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Talbot Murray
Ken Richardson
Lynda H. Griggs

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Talbot Murray
Ken Richardson
Lynda H. Griggs

NIWA
Private Bag 14901
Wellington

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EXECUTIVE SUMMARY

Murray, T.; Richardson, K.; Griggs, L. H. (2004). New Zealand tuna fisheries, 1991–2000.

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This report reviews information derived from the Ministry of Fisheries commercial catch and effort logbook data on the number of tuna vessels fishing, areas of operation, effort, landings, catch rates, and catches in New Zealand tuna fisheries from 1991 to 2000 (calendar year). Earlier data are used to standardise longline CPUE for bigeye and southern bluefin tuna (from 1980) and to describe trends in vessels fishing for tuna (from 1989). The fishing methods used include purse-seine, troll, longline, handline, and pole-and-line. The species considered include albacore (*Thunnus alalunga*), bigeye (*T. obesus*), skipjack (*Katsuwonus pelamis*), Pacific bluefin (*T. orientalis*), southern bluefin (*T. maccoyii*) and yellowfin (*T. albacares*) tunas, and swordfish (*Xiphias gladius*).

A large number of vessels are actively engaged in tuna fishing in New Zealand waters. Over the past few years most vessels have used trolling (200 to 300 vessels) and longlining (slightly more than 100), with fewer vessels using other methods (6–7 purse seining, and 2–5 pole-and-line) to catch tuna. With the exception of purse-seine vessels, these are mostly small vessels (50 GRT or less). The number of longline vessels fishing for tuna has steadily increased since 1989, and although the troll fleet reached a peak of 492 vessels in 1994, it has subsequently declined to 200–300 vessels in recent years. Tuna vessels operate in all months, throughout the EEZ and, to a limited extent, in adjacent high seas areas. The seasonal and spatial distribution of fishing effort and catches are described for each species.

Between 1991 and 2000, New Zealand tuna fisheries steadily evolved from seasonal fisheries for albacore, skipjack, and southern bluefin tuna to year-round fisheries that also catch appreciable quantities of bigeye tuna and swordfish. Landings of all tuna except southern bluefin tuna (subject to a competitive catch limit) and swordfish have increased over this time. Landings over the last 10 years have averaged 4583 t for albacore, 174 t for bigeye tuna, 9 t for Pacific bluefin tuna, 4583 t for skipjack tuna, 281 t for southern bluefin tuna, 98 t for yellowfin tuna, and 337 t for swordfish. Longline catches of these species when targeting bigeye tuna are all substantially higher than these averages in recent years. The rapid rise of the bigeye tuna longline fishery has resulted in increased catches of a number of species especially albacore (now accounting for about 40% of albacore landings) and swordfish (nearly 1000 t in the last 2 years). The recent increase in landings of Pacific bluefin tuna is related to this species only recently being distinguishable from southern bluefin tuna. Reports of catches of this species are expected to increase.

The main fisheries for tuna over the period 1991–2000 are the albacore troll fishery, the skipjack tuna purse-seine fishery, the southern bluefin tuna longline fishery, and the bigeye tuna longline fishery. The troll and purse-seine fisheries occur in summer, the southern bluefin tuna longline fishery operates in winter. The longline fishery targeting bigeye tuna operates primarily in autumn and winter, with smaller catches in spring and summer. Catch rates for the tuna and swordfish caught by these fisheries are reviewed. No trend in CPUE is evident for the surface fisheries for albacore or skipjack tuna, while the nominal (un-standardised) CPUE for tuna and swordfish in the longline fisheries vary with fleet and target species.

CPUE models using a negative binomial generalised additive model that standardise for a number of factors and covariates indicate that while relative abundance in the albacore troll fishery has not changed, the relative abundance of bigeye and southern bluefin tuna has decreased in the longline fisheries. In the latter two cases it was possible to incorporate foreign licensed longline data from 1980 to extend the time series of abundance indices and compare them with the nominal CPUE values. For both the bigeye and southern bluefin tuna fisheries there is evidence of variability in relative abundance over the time series with relative abundance in 2000 lower than in the early 1980s.

In the bigeye tuna longline fishery between 1980 and 2000, for the standardised model used here, there are only small differences between the estimated coefficients and the nominal CPUE values. Nominal and standardised CPUE exhibit similar trends with low relative abundance in 1981–83 compared with 1980 followed by an increase to about 80% (standardised) of the 1980 level during 1984–86. Since 1986 the relative abundance of bigeye tuna indices in the New Zealand EEZ further declined to about 15% of the 1980 level by 1995. The bigeye tuna abundance indices then increased to about 50% (of 1980 value) in 1998 followed by a decline to about 20% thereafter.

The southern bluefin tuna (SBT) longline fishery has changed its temporal and spatial distribution to such an extent that the fishery was analysed as three separate fishing areas (east coast north and south of 44° S and the west coast of both islands). The estimated SBT abundance indices for the east coast north of 44° S are similar to, or less than, the nominal CPUE values until 1994. There was a substantial increase in SBT nominal CPUE and abundance indices after 1995. In 1998 to 2000, the estimated abundance index was about 60–70% of the 1980 value in this area. The estimated abundance indices of SBT for the east coast fishing area south of 44° S for the years 1997 to 1999 increased to about 35% of the 1980 value before declining substantially in 2000. Only a small proportion of overall effort in the New Zealand SBT fishery has occurred in this region since 1992. For the west coast fishing area there appear to be significant differences between yearly SBT nominal CPUE values and estimated year coefficients. However, there was a sharp reduction in effort after 1993 and this is reflected in the increase in the size of the confidence intervals over that period. There is no compelling evidence in the model for an increase in southern bluefin tuna abundance in this region after 1994, as is suggested by the nominal CPUE time series, particularly since estimated confidence intervals probably under estimate the actual uncertainty.

In addition to analyses of data from catch and effort log sheets, information collected by the Ministry of Fisheries Scientific Observer Programme on size frequency distributions, length–weight relationships, sex ratios, and discards in the tuna longline fishery is also presented.

1. INTRODUCTION

New Zealand tuna fisheries are based on stocks that occur largely outside the 200 nautical mile Exclusive Economic Zone (EEZ). In New Zealand waters tuna represent important and valuable fisheries (currently more than $NZ20 million annually). No tuna species are included in the Quota Management System and only southern bluefin tuna (*Thunnus maccoyii*), managed by the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), is subject to catch restrictions, with a 420 t competitive national catch limit. Other tuna species of commercial importance to New Zealand are albacore (*T. alalunga*), bigeye (*T. obesus*), skipjack (*Katsuwonus pelamis*), and yellowfin tunas (*T. albacares*). Although a regular bycatch on tuna longlines, all billfish except swordfish (*Xiphias gladius*) must be released when caught. Swordfish may not be targeted, but can be landed by domestic fishers as an incidental catch. This species has become increasingly important to the domestic tuna longline fishery, and landings in the last few years have rapidly increased.

In New Zealand, albacore form the basis of a summer troll fishery, primarily on the west coasts of the North and South Islands. Although most albacore landings are from the troll fishery, significant catches are also made throughout the year by longline (usually 1000–2500 t per year). Annual landings over the past 10 years have averaged 4583 t (maximum 6526 t in 1998). Bigeye tuna are caught by longline around the northern half of the North Island throughout spring and autumn, with landings averaging 174 t per year over the past 10 years (maximum 422 t in 2000). Skipjack tuna are caught in small numbers by trolling with most of the catch by purse-seine during summer months. Skipjack tuna landings have averaged 4583 t per year over the past 10 years (maximum 9699 t in 2000). The southern bluefin tuna fishery began as a handline and troll fishery during winter off the west coast of the South Island from small vessels. These methods are now only occasionally used and longline vessels catch most southern bluefin tuna in autumn and winter. Southern bluefin tuna catches, restricted to a national competitive catch limit of 420 t since 1989, have usually been below this limit with landings averaging 281 t per year over the past 10 years (maximum 529 t in 1990). Pacific bluefin tuna (*Thunnus orientalis*), only recently recognised (June 2000) as contributing to tuna landings, have averaged 9 t per year over the past 10 years (maximum 21 t in 1999).

Yellowfin tuna, caught in low numbers in the troll fishery, are generally a bycatch of longline sets targeting bigeye tuna in summer months. Landings of yellowfin tuna have averaged 98 t per year over the past 10 years (maximum 198 t in 1996). Swordfish are a bycatch of longline sets targeting bigeye and southern bluefin tuna around both the North and South Islands. Swordfish landings have averaged 337 t per year over the past 10 years, but have been increasing with increased longline effort, especially over the last few years (maximum 1004 t in 1999).

In addition to the tuna target species, several other commercially valuable species, and many commonly caught species (both fish and non-fish) of little or no value, make up the longline bycatch. Catch composition and bycatch estimates were reported by Francis et al. (1999, 2000) for the tuna longline fishery. The longline bycatch has also focused attention on the potential to affect a range of dependent or associated species, particularly those that are rare, have low fecundity, or about which little is known. Similarly, for purse-seine fishing in the EEZ, a wide range of fish taxa (over 60 species) have been reported as bycatch in sets targeting skipjack tuna (Habib et al. 1982). Trolling and other tuna fishing methods do not appear to have an appreciable bycatch.

This report satisfies Objective 1 of Project TUN1999/01: *To produce a report on the status of New Zealand fisheries for albacore, bigeye, skipjack, yellowfin and southern bluefin tuna and swordfish for the 1998/1999 and 1999/2000 fishing years, respectively.*

2. METHODS

Data used in this report were taken from several sources. Landings data are from the Licensed Fish Receiver Reports (LFRR), and catch, fishing effort, fishing operational data, and vessel information are from the catch and effort logsheet data provided by each fisher to the Ministry of Fisheries on Catch Effort Landing Returns (CELR) and Tuna Longline Catch Effort Returns (TLCER). Information on size composition, length and weight, sex ratio, discard and loss rate of fish is from the Ministry of Fisheries Scientific Observer Programme. Additional information used in standardising CPUE included data on moon phase and on the southern oscillation index (SOI) for El Niño and La Niña events and is used as a proxy for basin-wide climatic variation known to affect tuna CPUE. Moon phase data were based on the algorithms of Duffet-Smith (1990) and the date and location of each operation from the CELR and TLCER data. Moon phase represents a measure of the fraction of the illuminated lunar disc and hence is a measure of the amount of light at night during longline sets. The SOI data are from the National Ocean and Atmospheric Administration Climate Prediction Center (http://www.cpc.ncep.noaa.gov/data/indices/indices.html). These data represent standardised differences between the standarised monthly sea level pressure anomalies of Tahiti and Darwin.

Tuna fisheries catch and effort data have been collected by the Ministry of Fisheries (Ministry of Agriculture and Fisheries at that time) since at least 1976, but changes to data collection and processing mean that domestic fisheries catch and effort data are not available before 1989. CELR and TLCER data are currently available beginning in the third quarter of 1989 (start of the 1989–90 fishing year). However, as noted by Murray et al. (1999), CELR data have a sufficiently high percentage of the catch reported in weight rather than number to make data up to at least 1990–91 unusable in most domestic tuna fisheries. In this report we have used catch and effort data (TLCER and CELR) from 1991 and LFRR data from 1987 onwards because these represent the earliest complete yearly data available electronically. One exception is the use of data from 1989 on the number of vessels fishing for tuna because these data are not affected by the errors in catch data. TLCER data from foreign licensed vessels from 1980 to 1995 have been used in the CPUE standardisation of bigeye and southern bluefin tuna in the longline fishery because the data supplied on these forms were not subject to the errors in catch reported on CELR forms. All data used in this report were checked for errors and groomed using the catch and effort constraints described by Murray et al. (1999). A few position errors (shown in Figure 2) have not been corrected, but any effect on the CPUE models are regarded as minor. Unless stated otherwise, results are given on a calendar year basis.

Estimates of catch in weight by gear type, Fisheries Management Area, and quarter (three monthly periods beginning in January) were done by stratifying the catch (in number) and multiplying the catch by an estimate of the average weight of a fish of a given species caught by a specific gear type. In the longline fisheries, a conversion factor was applied to convert processed weight to whole weight (1.15 for tunas other than albacore and skipjack tuna where no conversion factor is required, and 1.40 for swordfish). Where possible, estimates of average weight were derived annually from observer data (longline fishery only) for each fleet. Where data were inadequate, average fish weight was derived for pooled years. For handline fishing, and where the species caught was part of a winter fishery, longline average weights were used. For surface fishery methods (troll, pole-and-line, and some handline fishing) the average weights were taken from Ichikawa (1981) for skipjack tuna, Griggs & Murray (2001) for albacore, or from the Ministry of Fisheries gamefish tagging database (yellowfin, bigeye, and Pacific bluefin tuna). Estimates of catch in weight summed across strata for each year were found to have a strong linear relationship with the total landings reported in the LFRR data. The estimates of catch by strata were therefore scaled to the ratio of the sum of estimated catch in weight to the LFRR data. While we know from observer data that some discarding occurs in the longline fishery, this is typically small. No discards are reported on the TLCER or CELR forms for tunas or swordfish, so we used the LFRR landings data as the best estimate of the total catch of tunas and swordfish by domestic and charter fleets.

CPUE was standardised using a Generalised Linear Model (GLM) approach for the albacore troll fishery, and for the bigeye and southern bluefin tuna longline fisheries. GLMs are often used to account (standardise) for systematic changes in catchability, fishing power, etc, while estimating trends in abundance (e.g., Punt et al. 2000). GLMs have three main components: a linear predictor describing the systematic component of the data, a member of the exponential class of distributions describing the random component, and a link function relating the linear predictor to the mean of the distribution. Generalised Additive Models (GAMs), which are extensions of GLMs allowing the non-linear effects of covariates on the response to be estimated from the data, are also now being used (e.g., Bigelow et al. 1999, Daskalov 1999). In both model types, response variables are assumed independent, i.e., the data arise from a random sampling process. In this report we use a negative binomial GAM to standardise catch rates in albacore, bigeye, and southern bluefin tuna.

3. CHARACTERISTICS OF NEW ZEALAND TUNA FISHERIES

3.1 Size and number of vessels fishing for tuna

A wide range of vessel types fishes for tuna in the EEZ. Of these, only those engaged in purse seining and some longline vessels are purpose-built tuna vessels and most vessels also operate in other fisheries. Trolling, purse seining, and longlining are the main tuna fishing methods used in New Zealand, although handline and pole-and-line are occasionally used. Appendix 1 summarises the number of vessels reporting tuna catches by gear type, vessel size (GRT), and year.

Except for the small purse-seine fleet, other domestic vessels are predominantly small vessels, under 50 GRT. The other domestic vessels fish by troll, longline and/or pole-and-line. It is clear that a large number of vessels fish for tuna in New Zealand waters and that the longline and purse-seine fleets have been expanding, there does not appear to be a trend towards larger vessels other than in the purse-seine fishery.

Most vessels target albacore by trolling. The number of vessels trolling has been relatively constant at 200 to 300 vessels in each of the last few years (Figure 1). The number of vessels longlining has steadily increased since 1990 to 115 vessels, most targeting bigeye tuna. Six medium-sized purse-seiners catch most of the skipjack tuna. This fleet remained virtually unchanged until the entry of a large super seiner in 2000 (two more large super seiners entered the New Zealand fleet in 2001). Although up to 11 boats report using pole-and-line, this method is infrequently used and accounts for only a small proportion of the New Zealand tuna catch.

Foreign licensed tuna fishing, primarily for southern bluefin tuna, declining since the late 1980s, ceased operating in the New Zealand EEZ in 1995–96. At the same time, domestic tuna fishing has expanded through the increased use of longline for both southern bluefin and bigeye tunas. A few (usually five) Japanese longliners on charter to a New Zealand company have fished each year since 1988–89, except 1990–91 (three vessels) and 1995–96 (no vessels).

3.2 Areas of operation

The purse-seine fishery operates almost exclusively on the continental shelf in FMA 1 (Figure 2a) with some sets in FMA 2, FMA 8 and FMA 9. The only tuna species targeted by purse-seine in 2000 was skipjack tuna, although some albacore was reported as bycatch when other non-tuna species were targeted. Figure 2b shows the areas fished by trolling in 2000. Although some trolling was reported targeting skipjack and yellowfin tunas (less than 1% of all days trolling), nearly all trolling targeted albacore. Trolling for albacore occurs in nearly all FMAs with most done in FMA 7 on the continental shelf between 40° S and 44° S.

Although several species are reported as the target in the New Zealand tuna longline fishery, 93% of all hooks set in 2000 targeted either bigeye or southern bluefin tuna. The remaining target sets reported were albacore (6%) with Pacific bluefin tuna, yellowfin tuna, and swordfish accounting for 1% of hooks set. The start of set positions for all longline sets targeting bigeye and southern bluefin tuna in 2000 is shown in Figure 2c. Typically longline sets (regardless of target species) are made off the continental shelf in waters deeper than 1000 m. Sets targeting bigeye tuna occur primarily in areas north of 40° S on both coasts of the North Island. Sets targeting southern bluefin tuna are made both off the west coast of the South Island in FMA 6 and FMA 7, off the east coast of the South Island in FMA 3, and off the North Island in FMA 1 and FMA 2. Bigeye and southern bluefin tunas are both targeted north of 41° S, but in different months.

Positions where pole-and-line and handline fishing was reported in 2000 are shown in Figure 2d. These methods are used by only a few vessels and do not contribute substantially to New Zealand's tuna landings. Pole-and-line fishing is used to target skipjack tuna, yellowfin tuna, and albacore, while handline is used to target southern bluefin tuna. Because these methods are so seldom used in New Zealand, they will be considered only in relation to estimates of the catch of particular species.

3.3 Fishing effort by gear, target, area and quarter

The purse-seine and troll fisheries are surface fisheries that typically operate during the summer. The purse-seine fishery mainly targets skipjack tuna in the first quarter of the year (83.3% of target sets on average) with lower effort in the second (10.4%) and fourth (6.2%) quarters. This seasonal pattern is shown for 1991 to 2000 in Table 1. Nearly all purse-seine effort is conducted in FMA 1 (85.6% on average) with FMA 9 and FMA 2 accounting for 6.0% and 5.6% respectively (Table 2).

The troll fishery targets albacore during the first and second quarters of the year (89.2% and 7.2% respectively). The distribution of number of days trolling for albacore since 1991 is shown in Table 3. Trolling is done in all FMAs and in high seas areas (Table 4). Over half of all days spent trolling for albacore, however, occur in FMA 7 with boats landing their catch in Greymouth and Westport. Historically, some trolling has also targeted southern bluefin tuna during the winter; this method is only occasionally used for southern bluefin tuna and is not discussed further.

Unlike surface fishing methods, longlining is done year round in the EEZ. Two species are the focus of domestic longline effort. Due to confidentiality provisos of the Ministry of Fisheries, fishing effort by Japanese owned and operated longliners chartered by a New Zealand company and that by New Zealand owned and operated vessels are combined in this report. Longline effort targeting bigeye tuna has shown an exponential increase from 1991 to 2000, with about 6 million hooks being set for bigeye tuna in 2000. This effort is substantial in all quarters (Table 5), and, as shown in Table 6, is primarily distributed in FMA 1 (62.4% on average), FMA 2 (20.0%), and to a lesser extent FMA 9 (13.5%). Most of this effort is by domestic owned and operated longliners.

Table 7 shows the longline effort targeting southern bluefin tuna by quarter. Unlike bigeye tuna, southern bluefin tuna are primarily targeted during the second quarter (78.4% on average). Since southern bluefin tuna are subject to a national competitive catch limit (420 t since 1989), effort in this fishery has been relatively stable (1.4 million hooks per year on average, c.v. = 30%). Longline effort for southern bluefin tuna is primarily done in FMA 7 (40.6% on average), FMA 5 (30.9%), FMA 2 (13.0%), FMA 1 (7.2%) and FMA 3 (6.1%) although some fishing is reported in all months and in all areas (Table 8).

Between 1991 and 2000 nearly all tuna fishing reported was conducted within the EEZ.

3.4 Tuna and swordfish landings

The largest landings are from the surface fisheries for albacore (troll fishery) and skipjack tuna (purse-seine fishery). Skipjack tuna landings during the late 1980s to early 1990s were variable, ranging from 1000 to 5000 t (Figure 3). Since 1993, however, skipjack tuna landings have increased from less than 1000 to nearly 10 000 t in 2000. Albacore landings over the same period were also variable, increasing from about 1000 t in the late 1980s to 4000–6500 t after the mid 1990s.

The annual landings of tuna and swordfish, caught primarily by longline, are shown in Figure 4. Before 1990 most tuna longlining was by 3–5 Japanese vessels operating under charter, primarily targeting southern bluefin tuna, with catches of bigeye tuna, yellowfin tuna, and swordfish made at the end of the season. Landings of these species have increased with the expansion of the domestic longline fishery starting in 1990.

The landings in Figure 4 are typically by longliners targeting either southern bluefin or bigeye tunas. Bigeye tuna catches before 1996 were typically less than 100 t, but have risen rapidly since 1997 landings to about 400 t. Yellowfin tuna landings are low and up to 1994 were similar to those of bigeye tuna (less than 100 t); since 1994 they have ranged from 100 to 200 t. Southern bluefin tuna catches, limited by a national competitive catch limit of 420 t since 1989, have exceeded the national catch limit in only 4 of the past 15 years. Where the catch limit has been exceeded, the domestic allocation has been reduced so that New Zealand catches do not exceed the catch limit on average. In recent years, landings of Pacific bluefin tuna have increased to about 20 t, due to the recent ability to distinguish southern and Pacific bluefin tunas (Smith et al. 2001).

One striking feature of Figure 4 is the increase in swordfish landings in recent years. Before 1995 landings were typically less than 100 t. However, while the targeting of any billfish is prohibited, the increase in domestic longline effort has seen swordfish catch and landings increase to about 1000 t.

3.5 Tuna and swordfish catch by gear, area, and quarter

Gear type, target species, quarter, and Fisheries Management Area (FMA) and high seas areas have been used to stratify the catch (in number) using groomed CELR and TLCER data. Methods that rarely catch tuna or swordfish are excluded. Catches in number have been converted to weight and scaled to the LFRR data to estimate the domestic catch by area, quarter, gear, and target species.

3.5.1 Albacore

Trolling and longline catch most albacore with minor amounts by pole-and-line and handline. In recent years the longline albacore catch has become an important component of the total albacore catch, amounting to 40–60% of all albacore landings since 1997. Most albacore troll fishery catches are in the first and second quarters with the fourth quarter important in some years (1994–1996) (Table 9). Most of the troll fishery catch comes from FMA 7 off the west coast of the South Island although FMA 1, FMA 2, FMA 8 and FMA 9 have substantial catches in some years (Table 16). High seas troll catches have been infrequent and a minor component (maximum catch of 42.2 t in 1991) of the New Zealand fishery between 1991 and 2000. Most of the longline albacore catch is reported from FMA 1 and FMA 2, with lesser amounts caught in FMA 9 (Table 16). Albacore are caught regularly by longline in high seas areas, but catches are small (range is 2.0 to 76.5 t).

3.5.2 Bigeye tuna

Bigeye tuna are almost exclusively caught by longline with occasional small catches by trolling. It is clear from Table 10 that longline catches can be made in all quarters, but the third and fourth quarters are usually when most of the longline catch is realised. The troll bycatch of bigeye tuna, when it occurs, is in the first and fourth quarter. Most of the bigeye tuna catch comes from FMA 1 with smaller catches in FMA 2 and FMA 9 (Table 17). High seas catches are regularly made but are generally small (0.1 to 14.3 t).

3.5.3 Pacific bluefin tuna

Pacific bluefin tuna (previously called northern bluefin tuna) catches, are made only by longline and are generally small (0.3 to 21.2 t) before 2000. Most catches are made in the second and third quarters (Table 11) and almost all catches are from FMA 1 and FMA 2 (Table 18). Pacific bluefin tuna until recently have been confused with southern bluefin tuna, but now these species can be clearly distinguished in commercial catches (Smith et al. 2001).

3.5.4 Skipjack tuna

The New Zealand skipjack tuna fishery is now approaching 10 000 t, almost all of it caught by purse-seine. Small catches are made each year by trolling (0.4 to 15.0 t) and in some years by pole-and-line (0.1 to 20.4 t when this method is used). Surface fishery methods realise most of their catch in the first and second quarters with the fourth quarter occasionally important to the purse-seine fishery (1995, 1998, and 1999) (Table 12). Purse-seine catches are primarily from FMA 1 with occasional catches from FMA 2, FMA 8 and FMA 9 (Table 19). Troll catches of skipjack are primarily from FMA 1, FMA 7, FMA 8 and FMA 9. The few pole-and-line catches are nearly all from FMA 1.

3.5.5 Southern bluefin tuna

Southern bluefin tuna catches are made by longline when targeting either southern bluefin or bigeye tuna, and to a limited extent by handline and trolling. Nearly all southern of the bluefin tuna catch is by longline in the second and third quarters (Table 13). The distribution of catch by FMA is given in, and shows that most southern bluefin tuna are caught in FMA 1, FMA 2, FMA 5 and FMA 7. The northern FMAs (FMA 1 and FMA 2) accounted for a small proportion of southern bluefin tuna before 1998, but in recent years account for about the same amount of southern bluefin tuna as southern FMAs (FMA 5 and FMA 7). This change in spatial distribution of catches can be attributed to the increase in domestic longline effort (see Figure 1) in the northern FMAs.

3.5.6 Yellowfin tuna

Pole-and-line and handline occasionally catch yellowfin tuna but most of the catch is by longline and trolling. Most yellowfin tuna are caught in the first and fourth quarters, with some longline catches in the second quarter (Table 14). Yellowfin tuna are clearly a seasonal visitor, with summer catches by troll and longline vessels occurring primarily in FMA 1, FMA 2 and FMA 9 (Table 21).

3.5.7 Swordfish

Swordfish catches in New Zealand waters are essentially all by longline. As can be seen in Figure 4, catches have risen rapidly since 1995. While swordfish are caught in all quarters and most FMAs, most are caught in the first and second quarter in FMA 1, FMA 2 and FMA 9 (Tables 15 and 22). The spatial and temporal distribution of catches is consistent with the CPUE trend for swordfish shown in Figure 13 where the highest CPUE values were associated with the domestic longline fishery targeting bigeye tuna. High CPUE values for swordfish in the domestic southern bluefin tuna longline fishery are due to catches in FMA 2 in the third quarter.

3.6 Tuna and swordfish catch rates

Tuna and swordfish are highly migratory fish with extensive ranges so the utility of catch rates as stock status indicators is sometimes questioned. However, even though a specific fishery may exploit only a small portion of a large mobile stock, trends in catch rates can serve as an important regional diagnostic of stock status. This was clearly evident when stock assessment model results were compared with a range of fishery indicators, including fishery specific trends in catch rate, for southern bluefin tuna in the late 1980s (Caton 1991). In this case optimistic stock assessment results could not be corroborated by reference to catch rate trends and significant quota reductions were instituted from 1989.

Usually, however, the greatest use of catch rates is as an index of relative abundance either on its own or as an input to a stock assessment model. Where fishing practices are constant over time, unstandardised (or nominal) catch rates are generally used. However, in most instances the introduction of new fishing technology, changes in area or season fished, changes in fishing practice in response to regulatory or economic forces, and climatic shifts affect catch rate as a measure of abundance. It is then necessary to use information on changes in fishing operations and environmental information to adjust (or standardise) catch rates. If catch rates are not standardised, changes in nominal catch rates can be misleading and interpretation of changes in CPUE subjective.

We present a series of catch rate trends as catch per unit of fishing effort (CPUE), where the unit of effort is gear-specific and mirrors that used elsewhere for similar tuna fisheries. Nominal CPUE trends are shown for each of the six tuna species and for swordfish caught in the EEZ by the three primary gear types used (purse-seine, troll, and longline). Nominal CPUE is shown by fleet and target for each species caught in the longline fishery since the different fishing practices used, as well as the different areas and seasons fished, can affect CPUE. For three fisheries (albacore troll, bigeye tuna longline, and southern bluefin tuna longline) we present the results of CPUE modelling to standardise catch rates for factors shown to influence CPUE. The results of the standardisation are contrasted with equivalent nominal trends.

3.6.1 Purse-seine fishery

The trend in skipjack tuna CPUE in the domestic purse-seine fishery when targeting this species is shown in Figure 5. CPUE is given as the number of tonnes per set fished and includes unsuccessful sets. There is no clear trend in CPUE since the earliest electronic records in 1989 (average =12.8 t per set, c.v. = 24.0%). Given that New Zealand purse-seine vessels fish an average of 1.7 sets per day, this catch rate is equivalent to about 22 t per day fished. This catch rate is similar to most other purse-seine fleets operating in the western and central Pacific Ocean over the same period (Lawson 2000).

3.6.2 Troll fishery

3.6.2.1 Nominal CPUE

The nominal CPUE trend for the albacore troll fishery in New Zealand waters is shown in Figure 6. CPUE is given as the number of albacore caught per day fished by a vessel targeting albacore. Like skipjack tuna, there is no discernible trend in CPUE between 1991 and 2000. Troll catches have been remarkably stable, averaging 84.3 albacore per day fished (c.v. = 14.6%). CPUE in the New Zealand fishery is similar to that of the high seas US troll fishery, the only other large troll fishery for albacore in the South Pacific Ocean. Childers & Bartoo (1999) reported CPUE from US troll vessels that operated more than 1000 n. miles east of New Zealand along the Subtropical Convergence Zone as 82.3 fish per day (c.f. 84.3 for the EEZ), but CPUE is also more variable (c.v. = 40.8%). In addition, the peaks and troughs in the CPUE time series for the US and New Zealand troll fisheries are nearly synchronous, suggesting that relative abundance of juvenile albacore is similar in a given year for the two fishing grounds.

3.6.2.2 Standardised CPUE

The trend in CPUE relative to 1990 was modelled to produce a standardised CPUE series for the albacore troll fishery. For all trolling where albacore was reported as the target species, catch (number of fish) and effort (days fished) for target and main bycatch species, troll start position, date, start times, and Southern Oscillation Index (SOI) data were used in the standardisation.

The model selection process was as described by Richardson et al. (2001), except that a negative binomial response model was used. Residual plots for the albacore CPUE model given here were similar in the lack of trend in residuals to those of Richardson et al. (2001) for southern bluefin tuna and references therein.

A GAM was fitted to the data under the assumption that the predictor variables selected in the context of a linear model would also be important in an additive model. Predictor variables in the additive model were the same as for the precursor linear models, but interactions between longitude and latitude were allowed (i.e., using a two-dimensional smooth term in latitude and longitude) if these proved significant.

For the additive models used, covariates were fitted using the local regression scatter plot smoother, loess (Chambers & Hastie 1993) with the default smoothing parameter (0.5 for a one-predictor term). For a two-predictor term, a smoothing parameter of 0.25 was used.

Predictor variables tested for inclusion were:

1. Factors (categorical)
    - *year*
    - *month* – January to February
2. Covariates (continuous)
    - *lat* – latitude of daily fishing position
    - *long* – longitude of daily fishing position
    - *effort* – number of days fished by trolling
    - *SOI* – NOAA standardised Tahiti-Darwin sea level pressure difference
    - *bycatch* – catch per unit effort of bycatch species

The final model is:

```
CPUE ~ year + lo(lat, long) + month + lo(SOI) + bycatch
```

where lo( ) is the local regression scatter plot smoother, loess (Chambers & Hastie 1993). Analysis of deviance tables for the preliminary negative binomial GLM and final GAM models are given in Appendix 2.

It was found during initial model runs that both duration and effort were highly significant predictors. CPUE is defined here as catch per day, but in reality the trolling operation is probably similar in many respects to a longline operation that was discussed in detail by Richardson et al. (2001). These authors concluded that longline CPUE can be viewed as proportions (of successes), and it would be worth investigating whether albacore CPUE should be redefined as catch per hook per unit time.

In this analysis two models have been fitted and spatio-temporal interactions have not been included. In the first model, effort and duration were dropped from the model. The negative binomial dispersion parameter was estimated as 1.32 for this model. In a second model (not reported here), the product of numbers of hooks and duration was incorporated as a fixed term (i.e., not estimated), effectively re-defining CPUE as catch per unit time per hook. The dispersion parameter for this model is 1.40.

There is little difference between the relative year abundance estimated by either model, and no clear trend can be discerned from either the nominal CPUE or model abundance indices (Figure 7).

3.6.3 Longline fishery

3.6.3.1 Nominal CPUE

The nominal CPUE for tunas and swordfish caught in the longline fishery is shown by fleet (chartered Japanese vessels and domestic owned and operated vessels) and target species (bigeye and southern bluefin tunas). CPUE is affected, in some cases strongly so, by both the nature of the fleet and the stated target species (Figures 8 to 13). Most of the species caught in the longline fishery, while commercially valuable, are not the primary species fishers seek. These bycatch species are usually a regular component of the catch and their CPUE may be related to abundance. Exceptions to this are species that occur infrequently (eg Pacific bluefin tuna) or are caught seasonally and in small quantities (e.g., yellowfin tuna). For species that are targeted (eg bigeye and southern bluefin tuna) or caught in substantial amounts (e.g., albacore and swordfish) it is generally assumed that nominal CPUE is related to relative abundance.

Albacore longline CPUE (Figure 8) is highest for the domestic fleet when targeting bigeye tuna and can be substantial for both fleets regardless of target. While there is no clear trend in CPUE over the entire period for the fleet/target combinations, CPUE for these combinations appears to have declined since 1998.

Bigeye tuna are targeted by longline, especially by domestic owned and operated vessels, throughout most of the year, mainly north of 40° S. Bigeye tuna CPUE is shown in Figure 9 by fleet and target. Some bigeye tuna are caught in the southern bluefin tuna target fishery, but CPUE is very low (Figure 9). The charter fleet targets bigeye tuna in some, but not all, years and interpreting the CPUE trend for this fleet is problematic. The relatively high CPUEs seen in this fleet in 1998 and 1999 are much higher than in any other year, and may be due to a few sets. Bigeye tuna nominal CPUE for the domestic fleet targeting bigeye tuna shows an initial period of decline in 1991 and 1992 followed by an essentially flat CPUE trend averaging 1.4 bigeye tuna per 1000 hooks set. The CPUE values are slightly lower than bigeye tuna longline fisheries in the rest of the central and western Pacific Ocean (Hampton et al. 2000).

The nominal CPUE of southern bluefin when bigeye tuna are targeted is very low (Figure 11). However, southern bluefin tuna CPUE when targeted by domestic and charter fleets is substantially higher. Domestic and charter fleets (when targeting southern bluefin tuna) show increasing CPUE from 1991 to 1994 (charter fleet) or 1995 (domestic fleet), followed by a period of substantially lower CPUEs averaging 2.8 and 2.3 southern bluefin tuna per 1000 hooks respectively (Figure 11). The period of increasing CPUEs in the early 1990s follows the 60% quota reductions imposed by Australia, Japan, and New Zealand and coincides with a period of increased recruitment of juveniles (Anon. 1996). Although these CPUE values have not been adjusted for changes in fishing practices, the nominal CPUEs are one of the few hopeful signs in a global stock regarded by the IUCN as critically endangered (Matsuda et al. 1998).

Swordfish are commonly caught on tuna longlines set for bigeye and southern bluefin tunas, but cannot legally be targeted in the EEZ. Anecdotal reports, however, suggest that targeting of swordfish occurs and it is clear that swordfish landings have been increasing at a faster rate than for the stated target species (see Figure 4). Murray et al. (2001) provided an explanation for the rapid rise in swordfish catch, noting the increase in longline sets and a positive correlation between fishing effort and CPUE. It is clear from Figure 13 that charter fleet CPUE is substantially lower than for the domestic fleet, regardless of target. It is also clear that swordfish CPUE has been increasing for both target species since the mid 1990s for domestic longline vessels. The increasing trend in swordfish CPUE could be interpreted as evidence of targeting, but the magnitude of CPUE is substantially lower than in swordfish target fisheries elsewhere. This probably suggests that some targeting of swordfish has been taking place (possibly with increasing frequency), but that it is not widespread. Ward & Elscot (2000) reported swordfish CPUEs of 12–16 fish per 1000 hooks in the former Hawaiian longline target fishery and 3–10 per 1000 hooks for the Brisbane target fishery. In contrast, Figure 13 shows the peak swordfish CPUE (in 1998) was about 2.0 fish per 1000 hooks for the New Zealand longline fishery and has been less than that in other years.

Two other tuna species are caught in the longline fisheries in the EEZ, but at sufficiently low numbers that it is unclear whether CPUE trends represent relative abundance or variable climatic conditions that affect the catch rate of more northerly distributed species. Pacific bluefin tuna, caught with increasing frequency in recent years, was until recently regarded as a subspecies of northern bluefin tuna (Collette 1999). Figure 10 shows the CPUE of Pacific bluefin tuna by fleet and target species. This species is not frequently caught as is indicated by the very low CPUE values (generally less than 1 fish per 10 000 hooks set). The only remarkable feature of Figure 10 is the dramatic increase in CPUE in 2000 for the domestic fleet targeting southern bluefin tuna. This increase is almost certainly due to fishers learning to distinguish Pacific from southern bluefin tuna and the Ministry of Fisheries instituting a separate species code for Pacific bluefin in June 2000. Only the domestic fleet targeting bigeye tuna in northern waters catches appreciable numbers of yellowfin tuna. Yellowfin tuna CPUE is typically low (Figure 12) and only in 1995 to 1997 did the CPUE approach levels seen in longline fisheries elsewhere in the central and western Pacific Ocean (Lawson 2000).

3.6.3.2 Standardised CPUE of bigeye tuna

Catch (number of fish), effort (number of hooks) for target and by-catch species, longline start of set position, date, start and finish times, sea surface temperature, vessel specifications, and moon phase were used during the standardisation procedure for longline sets where bigeye tuna was reported as the target species. The model selection process used for bigeye tuna CPUE was as described by Richardson et al. (2001), except that a negative binomial response model was used throughout. Residual plots for the bigeye tuna CPUE model given here were similar in a lack of trend in residuals to those shown by Richardson et al. (2001) for southern bluefin tuna and references therein.

A GAM was fitted to the data under the assumption that the predictor variables selected in the context of a linear model would also be important in an additive model. Predictor variables in the additive model were the same as for the precursor linear models, but interactions between longitude and latitude were allowed (i.e., using a two-dimensional smooth term in latitude and longitude) if these proved significant.

For the additive models used, covariates were fitted using the local regression scatter plot smoother, loess (Chambers & Hastie 1993) with the default smoothing parameter (0.5for a one-predictor term). For a two-predictor term, a smoothing parameter of 0.25 was used.

Predictor variables tested for inclusion were as follows:

1. Factors
    - *year*
    - *month* – February to August
    - *nation* – Foreign (Japanese or charter), domestic (NZ owned and operated).

2. Covariates
    - *moon phase* – fraction of illuminated lunar disc
    - *SST*– sea surface temperature measured by vessels
    - *lat* – latitude of longline set start position
    - *long* – longitude of longline set start position
    - *effort* – number of hooks (thousands)
    - *bycatch* – catch per unit effort of bycatch species

The final model for bigeye tuna CPUE is (in pseudo-S notation):

```
CPUE ~ year + month + lo(SST) + lo(effort) + lo(lat, long)
```

where lo() is the local regression scatter plot smoother, loess (Chambers & Hastie 1993), and the negative binomial dispersion parameter was estimated as 1.85. Note that bycatch, a significant predictor, was positively correlated with bigeye tuna catch rates. Since this suggests that bycatch was not determining catchability in this fishery, bycatch was dropped from the final model. Analysis of deviance tables for the preliminary negative binomial GLM and final GAM models are given in Appendix 2.

Between 1980 and 2000, there are only small differences between the estimated coefficients and the nominal CPUE values (Figure 14). Nominal and standardised CPUE exhibit similar trends with low relative abundance in 1981 to 1983 compared with 1980 followed by an increase to about 80% (standardised) of the 1980 level during 1984 to 1986. Since 1986, the relative abundance indices for bigeye tuna in the New Zealand EEZ have further declined by 1995 to about 15% of the 1980 level. The bigeye tuna abundance indices then increased to about 50% (of 1980) in 1998, followed by a decline to about 20% thereafter.

The bigeye tuna CPUE model does not incorporate spatial-temporal interactions, which are likely to be significant, and may change the above conclusions.

3.6.3.3 Standardised CPUE of southern bluefin tuna

The spatio-temporal complexity of the southern bluefin tuna fishery, particularly during the 1990s, motivated the division of the EEZ into three regions (east coast north of 44° S, east coast south of 44° S, and the west coast) for this analysis. On the east coast south of 44° S, the data for 1992 to 1996 were combined because there was very little fishing in that period. All three areas have contracted since the 1980s.

Model selection was as described by Richardson et al. (2001). Residual plots for the for southern bluefin tuna CPUE models given here were similar in a lack of trend in residuals to those shown by Richardson et al. (2001) and references therein.

Model fitting was done in the same way as for bigeye tuna and the same predictor variables were used (see Section 3.6.3.2).

The final area specific models for southern bluefin tuna CPUE are (in pseudo-S notation):

East coast north of 44° S:

```
CPUE ~ year + lo(moon phase) + month + lo(lat, long) +lo(bycatch) +
lo(effort) + nation
```

East coast south of 44° S:

```
CPUE ~ year + month + lo(moon phase) + lo(effort) + lo(lat, long) +
lo(SST) + lo(bycatch)
```

West coast:

```
CPUE ~ year + lo(moon phase) + lo(lat, long) + month + lo(SST) +
lo(effort) + nation + lo(bycatch)
```

Negative binomial dispersion parameters were estimated as 3.24, 15.62, and 4.36 for the models respectively. Analysis of deviance tables for the preliminary negative binomial GLM and final GAM models are given in Appendix 2.

The estimated SBT abundance indices for the east coast north of 44° S are, considering errors in the estimates, similar to or less than the nominal CPUE values until 1994 (Figure 15a). There is a substantial increase in mean southern bluefin tuna CPUE and abundance indices after 1995. In 1998 to 2000, the estimated abundance index is about 60–70% of the 1980 value.

The estimated abundance indices of southern bluefin tuna for the east coast fishing area south of 44° S when 1992 to 1996 are combined (Figure 15b). Aggregation of these years was required because there was little effort in this region during that time. Indices for the years 1997 to 1999 increased to about 35% of the 1980 value before declining substantially in 2000. Since 1992, only a small proportion of overall effort in the New Zealand southern bluefin tuna fishery has been in this region.

For the west coast fishing area there appear to be significant differences between nominal southern bluefin tuna CPUE values and estimated year coefficients (Figure 15c). However, there was a sharp reduction in effort after 1993, and this is reflected in an increase in the width of the confidence intervals since 1993. There is no compelling evidence in the model for an increase in southern bluefin tuna abundance in this region after 1994, as is suggested by the nominal CPUE time series, particularly since estimated confidence intervals probably under estimate actual uncertainty.

The southern bluefin tuna CPUE models do not include spatio-temporal interactions, which are likely to be significant (see Richardson et al. 2001), and may change the above conclusions.

4. BIOLOGICAL PARAMETERS OF TUNA AND SWORDFISH

New Zealand has conducted an observer programme on tuna longliners targeting bigeye and southern bluefin tunas. Typically, coverage of the domestic longline fleet has been low (generally less than 10% of sets) and has focused primarily on Japanese owned and operated vessels fishing for southern bluefin tuna during winter months (up to 100% of sets covered). Considerable information has been collected on catch composition, as well as sex ratios, size composition, and discard practices on these vessels. Catch composition was reported by Francis et al. (1999, 2000).

There has been no observer coverage of the purse-seine or troll fishery for several years.

4.1 Size frequency distributions

The size composition of longline-caught tunas (fork length) and swordfish (lower jaw to fork length) is shown for albacore, bigeye, southern bluefin and yellowfin tuna and swordfish (Figures 16–20). Data for each species aggregated over the entire period for which observer data are available are shown together with the data collected in 2000. Longline-caught albacore (Figure 16) range in size from 40 to 133 cm (mean = 83.6 cm, n = 34 364) and have several overlapping size classes. The albacore size frequency distribution for 2000 (n = 1358), showing two modes at about 78 and 98 cm, is similar in mean and range to the overall size frequency distribution (mean = 84.6 c.f. 83.6 cm).

Bigeye tuna (Figure 17) ranged from 78 cm to 190 cm (mean = 131.4 cm, n = 1459). The size composition for 2000 appears similar to that aggregated over the period 1987 to 2000 (mean = 135.9 cm, n = 91). The aggregated size frequency distribution for southern bluefin tuna may be misleading because size composition of the stock has changed appreciably over time and some of the larger fish measured are likely to be Pacific rather than southern bluefin tuna, especially in early data. A wide range of size classes has been reported in the southern bluefin tuna fishery (range 75 to 215 cm) with a mean fork length of 150.7 cm (n = 20 981) (Figure 18). Data for 2000 (n = 1752) similarly show a wide range in fish length (90–203 cm) with a mean length similar to that of the aggregated sample (146.2 c.f. 150.7 cm).

Longline caught yellowfin tuna ranged in size from 58 to 160 cm (mean = 113.8 cm, n = 810) (Figure 19). Low observer coverage in 2000 means that only 36 yellowfin tuna were measured; these fish fell within the range of sizes generally caught in the EEZ, although the mean length of 109.8 cm was slightly lower. Swordfish caught on longline ranged in size from 42 cm to 300 cm (mean = 179.3 cm, n = 3082) (Figure 20). In 2000, 277 swordfish were measured which ranged in length from 95 cm to 281 cm. The swordfish measured in 2000 were slightly larger on average (188.0 c.f. 179.3 cm) than for 1987 to 2000.

4.2 Length-weight relationships

Length-weight relationships were derived using ordinary least squares regressions of natural log of greenweight on the natural log of length. The parameters of these relationships together with their standard errors and sample sizes are given in Table 23 for albacore, bigeye, southern bluefin and yellowfin tunas, and swordfish. Length-weight relationships are given separately for males and females and for the sexes combined. The parameters are similar both between sexes and between species, as is expected in species with allometric growth (b_1 close to 3.0).

4.3 Sex ratio

Although the sex ratios of tunas caught by longline are all close to 1:1, chi-square tests yield statistically significant differences from a 1:1 ratio for all tunas except bigeye tuna (Table 24). Earlier analysis of sex ratio by year (Murray et al. 1999) suggests that these departures from a 1:1 ratio may be related to sample size differences for albacore and yellowfin tuna. However, for southern bluefin tuna caught in the EEZ, the departure from 1:1 is a regular feature in each year and may be due to the age composition of the catch in the EEZ. Caton (1991) reported departures from a 1:1 sex ratio in southern bluefin tuna from different fishing grounds, noting that females appear to predominate in catches of juveniles while males (as here) appear to predominate in catches of adults. In swordfish, the sex ratio is significantly different from a 1:1 sex ratio with females caught about three times as frequently as males in the longline fishery. Nakamura (1985) also reported a departure from a 1:1 sex ratio in swordfish in other areas noting that most swordfish over 140 kg are females (equivalent to about 215 cm lower jaw to fork length). However, in the EEZ, females predominate in the catch in swordfish 125 cm lower jaw to fork length and larger.

4.4 Discards

Observers have routinely recorded the number of fish lost or discarded on longline vessels and their condition (dead or alive) by species since the early 1990s. For albacore, bigeye, southern bluefin, and yellowfin tuna, and swordfish, discard and loss rates are low, with discard rates usually slightly higher than loss rates (Table 25). On average, discarded and lost fish account for 3.5% of the albacore, 4.7% of the bigeye, 2.0% of the southern bluefin, 11.2% of the yellowfin tuna catch, and 5.7% of the swordfish catch. Discarded and lost fish are estimated to be a minor source of mortality (2.0–2.6% of all discarded or lost fish were observed to be dead).

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Table 1: Number of purse-seine sets targeting skipjack tuna (including nil sets) by quarter (Q1 = January to March) and year.

Year	Q1	Q2	Q3	Q4	Total
1991	428	19			447
1992	81	11			92
1993	73	3			76
1994	226	86			312
1995	45	42	1	72	160
1996	251	22		5	278
1997	259	74			333
1998	389	28		55	472
1999	295	32	2	75	404
2000	569	14			583

Table 2: Number of purse-seine sets targeting skipjack tuna (including nil sets) by Fisheries Management Area (FMA) and year (ET, high seas areas).

Year	FMA1	FMA2	FMA7	FMA8	FMA9	ET	Unknown	Total
1991	444				1		2	447
1992	91					1		92
1993	32				44			76
1994	223			2	82		5	312
1995	122	37					1	160
1996	165	94			1		18	278
1997	317				5	5	6	333
1998	448	11		1	4		8	472
1999	266	61		11	56		10	404
2000	572	3		1	4		3	583

Table 3: Number of vessel days targeting albacore by trolling (including nil days) by quarter (Q1=January to March) and year.

Year	Q1	Q2	Q3	Q4	Total
1991	2 613	86	1	54	2 754
1992	3 392	56	0	187	3 635
1993	4 366	369	3	179	4 917
1994	5 865	747	5	443	7 060
1995	5 204	677	5	218	6 104
1996	4 397	338	0	277	5 012
1997	3 767	253	2	97	4 119
1998	4 475	273	6	26	4 780
1999	2 165	124	0	112	2 401
2000	4 423	371	0	0	4 794

Table 4: Number of vessel days targeting albacore by trolling (including nil days) by Fisheries Management Area (FMA) and year (ET, high seas areas).

Year	FMA1	FMA2	FMA3	FMA4	FMA5	FMA6	FMA7	FMA8	FMA9	FMA10	ET	Unknown	Total
1991	124	205			137	1	2 307	5	25		38	16	2 858
1992	170	309	3	3	64		3 161	58	94		12	14	3 888
1993	819	375	27	1	55		2 995	240	659		32	7	5 210
1994	1 250	693	1	1	81		4 079	195	1 320	2	11	28	7 661
1995	916	762	1		60		3 117	388	1 404	1	20	53	6 722
1996	976	386	11	1	71		2 432	886	742		19	64	5 588
1997	814	92	18	2	75		2 433	424	398		1	80	4 337
1998	697	222			57	1	2 572	553	807		1	108	5 018
1999	604	65	1		26		1 777	47	49		4	25	2 598
2000	549	53	3	2	55		3 950	181	130			39	4 962

Table 5: Number of hooks set by domestic and chartered longliners targeting bigeye tuna (including nil sets, TLCER and CELR data combined) by quarter and year.

Year	Q1	Q2	Q3	Q4	Total
1991	9 400	77 080	88 770	56 185	231 435
1992	84 068	138 460	113 370	16 000	351 898
1993	155 680	414 066	88 365	121 240	779 351
1994	428 275	515 693	59 660	198 510	1 202 138
1995	793 818	236 370	37 570	348 110	1 415 868
1996	694 640	387 224	36 225	241 130	1 359 219
1997	651 771	434 351	115 855	260 160	1 462 137
1998	799 107	725 286	485 710	595 476	2 605 579
1999	1 426 043	1 346 757	1 216 419	1 357 190	5 346 409
2000	1 708 259	1 264 032	1 575 745	1 386 235	5 934 271

Table 6: Number of hooks set (millions) by domestic and chartered longliners targeting bigeye tuna (including nil sets, TLCER and CELR data combined) by Fisheries Management Area (FMA) and year (ET, high seas areas).

Year	FMA1	FMA2	FMA3	FMA4	FMA7	FMA8	FMA9	FMA10	ET	Unknown	Total
1991	0.2	< 0.1					0.1	< 0.1	< 0.1		0.2
1992	0.2	< 0.1					0.1	< 0.1	< 0.1	< 0.1	0.4
1993	0.6	0.1					< 0.1	< 0.1	0.1	< 0.1	0.8
1994	0.9	0.2	< 0.1				0.1	< 0.1	< 0.1	< 0.1	1.2
1995	0.9	0.4			< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	1.4
1996	0.7	0.5			< 0.1	< 0.1	< 0.1		< 0.1	< 0.1	1.4
1997	1.0	0.3				< 0.1	0.2		< 0.1	< 0.1	1.5
1998	1.7	0.4					0.4	< 0.1	< 0.1	< 0.1	2.6
1999	3.4	0.9	< 0.1		< 0.1	0.1	0.8	0.1	< 0.1	0.1	5.3
2000	3.4	1.2	< 0.1	< 0.1	< 0.1	< 0.1	1.1	0.1	0.1	< 0.1	5.9

Table 7: **Number of hooks set by domestic and chartered longliners targeting southern bluefin tuna (including nil sets, TLCER and CELR data combined) by quarter and year.**

Year	Q1	Q2	Q3	Q4	Total
1991	24 240	449 460	200 940		674 640
1992	72 000	1 214 489	209 814		1 496 303
1993	72 780	873 990	417 103	8 320	1 372 193
1994	47 760	971 859	182 872	900	1 203 391
1995	12 600	1 657 154	349 002		2 018 756
1996	58 880	755 352	71 185	1 000	886 417
1997	156 938	1 362 603	111 860	500	1 631 901
1998	52 355	941 067	288 222	23 850	1 305 494
1999	22 950	1 370 045	479 485	24 400	1 896 880
2000	61 132	1 567 088	84 590	33 600	1 746 410

Table 8: **Number of hooks set (millions) by domestic and chartered longliners targeting southern bluefin tuna (including nil sets, TLCER and CELR data combined) by Fisheries Management Area (FMA) and year (ET, high seas areas).**

Year	FMA1	FMA2	FMA3	FMA4	FMA5	FMA6	FMA7	FMA8	FMA9	FMA10	ET	Unknown	Total
1991	0.1	< 0.1	0.1		0.2		0.2						0.7
1992	< 0.1	< 0.1	< 0.1		0.4		1.0				< 0.1		1.5
1993	0.1	0.2	< 0.1		0.5	< 0.1	0.6		< 0.1			< 0.1	1.4
1994	0.1	< 0.1	< 0.1		0.4	< 0.1	0.6		< 0.1		< 0.1		1.2
1995	0.1	0.1	< 0.1	< 0.1	0.7	< 0.1	1.1	< 0.1	< 0.1		< 0.1	< 0.1	2.0
1996	0.1	0.2	< 0.1	< 0.1	0.5		0.2		< 0.1		< 0.1	< 0.1	0.9
1997	0.1	0.2	0.3		0.4	0.1	0.5		< 0.1		< 0.1	< 0.1	1.6
1998	0.1	0.3	0.1		0.3	< 0.1	0.5		< 0.1		< 0.1	< 0.1	1.3
1999	0.3	0.2	0.2		0.7	< 0.1	0.5	< 0.1	0.1		< 0.1	< 0.1	1.9
2000	0.1	0.6	0.1		0.3		0.6		< 0.1	< 0.1		< 0.1	1.7

Table 9: Albacore catch (t) by gear, target species, and quarter (Q1 = January to March) scaled to LFRR landings data (ALB, albacore; BIG, bigeye tuna; STN, southern bluefin tuna; spp, species).

Target	Method	Year	Q1	Q2	Q3	Q4	Total
ALB	**troll**	1991	2 278.4	41.4	0.0	40.1	2 359.9
		1992	3 222.7	28.4	0.0	87.1	3 338.2
		1993	2 553.3	161.4	0.1	74.7	2 789.5
		1994	3 784.9	501.3	0.1	202.8	4 489.2
		1995	4 663.4	414.8	0.4	101.3	5 180.0
		1996	4 395.1	203.7	0.0	176.6	4 775.3
		1997	2 068.7	106.0	1.8	35.6	2 212.1
		1998	3 848.2	143.8	4.5	11.0	4 007.4
		1999	1 353.4	50.1	0.0	33.6	1 437.2
		2000	2 549.9	111.8	0.0	0.0	2 661.7
BIG & STN	**longline**	1991	15.9	19.9	42.3	11.9	90.0
		1992	15.6	79.3	38.8	7.7	141.5
		1993	48.2	367.2	71.5	43.6	530.5
		1994	143.0	555.6	14.2	62.9	775.8
		1995	375.5	423.8	45.3	241.2	1 085.8
		1996	425.4	868.3	83.3	193.5	1 570.5
		1997	378.9	645.9	108.9	282.1	1 415.8
		1998	413.8	897.0	829.7	378.0	2 518.4
		1999	276.7	1 256.1	527.5	405.4	2 465.7
		2000	270.8	955.2	388.4	223.7	1 838.0
all spp	**pole-&-line**	1991	6.5	0.4	0.0	0.0	6.8
		1992	6.9	0.4	0.0	0.0	7.3
		1993	60.8	3.3	0.0	0.0	64.1
		1994	48.9	2.7	0.0	0.0	51.6
		1995	25.7	1.4	0.0	0.0	27.1
		1996	0.4	0.0	0.0	0.0	0.5
		1997	0.0	0.0	0.0	0.0	0.0
		1998	0.2	0.0	0.0	0.0	0.2
		1999	0.1	0.0	0.0	0.0	0.1
		2000	0.0	0.0	0.0	0.0	0.0
all spp	**handline**	1991	0.1	0.0	1.8	0.0	2.0
		1992	0.0	0.0	0.1	0.0	0.2
		1993	0.2	0.0	2.5	0.0	2.6
		1994	0.0	0.0	0.3	0.0	0.3
		1995	0.1	0.0	2.1	0.0	2.3
		1996	0.0	0.0	0.0	0.0	0.0
		1997	0.0	0.0	0.5	0.0	0.5
		1998	0.0	0.0	0.1	0.0	0.1
		1999	0.0	0.0	0.2	0.0	0.2
		2000	0.0	0.0	0.0	0.0	0.0

Table 10: Bigeye tuna catch (t) by gear, target species, and quarter (Q1 = January to March) scaled to LFRR landings data (ALB, albacore; BIG, bigeye tuna; STN, southern bluefin tuna).

Target	Method	Year	Q1	Q2	Q3	Q4	Total
BIG & STN	longline	1991	11.1	6.9	17.6	8.6	44.2
		1992	11.4	11.6	9.4	7.0	39.4
		1993	15.3	30.5	9.0	19.1	73.9
		1994	35.1	23.5	1.4	10.7	70.7
		1995	32.7	6.7	2.0	18.3	59.6
		1996	27.1	12.0	2.4	47.2	88.7
		1997	32.1	16.9	9.4	83.5	141.9
		1998	65.3	74.4	129.3	118.6	387.5
		1999	49.5	56.3	160.0	154.6	420.4
		2000	61.1	34.8	214.5	111.0	421.4
ALB	troll	1991	0.0	0.0	0.0	0.0	0.0
		1992	0.0	0.0	0.0	0.0	0.0
		1993	0.0	0.0	0.0	0.0	0.0
		1994	0.0	0.0	0.0	0.0	0.0
		1995	0.1	0.0	0.0	0.0	0.1
		1996	0.0	0.0	0.0	0.0	0.0
		1997	0.0	0.0	0.0	0.0	0.0
		1998	0.0	0.0	0.0	0.0	0.0
		1999	0.0	0.0	0.0	1.0	1.0
		2000	0.1	0.0	0.0	0.0	0.1

Table 11: Pacific bluefin tuna catch (t) by gear, target species, and quarter (Q1 = January to March) scaled to LFRR landings data (BIG, bigeye tuna; STN, southern bluefin tuna).

Target	Method	Year	Q1	Q2	Q3	Q4	Total
BIG & STN	longline	1991	0.0	0.0	1.5	0.0	1.5
		1992	0.0	0.1	0.1	0.0	0.3
		1993	0.3	4.2	1.1	0.0	5.6
		1994	0.7	1.2	0.0	0.0	1.9
		1995	0.2	1.6	0.0	0.0	1.8
		1996	0.5	3.5	0.0	0.2	4.2
		1997	1.1	10.4	1.2	1.6	14.3
		1998	1.3	9.5	8.7	0.9	20.4
		1999	0.4	7.8	8.8	4.2	21.2
		2000	1.3	16.5	1.2	1.9	20.9

Table 12: Skipjack tuna catch (t) by gear, target species, and quarter (Q1 = January to March) scaled to LFRR landings data (ALB, albacore; BIG, bigeye tuna; STN, southern bluefin tuna; SKJ, skipjack tuna; spp, species).

Target	Method	Year	Q1	Q2	Q3	Q4	Total
SKJ	purse-seine	1991	5 131.9	125.7	0.0	0.0	5 257.6
		1992	902.3	85.7	0.0	0.0	988.0
		1993	906.4	34.7	0.0	0.0	941.1
		1994	2 344.0	773.0	0.0	0.0	3 117.0
		1995	500.1	349.6	0.0	847.7	1 697.4
		1996	3 324.8	275.3	0.0	29.9	3 630.0
		1997	5 460.0	1 105.9	0.0	0.0	6 566.0
		1998	6 966.7	437.2	0.0	740.4	8 144.4
		1999	4 307.4	190.3	36.8	1 134.7	5 669.1
		2000	9 170.7	519.7	0.0	0.0	9 690.4
ALB	troll	1991	1.4	0.5	0.0	0.0	1.9
		1992	0.1	0.2	0.0	0.0	0.4
		1993	2.6	0.7	0.0	0.3	3.7
		1994	10.3	3.8	0.0	0.1	14.2
		1995	8.7	0.8	0.0	1.0	10.5
		1996	12.9	1.5	0.0	0.5	15.0
		1997	2.7	1.1	0.0	0.1	3.9
		1998	2.5	9.3	0.0	0.0	11.8
		1999	4.9	6.3	0.0	0.4	11.6
		2000	4.6	4.1	0.0	0.0	8.7
all spp	pole-&-line	1991	0.0	0.0	0.0	0.0	0.0
		1992	0.0	0.0	0.0	0.0	0.0
		1993	0.8	0.0	0.0	0.0	0.8
		1994	5.3	0.1	0.0	0.0	5.4
		1995	20.0	0.5	0.0	0.0	20.4
		1996	7.1	0.2	0.0	0.0	7.2
		1997	0.1	0.0	0.0	0.0	0.1
		1998	0.1	0.0	0.0	0.0	0.1
		1999	7.5	0.2	0.0	0.0	7.7
		2000	0.0	0.0	0.0	0.0	0.0
BIG & STN	longline	1991	0.0	0.0	0.0	0.0	0.0
		1992	0.0	0.0	0.0	0.0	0.0
		1993	0.0	0.0	0.0	0.0	0.0
		1994	0.0	0.0	0.0	0.0	0.0
		1995	0.0	0.0	0.0	0.2	0.2
		1996	0.1	0.1	0.0	0.0	0.2
		1997	0.0	0.0	0.0	0.0	0.0
		1998	0.0	0.0	0.0	0.0	0.0
		1999	0.0	0.0	0.0	0.0	0.0
		2000	0.0	0.0	0.0	0.0	0.0

Table 13: Southern bluefin tuna catch (t) by gear, target species, and quarter (Q1 = January to March) scaled to LFRR landings data (ALB, albacore; BIG, bigeye tuna; STN, southern bluefin tuna; spp, species).

Target	Method	Year	Q1	Q2	Q3	Q4	Total
BIG & STN	**longline**	1991	0.5	48.0	20.9	0.0	69.5
		1992	2.5	164.6	36.1	0.0	203.2
		1993	3.9	129.1	70.2	0.2	203.3
		1994	3.0	237.3	25.7	0.1	266.2
		1995	2.2	375.2	47.8	0.7	426.0
		1996	13.0	111.6	8.6	0.4	133.6
		1997	19.2	220.0	46.5	0.4	286.1
		1998	2.8	180.4	143.5	5.3	332.1
		1999	2.7	284.8	163.2	10.0	460.6
		2000	4.2	345.6	21.5	8.6	379.9
all spp	**handline**	1991	0.0	15.0	79.9	0.0	94.8
		1992	0.0	13.4	62.5	0.0	75.9
		1993	0.0	0.0	13.1	0.0	13.1
		1994	0.0	0.1	10.7	0.0	10.8
		1995	0.0	0.0	9.5	0.0	9.5
		1996	0.0	2.8	2.9	0.0	5.7
		1997	0.0	7.6	40.0	0.0	47.6
		1998	0.0	0.0	0.0	0.0	0.0
		1999	0.0	0.0	0.0	0.0	0.0
		2000	0.0	0.2	0.0	0.0	0.2
STN	**troll**	1991	0.0	0.0	0.2	0.0	0.2
		1992	0.0	0.0	0.2	0.0	0.2
		1993	0.0	0.0	0.2	0.0	0.2
		1994	0.0	0.0	0.0	0.0	0.0
		1995	0.0	0.2	0.0	0.0	0.2
		1996	0.0	0.0	0.0	0.0	0.0
		1997	0.0	0.0	0.0	0.0	0.0
		1998	0.0	5.1	0.0	0.0	5.1
		1999	0.0	0.0	0.0	0.0	0.0
		2000	0.1	0.0	0.2	0.0	0.2
ALB	**troll**	1991	0.0	0.0	0.0	0.0	0.0
		1992	0.0	0.0	0.0	0.0	0.0
		1993	0.0	0.0	0.0	0.0	0.0
		1994	0.0	0.0	0.0	0.0	0.0
		1995	0.5	0.2	0.0	0.0	0.7
		1996	0.0	0.0	0.0	0.0	0.0
		1997	0.0	0.0	0.0	0.0	0.0
		1998	0.0	0.0	0.0	0.0	0.0
		1999	0.0	0.0	0.0	0.0	0.0
		2000	0.1	0.0	0.0	0.0	0.1

Table 14: Yellowfin tuna catch (t) by gear, target species, and quarter (Q1 = January to March) scaled to LFRR landings data (ALB, albacore; BIG, bigeye tuna; STN, southern bluefin tuna; spp, species).

Target	Method	Year	Q1	Q2	Q3	Q4	Total
BIG & STN	**longline**	1991	5.4	0.2	0.0	0.3	5.9
		1992	15.8	0.6	0.1	2.3	18.8
		1993	3.6	2.0	1.0	13.5	20.0
		1994	17.8	8.2	1.0	5.0	32.1
		1995	72.2	8.3	0.1	35.1	115.6
		1996	113.0	10.2	0.0	48.3	171.5
		1997	79.2	21.8	2.8	25.5	129.3
		1998	58.3	10.7	1.5	51.3	121.9
		1999	106.7	18.0	0.4	25.7	150.9
		2000	32.4	25.5	12.3	35.6	105.8
ALB	**troll**	1991	0.2	0.0	0.0	0.0	0.2
		1992	1.0	0.0	0.0	0.0	1.0
		1993	3.2	0.0	0.0	0.8	4.0
		1994	10.3	0.1	0.0	8.3	18.8
		1995	8.6	0.1	0.0	7.4	16.1
		1996	22.9	0.0	0.0	3.5	26.4
		1997	12.6	0.4	0.0	0.1	13.1
		1998	4.7	0.5	0.0	0.0	5.1
		1999	0.2	0.1	0.0	1.6	1.8
		2000	1.0	0.0	0.0	0.0	1.0
all spp	**pole-&-line**	1991	0.0	0.0	0.0	0.0	0.0
		1992	0.0	0.0	0.0	0.0	0.0
		1993	0.0	0.0	0.0	0.0	0.0
		1994	1.6	0.1	0.0	0.0	1.6
		1995	4.2	0.2	0.0	0.0	4.4
		1996	0.1	0.0	0.0	0.0	0.1
		1997	0.2	0.0	0.0	0.0	0.2
		1998	0.0	0.0	0.0	0.0	0.0
		1999	1.0	0.0	0.0	0.0	1.0
		2000	0.0	0.0	0.0	0.0	0.0
all spp	**handline**	1991	0.3	0.0	0.0	0.0	0.3
		1992	0.0	0.0	0.0	0.0	0.0
		1993	10.2	0.0	0.0	0.0	10.2
		1994	0.6	0.0	0.0	0.0	0.6
		1995	4.7	0.0	0.0	0.0	4.7
		1996	0.1	0.0	0.0	0.0	0.1
		1997	0.0	0.0	0.0	0.0	0.0
		1998	0.0	0.0	0.0	0.0	0.0
		1999	0.0	0.0	0.0	0.0	0.0
		2000	0.0	0.0	0.0	0.0	0.0

Table 15: Swordfish catch (t) by gear, target species, and quarter (Q1 = January to March) scaled to LFRR landings data (BIG, bigeye tuna; STN, southern bluefin tuna).

Target	Method	Year	Q1	Q2	Q3	Q4	Total
BIG & STN	**longline**	1991	0.4	20.2	17.2	4.1	41.9
		1992	12.3	13.8	2.9	0.0	29.0
		1993	16.0	47.1	16.6	13.2	92.9
		1994	32.1	43.2	13.6	4.9	93.8
		1995	48.3	39.6	7.4	12.8	108.0
		1996	88.3	73.8	10.5	9.8	182.4
		1997	110.2	124.7	41.2	6.0	282.1
		1998	155.0	258.1	113.9	36.6	563.6
		1999	254.6	448.1	219.3	81.6	1 003.6
		2000	315.6	444.2	134.4	80.3	974.5

Table 16: Albacore catch (t) by gear, target species, and Fisheries Management Area scaled to LFRR landings data (ET, high seas areas) (ALB, albacore; BIG, bigeye tuna; STN, southern bluefin tuna; spp, species).

Target	Method	Year	FMA1	FMA2	FMA3	FMA4	FMA5	FMA6	FMA7	FMA8	FMA9	FMA10	ET	Unknown	Total
ALB	**troll**	1991	39.1	99.9	0.0	0.0	92.4	0.4	2 057.6	1.5	9.5	0.0	42.2	17.4	2 359.9
		1992	66.8	118.0	5.1	1.9	45.7	0.0	2 953.8	51.2	78.5	0.0	2.4	14.9	3 338.2
		1993	289.8	82.7	9.2	0.0	23.7	0.0	1 769.2	163.6	439.1	0.0	8.7	3.6	2 789.5
		1994	462.1	381.9	0.3	0.3	42.7	0.0	2 513.0	136.0	931.1	0.6	5.4	15.7	4 489.2
		1995	388.4	312.6	1.2	0.0	37.7	0.0	2 855.5	309.3	1 222.7	0.7	18.7	33.1	5 180.0
		1996	610.5	182.5	3.6	0.8	33.6	0.0	2 187.6	960.4	737.4	0.0	8.5	50.5	4 775.3
		1997	394.6	30.6	7.9	0.2	36.1	0.0	1 367.1	188.2	142.6	0.0	0.0	44.8	2 212.1
		1998	543.2	56.0	0.0	0.0	38.5	0.2	2 275.2	325.6	684.0	0.0	0.0	84.5	4 007.4
		1999	281.8	26.7	1.0	0.0	10.9	0.0	1 074.2	21.1	12.3	0.0	0.3	8.8	1 437.2
		2000	263.1	13.4	2.4	0.1	20.5	0.0	2 219.6	82.1	40.9	0.0	0.0	19.5	2 661.7
BIG & STN	**longline**	1991	54.4	4.9	0.0	0.0	2.1	0.0	12.5	0.0	13.9	0.0	2.1	0.0	90.0
		1992	96.0	15.8	0.0	0.0	0.2	0.0	4.9	0.0	18.8	3.7	2.0	0.1	141.5
		1993	368.7	97.8	0.0	0.0	0.0	0.1	5.6	0.0	17.4	7.0	32.8	1.1	530.5
		1994	625.0	127.7	0.3	0.0	0.7	0.0	2.4	0.0	10.3	3.5	4.4	1.3	775.8
		1995	713.0	217.8	0.0	1.4	1.1	0.0	85.0	15.4	27.8	5.2	14.1	5.1	1 085.8
		1996	647.1	729.3	0.0	0.0	2.9	0.0	32.9	1.2	70.9	0.0	76.5	9.7	1 570.5
		1997	869.1	341.6	0.0	0.0	0.5	0.0	5.8	0.7	158.7	0.0	22.0	17.3	1 415.8
		1998	1 630.2	571.4	0.0	0.0	1.4	0.0	11.0	0.0	265.1	3.0	16.1	20.2	2 518.4
		1999	1 650.5	525.2	0.0	0.0	5.2	0.0	13.1	17.1	220.5	10.2	9.0	14.8	2 465.7
		2000	655.8	805.4	1.0	0.4	1.2	0.0	16.6	9.2	316.7	8.7	20.2	2.9	1 838.0

Table 16 continued:

Target	Method	Year	FMA1	FMA2	FMA3	FMA4	FMA5	FMA6	FMA7	FMA8	FMA9	FMA10	ET	Unknown	Total
all spp	**pole-&-line**	1991	0.0	0.0	0.0	0.0	2.8	0	4.1	0.0	0.0	0.0	0.0	0.0	6.8
		1992	0.0	0.0	0.0	0.0	7.3	0	0.0	0.0	0.0	0.0	0.0	0.0	7.3
		1993	57.9	0.0	0.0	0.0	4.4	0	0.0	0.0	1.8	0.0	0.0	0.0	64.1
		1994	25.4	5.1	0.0	0.0	0.0	0	21.1	0.0	0.0	0.0	0.0	0.0	51.6
		1995	10.0	0.9	0.0	0.0	0.0	0	16.2	0.0	0.0	0.0	0.0	0.0	27.1
		1996	0.3	0.0	0.0	0.0	0.0	0	0.2	0.0	0.0	0.0	0.0	0.0	0.5
		1997	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1998	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.2	0.0	0.0	0.0	0.2
		1999	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
		2000	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
all spp	**handline**	1991	0.2	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.3	2.0
		1992	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
		1993	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	2.6
		1994	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.3
		1995	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3
		1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.5
		1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
		1999	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2
		2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 17: ***Bigeye tuna catch (t) by gear, target species, and Fisheries Management Area scaled to LFRR landings data (ET, high seas areas; ALB, albacore; BIG, bigeye tuna; STN, southern bluefin tuna).***

Target	Method	Year	FMA1	FMA2	FMA3	FMA4	FMA5	FMA6	FMA7	FMA8	FMA9	FMA10	ET	Unknown	Total
BIG & STN	**longline**	1991	33.2	2.0	0.0	0.0	0.0	0.0	0.0	0.0	7.9	0.1	1.0	0.0	44.2
		1992	25.4	8.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	1.0	0.1	0.0	39.4
		1993	44.6	6.8	0.0	0.0	0.0	0.0	0.0	0.0	5.1	7.1	10.2	0.1	73.9
		1994	52.9	10.2	0.0	0.0	0.0	0.0	0.0	0.0	4.8	1.3	1.4	0.1	70.7
		1995	36.8	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.8	3.2	1.2	0.3	59.6
		1996	63.3	22.9	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.9	0.1	88.7
		1997	115.6	11.6	0.0	0.0	0.1	0.0	0.0	0.0	11.1	0.0	2.3	1.2	141.9
		1998	286.1	49.4	0.0	0.0	0.0	0.0	0.0	0.0	45.4	0.1	6.0	0.6	387.5
		1999	328.8	45.0	0.0	0.0	0.0	0.0	0.1	1.8	27.0	13.1	2.4	2.1	420.4
		2000	282.8	35.8	0.0	0.0	0.0	0.0	0.0	0.3	82.1	5.3	14.3	0.7	421.4
ALB	**troll**	1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
		1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1999	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
		2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1

Table 18: Pacific bluefin tuna catch (t) by gear, target species, and Fisheries Management Area scaled to LFRR landings data (ET, high seas areas; BIG, bigeye tuna; STN, southern bluefin tuna).

Target	Method	Year	FMA1	FMA2	FMA3	FMA4	FMA5	FMA6	FMA7	FMA8	FMA9	FMA10	ET	Unknown	Total
BIG & STN	longline	1991	1.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
		1992	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.3
		1993	4.2	1.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	5.6
		1994	1.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	1.9
		1995	1.3	0.4	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8
		1996	0.9	3.2	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	4.2
		1997	9.5	4.3	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.4	14.3
		1998	9.3	6.4	0.0	0.0	1.6	0.0	0.8	0.0	1.9	0.0	0.4	0.0	20.4
		1999	13.2	5.1	0.0	0.0	0.3	0.0	0.3	0.1	1.6	0.1	0.1	0.3	21.2
		2000	2.7	16.7	0.1	0.0	0.0	0.0	0.1	0.1	1.0	0.1	0.1	0.0	20.9

Table 19: Skipjack tuna catch (t) by gear, target species, and Fisheries Management Area scaled to LFRR landings data (ET, high seas areas; ALB, albacore; SKJ, skipjack tuna).

Target	Method	Year	FMA1	FMA2	FMA3	FMA4	FMA5	FMA6	FMA7	FMA8	FMA9	FMA10	ET	Unknown	Total
SKJ	purse-seine	1991	5 250.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	0.0	0.0	0.0	5 257.6
		1992	988.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	988.0
		1993	396.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	544.5	0.0	0.0	0.0	941.1
		1994	2 286.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	752.8	0.0	0.0	77.6	3 117.0
		1995	1 293.6	365.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.8	1 697.4
		1996	2 268.0	1 008.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	353.1	3 630.0
		1997	6 354.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.6	0.0	71.2	87.7	6 566.0
		1998	7 801.2	76.4	0.0	0.0	0.0	0.0	0.0	16.5	132.8	0.0	0.0	117.5	8 144.4
		1999	3 811.8	1 025.9	0.0	0.0	0.0	0.0	0.0	134.5	418.3	0.0	0.0	278.5	5 669.1
		2000	9 085.1	202.1	0.0	0.0	0.0	0.0	0.0	63.2	286.5	0.0	0.0	53.5	9 690.4
ALB	troll	1991	1.1	0.2	0.0	0.0	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.0	1.9
		1992	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.4
		1993	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.9	0.0	0.0	0.0	3.7
		1994	5.7	1.0	0.0	0.0	0.0	0.0	3.7	0.3	3.3	0.0	0.1	0.2	14.2
		1995	4.8	0.3	0.0	0.0	0.0	0.0	1.0	0.8	3.2	0.0	0.0	0.4	10.5
		1996	5.3	4.8	0.1	0.0	0.0	0.0	1.7	1.6	1.3	0.0	0.0	0.2	15.0
		1997	1.0	0.0	0.0	0.1	0.0	0.0	0.1	0.2	2.5	0.0	0.0	0.0	3.9
		1998	0.9	0.6	0.0	0.0	0.0	0.0	2.2	6.5	1.6	0.0	0.0	0.1	11.8
		1999	6.1	0.0	0.0	0.0	0.0	0.0	4.6	0.4	0.4	0.0	0.0	0.1	11.6
		2000	3.0	0.5	0.0	0.2	0.0	0.0	1.8	1.8	1.3	0.0	0.0	0.0	8.7

Table 19 continued:

Target	Method	Year	FMA1	FMA2	FMA3	FMA4	FMA5	FMA6	FMA7	FMA8	FMA9	FMA10	ET	Unknown	Total
all spp	pole-&-line	1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1993	0.4	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.8
		1994	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4
		1995	20.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.4
		1996	7.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2
		1997	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
		1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
		1999	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7
		2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BIG & STN	longline	1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1995	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
		1996	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
		1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 20: **Southern bluefin tuna catch (t) by gear, target species, and Fisheries Management Area scaled to LFRR landings data (ET, high seas areas; BIG, bigeye tuna; STN, southern bluefin tuna).**

Target	Method	Year	FMA1	FMA2	FMA3	FMA4	FMA5	FMA6	FMA7	FMA8	FMA9	FMA10	ET	Unknown	Total
BIG & STN	***longline***	1991	13.9	1.4	2.0	0.0	10.7	0.0	41.5	0.0	0.0	0.0	0.0	0.0	69.5
		1992	1.9	3.3	0.2	0.0	37.6	0.0	159.3	0.0	0.2	0.0	0.7	0.0	203.2
		1993	8.5	19.6	0.1	0.0	36.0	0.9	137.8	0.0	0.0	0.0	0.2	0.3	203.3
		1994	7.0	0.9	0.1	0.0	63.8	2.3	190.4	0.0	0.1	0.0	1.6	0.0	266.2
		1995	5.1	2.4	0.1	4.0	127.3	0.6	272.3	0.1	0.0	0.0	13.0	1.2	426.0
		1996	4.9	20.6	0.2	1.0	74.8	0.0	29.3	0.0	0.2	0.0	1.9	0.7	133.6
		1997	14.6	49.8	35.7	0.0	63.5	5.5	116.0	0.0	0.4	0.0	0.2	0.3	286.1
		1998	34.6	133.9	10.1	0.0	64.2	1.0	84.8	0.0	1.1	0.0	1.8	0.5	332.1
		1999	108.9	92.3	17.9	0.0	143.4	0.1	93.0	0.2	3.4	0.1	0.5	0.7	460.6
		2000	14.7	155.5	5.1	0.0	41.3	0.0	159.0	0.3	2.4	0.5	0.6	0.3	379.9
STN	**handline**	1991	0.0	0.0	0.0	0.0	0.2	0.0	88.2	0.0	0.0	0.0	0.0	6.4	94.8
		1992	0.0	0.0	0.0	0.0	0.0	0.0	75.9	0.0	0.0	0.0	0.0	0.0	75.9
		1993	0.9	0.0	0.0	0.0	0.0	0.0	12.2	0.0	0.0	0.0	0.0	0.0	13.1
		1994	0.0	0.0	0.0	0.0	0.0	0.0	10.8	0.0	0.0	0.0	0.0	0.0	10.8
		1995	0.0	0.0	0.0	0.0	0.0	0.0	9.5	0.0	0.0	0.0	0.0	0.0	9.5
		1996	0.0	0.0	0.0	0.0	0.0	0.0	5.7	0.0	0.0	0.0	0.0	0.0	5.7
		1997	0.0	0.0	0.0	0.0	0.0	0.0	47.6	0.0	0.0	0.0	0.0	0.0	47.6
		1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		2000	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2

Table 20 continued:

Target	Method	Year	FMA1	FMA2	FMA3	FMA4	FMA5	FMA6	FMA7	FMA8	FMA9	FMA10	ET	Unknown	Total
STN	**troll**	1991	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2
		1992	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2
		1993	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
		1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1995	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
		1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1998	0.0	0.0	0.0	0.0	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1
		1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		2000	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
ALB	**troll**	1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1995	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.7
		1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		2000	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1

Table 21: Yellowfin tuna catch (t) by gear, target species, and Fisheries Management Area scaled to LFRR landings data (ET, high seas areas; ALB, albacore; BIG, bigeye tuna; STN, southern bluefin tuna).

Target	Method	Year	FMA1	FMA2	FMA3	FMA4	FMA5	FMA6	FMA7	FMA8	FMA9	FMA10	ET	Unknown	Total
BIG & STN	longline	1991	1.5	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	5.9
		1992	17.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	18.8
		1993	7.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.8	7.0	4.0	0.0	20.0
		1994	23.4	6.3	0.1	0.0	0.0	0.0	0.0	0.0	0.3	1.8	0.3	0.0	32.1
		1995	82.8	23.4	0.0	0.0	0.0	0.0	0.3	0.0	2.9	1.5	2.9	1.7	115.6
		1996	100.2	50.4	0.0	0.0	0.0	0.0	0.0	0.1	9.5	0.0	10.3	0.8	171.5
		1997	76.2	26.0	0.0	0.0	0.0	0.0	0.0	0.0	24.4	0.0	2.1	0.6	129.3
		1998	68.2	15.0	0.0	0.0	0.0	0.0	0.0	0.0	36.0	0.0	2.3	0.4	121.9
		1999	45.1	34.3	0.0	0.0	0.0	0.0	0.1	6.1	63.6	0.7	0.6	0.4	150.9
		2000	54.9	24.0	0.0	0.0	0.0	0.0	0.0	0.1	13.1	8.2	5.1	0.3	105.8
ALB	troll	1991	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
		1992	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
		1993	1.7	0.2	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	4.0
		1994	17.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	18.8
		1995	9.8	3.3	0.0	0.0	0.0	0.0	0.2	0.0	2.8	0.0	0.0	0.0	16.1
		1996	6.7	1.4	0.0	0.0	0.0	0.0	1.2	1.7	14.1	0.0	0.0	1.3	26.4
		1997	2.2	0.2	0.0	0.0	0.2	0.0	0.0	0.5	9.2	0.0	0.0	0.7	13.1
		1998	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.5	3.9	0.0	0.0	0.0	5.1
		1999	0.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	1.8
		2000	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	1.0

Table 21 continued:

Target	Method	Year	FMA1	FMA2	FMA3	FMA4	FMA5	FMA6	FMA7	FMA8	FMA9	FMA10	ET	Unknown	Total
all spp	**pole-&-line**	1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1994	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6
		1995	3.9	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4
		1996	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
		1997	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
		1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1999	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
		2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
all spp	**handline**	1991	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
		1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1993	10.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.2
		1994	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
		1995	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7
		1996	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
		1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 22: Swordfish catch (t) by gear, target species, and Fisheries Management Area scaled to LFRR landings data (ET, high seas areas; BIG, bigeye tuna; STN, southern bluefin tuna).

Target	Method	Year	FMA1	FMA2	FMA3	FMA4	FMA5	FMA6	FMA7	FMA8	FMA9	FMA10	ET	Unknown	Total
BIG & STN	longline	1991	12.2	3.2	0.0	0.0	0.4	0.0	25.2	0.0	0.2	0.0	0.7	0.0	41.9
		1992	24.0	1.7	0.0	0.0	0.0	0.0	2.0	0.0	0.4	0.7	0.2	0.0	29.0
		1993	51.4	21.7	0.0	0.0	0.0	0.3	6.0	0.0	3.3	5.9	4.3	0.0	92.9
		1994	55.7	19.4	0.1	0.0	0.0	0.0	1.8	0.0	8.3	7.7	0.8	0.2	93.8
		1995	57.2	27.1	0.0	0.0	0.1	0.0	13.2	0.2	2.3	4.0	3.3	0.6	108.0
		1996	86.9	74.8	0.0	0.0	1.5	0.0	9.1	0.0	6.2	0.0	3.1	0.8	182.4
		1997	118.5	104.4	0.0	0.0	2.0	0.0	10.4	0.0	44.4	0.0	1.0	1.4	282.1
		1998	219.9	178.2	0.0	0.0	1.9	0.0	23.7	0.0	130.8	0.1	4.6	4.4	563.6
		1999	395.3	282.9	0.0	0.0	31.3	0.0	43.3	15.1	185.5	32.4	4.0	13.7	1 003.6
		2000	278.3	417.9	0.1	0.0	7.7	0.0	40.5	5.2	182.6	23.4	15.4	3.4	974.5

Table 23: Length–weight relationships (ln(length) vs ln(weight)) of longline caught tuna and swordfish, 1987 to 2000.

Species	Sex	n	b_0	SEb_0	b_1	SEb_1	R^2
albacore	male	1 108	-11.61	0.13	3.16	0.03	0.91
	female	1 087	-11.43	0.15	3.12	0.03	0.89
	all	24 079	-10.37	0.03	2.89	0.01	0.91
bigeye tuna	male	424	-10.74	0.21	2.99	0.04	0.92
	female	426	-9.87	0.23	2.81	0.05	0.90
	all	873	-10.34	0.15	2.91	0.03	0.91
southern bluefin tuna	male	10 113	-10.94	0.03	3.02	0.01	0.96
	female	8 676	-10.91	0.04	3.01	0.01	0.95
	all	18 994	-10.93	0.02	3.02	0.00	0.96
yellowfin tuna	male	150	-9.83	0.44	2.76	0.09	0.85
	female	173	-9.89	0.43	2.77	0.09	0.85
	all	337	-9.54	0.27	2.70	0.06	0.87
swordfish	male	392	-11.91	0.20	3.14	0.04	0.94
	female	1 400	-12.32	0.12	3.21	0.02	0.94
	all	2 153	-12.25	0.09	3.20	0.02	0.94

Table 24: Sex ratios observed in longline caught tuna and swordfish, 1987 to 2000.

Species	Males	Females	n	ratio	X^2	P
albacore	1 715	1 507	3 222	1.1	13.43	< 0.005
southern bluefin tuna	11 178	9 606	20 784	1.2	118.90	< 0.005
bigeye tuna	634	684	1 318	0.9	1.90	0.244
yellowfin tuna	330	408	738	0.8	8.24	< 0.005
swordfish	554	2 046	2 600	0.3	856.18	< 0.005

Table 25: **Discards, loss rates, and life status in longline caught tuna and swordfish by fishing year.**

Species	Year	No. obs.	% discarded	% lost	% dead (of lost or discarded)
albacore	1991-92	3 029	1.3	0.0	1.1
	1992-93	3 308	3.3	0.4	2.1
	1993-94	793	3.3	0.0	2.9
	1994-95	1 855	2.4	0.1	2.2
	1995-96	3 210	9.0	1.7	2.6
	1996-97	5 222	1.2	0.8	1.1
	1997-98	9 556	2.5	0.8	2.5
	1998-99	2 456	1.8	0.7	1.7
	1999-00	1 651	1.6	1.5	2.4
bigeye tuna	1991-92	81	4.9	0.0	4.9
	1992-93	39	0.0	0.0	0.0
	1993-94	53	0.0	1.9	0.0
	1994-95	87	0.0	0.0	0.0
	1995-96	43	11.6	2.3	9.3
	1996-97	85	15.3	1.2	3.5
	1997-98	355	2.8	0.3	2.8
	1998-99	262	3.1	0.4	1.9
	1999-00	100	4.0	3.0	2.0
southern bluefin tuna	1991-92	547	0.2	0.0	0.0
	1992-93	1 527	1.7	0.0	0.3
	1993-94	2 899	1.2	0.4	0.3
	1994-95	2 482	0.4	0.2	0.3
	1995-96	223	2.2	2.7	0.4
	1996-97	2 874	0.8	1.9	0.9
	1997-98	3 240	0.6	0.9	0.6
	1998-99	2 917	1.2	2.0	0.5
	1990-00	1 801	0.2	1.9	0.3
yellowfin tuna	1991-92	0	0.0	0.0	0.0
	1992-93	0	0.0	0.0	0.0
	1993-94	2	0.0	0.0	0.0
	1994-95	209	7.2	0.0	3.8
	1995-96	248	18.5	0.0	2.0
	1996-97	229	5.2	0.4	0.4
	1997-98	90	4.4	4.4	3.3
	1998-99	69	11.6	0.0	1.4
	1999-00	42	19.0	2.4	2.4
swordfish	1991-92	355	2.5	0.6	2.8
	1992-93	228	9.6	0.0	4.4
	1993-94	82	7.3	0.0	1.2
	1994-95	38	10.5	0.0	5.3
	1995-96	50	12.0	2.0	2.0
	1996-97	499	2.8	1.6	2.8
	1997-98	576	3.1	2.6	2.8
	1998-99	344	1.7	4.1	0.9
	1999-00	310	2.6	2.6	2.6

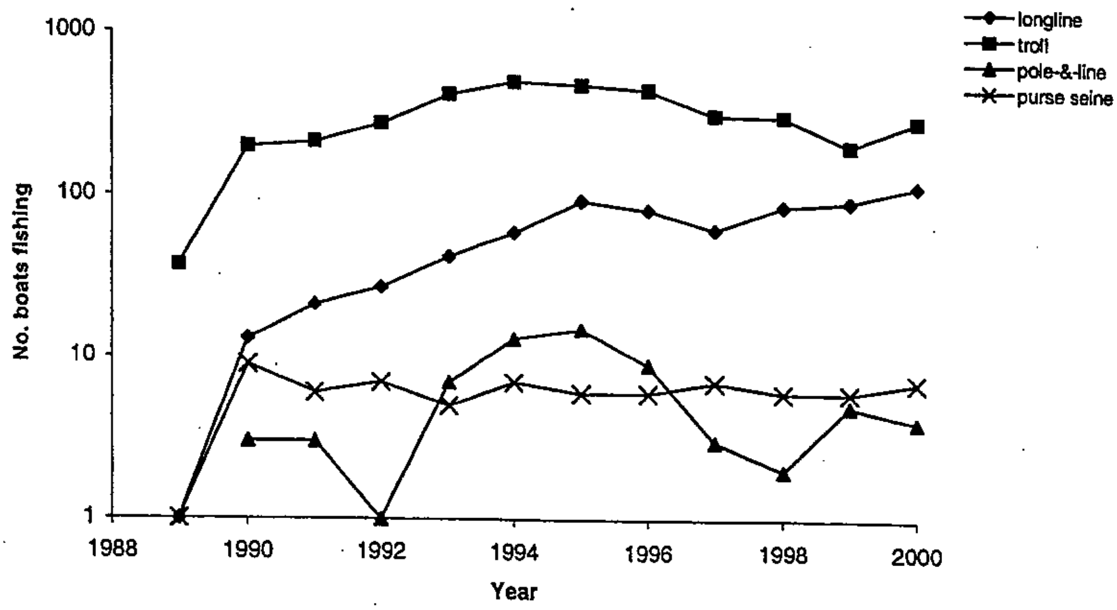


Figure 1: Total number of tuna New Zealand vessels (including chartered vessels) by fishing method (note the logarithmic abcissa).

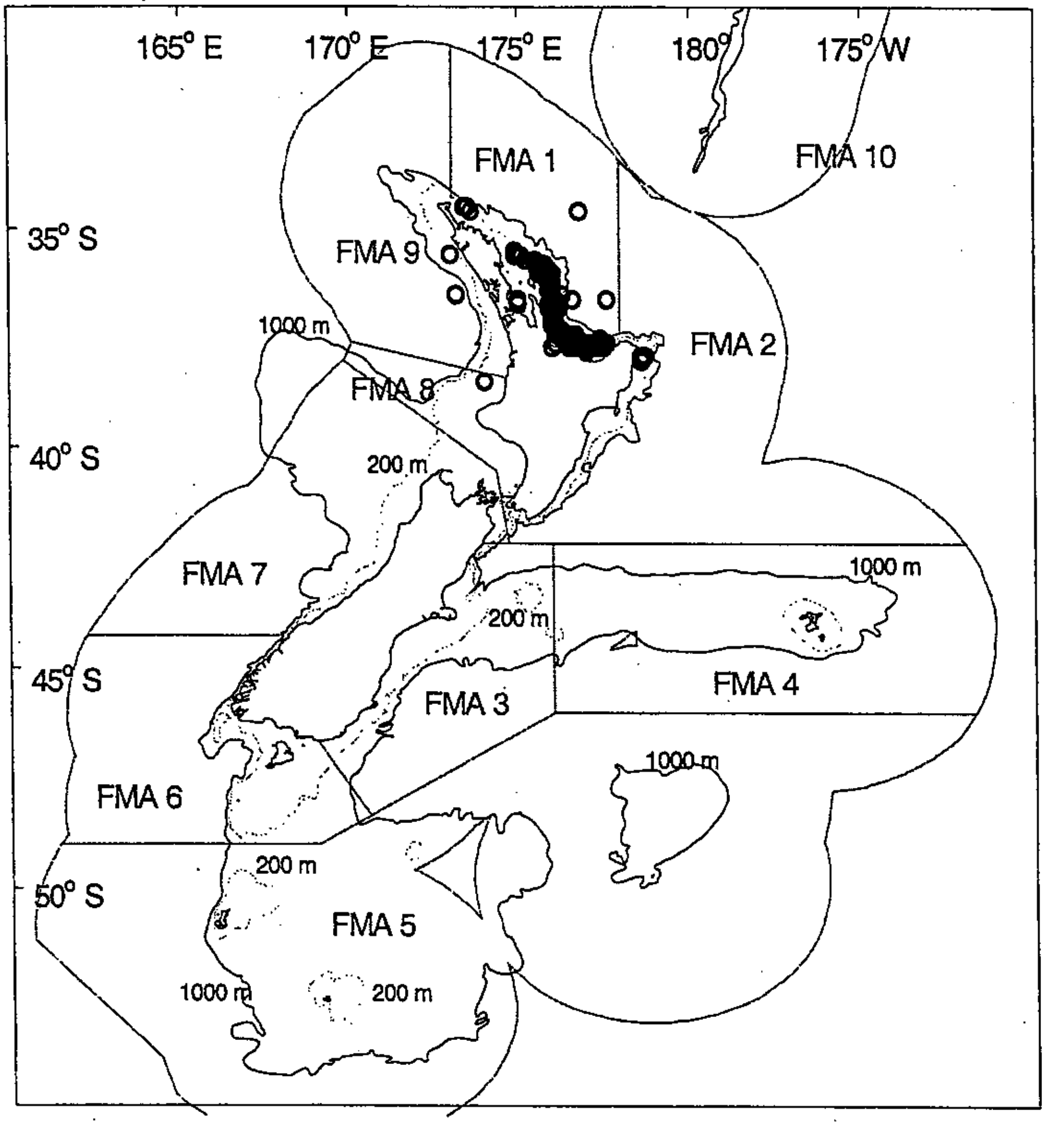


Figure 2a: Purse-seine set positions targeting skipjack tuna in 2000.

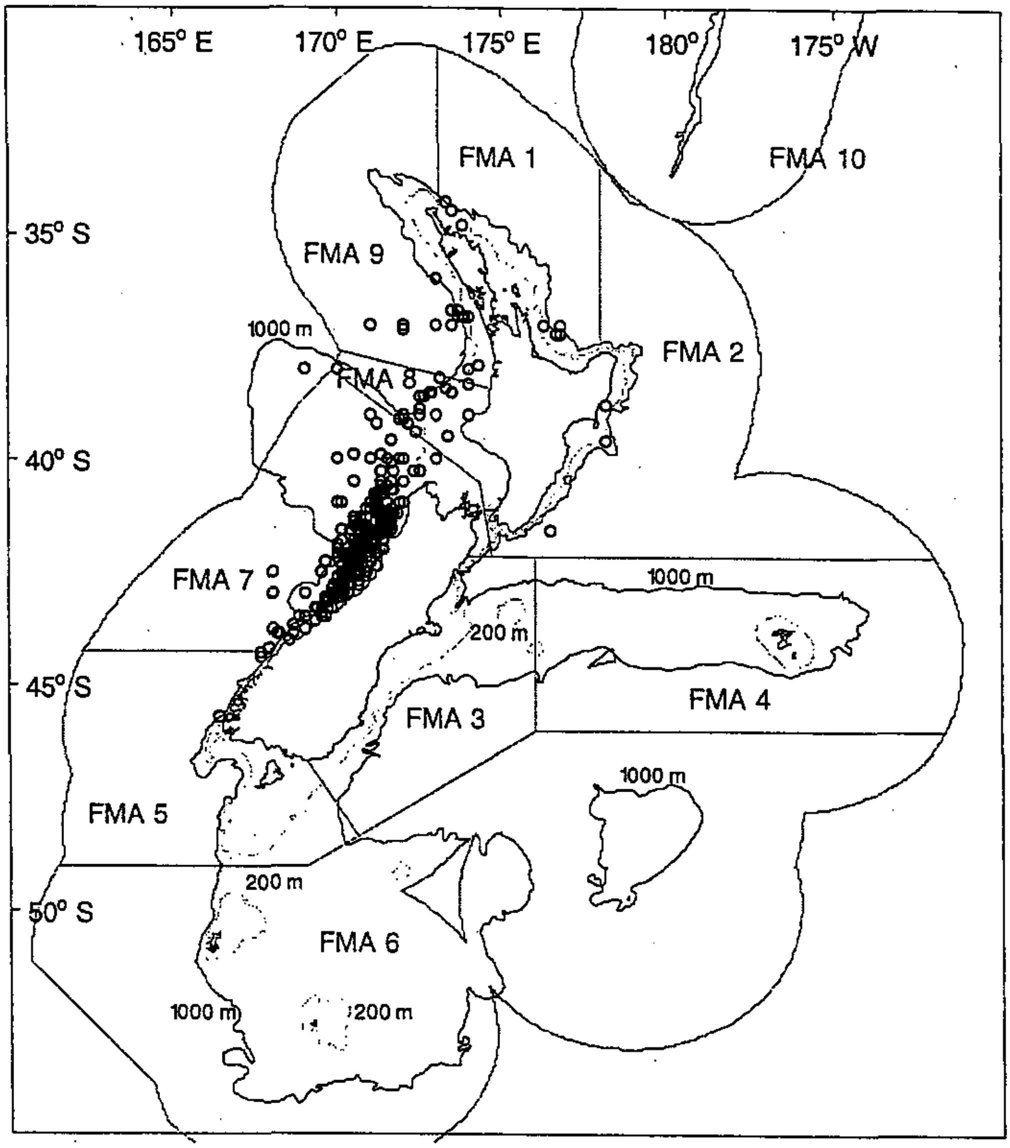


Figure 2b: Trolling positions targeting albacore in 2000.

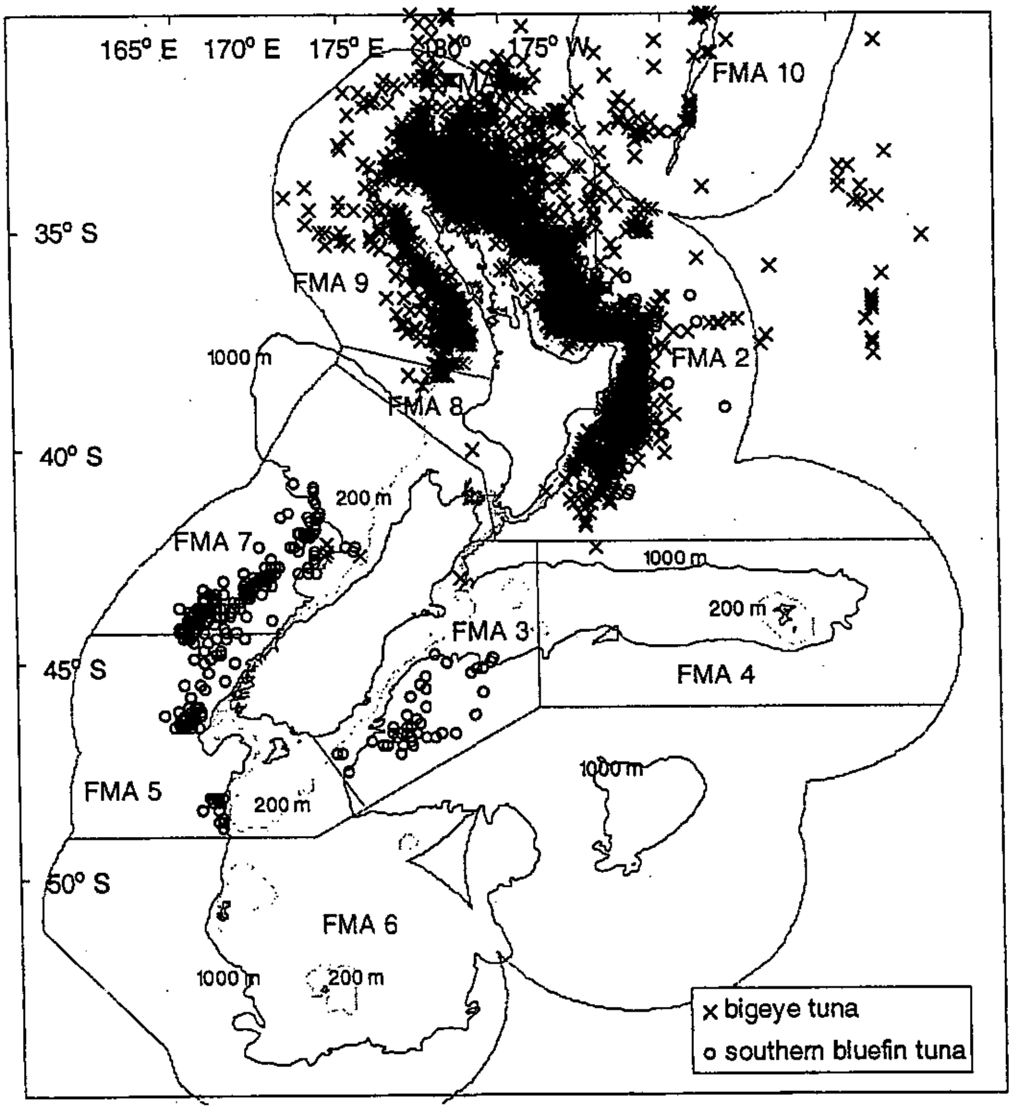


Figure 2c: Tuna longline set positions in 2000 by target species.

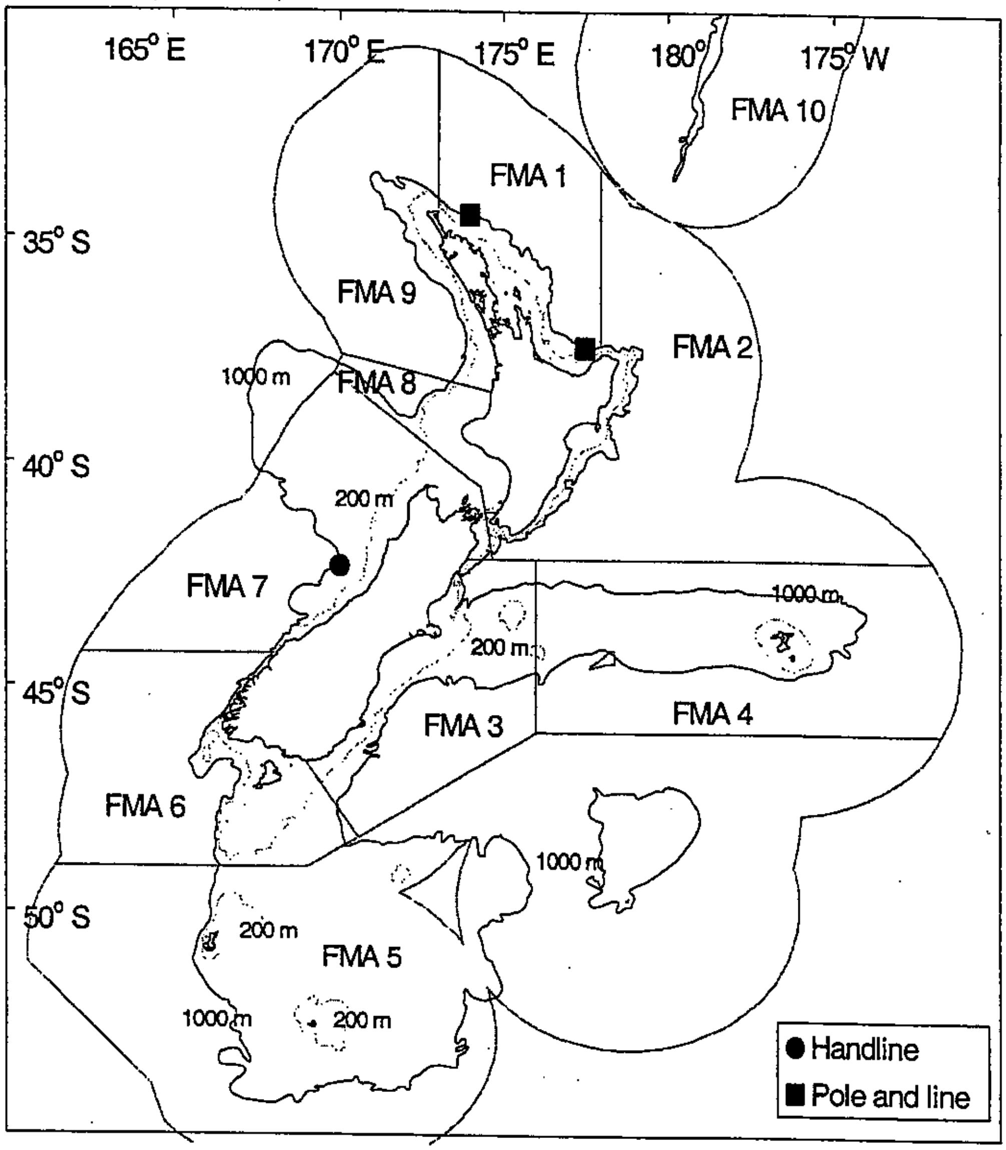


Figure 2d: Handline and pole-&-line fishing positions in 2000.

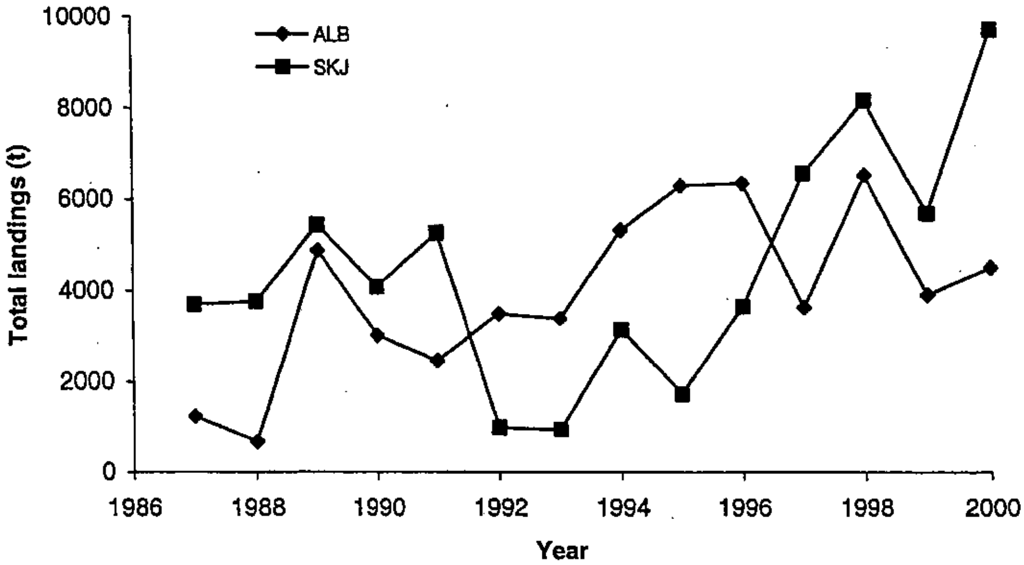


Figure 3: Domestic landings (tonnes whole weight) of albacore (ALB) and skipjack tuna (SKJ) by year from LFR reports.

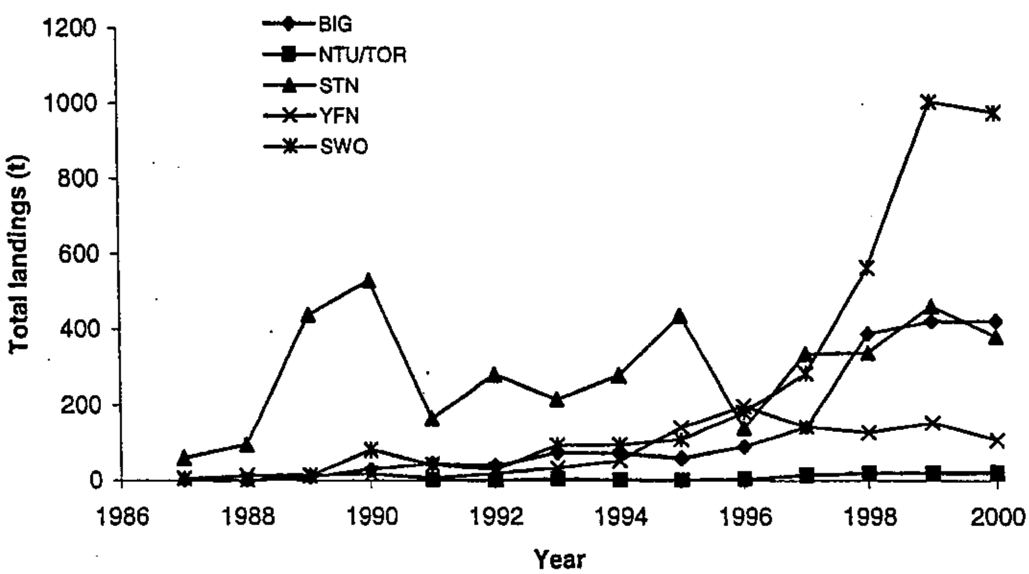


Figure 4: Domestic landings (tonnes whole weight) of bigeye (BIG), southern bluefin (STN), Pacific bluefin (NTU/TOR), and yellowfin (YFN) tunas and swordfish (SWO) by year from LFR reports.

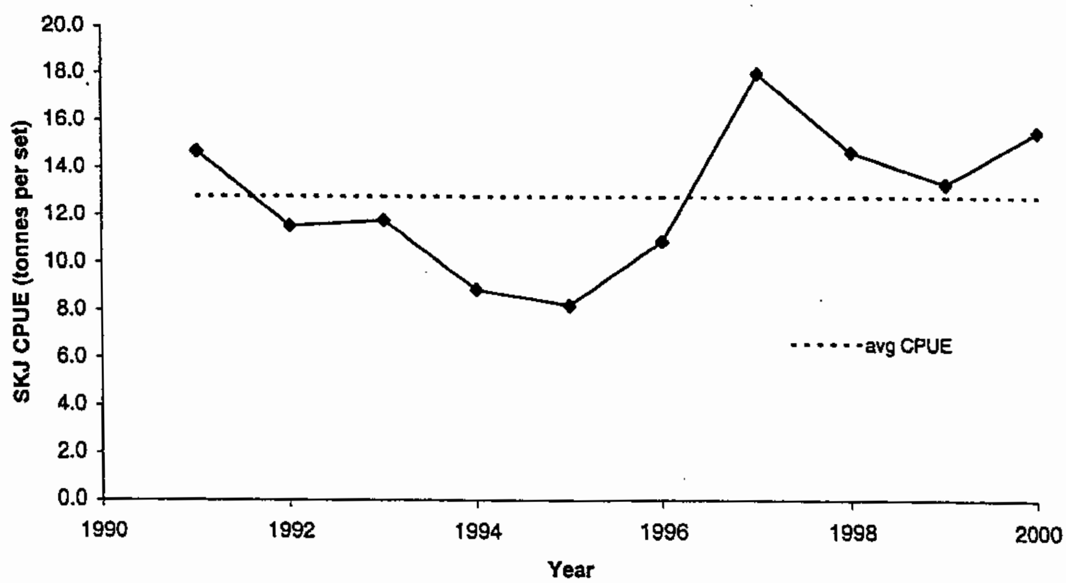


Figure 5: Purse seine CPUE for skipjack tuna (tonnes per set) when targeted by domestic vessels.

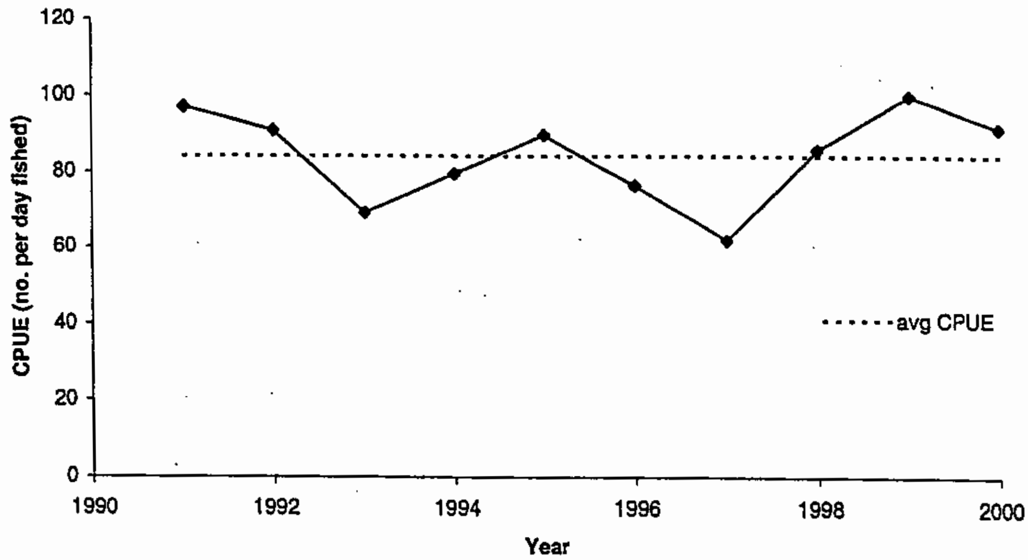


Figure 6: Troll fishery CPUE for albacore (number of fish per day) when targeted by domestic vessels.

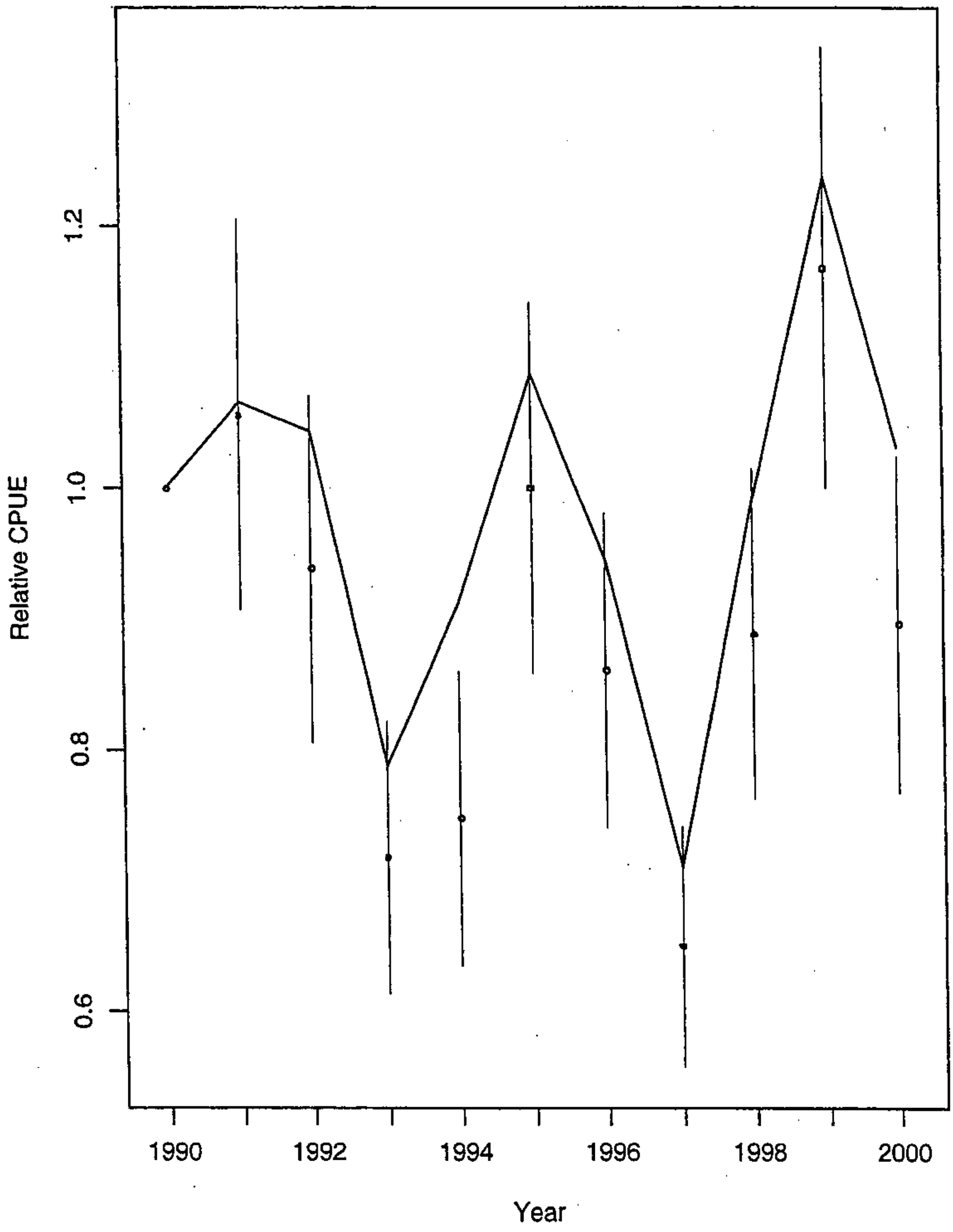


Figure 7: Standardised CPUE for albacore in the New Zealand troll fishery (circles +/- 2σ errors) contrasted with nominal CPUE (solid line). CPUE values are shown relative to the 1990 CPUE value.

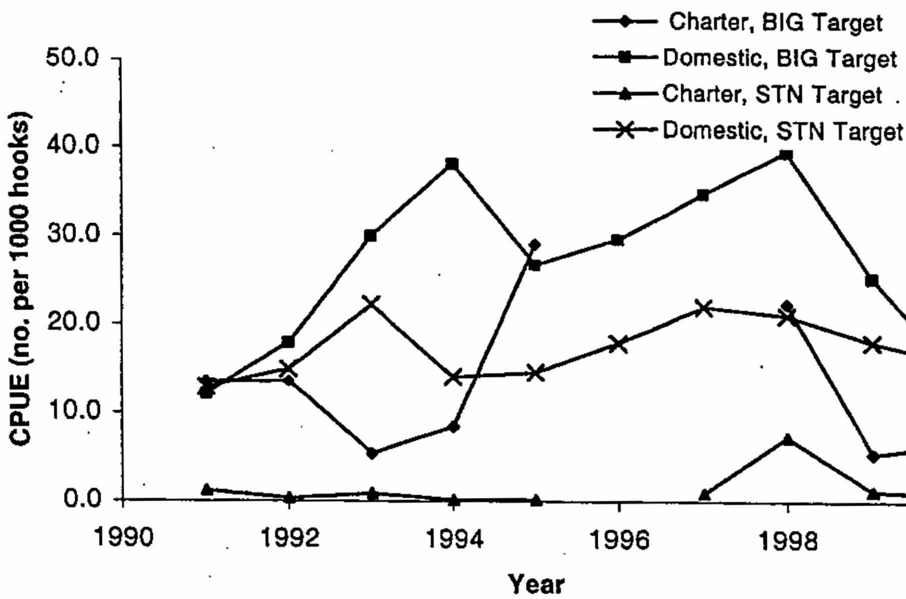


Figure 8: Tuna longline fishery CPUE of albacore (number of fish per 1000 hooks) by target and fleet.

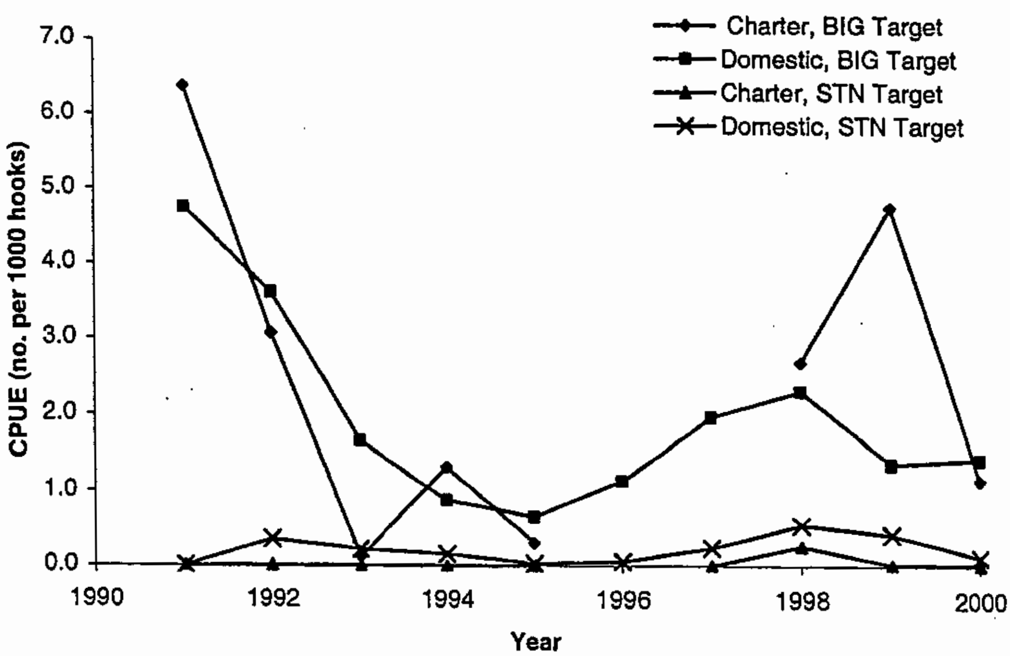


Figure 9: Tuna longline fishery CPUE of bigeye tuna (number of fish per 1000 hooks) by target and fleet.

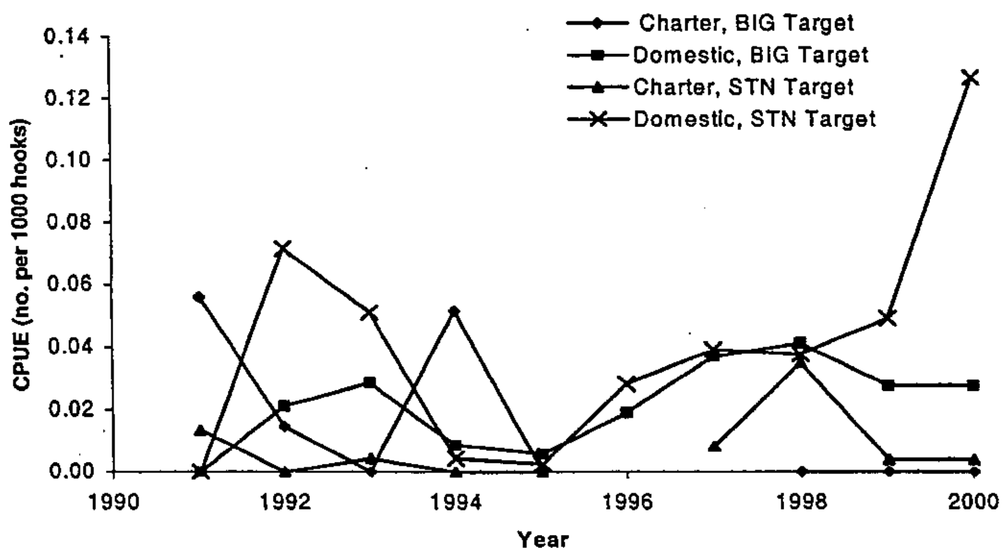


Figure 10: Tuna longline fishery CPUE of Pacific bluefin tuna (number of fish per 1000 hooks) by target and fleet.

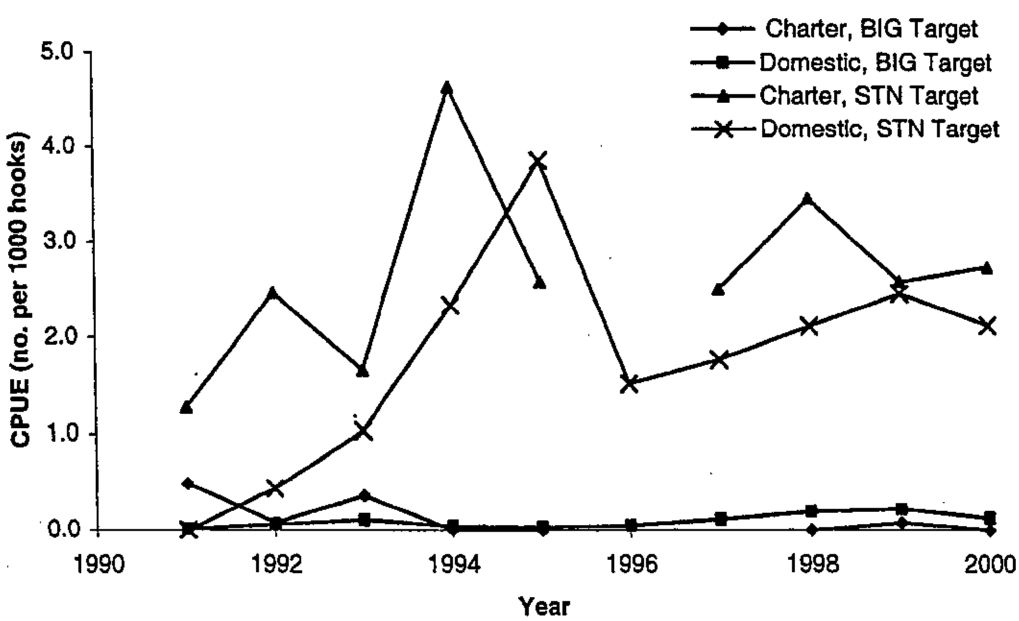


Figure 11: Tuna longline fishery CPUE of southern bluefin tuna (number of fish per 1000 hooks) by target and fleet.

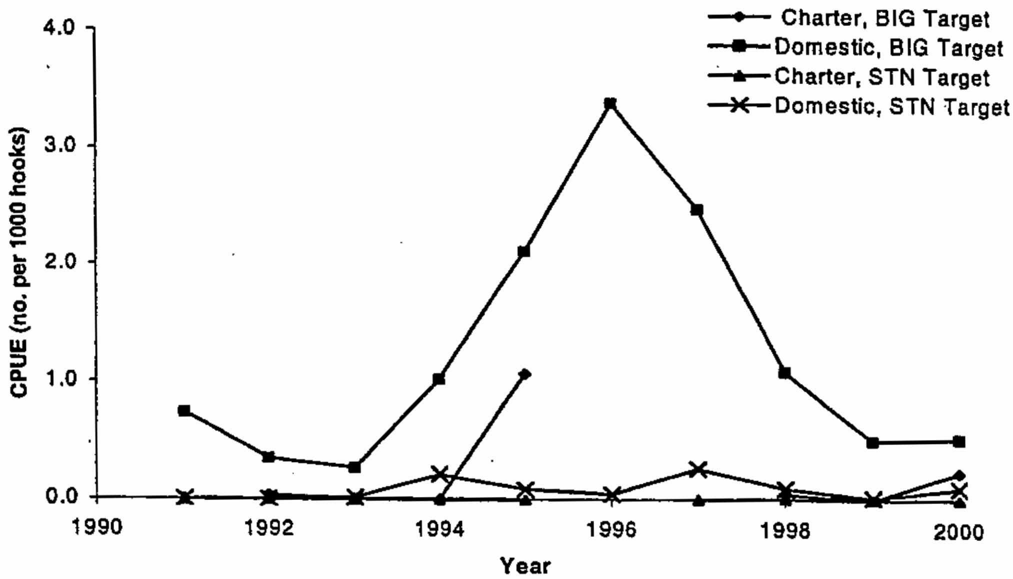


Figure 12: Tuna longline fishery CPUE of yellowfin tuna (number of fish per 1000 hooks) by target and fleet.

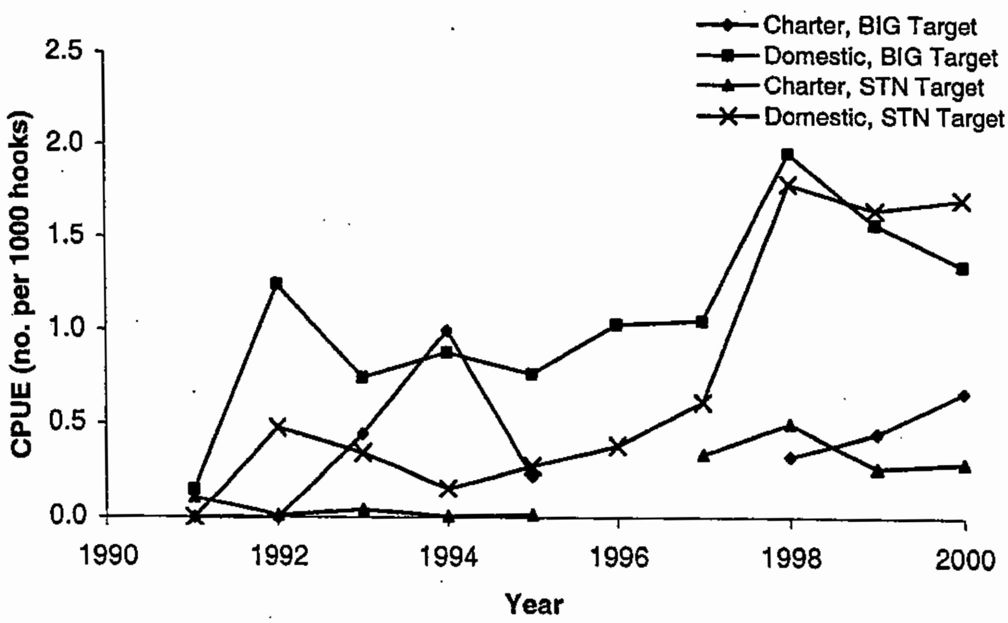


Figure 13: Tuna longline fishery CPUE of swordfish (number of fish per 1000 hooks) by target and fleet.

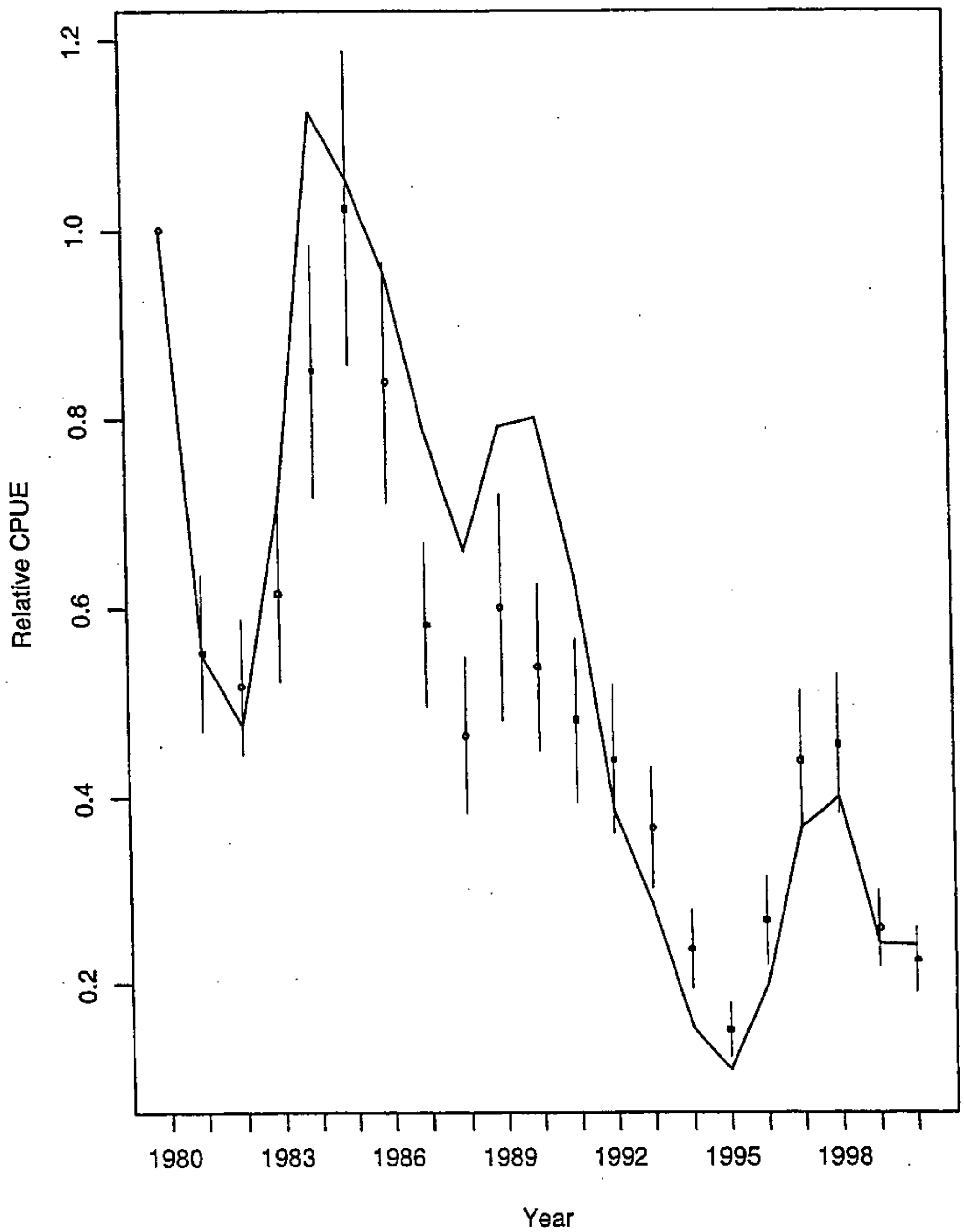


Figure 14: Standardised CPUE for bigeye tuna in the New Zealand longline fishery (circles +/- 2σ errors) contrasted with nominal CPUE (solid line). CPUE values are shown relative to the 1980 CPUE value.

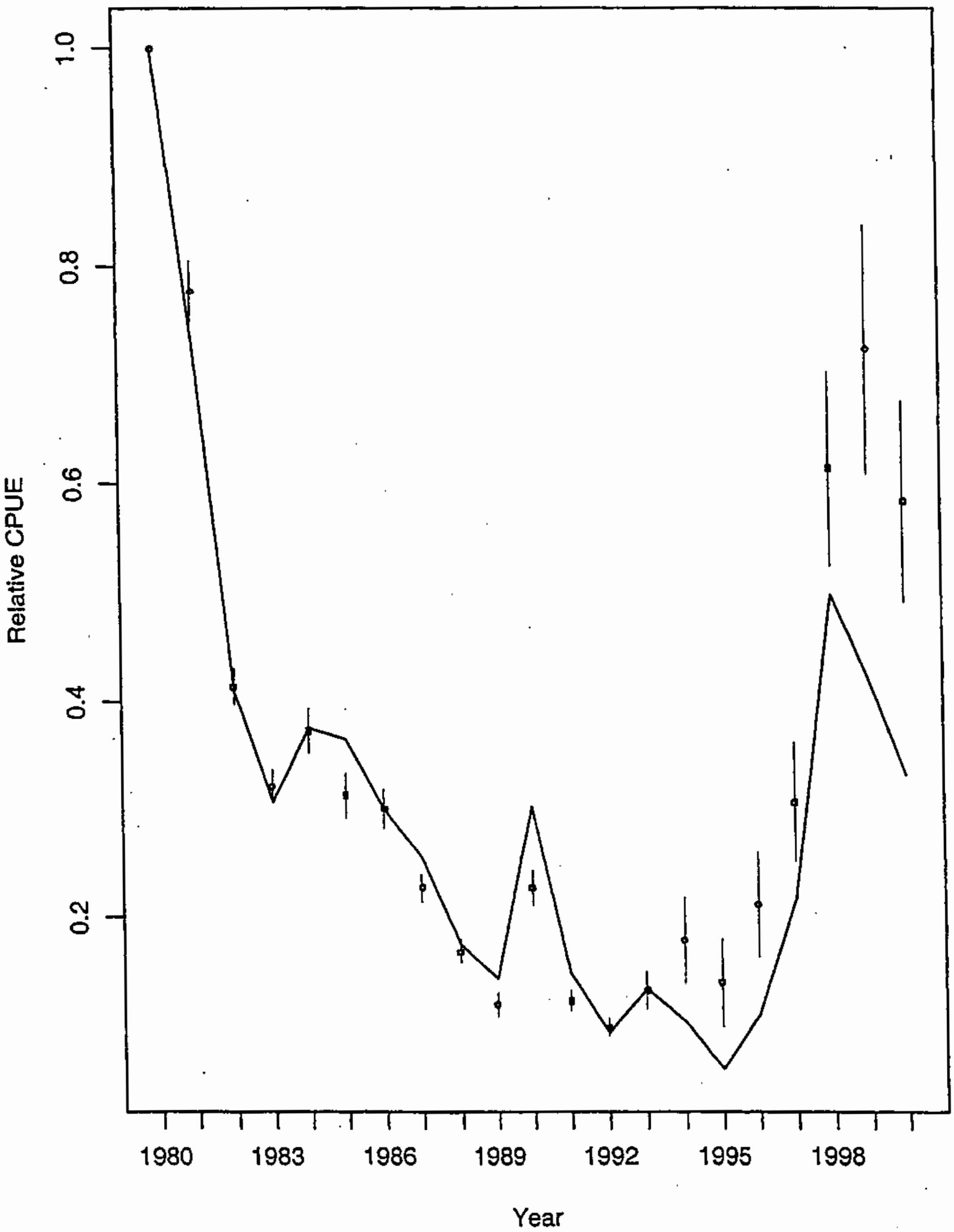


Figure 15a: Standardised CPUE for southern bluefin tuna in the New Zealand longline fishery off the east coast of New Zealand north of 44° S (circles +/- 2σ errors) contrasted with nominal CPUE (solid line). CPUE values are shown relative to the 1980 CPUE value.

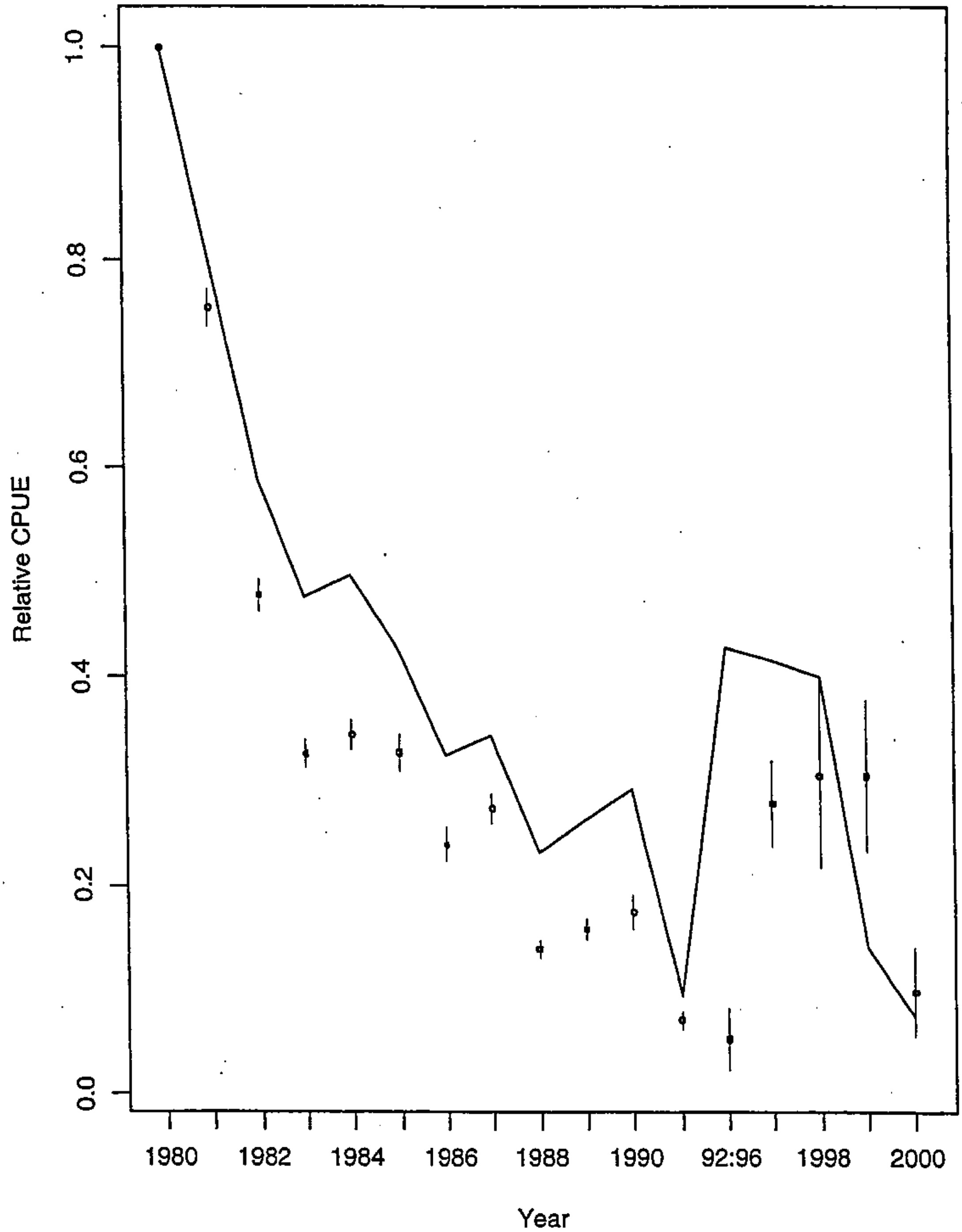


Figure 15b: Standardised CPUE for southern bluefin tuna in the New Zealand longline fishery off the east coast of the South Island south of 44° S (circles +/- 2σ errors) contrasted with nominal CPUE (solid line). CPUE values are shown relative to the 1980 CPUE value.

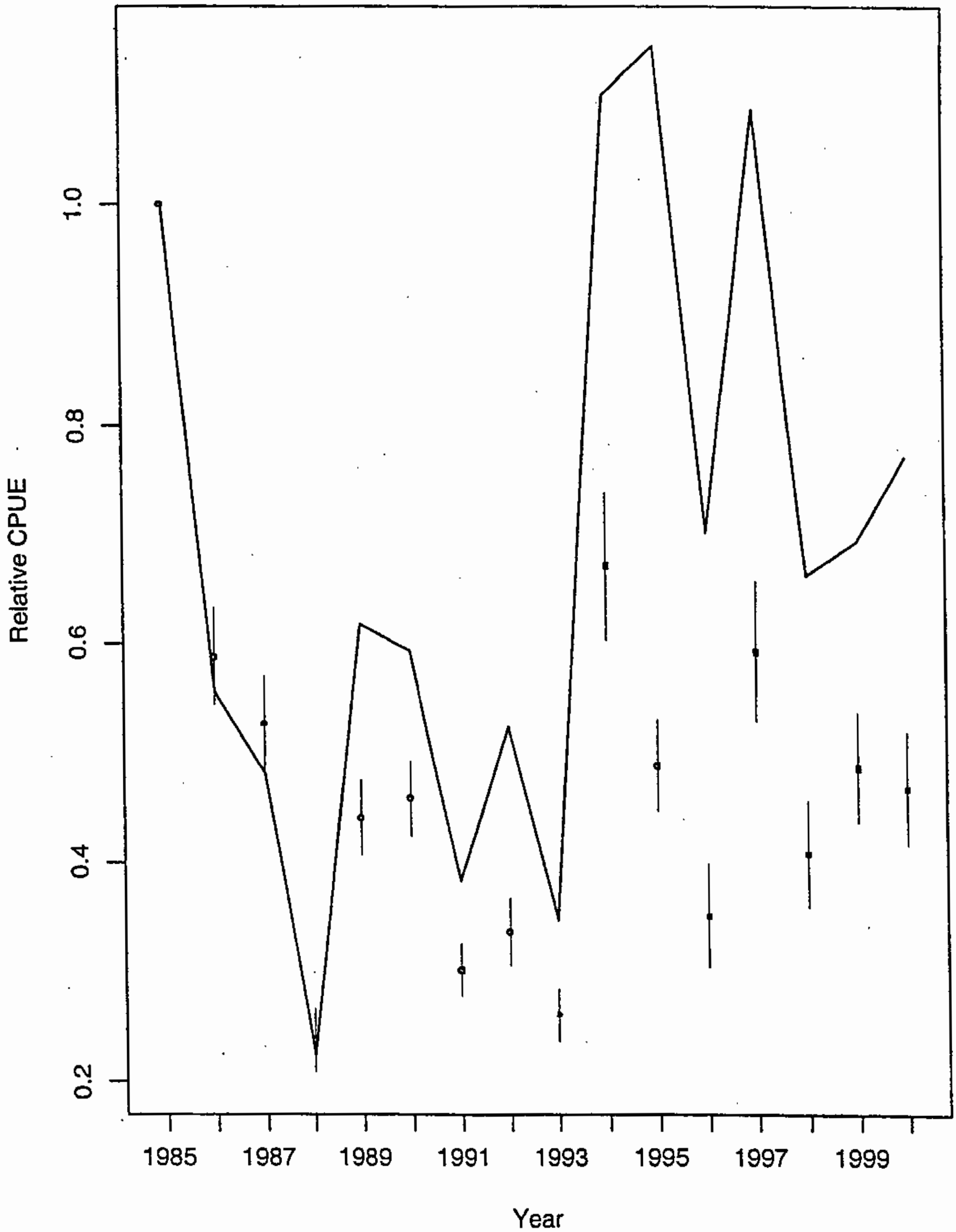
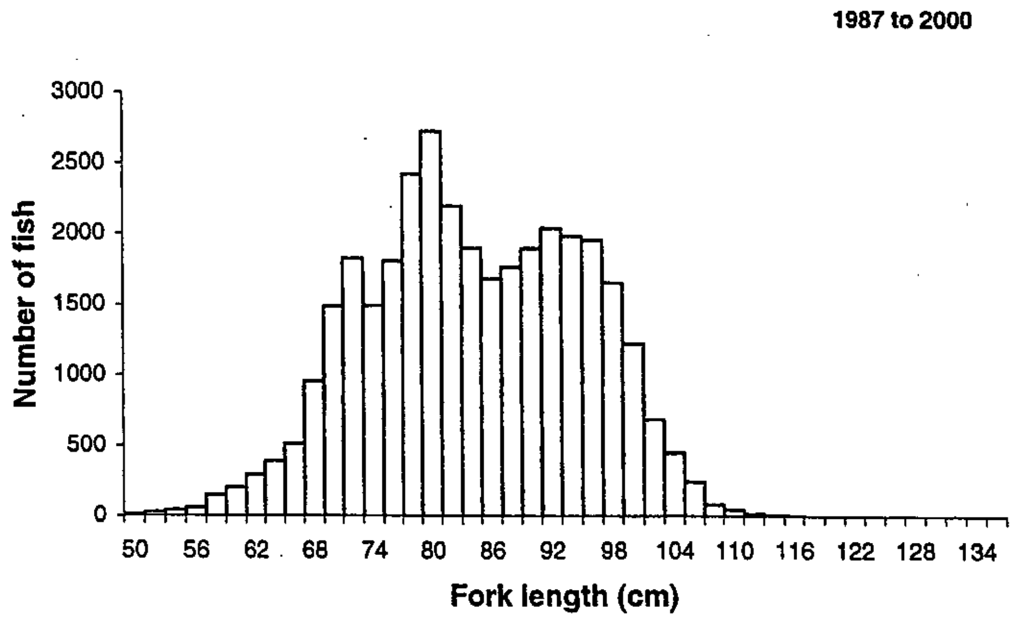


Figure 15c: Standardised CPUE for southern bluefin tuna in the New Zealand longline fishery off the west coast of the South Island (circles +/- 2σ errors) contrasted with nominal CPUE (solid line). CPUE values are shown relative to the 1980 CPUE value.



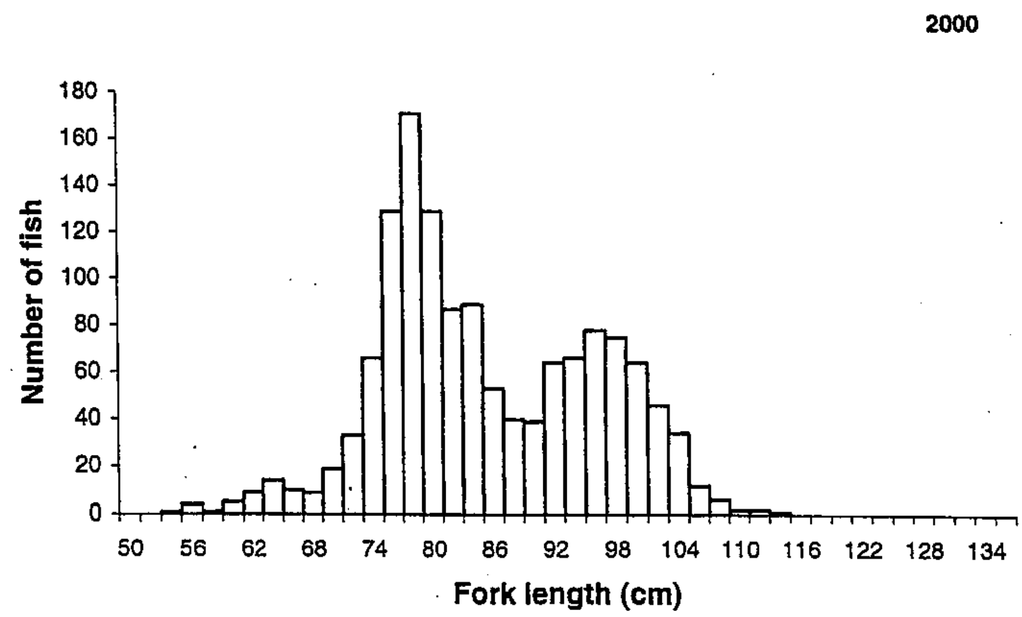
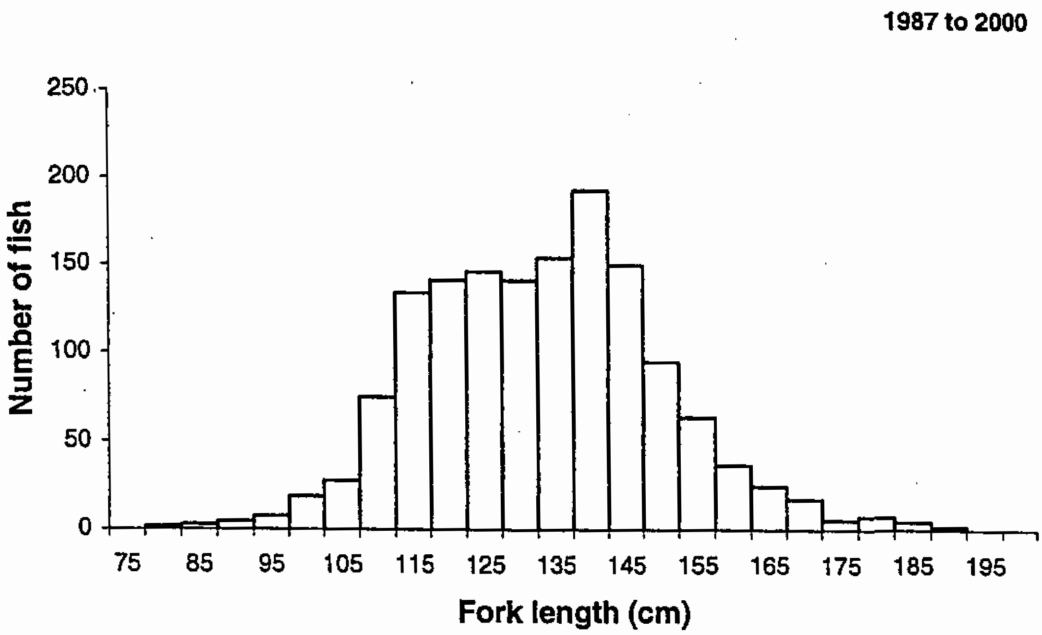


Figure 16: Size frequency distributions (fork length) of longline caught albacore, data collected in 2000 compared with all observer data collected since 1987, all fleets combined. Fork length size classes are 2 cm intervals, e.g., size class 80 includes all albacore 80 or 81 cm.



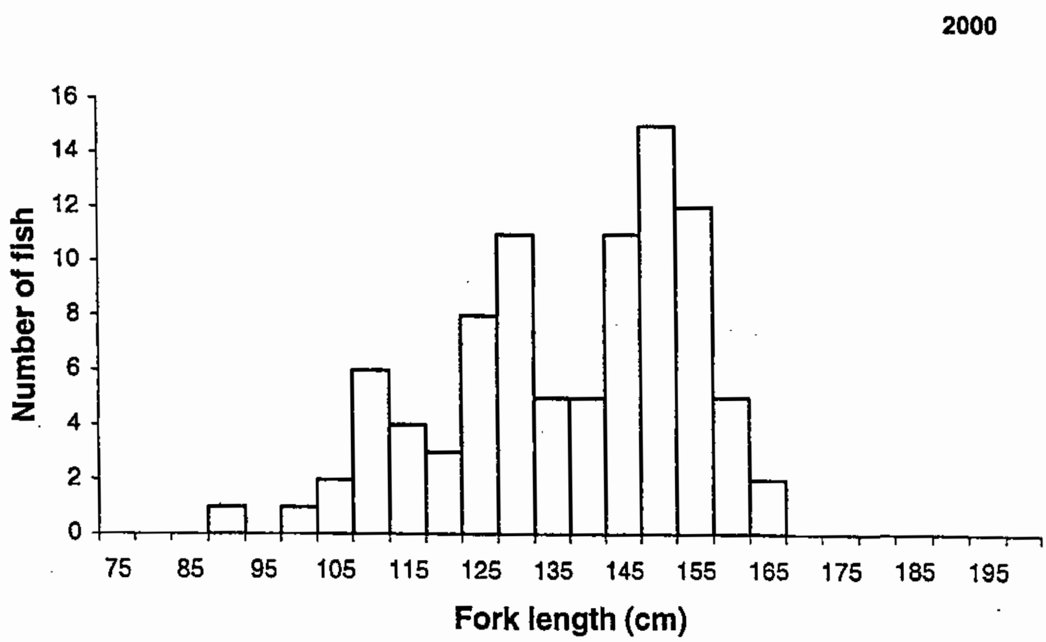
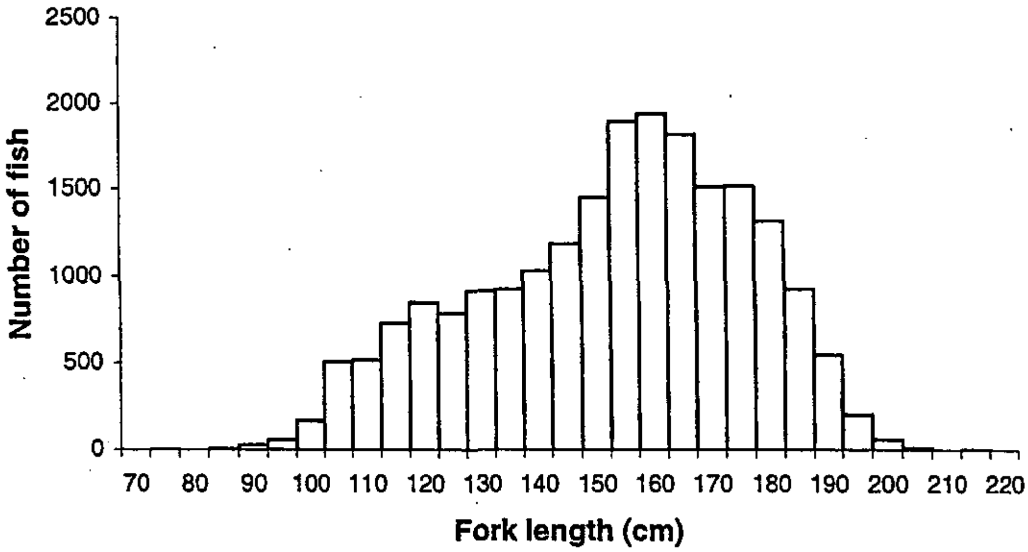


Figure 17: Size frequency distributions (fork length) of longline caught bigeye tuna, data collected in 2000 compared with all observer data collected since 1987, all fleets combined. Fork length size classes are 5 cm intervals, e.g., size class 125 includes all bigeye tuna 125–129 cm.

1987 to 2000



2000

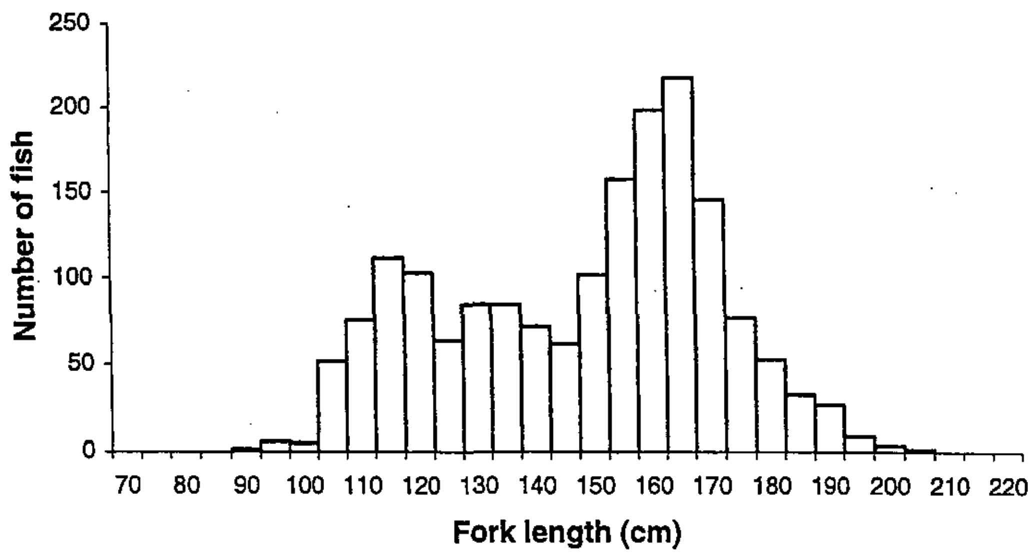
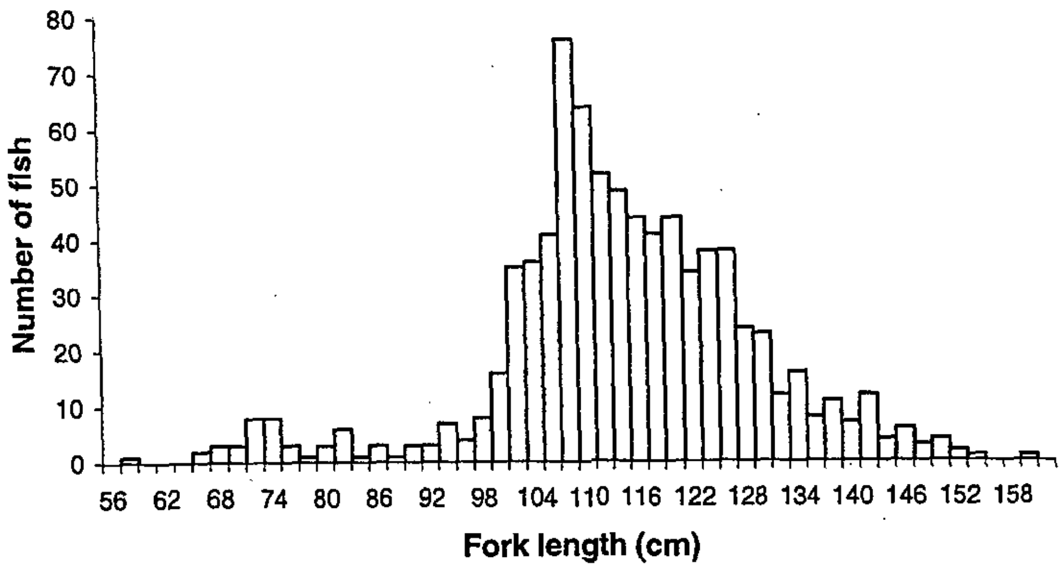


Figure 18: Size frequency distributions (fork length) of longline caught southern bluefin tuna, data collected in 2000 compared with all observer data collected since 1987, all fleets combined. Fork length size classes are 5 cm intervals, e.g., size class 125 includes all southern bluefin tuna 125–129 cm.

1987 to 2000



2000

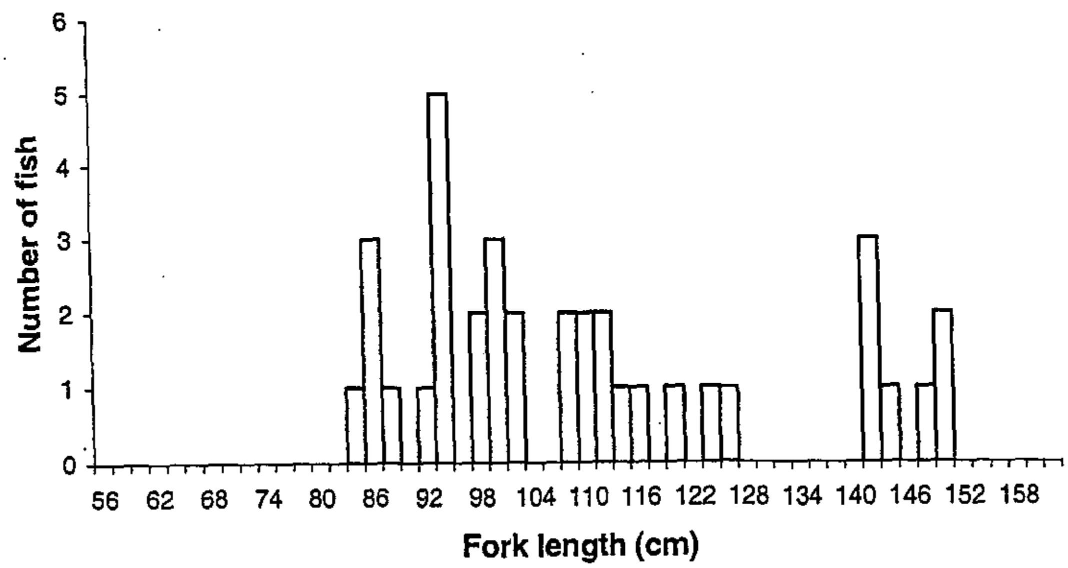
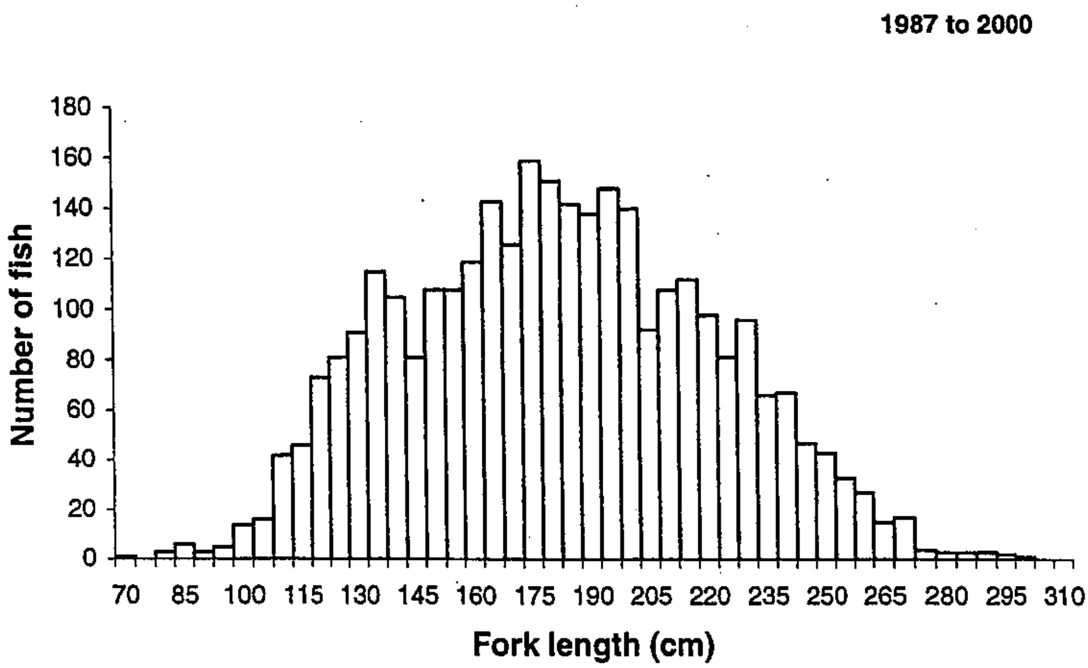


Figure 19: Size frequency distributions (fork length) of longline caught yellowfin tuna, data collected in 2000 compared with all observer data collected since 1987, all fleets combined. Fork length size classes are 2 cm intervals, e.g., size class 86 includes all yellowfin tuna 86–87 cm.



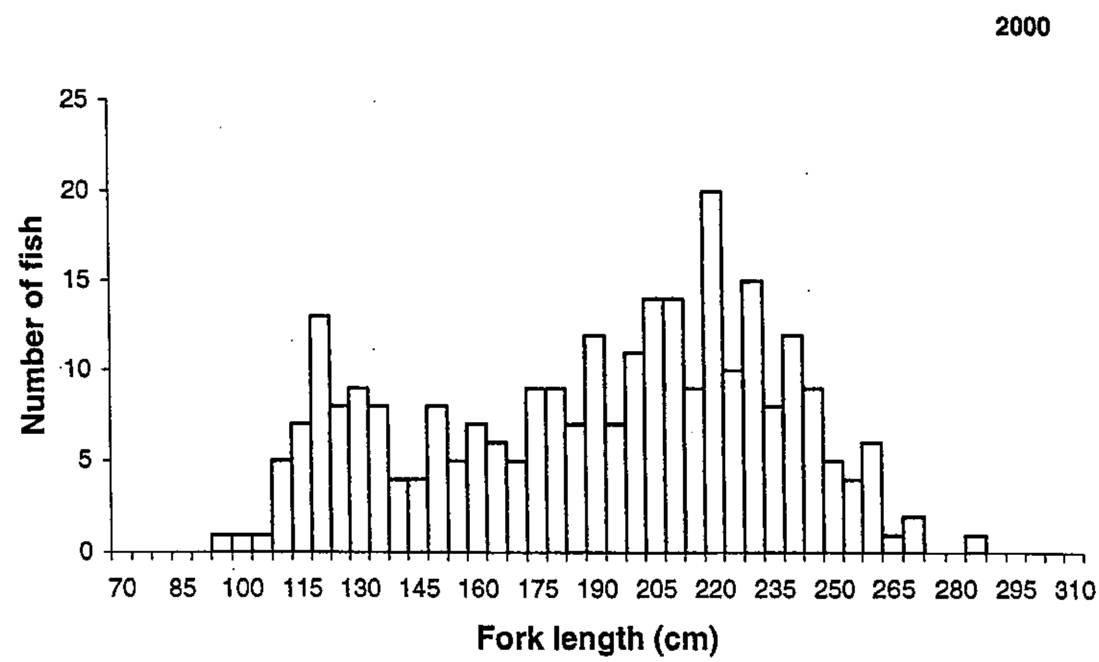


Figure 20: Size frequency distributions (lower jaw to fork length) of longline caught swordfish, data collected in 2000 compared with all observer data collected since 1987, all fleets combined. Fork length size classes are 5 cm intervals, e.g., size class 130 includes all swordfish 130–134 cm.

Appendix 1: Number of New Zealand tuna vessels (including chartered vessels) by fishing method and vessel size (GRT), *1989 to 2000*

Longline	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
0-50	1	12	13	18	27	36	64	60	38	58	57	80
51-200		1	3	3	7	14	21	20	17	21	28	30
201-500			5	6	7	9	8	2	6	7	7	5
500+					1				1			
Total	1	13	21	27	42	59	93	82	62	86	92	115

Troll	1989	1990	*1991*	1992	*1993*	*1994*	*1995*	*1996*	1997	*1998*	1999	2000
0-50	32	181	199	248	369	445	432	401	281	270	189	261
51-100	4	10	8	17	30	36	29	28	22	27	8	21
101-150	1	5	3	4	9	7	9	8	3	2	2	1
150+		2	1	4	6	4	4	4	3	3	2	2
Total	37	*198*	*211*	273	414	492	474	441	309	302	201	285

Pole-&-line	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
0-50		3	1		7	13	15	9	3	2	5	4
51-150			2	1								
150+												
Total	0	3	3	1	7	13	15	9	3	2	5	4

Purse-seine	1989	1990	1991	1992	1993	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	2000
0-50						1			1			
51-100												
101-200		1	1	2	1	2	1	1	1	1	1	1
201-300		3	2	2	2	2	2	2	2	2	2	2
301-400					1	1	2	2	2	2	2	2
400+	1	5	3	3	1	1	1	1	1	1	1	2
Total 1	9	6	7	5	7	6	6	7	6	6	7	

Appendix 2: Analysis of deviance tables for the final GLM and GAM CPUE models derived for the albacore troll, bigeye tuna longline, and southern bluefin tuna longline fisheries

Albacore troll fishery

Analysis of deviance table for negative binomial GLM model, fixed theta

	Df	Deviance	Resid. Df	Resid. Dev	F Value	Pr(F)
NULL			38341	46591.97		
year	10	968.9088	38331	45623.06	134.3563	0.00E+00
ns(long, 4)	4	534.1303	38327	45088.93	185.1665	0.00E+00
ns(lat, 4)	4	206.6838	38323	44882.25	71.6509	0.00E+00
month	2	128.0918	38321	44754.15	88.8109	0.00E+00
ns(soi, 4)	4	39.8021	38317	44714.35	13.7981	0.00E+00
ns(bycatch, 4)	1	8.2186	38316	44706.13	11.3965	0.000737

Analysis of deviance table for equivalent GAM

	Df	Npar Df	Npar F	Pr(F)
(Intercept)	1			
year	10			
lo(lat, long, 0.25)	2	18.2	27.81803	0.00E+00
month	2			
lo(soi)	1	3	23.12847	0.00E+00
lo(bycatch)	1	3.7	3.32314	0.011785

Bigeye tuna longline fishery

Analysis of deviance table for negative binomial model, fixed theta

	Df	Deviance	Resid. Df	Resid. Dev	F Value	Pr(F)
NULL			23806	44190.3		
year	20	9372.518	23786	34817.78	266.4366	0.00E+00
month	11	6579.244	23775	28238.53	340.0564	0.00E+00
ns(SST, 3)	3	119.831	23772	28118.7	22.7098	0.00E+00
ns(effort, 3)	3	195.225	23769	27923.48	36.9983	0.00E+00
ns(bycatch, 4)	4	310.307	23765	27613.17	44.1062	0.00E+00
ns(lat, 4)	4	268.068	23761	27345.1	38.1024	0.00E+00
ns(long, 4)	4	419.408	23757	26925.7	59.6135	0.00E+00
nation	1	0.829	23756	26924.87	0.4712	0.492436

Analysis of deviance table for equivalent GAM

	Df	Npar Df	Npar F	Pr(F)
(Intercept)	1			
year	20			
month	11			
lo(SST)	1	2.3	47.44984	0.00E+00
lo(effort)	1	2.5	18.23071	2.81E-10
lo(bycatch)	1	3.8	20.64188	2.00E-16
lo(lat, long, 0.25)	2	17.2	16.51255	0.00E+00

Appendix 2 continued:

Southern bluefin tuna longline fishery (east coast north of 44° S)

Analysis of deviance table for negative binomial GLM, fixed theta

	Df	Deviance Resid.	Df	Resid. Dev	F Value	Pr(F)
NULL			26964	53544.82		
year	20	17632.88	26944	35911.94	761.4881	0.00E+00
ns(moonphase, 3)	3	3247.98	26941	32663.96	935.1096	0.00E+00
month	4	2587.97	26937	30075.98	558.8171	0.00E+00
ns(lat, 4)	4	851.89	26933	29224.09	183.947	0.00E+00
ns(bycatch, 4)	4	194.58	26929	29029.51	42.0156	0.00E+00
ns(long, 4)	4	101.03	26925	28928.48	21.8157	0.00E+00
ns(effort, 3)	3	73.04	26922	28855.44	21.0297	1.30E-13
nation	1	33.18	26921	28822.25	28.662	8.69E-08

Analysis of deviance table for equivalent GAM

	Df	Npar Df	Npar F	Pr(F)
(Intercept)	1			
year	20			
lo(moonphase)	1	2.3	58.16877	0.00E+00
month	4			
lo(lat, long, 0.25)	2	16.7	42.97473	0.00E+00
lo(bycatch)	1	3.7	16.20399	2.37E-12
lo(effort)	1	2.8	14.08359	9.37E-09
nation	1			

Southern bluefin tuna longline fishery (east coast south of 44° S)

Analysis of deviance table for negative binomial model, fixed theta

	Df	Deviance	Resid. Df	Resid. Dev	F Value	Pr(F)
NULL			27594	47509.06		
year	16	11194.42	27578	36314.64	738.052	0.00E+00
month	4	3999.59	27574	32315.06	1054.776	0.00E+00
ns(moonphase, 3)	3	2543.38	27571	29771.68	894.323	0.00E+00
ns(long, 4)	4	682.52	27567	29089.16	179.996	0.00E+00
ns(effort, 4)	4	270.42	27563	28818.74	71.315	0.00E+00
ns(SST, 3)	3	131.31	27560	28687.43	46.172	0.00E+00
ns(lat, 4)	4	95.55	27556	28591.88	25.2	0.00E+00
ns(bycatch, 5)	3	75.81	27553	28516.06	26.658	0.00E+00

Analysis of deviance table for equivalent GAM

	Df	Npar Df	Npar F	Pr(F)
(Intercept)	1			
year	16			
month	4			
lo(moonphase)	1	2.3	123.5638	0.00E+00
lo(effort)	1	3.2	30.4831	0.00E+00
lo(lat, long, 0.25)	2	16	34.4322	0.00E+00
lo(SST)	1	2.6	9.071	1.75E-05
lo(bycatch)	1	4.4	16.4373	0.00E+00

Appendix 2 continued:

Southern bluefin tuna longline fishery (west coast)

Analysis of deviance table for negative binomial model, fixed theta

	Df	Deviance Resid.	Df	Resid. Dev	F Value	Pr(F)
NULL			13414	20239.47		
year	15	3461.479	13399	16777.99	216.6347	0.00E+00
ns(lat, 4)	4	1161.654	13395	15616.34	272.6304	0.00E+00
ns(moonphase, 3)	3	761	13392	14855.34	238.1339	0.00E+00
month	6	660.64	13386	14194.7	103.3645	0.00E+00
ns(long, 4)	4	322.812	13382	13871.88	75.7613	0.00E+00
ns(SST, 3)	3	127.611	13379	13744.27	39.9324	0.00E+00
ns(effort, 4)	4	128.234	13375	13616.04	30.0954	0.00E+00
nation	1	52.247	13374	13563.79	49.048	0.00E+00
ns(bycatch, 4)	4	21.571	13370	13542.22	5.0625	0.000448

Analysis of deviance table for equivalent GAM

	Df	Npar Df	Npar F	Pr(F)
(Intercept)	1			
year	15			
lo(moonphase)	1	2.3	93.22734	0.00E+00
lo(lat, long, 0.25)	2	16.9	32.99852	0.00E+00
month	6			
lo(SST)	1	2.7	67.56999	0.00E+00
lo(effort)	1	3.2	44.58389	0.00E+00
nation	1			
lo(bycatch)	1	3.2	4.88554	0.001595