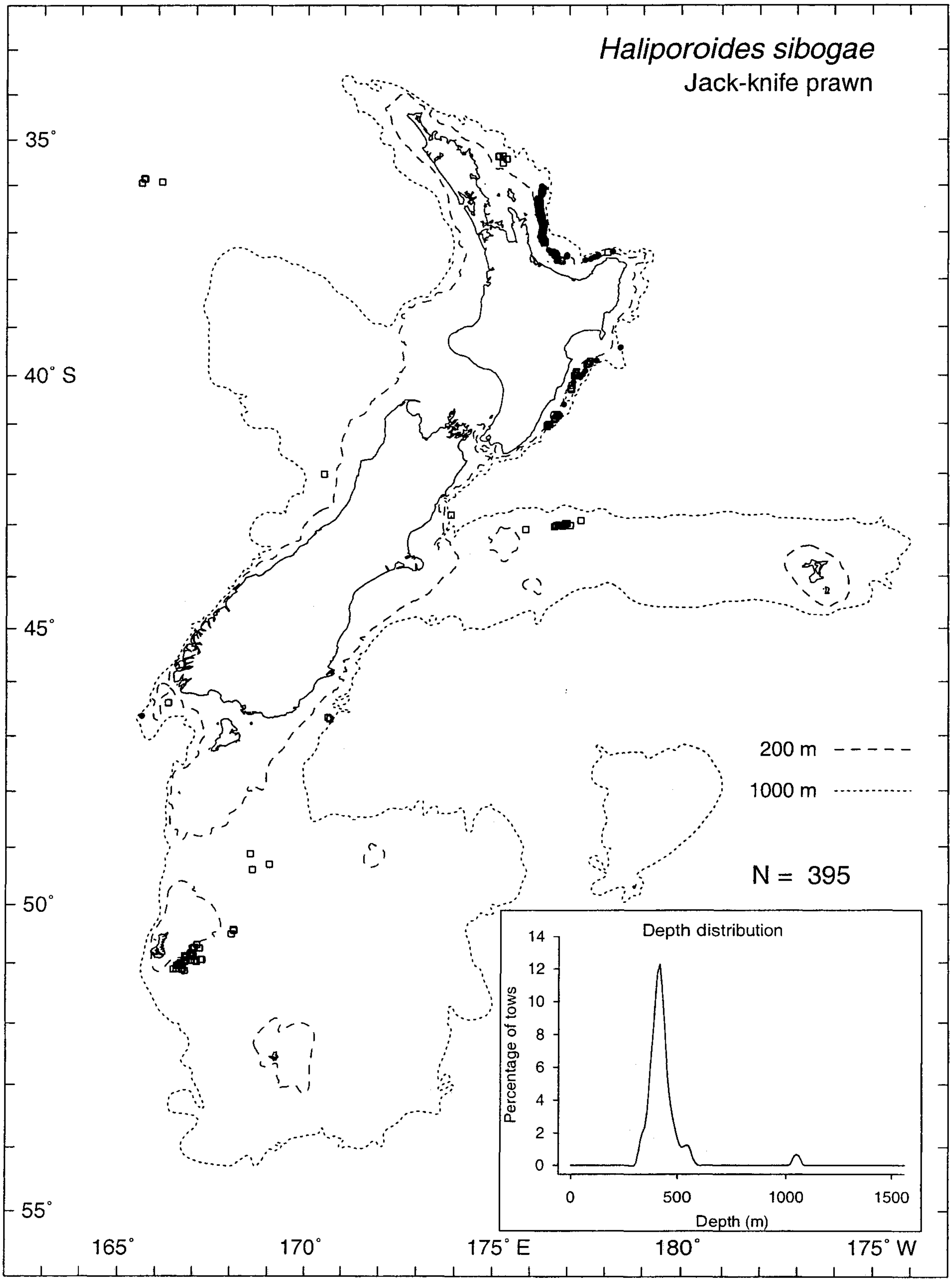
Echinothuriidae
Tam-o-shanter urchins
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 402
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
10
12
14
0
500
1000
1500



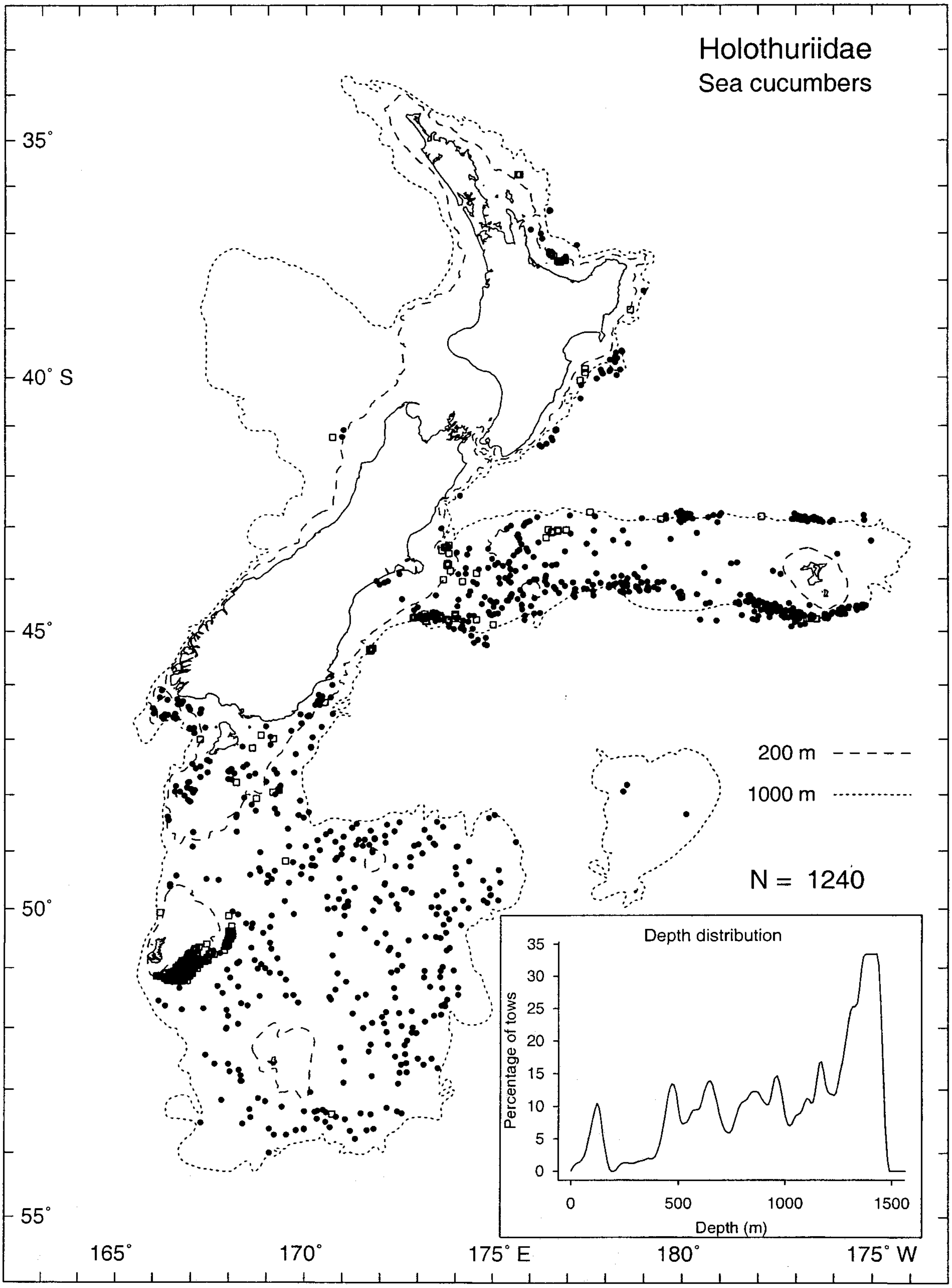
Fusitriton magellanicus
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 24
Depth distribution
Percentage of tows
0.5
0.4
0.3
0.2
0.1
0.0
0
500
1000
1500
Depth (m)

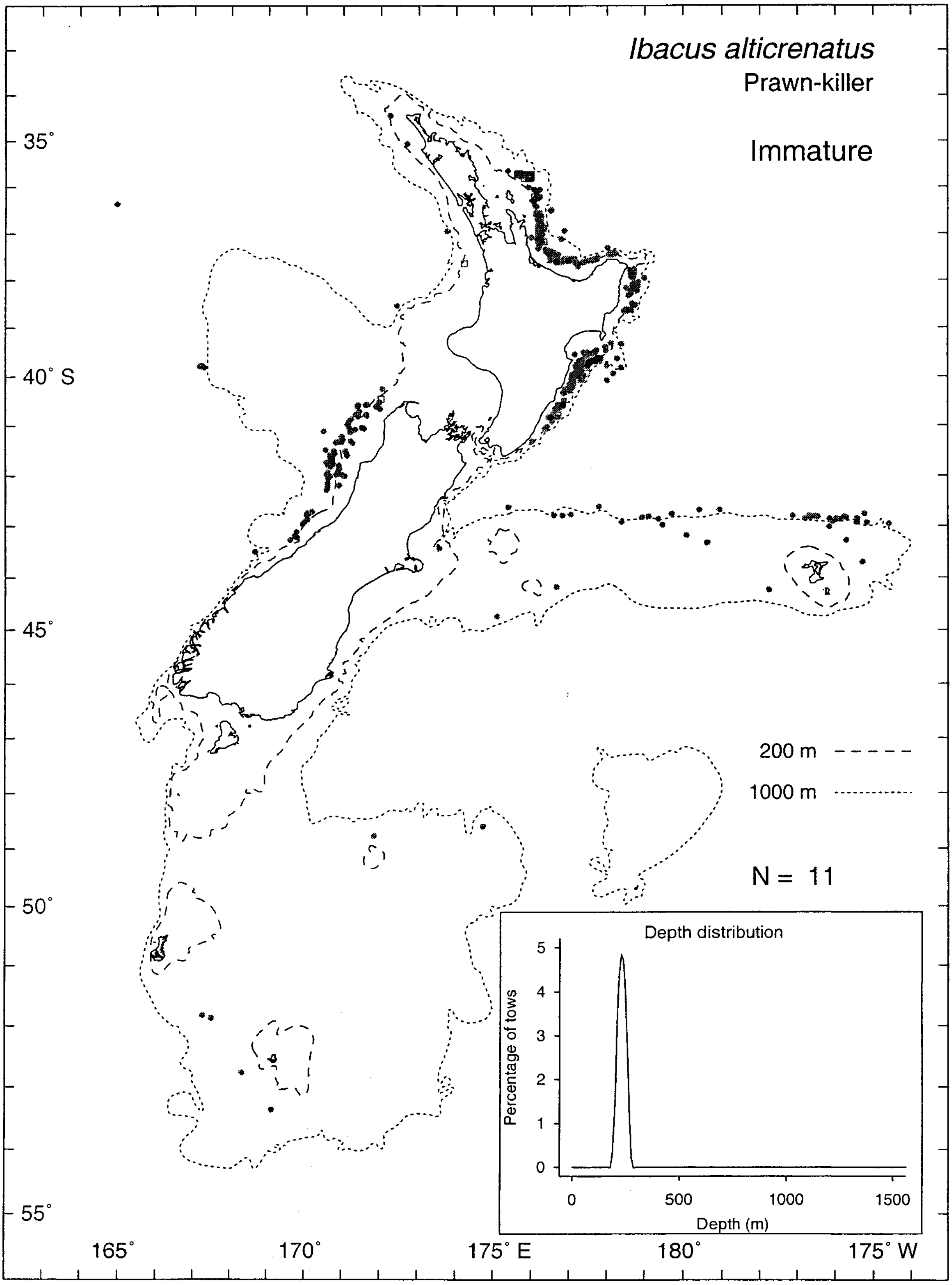


Gracilechinus multidentatus
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 246
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
10
0
500
1000
1500

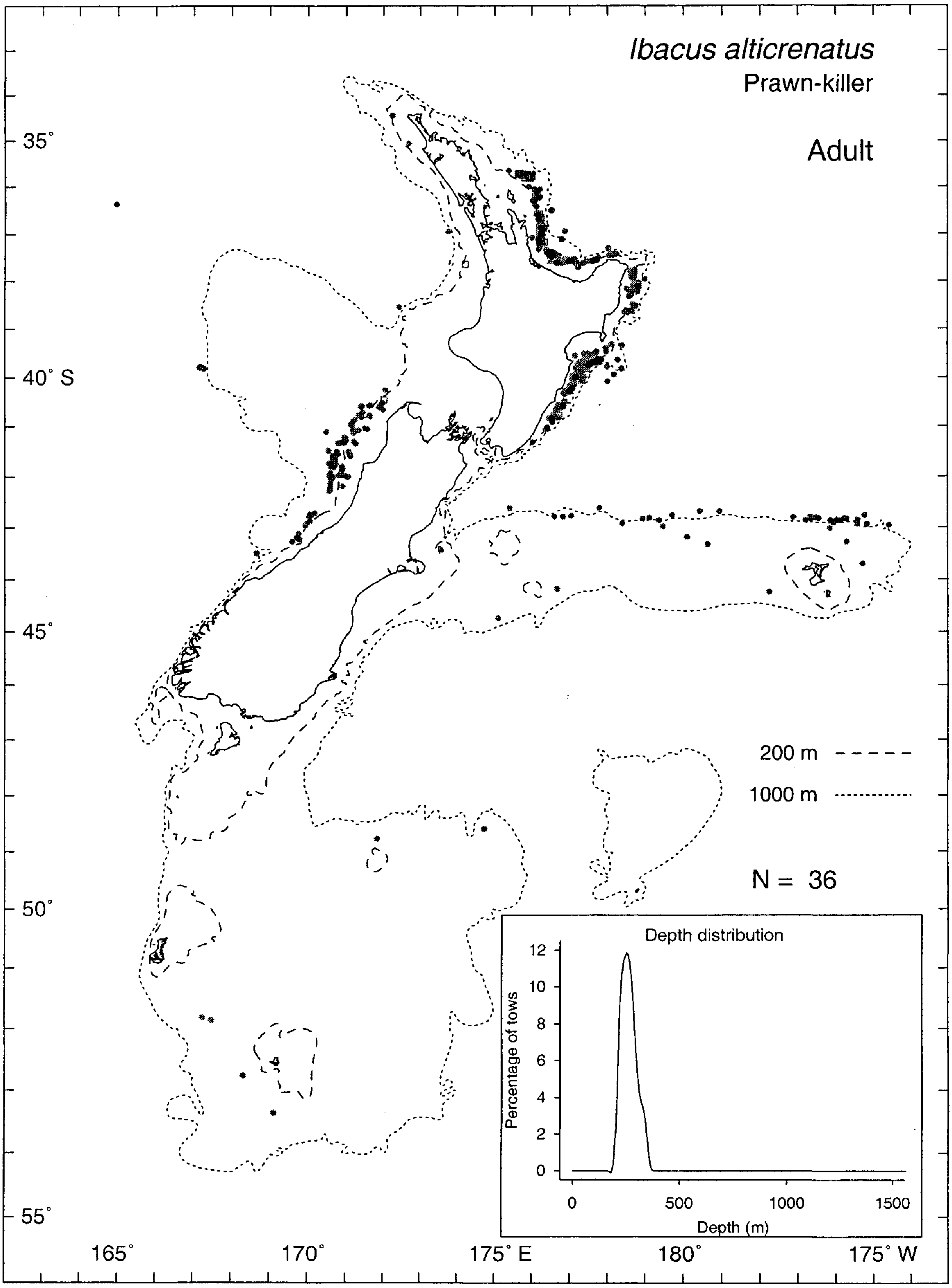


Haliporoides sibogae
Jack-knife prawn
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 395
Depth distribution
Percentage of tows
14
12
10
8
6
4
2
0
0
500
1000
1500
Depth (m)

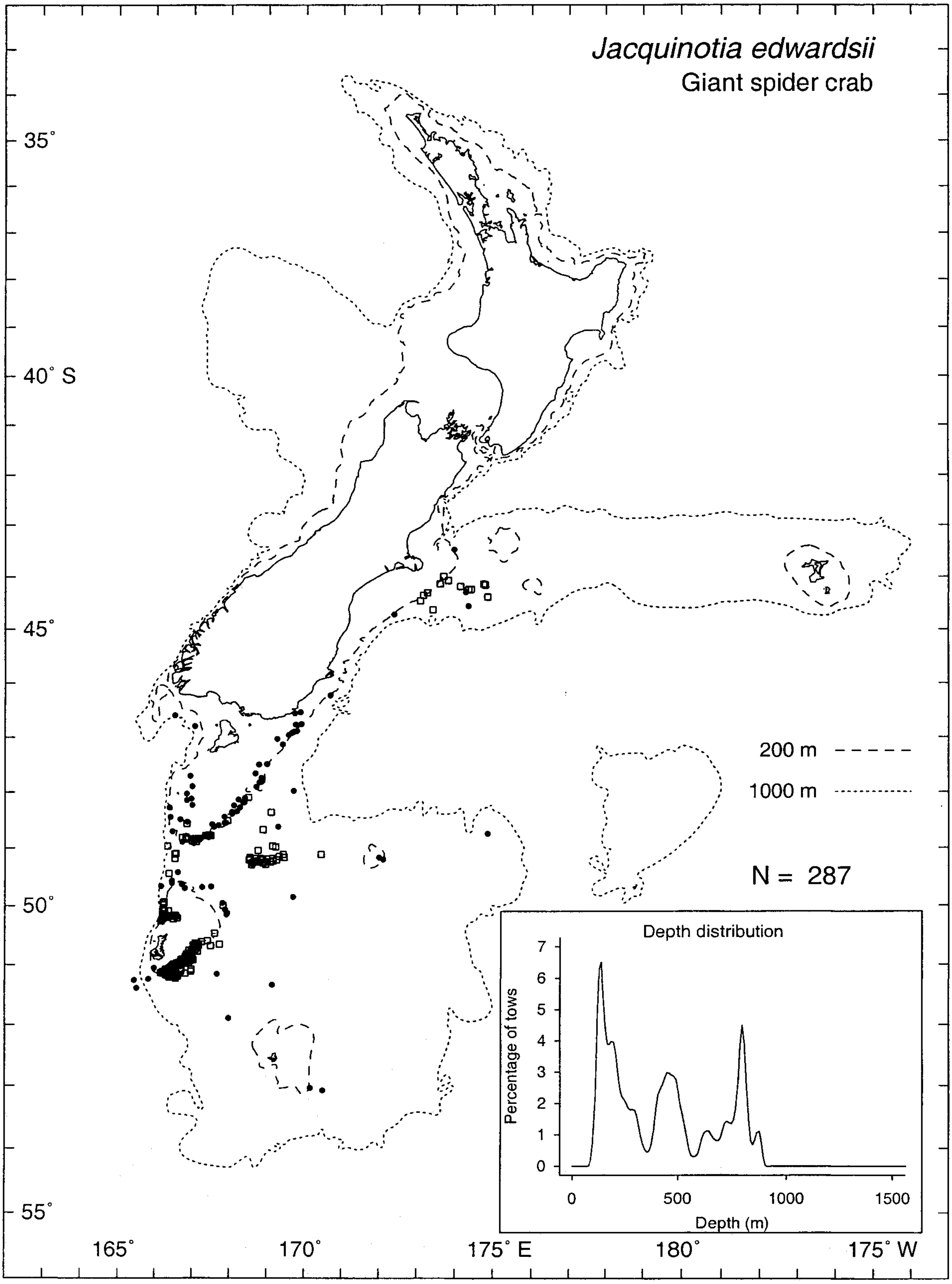

Holothuriidae
Sea cucumbers
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 1240
Depth distribution
Percentage of tows
Depth (m)
0
500
1000
1500
0
5
10
15
20
25
30
35



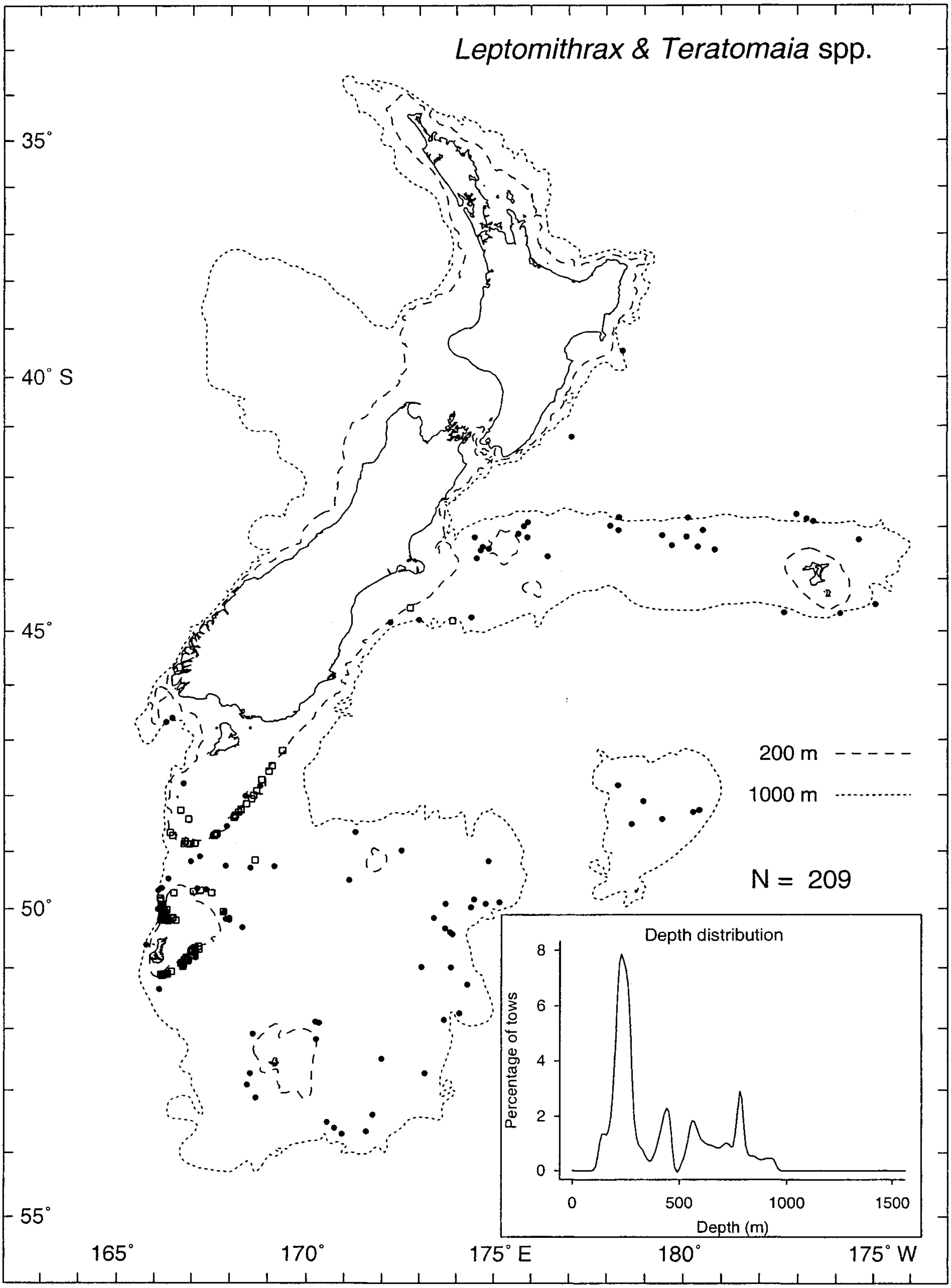
Ibacus alticrenatus
Prawn-killer
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 11
Depth distribution
Percentage of tows
0
1
2
3
4
5
0
500
1000
1500
Depth (m)



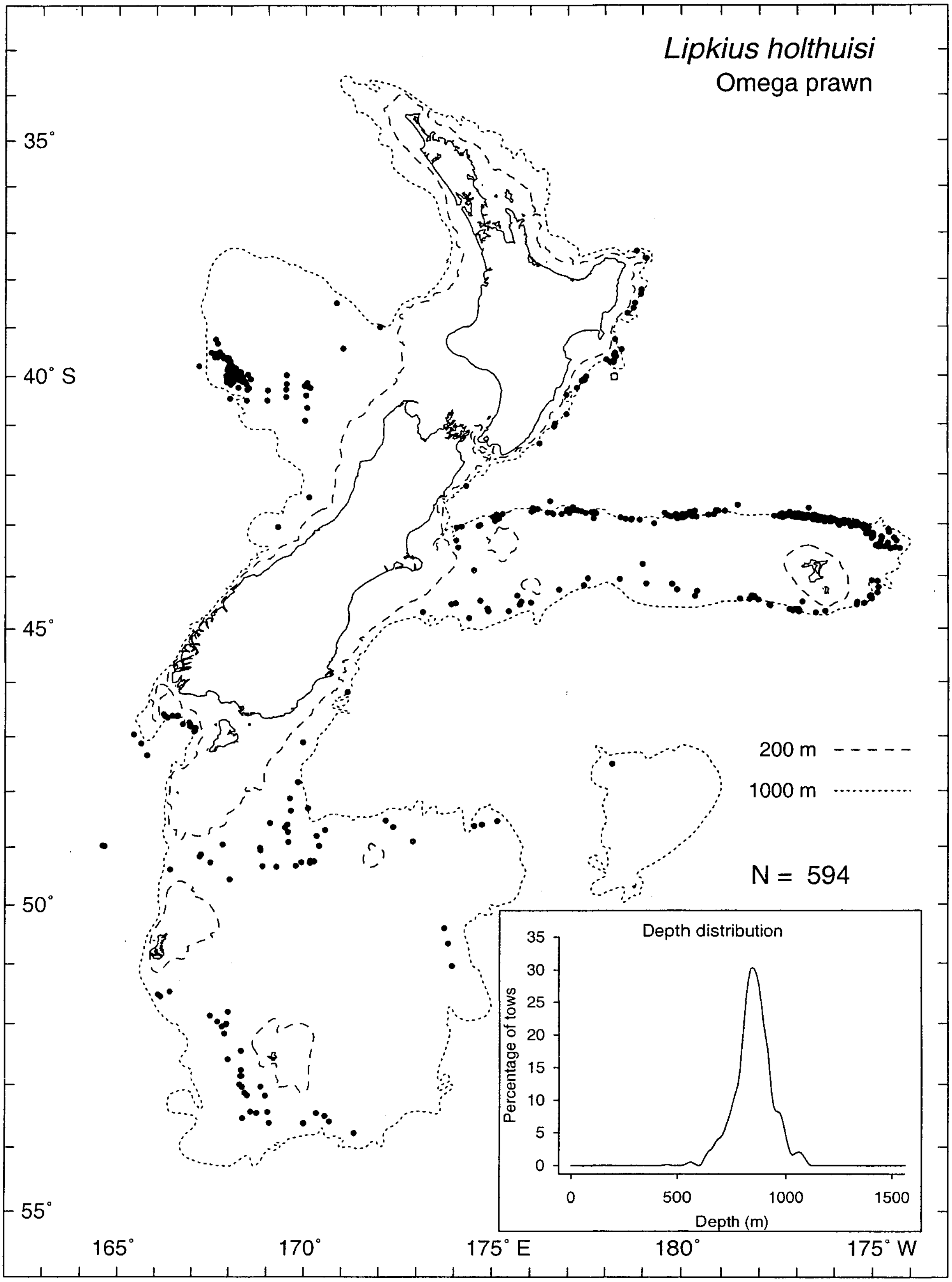
Ibacus alticrenatus
Prawn-killer
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 36
Depth distribution
Percentage of tows
0
2
4
6
8
10
12
0
500
1000
1500
Depth (m)

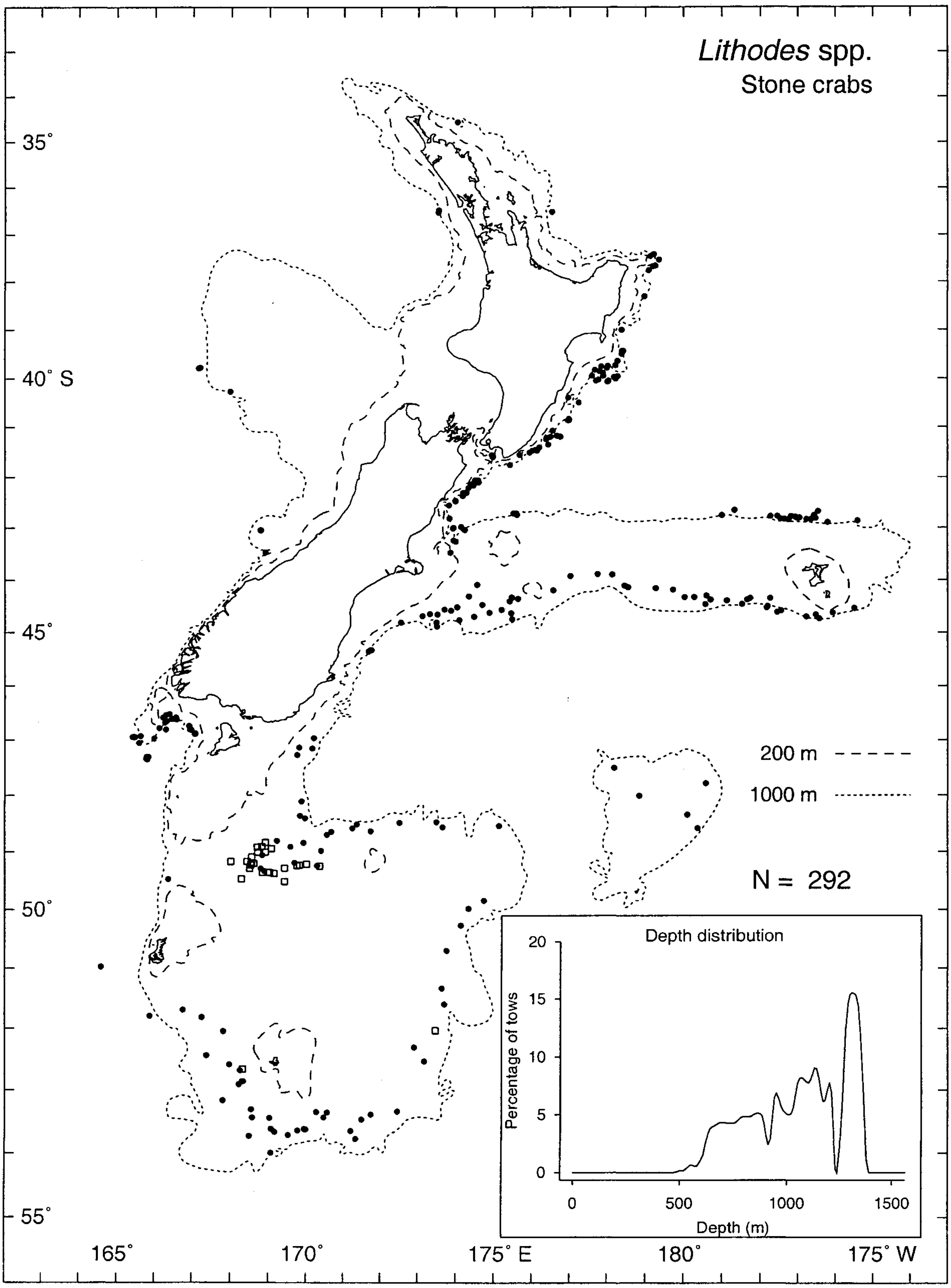


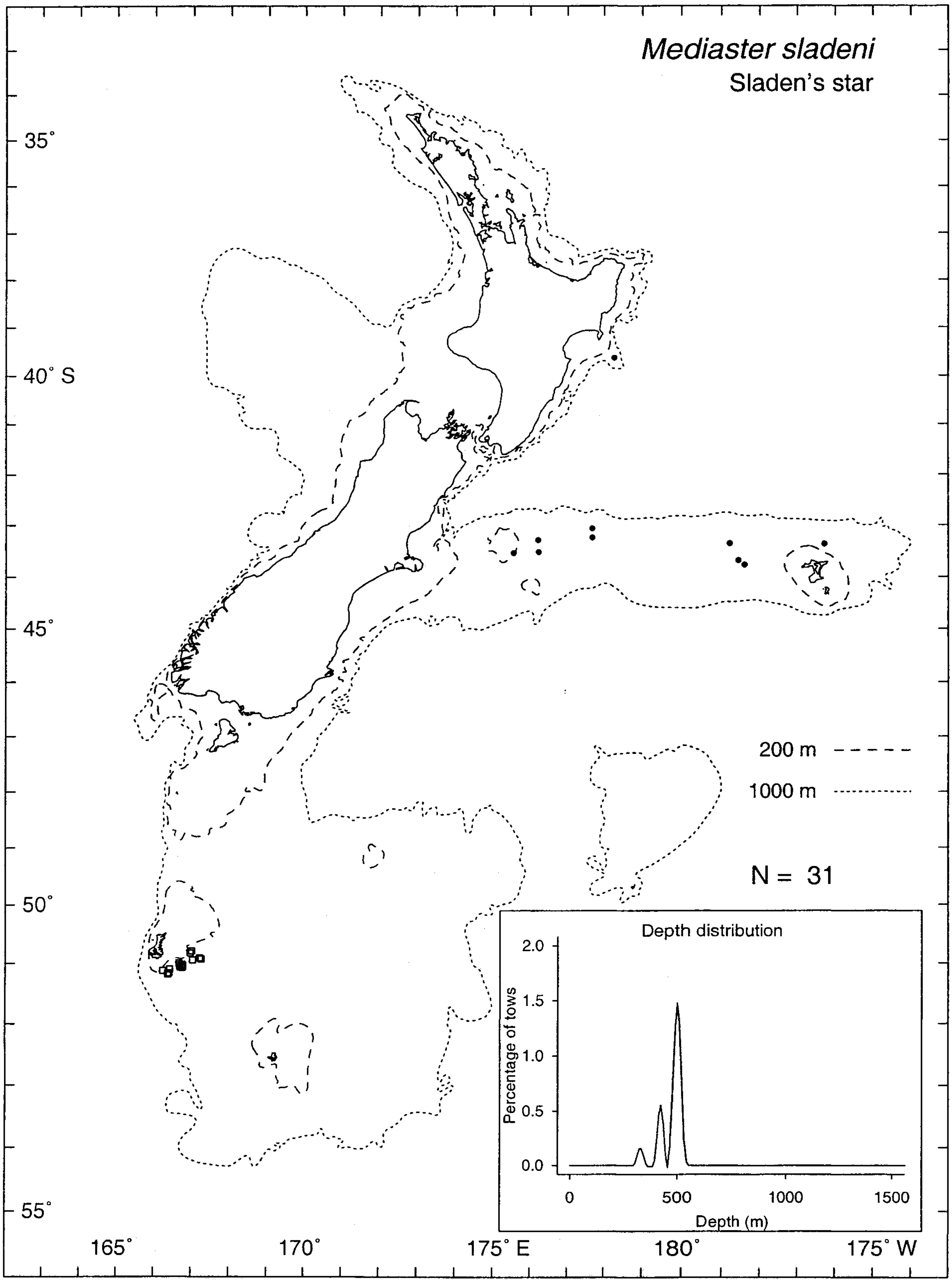
Jacquinotia edwardsii
Giant spider crab
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 287
Depth distribution
Percentage of tows
0
1
2
3
4
5
6
7
0
500
1000
1500
Depth (m)



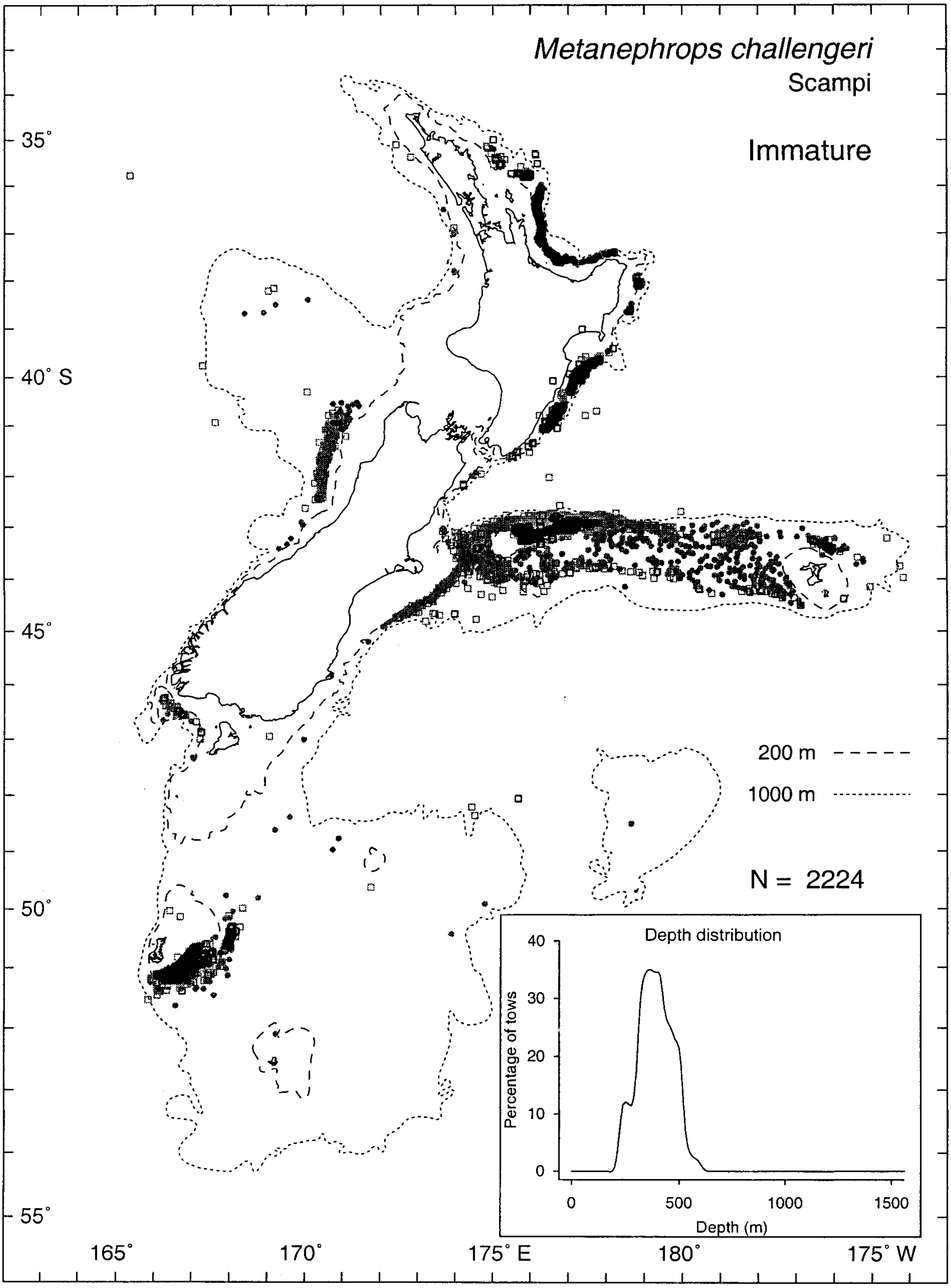
Leptomithrax & Teratomaia spp.
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 209
Depth distribution
Percentage of tows
8
6
4
2
0
0
500
1000
1500
Depth (m)


Lipkius holthuisi
Omega prawn
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 594
Depth distribution
Percentage of tows
35
30
25
20
15
10
5
0
0
500
1000
1500
Depth (m)

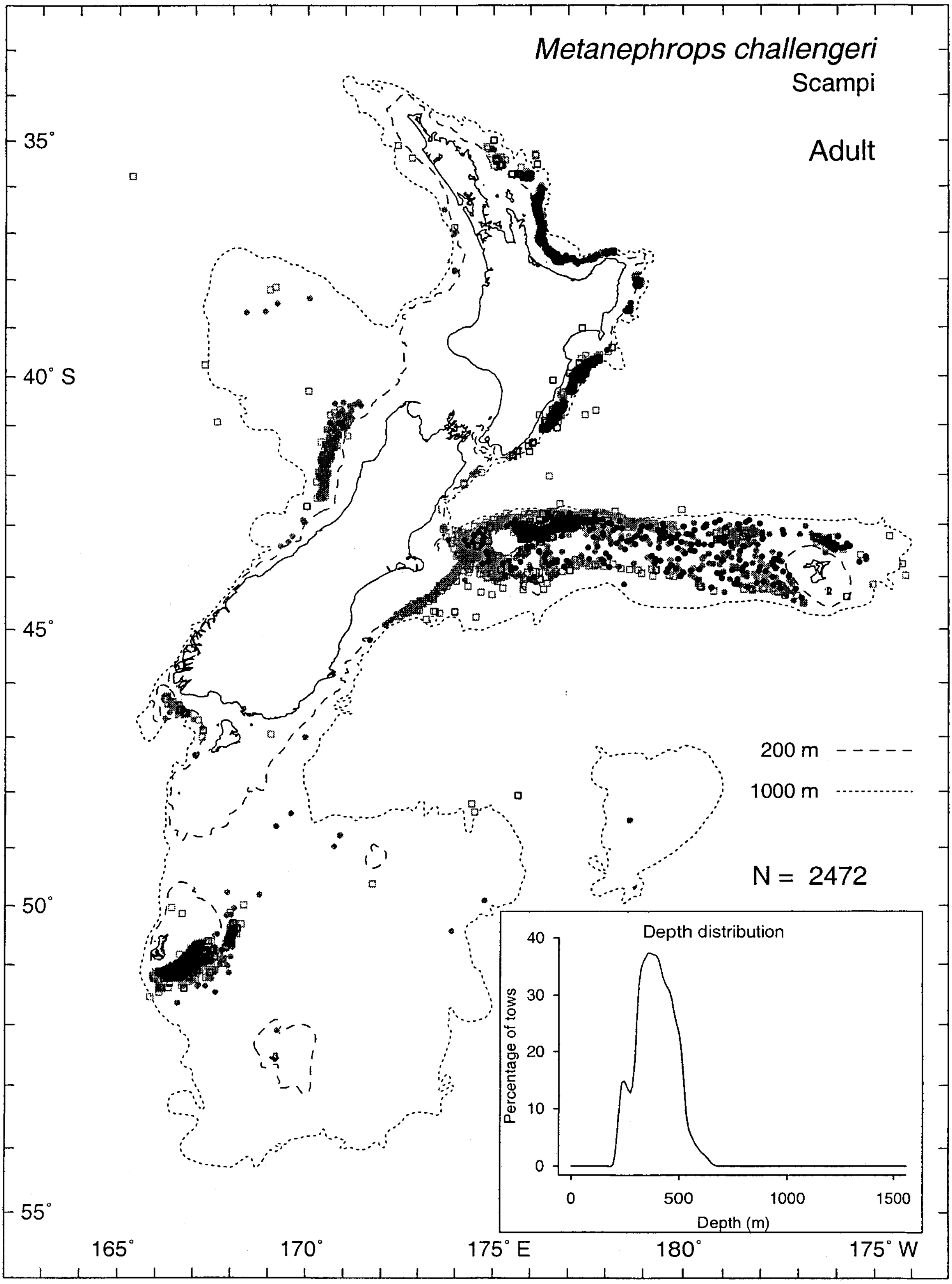

Lithodes spp.
Stone crabs
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 292
Depth distribution
Percentage of tows
Depth (m)
0
5
10
15
20
0
500
1000
1500



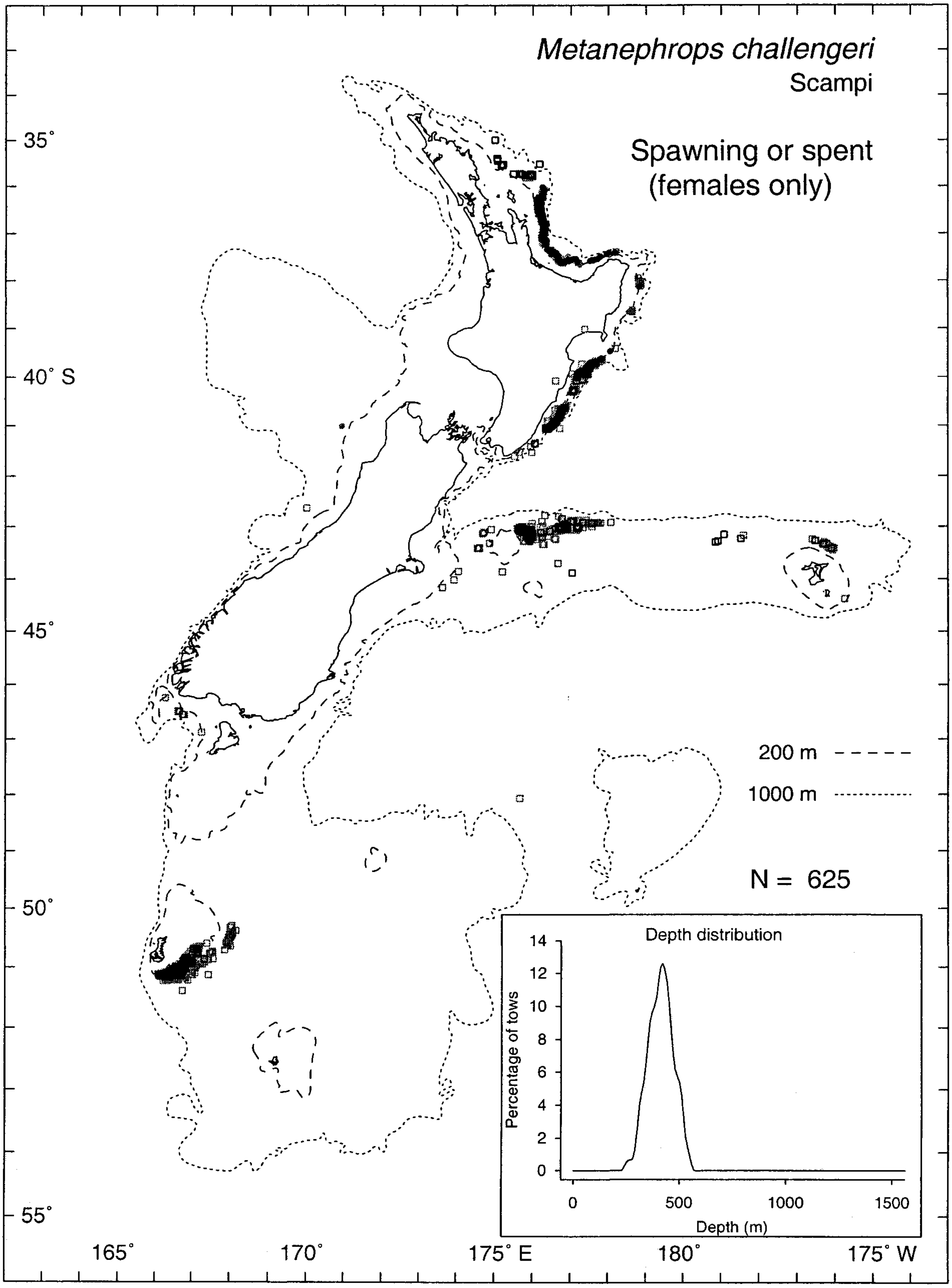
Mediaster sladeni
Sladen's star
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 31
Depth distribution
Percentage of tows
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Depth (m)

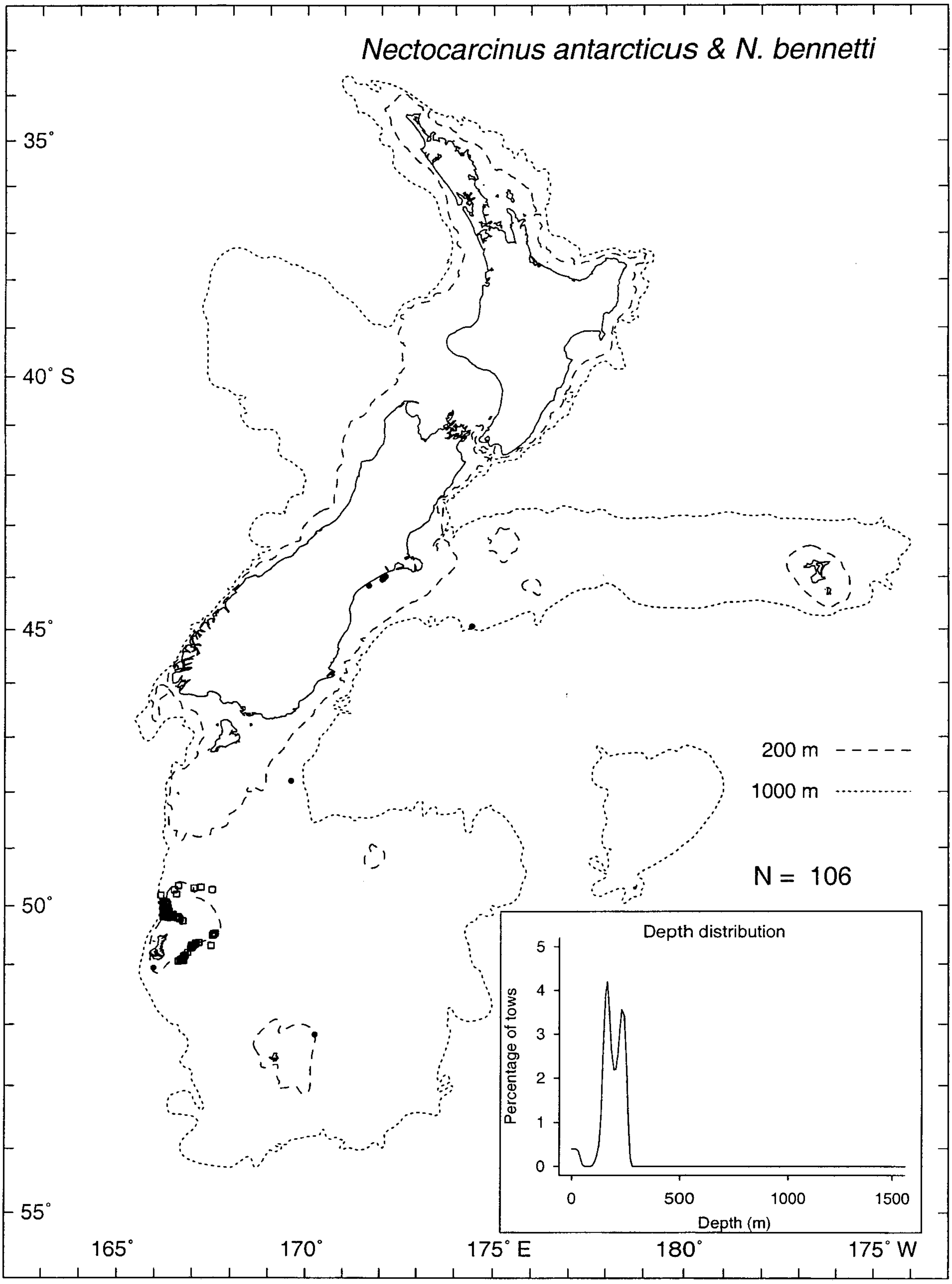


Metanephrops challengeri
Scampi
Immature
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 2224
Depth distribution
Percentage of tows
40
30
20
10
0
0
500
1000
1500
Depth (m)

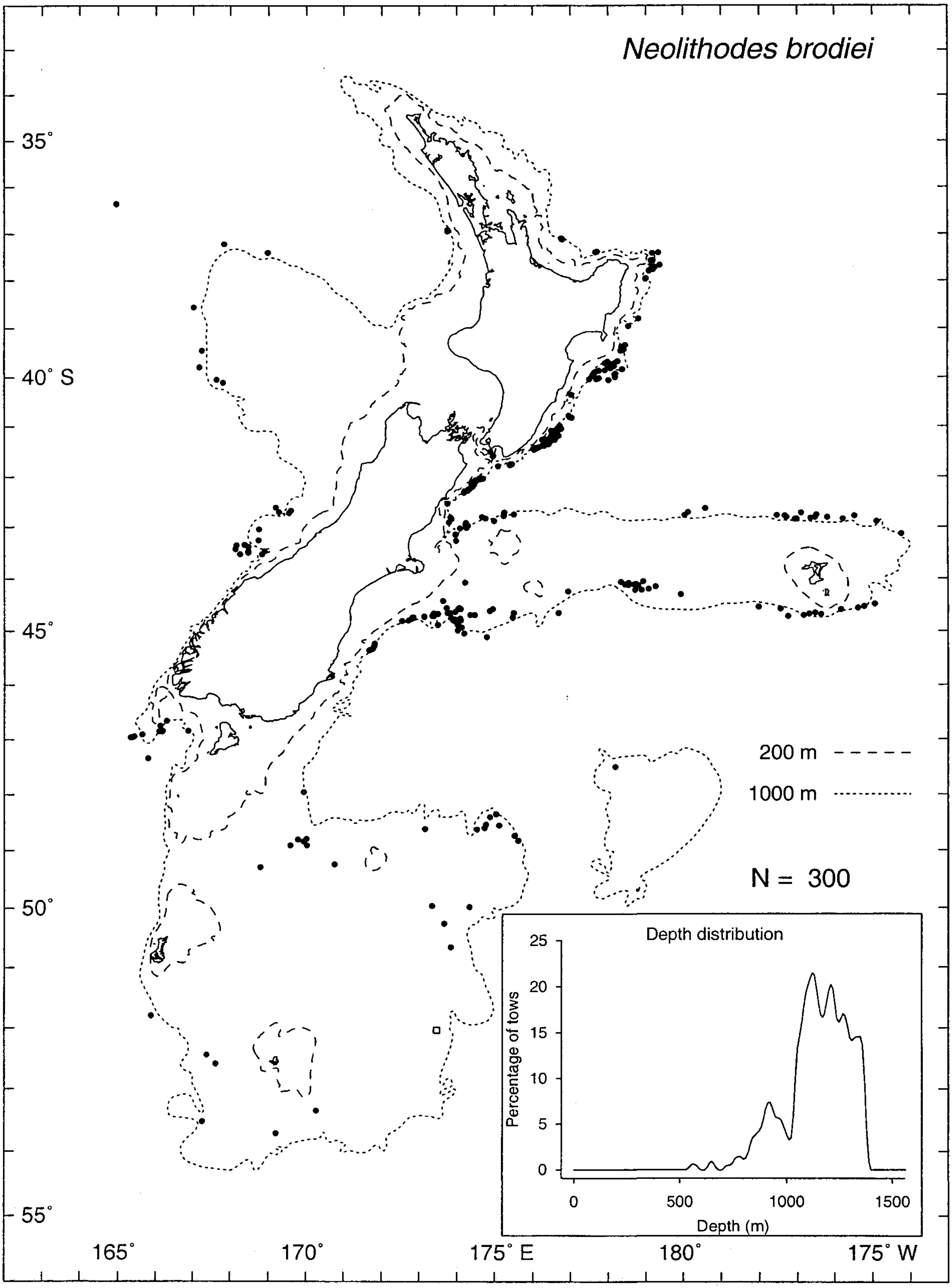


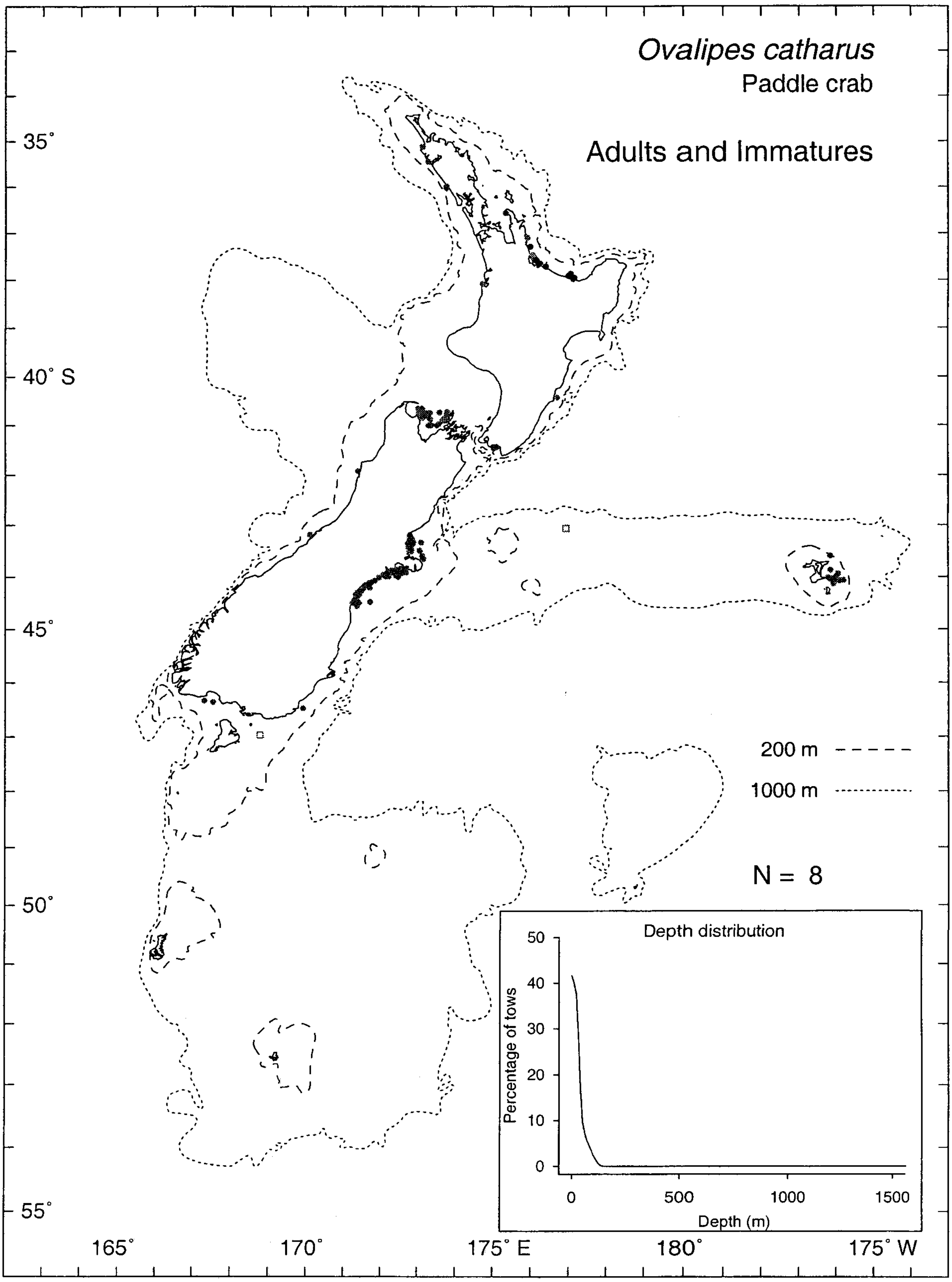
Metanephrops challengeri
Scampi
Adult
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 2472
Depth distribution
Percentage of tows
40
30
20
10
0
0
500
1000
1500
Depth (m)


Metanephrops challengeri
Scampi
Spawning or spent
(females only)
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 625
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
10
12
14
0
500
1000
1500

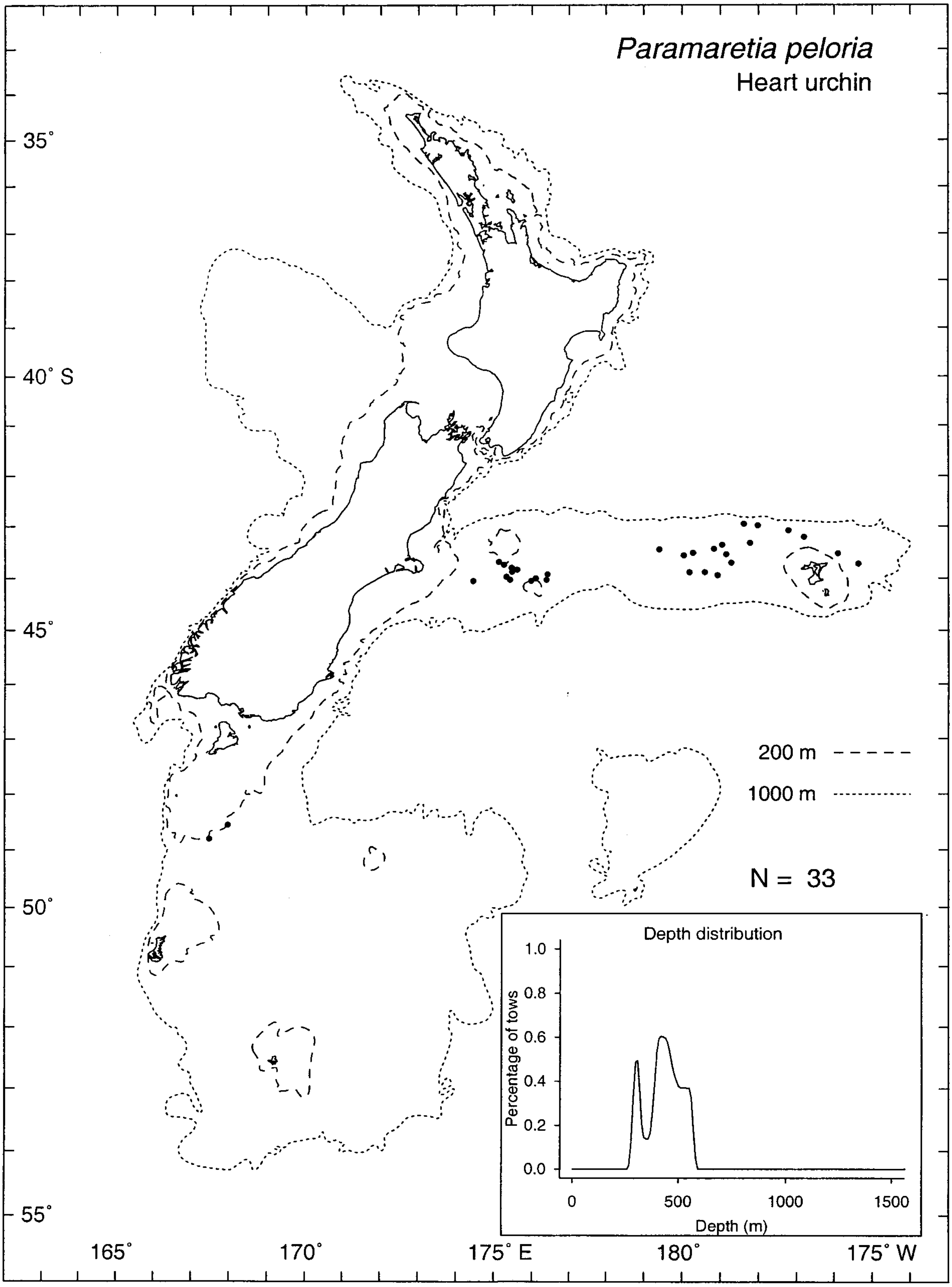


Nectocarcinus antarcticus & N. bennetti
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 106
Depth distribution
Percentage of tows
0
1
2
3
4
5
0
500
1000
1500
Depth (m)

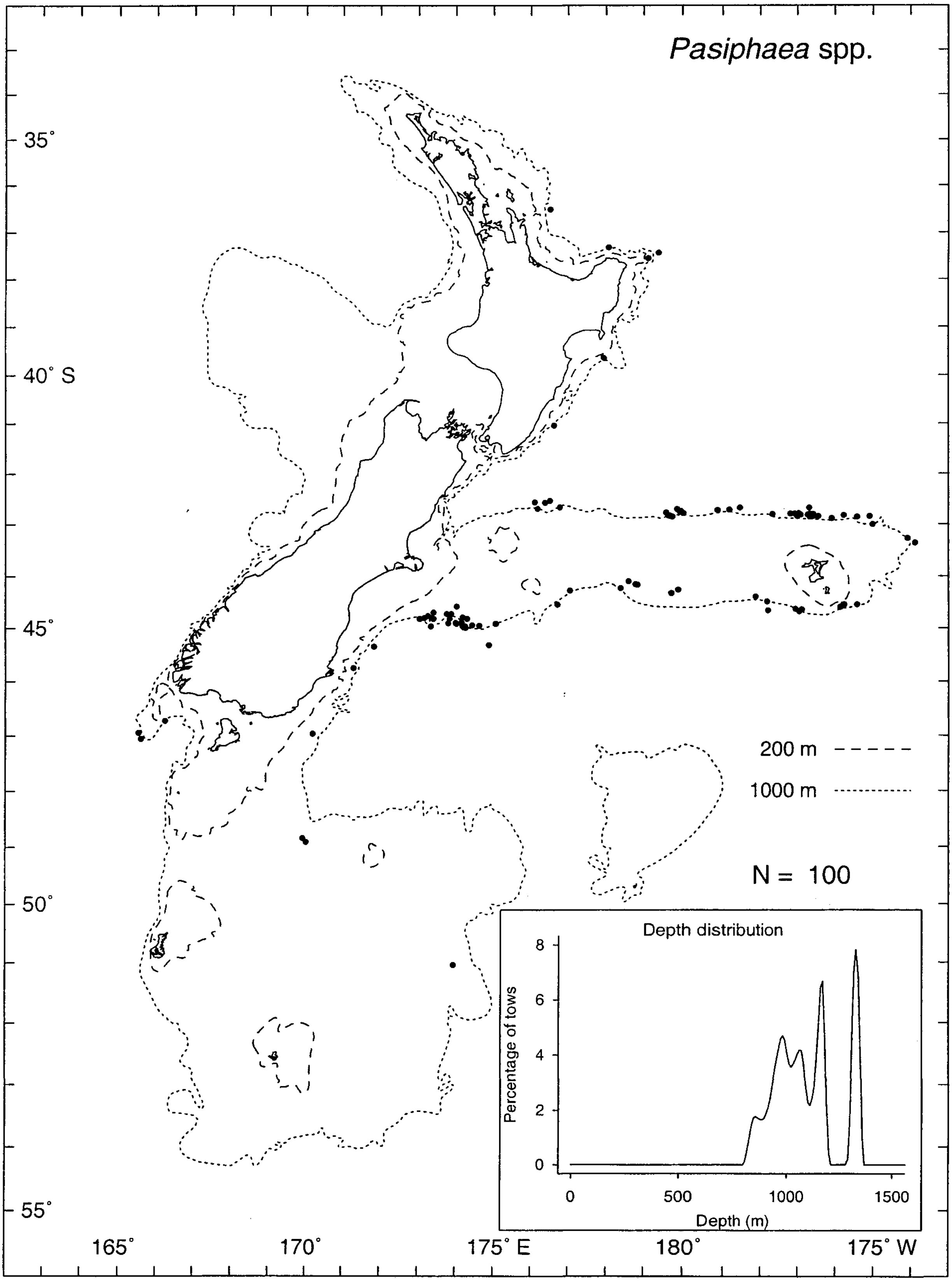

Neolithodes brodiei
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 300
Depth distribution
Percentage of tows
Depth (m)
0
500
1000
1500
5
10
15
20
25



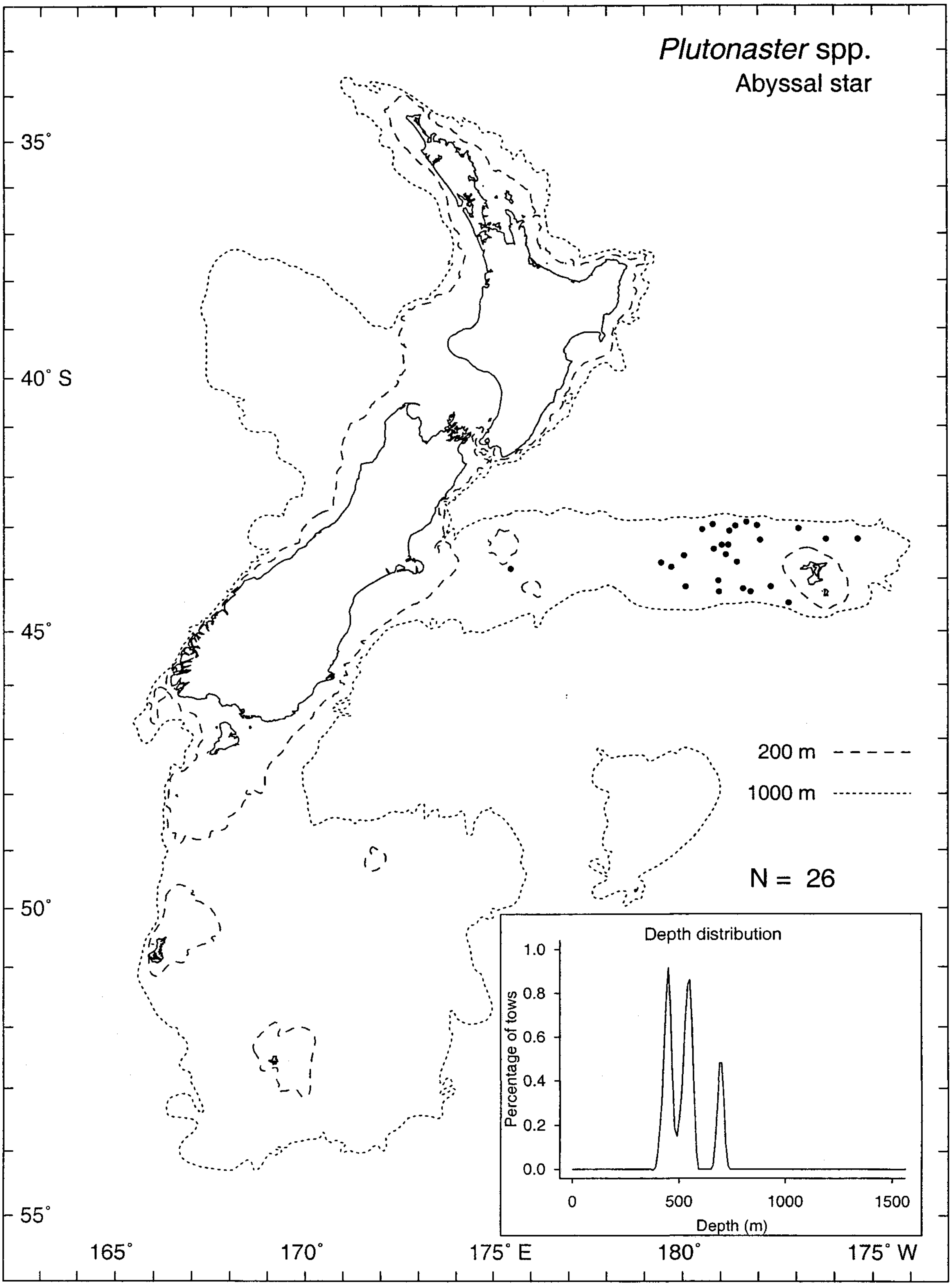
Ovalipes catharus
Paddle crab
Adults and Immatures
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 8
Depth distribution
Percentage of tows
50
40
30
20
10
0
0
500
1000
1500
Depth (m)



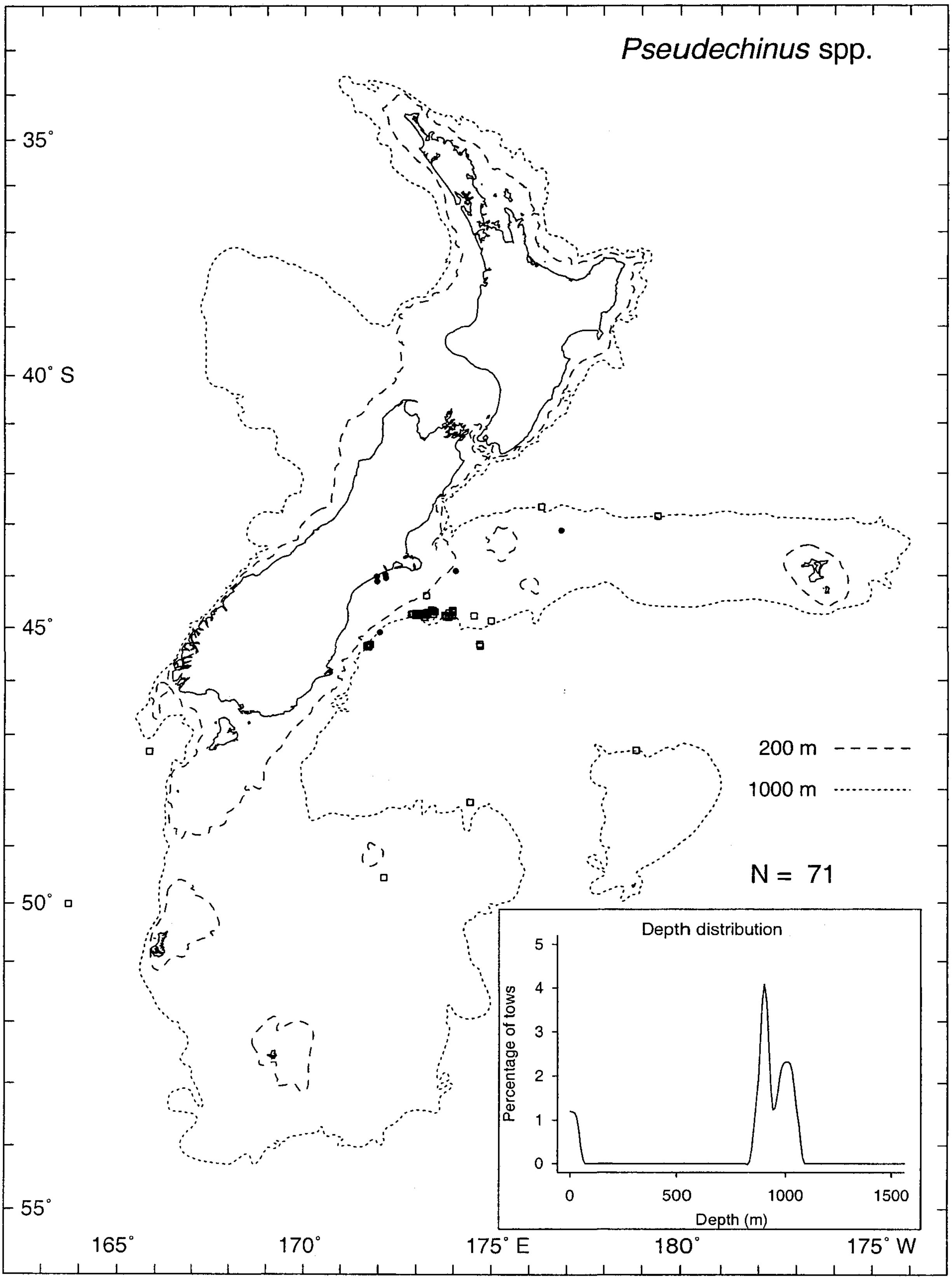
Paramaretia peloria
Heart urchin
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 33
Depth distribution
Percentage of tows
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
Depth (m)



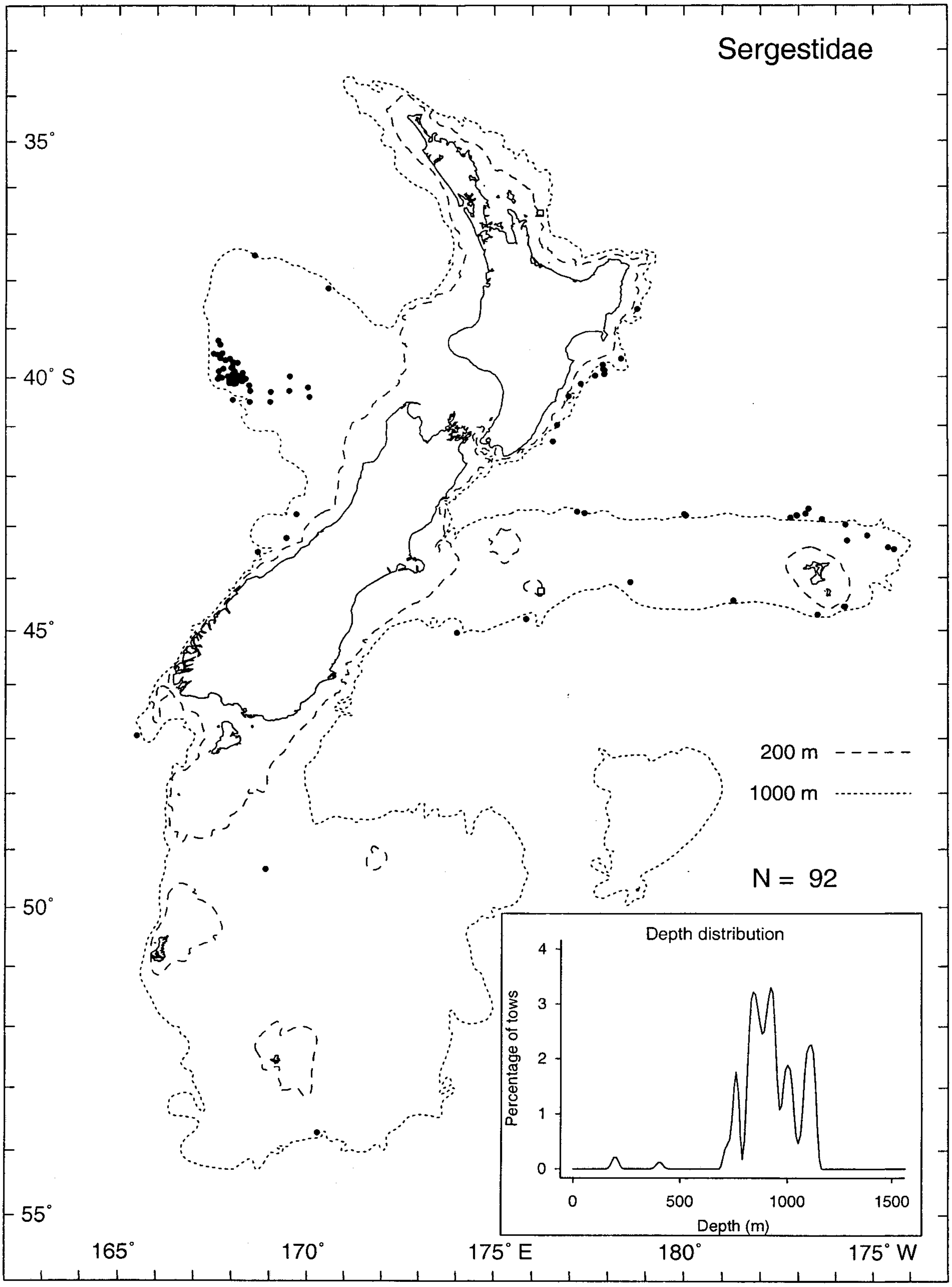
Pasiphaea spp.
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 100
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
0
500
1000
1500



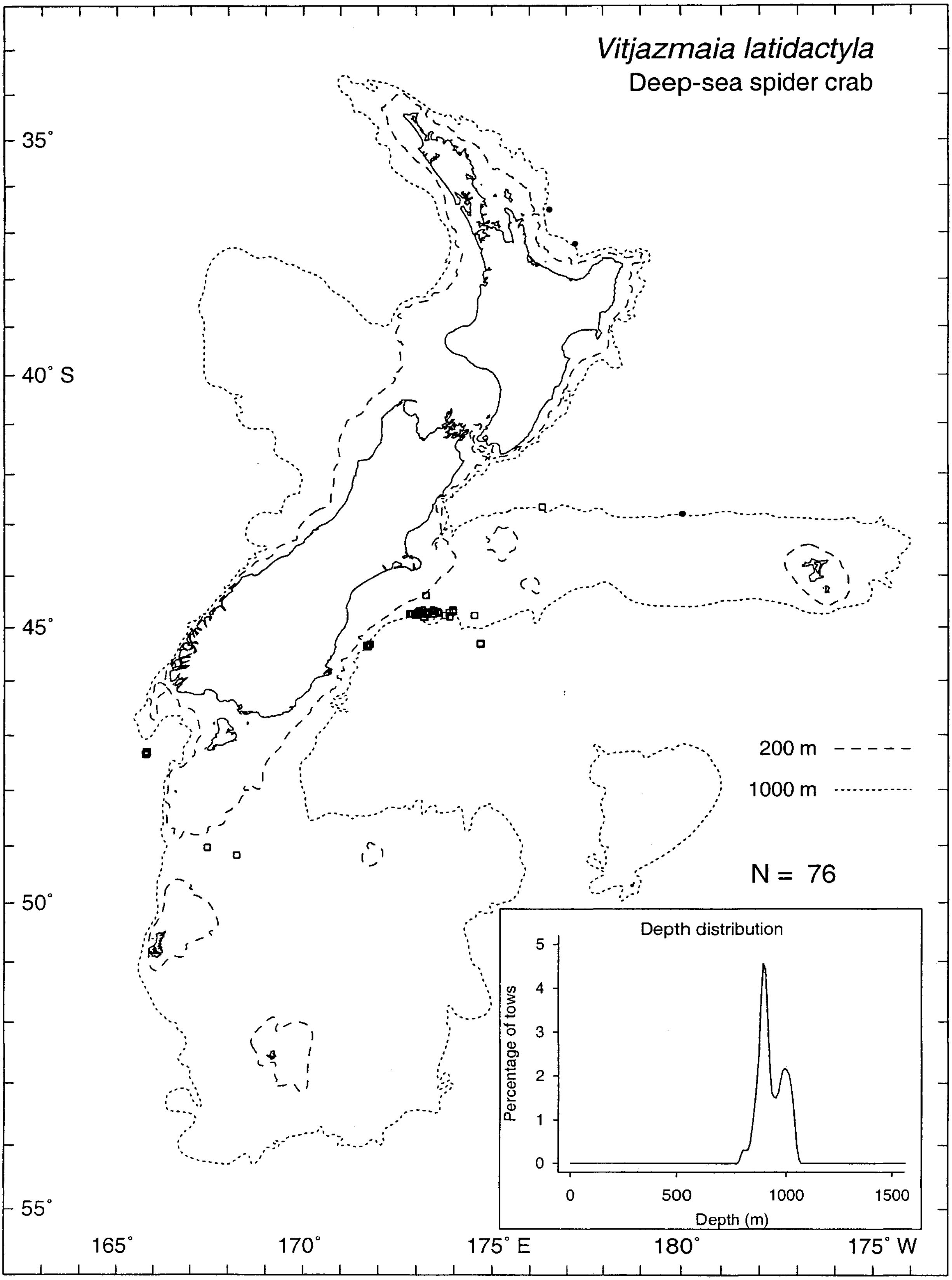
Plutonaster spp.
Abyssal star
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 26
Depth distribution
Percentage of tows
1.0
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
Depth (m)

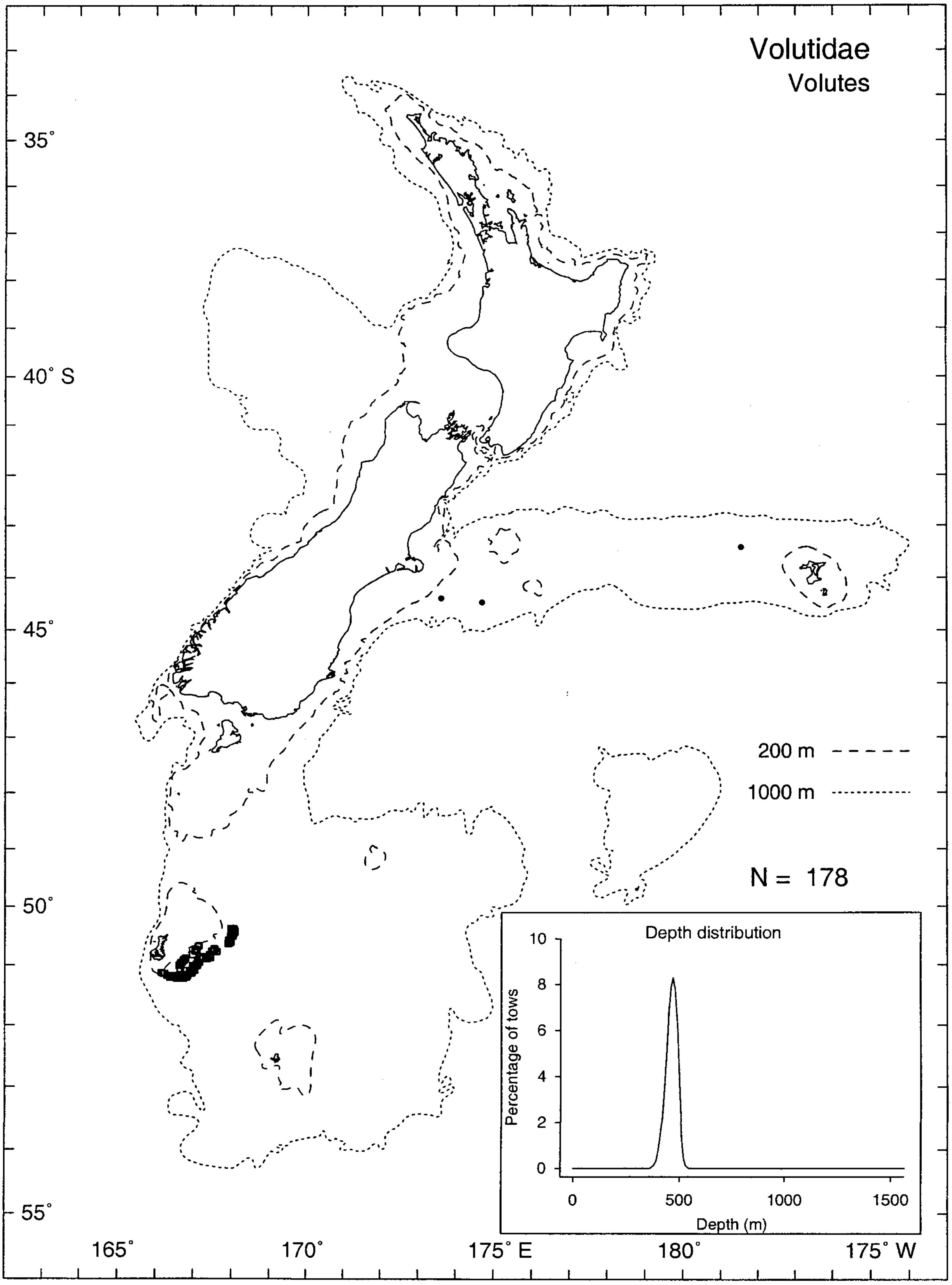


Pseudechinus spp.
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 71
Depth distribution
Percentage of tows
Depth (m)
0
1
2
3
4
5
0
500
1000
1500



Sergestidae
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 92
Depth distribution
Percentage of tows
Depth (m)
0
1
2
3
4
0
500
1000
1500


Vitjazmaia latidactyla
Deep-sea spider crab
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 76
Depth distribution
Percentage of tows
Depth (m)
0
500
1000
1500
0
1
2
3
4
5


Volutidae
Volutes
35°
40° S
45°
50°
55°
165°
170°
175° E
180°
175° W
200 m
1000 m
N = 178
Depth distribution
Percentage of tows
Depth (m)
0
2
4
6
8
10
0
500
1000
1500

NIWA

Taihoro Nukurangi

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Water & Atmospheric
Research Ltd