

# **New Zealand billfish and gamefish tagging 2001–02**

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## EXECUTIVE SUMMARY

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The gamefish tagging programme has been an integral part of the New Zealand marine sports fishery since the mid 1970s. Worldwide there has been a growing trend toward the catch and release of large pelagic species hooked by recreational fishers. The collection of movement and, on occasion, growth information through cooperative tagging programmes with recreational fishers is a cost-effective way of collecting information on large pelagic species that are difficult to study by other means.

The species that form the focus of the programme are striped marlin (*Tetrapturus audax*), mako shark (*Isurus oxyrinchus*), blue shark (*Prionace glauca*), and yellowtail kingfish (*Seriola lalandi*). In cooperative programmes, tagging may be spread over a long period and it is difficult to control the tagging event and quality of reporting.

Release and recapture data for the 2001–02 season is summarised in this report and compared with those from previous seasons. Particular recaptures that provide growth or movement information of significance or interest over the last two seasons are described.

This season 2168 fish were reported tagged and released, which is an increase on the total from last year but lower than tallies over the previous five years. The number of striped marlin tagged in 2001–02 was the lowest for 8 years, but the proportion tagged remained about the same. The number of kingfish and mako sharks tagged was higher than in 2000–01.

A total of 70 recaptures were reported in the 2001–02 fishing season, including 48 yellowtail kingfish, 15 mako and 3 blue sharks, 2 striped marlin, and the first broadbill swordfish recapture for this programme. Of these, 20 (29%) were from commercial vessels. Long-term recaptures of swordfish and kingfish in 2001–02 have provided an insight into growth and longevity in these species.

## 1. INTRODUCTION

### 1.1 Overview

The New Zealand Cooperative Gamefish Tagging Programme was initiated by the Ministry of Agriculture and Fisheries in 1975 following requests from gamefish clubs. For 20 years the programme was coordinated from the Ministry's northern regional office in Whangarei. At first the aim was to introduce the concept of tag and release to New Zealand anglers and to study the seasonal and short-term movements of pelagic gamefish (Saul & Holdsworth 1992).

In 1996, the Ministry of Fisheries was formed and administration for the gamefish tagging programme was contracted out to the National Institute of Water and Atmosphere (NIWA). For the last 10 years the New Zealand Big Game Fishing Council (NZBGFC) has been involved in the purchase and distribution of tags to gamefish clubs. This report has been prepared by Blue Water Marine Research Ltd as part of the requirements of a three year contract to administer the programme ("Management of data from the gamefish tag recapture programme" PEL2000/01).

### 1.2 Description of the fishery

The recreational fishery for gamefish off northern New Zealand is an important component of the recreational fishery and local tourist industry and is seasonal, with activity peaking between December and May. Historically, the main area of the striped marlin target fishery is on the Northland east coast. Striped marlin (*Tetrapturus audax*) is the mainstay of the gamefishery in this area, with small numbers of blue marlin (*Makaira nigricans*), black marlin (*Makaira indica*), shortbill spearfish (*Tetrapturus angustirostris*), and swordfish (*Xiphias gladius*) also caught. Yellowfin tuna (*Thunnus albacares*) and mako sharks (*Isurus oxyrinchus*) are largely an incidental bycatch of the billfish fishery in Northland. In the Bay of Plenty, yellowfin tuna and large yellowtail kingfish (*Seriola lalandi*) are the main gamefish targeted, though billfish are still sought. On the North Island east coast fishing clubs are established from Gisborne to Wairarapa. Shark species become increasingly important with distance south. Gamefishing has developed on the west coast of the North Island over the last 12 years with, at times, very good marlin fishing accessed from the west coast harbours down to New Plymouth. In the South Island, gamefishing has been largely centred near Christchurch, Dunedin, and Fiordland, with blue shark (*Prionace glauca*) abundant and the primary target species (Figure 1).

Where billfish and tuna are targeted by recreational anglers, surface trolling with artificial lures or baits is the predominant method of fishing, with most gamefish being caught on artificial lures trolled at speeds ranging from 4 to 10 knots. Since 1997 there has been a slight trend back towards the use of live baits for billfish, but most marlin are still caught on lures, as are many mako sharks. Some mako sharks and most other shark species are caught on drifted baits, either targeted or as an incidental catch during broadbill swordfish fishing. The process of tagging gamefish has been described by Saul & Holdsworth (1992).

Marlin species are also a bycatch of the commercial surface longline fishery that targets large tuna off northeastern New Zealand. Within the New Zealand Exclusive Economic Zone (EEZ), commercial fishers are obliged by regulation to release all billfish alive or dead, except swordfish. This regulation includes a provision that live billfish should be tagged if possible and previously tagged marlin recaptured by commercial fishers may be boated and brought to port for study.

### 1.3 Background

Between 1975 and 1984, Floy FH-69 billfish tags supplied by the US National Marine Fisheries Service (NMFS) were issued (H series). During 1985, 1000 modified Floy tags (model FH-69A, first of the G series) were issued. These tags were modified by enclosing the polyvinyl sleeve in a plastic sheath but still relied on a brass crimp to hold the message sleeve on. Since 1986, the Hallprint billfish tag has been issued (G series continued). All three tag types have stainless steel tag heads capable of being implanted with the same slotted stainless steel applicator. During 1995 and 1996 a number of striped marlin were recaptured with the tag head and a short section of the Hallprint plastic streamer, but no readable information. These tags could be identified as G series but had broken below the tag number. Tags made for New Zealand were modified so that the stainless wire used to attach the tag head extended the full length of the tag. The new tag type started with number G 53501, and was issued from December 1996 onward.

Data management and reporting for the Gamefish Tagging Programme is funded by the New Zealand Ministry of Fisheries and the New Zealand Big Game Fishing Council purchases and distributes tags to fishing clubs and anglers at cost. Tags are supplied free of charge to commercial fishers who express an interest in tagging gamefish. Collection of tag report cards has been greatly assisted by the fishing clubs, most of which keep accurate records of captures and insist that tag report cards are handed in at the completion of successful trips.

For the last 10 years striped marlin, mako shark, blue shark, and yellowtail kingfish have been the focus of the programme. These species were selected on the basis that either there was potential to tag substantial numbers of fish and make sufficient recaptures to provide useful data; and/or they were species of national or international significance or concern. These criteria are still valid.

Before the 2000–01 season fishers and stakeholder groups were consulted on the scope and objectives of the programme and the resulting Gamefish Tagging Policy (Appendix 1) was circulated to clubs and organisations. It was recommended that tagging of striped marlin, mako shark, blue shark, and kingfish continue, and that a trial to test angler willingness to tag and release yellowfin tuna be instigated. Objectives included increasing our knowledge of the nature and range of migration of striped marlin and mako and blue sharks tagged in the southwest Pacific, and improving our knowledge of kingfish growth and movement.

## 2. METHODS

Three Thousand tags were purchased by the N.Z. Big Game Fishing Council for the 2001–02 season. The tag cards issued over the previous two seasons were redesigned to include space for latitude and longitude, the skipper's phone number, and tick boxes for capture method and whether or not the hook was removed before release.

Data presented in this report are variously summarised by species and season, month, fishing method, and area. The gamefish season refers to the period starting on July 1 and ending on June 30. This is the standard fishing season for all New Zealand game fishing clubs.

Large fish are not removed from the water during tag and release. For most records, weights are estimated by skipper or crew. Estimated weights have been summarised by 10 kg weight class rounded down as in previous NIWA gamefish tagging reports. For example, the 10 kg weight class includes fish from 10 to 19 kg.

More than half of the kingfish tagged are measured before release. These data are more accurate records of the size of fish than the estimated weights. The kingfish size distribution has been summarised by 5 cm size

classes; lengths are rounded down. For records where the length was not measured, the estimated weight was converted to length using the following formula (J. McKenzie et al., NIWA unpublished results):

$$\text{length} = 2.890 \sqrt{\frac{\text{weight(g)}}{0.0134}}$$

Distances moved are expressed as minimum possible travel distances in nautical miles. Where straight lines between release and recapture positions cross land masses, the shortest distance by sea was calculated.

### 3. RESULTS

#### 3.1 Striped marlin

In the 2001–02 season 751 striped marlin were tagged and released, which is somewhat less than in 2000–01 (851) and 23% down on the 10 year average of 976 (Table 1). A further 427 striped marlin were reported as landed in gamefish club records (N.Z. Big Game Fishing Council pers. comm.) It is estimated that 64% of recreationally caught striped marlin were tagged in 2001–02. The number of striped marlin landed by non-club fishers in 2001–02 is not known. An estimate of billfish not recorded in club records of 7% was calculated as part of a survey on the economic contribution of the New Zealand recreational billfish fishery in the 2000–01 season (Boyd et al. 2002).

The principal areas for striped marlin tagging were combined Ministry of Fisheries statistical areas 002 and 003 off East Northland and areas 047 and 048 near the Three Kings Islands (Figure 2). This season 86% of all striped marlin tagged were released in these four areas. This figure is down 6% from the 2000–01 season. The Bay of Plenty from Coromandel Peninsula to Cape Runaway accounted for 8% of striped marlin, with most of the remaining tag reports coming from the west coast of the North Island, between Manukau and Taranaki (see Figure 1). Only one striped marlin was tagged by a commercial vessel this season.

Mean estimated release weights of striped marlin for 2000–01 were of 92.5 kg and for 2001–02, 100.3 kg, a significant increase. This increase was mainly due to a decrease in the number of marlin estimated in the 70 kg and 80 kg size (see Figure 3a) compared with the 2000–01 season (see Figure 3b). NZBGFC affiliated clubs have applied a voluntary minimum size of 90 kg for marlin since 1988. Landed fish under this weight are recorded but not recognised by the club for contests or trophies. In 1999–2000 and 2000–01 seasons the proportion of tagged striped marlin estimated as 95 kg or larger was 42%. This increased in the current season to 59%.

The monthly totals of striped marlin tagged over the last two seasons are shown in Figure 4, indicating this is more a summer and autumn fishery which peaked in February in 2001 and March in 2002. This season the first striped marlin caught by a recreational boat was tagged on 22 December 2001 from the vessel *Tuturangi* off the Poor Knights Islands. Two striped marlin qualified as the last caught in the season, both being tagged on the King Bank on 10 June 2002 from *Prime Time* and *Harlequin*.

Three recaptures of tagged striped marlin were reported in 2000–01. A tagged striped marlin caught on 23 June 2000 was taken by a tuna longline vessel south of Fiji, but not reported until August. It had travelled a minimum distance of 960 nautical miles in just 67 days after being tagged in mid April on the King Bank. The angler was Guy Jacobson and the fish was estimated to be 65 kg at release.

One striped marlin tagged and recaptured at the Middlesex Bank redefined the phrase "short-term recapture". The marlin was originally caught on a live bait and tuna circle hook by David Horne from

*Tuturangi* on 29 March 2001. Just 2 hours later, it was recaptured on a lure trolled from the Bay of Islands charter vessel *Maraqeta* by Terry Rolf. Although described as sluggish to begin with, the marlin still took nearly 45 minutes to bring alongside on the second occasion, when it was once again released; a most fortunate fish.

The third striped marlin recaptured was tagged on 28 March 2001 on the Middlesex Bank. It was estimated to be 100 kg on release from *Anita Rose*. It was recaptured on 25 April, also on the Middlesex Bank, from *Predator*. It took 45 minutes to bring to the boat and was measured at 231 cm lower jaw to tail fork length and 107 cm girth before being released. From these measurements the fish is estimated to have weighed 95 kg and was in good condition. The tag was holding well. This fish had been at liberty for 28 days and was caught within a few miles of its release point.

Since 1990 seven striped marlin have been tagged on the Middlesex Bank and later recaptured. Five of these were recaptured in the same area. One, as detailed above, was recaptured after two hours and the others after periods of 14, 41 and 70 days. Of the fish that moved, one was caught on the King Bank after 33 days and the other was caught in June near the Poor Knights Terrace after just 17 days at liberty (see Figure 6).

Two striped marlin were reported recaptured in 2001–02. On 18 February 2002, a fish that had been at liberty for 329 days was recaptured less than 40 nautical miles from the point of release. It was caught off Cape Karikari by a New Zealand tuna longline vessel and was measured at 238 cm fork length, estimated to weigh 65 to 70 kg, and was recorded as 'skinny'. This would appear to be true since, on average, a striped marlin of 238 cm lower jaw fork length would weigh 98 kg. This fish was tagged on 26 March 2001 also off Cape Karikari by Robert Teixeira from *Santana*. The fish was caught on a lure after a 20 minute fight and was estimated to be 85 kg. This is the first striped marlin recapture reported by a New Zealand tuna longline vessel since the 1997–98 season.

A striped marlin tagged on 9 March 2002, 5 nautical miles northeast of Plate Island, Bay of Plenty, was recaptured. This fish was foul hooked by a lure and was tagged after a 45 minute fight on 15 kg line. It was estimated to be between 100 and 120 kg on release. It was recaptured 14 days later, northwest of the Astrolabe Reef, 14 nautical miles from where it was released (see Figure 6). It was hooked in the upper jaw and took an hour to boat on 24 kg line. This fish was measured at 242 cm from the lower jaw to tail fork, weighed 103.2 kg, and was in excellent condition. The tag was well anchored.

Overall most striped marlin recaptures in the programme (83%) have been within 5 months of release (Figure 5). Some are recaptured close to their release point up to 70 days later, but recaptures generally show dispersal away from New Zealand, some moving large distances in this time. For example, a striped marlin tagged in May 1999 travelled 1000 nautical miles to Tonga in just 33 days, an average minimum displacement rate of just over 30 nautical miles per day. There is a wide spread of recapture locations across the southwest Pacific (Figure 7) that is not seen in other striped marlin tagging results elsewhere in the Pacific (Ortiz et al., in press).

The recapture rate of striped marlin over the last 10 seasons is 0.6%. In recent years reports of marlin recaptures have increased for tuna longliners fishing from Pacific island states (10 in the last 5 years plus 4 from Australia) but decreased from New Zealand based commercial vessels (2 in the last 5 years). Overall, the striped marlin recapture rate has been quite consistent.

### 3.2 Mako shark

The number of mako sharks tagged was 277 in 2000–01 and 329 in the 2001–02 season (Table 1). This represents 40% and 48% of the 10 year average of makos tagged per season for those seasons respectively. All of the makos were tagged and released by recreational fishers. According to NZBGFC records 135, makos were landed this year. Therefore, the proportion tagged was 71%. The number of makos landed but not recorded in club records is likely to be small, and the number caught and released without being tagged is unknown.

Generally, makos are not a target species in northern New Zealand and the number tagged fluctuates with the numbers caught as a bycatch of fishing for billfish or tuna. Most makos tagged in 2001–02 were caught in waters off central and northern areas of the North Island from New Plymouth on the west coast around to Whakatane on the east coast (Figure 8). Of the 329 mako sharks tagged and released, 54% were tagged off east Northland and the Three Kings area, 10% off Coromandel/Bay of Plenty, and 33% off the west coast of the North Island (Figure 8).

The size distribution of makos tagged in 2001–02 shows a broad distribution of sizes from 20 kg to 100 kg with a mode at 40 kg (Figure 9). The average estimated weight this season was 69 kg. The size of makos tagged in 2000–01 was significantly larger than in previous seasons, with an average weight of 78 kg, compared with 63 kg in 1999–2000 and 52 kg in 1998–99. There were far fewer makos tagged in the 40, 50, and 60 kg size classes than usual in 2000–01, while the number tagged over 120 kg increased.

Most makos were tagged between the months of January and July over the last two seasons with a seasonal mode in February (Figure 10). The increase in February 2002 is due to more small and medium sized makos (15 – 80 kg) than usual being tagged off the west coast North Island.

The distribution of mako shark recaptures plotted as distance travelled against days at liberty shows clusters of recaptures close to the release points in the first few months, then again after about one year, and again after two years (Figure 11). There is also a band of recaptures between 800 and 1250 nautical miles for fish at liberty from 36 days to 5 years or more. Not all these movements are to the tropics as both tropical Fiji, New Caledonia, Tonga, and temperate Australian waters are within this range (and recaptures have been recorded at all these locales). The tags appear to be holding well in makos and the recapture rate over the last 10 seasons is 2.6%.

There were 16 mako recaptures reported in the 2000–01 season and 15 reported in 2001–02. Time at liberty for these fish ranged from 8 to 2143 days with a mean of 434 days.

Two makos released on the west coast, from Kawhia and New Plymouth, were recaptured on the east coast off Cape Kidnappers after one year and two years respectively (Figure 15). The shortest travel distance for these fish between release and recapture points is via Cook Strait and this distance is recorded, as is the convention. The New Plymouth fish was released at an estimated size of 45 kg and 160 cm, and was measured on recapture at 196 cm (girth 96 cm). This fish is estimated to have grown about 36 cm and 20 kg in two years.

A coast to coast movement from east to west occurred with a mako tagged off Otago Heads in February 1999 being recaptured on the Hokitika Trench off the West Coast after 18 months. Again the shortest distance is the southern route, but given the time at liberty (552 days) this is not the only possible route taken. The general trend in other mako recaptures has been movement north (see Figures 15 and 16).

Three mako recaptures were reported from Fijian waters in 2000–01. The first, tagged in May 2001 at the Three Kings, was recaptured mid August, 150 nautical miles south of Viti Levu. A second was recaptured in

October just west of Viti Levu but, unfortunately, had no corresponding release data on record. The third was tagged in April 2000 off Whangaroa and was recaptured in late May 2001 by a tuna longline vessel, but no position was given. The one recapture from Fiji in 2001–02 was a mako tagged at Cape Brett, Bay of Islands, at the end of December 2000 and at liberty for 430 days. A total of 48 mako sharks tagged in New Zealand have now been reported as recaptured in Fijian waters. This is 17% of all mako recaptures, which now total 289.

There were also recaptures of makos reported from Vanuatu, the Solomon Islands and Tahiti in 2001–02. The Vanuatu recapture is the first to be reported from that area. A 30 kg mako tagged in March 1996 off Tutukaka was recaptured mid January 2002 northwest of Guadalcanal in the Solomons. This fish had been at liberty for 2143 days and measured 222 cm on recapture. Assuming that both the recapture length and the estimated release length (130 cm) are both total lengths, this fish has grown about 102 cm in 5.9 years, an average of 17.3 cm per year.

Like striped marlin, mako sharks are capable of travelling considerable distances in a short time. One that was tagged in March 2000 travelled 980 nautical miles in 36 days; a minimum displacement rate of 27 nautical miles per day. The longest distance recapture in this programme for a mako is 3000 nautical miles from East Northland to the Marquesas group (French Polynesia) in 162 days, a minimum displacement rate of 18.5 nautical miles per day.

### 3.3 Blue shark

The number of blue sharks tagged during the 2001–02 season was 163, a little less than 2000–01 season (202). The 10 year average for this species is 259. In 2001–02 most blue sharks tagged were between 20 and 50 kg with a mean of 32 kg (Figure 12). Of the blue sharks tagged in 2001–02, 93% (152) were tagged off Otago Heads during February and most of these were tagged between 16 and 23 February during the NZBGFC Nationals Competition (Figures 8 and 13).

In September 2000 an Otago tagged blue shark was recaptured by a Taiwanese longliner near Papua New Guinea. No exact recapture location or date was received from the crew member who returned the tag. Another blue shark was recaptured near its release point off Otago Heads after 3 years at liberty. It was estimated to be 25 kg on release and 145 kg and 180 cm on recapture. A new tag was placed and the fish released.

Four blue sharks were recaptured in 2001–02. One tagged off Otago in February 1998 was recaptured in Fiji. This fish was estimated to be 45 kg on release and 1200 days later was estimated at 75 kg on recapture. An observer on a tuna longline boat off the West Coast reported a blue shark recapture in June. This fish was estimated at 135 cm and 30 kg when tagged off Motinau, Canterbury, in December 2000 and was measured at 178 cm and 55 kg on recapture after 553 days at liberty. The first dead blue shark return was reported in March, washed up on Taylors Mistake Beach, Christchurch. This fish had no external wounds and was fresh. It had been tagged 23 days earlier off Otago Heads, 190 nautical miles to the south (Figure 17).

The distribution of time at liberty plotted against minimum distance travelled for blue sharks shows dispersion away from their release point, a number of recaptures at 1000 to 1200 nautical miles, and a number of recaptures after one year with little apparent movement (Figure 14). The latter may be due to a concentration of fishing effort by recreational fishers in February as well as the possibility of little movement away from, or annual homing to, that location. Three Otago blue sharks have been recaptured in the same place after one year at liberty, there have also been returns at the same locations after 2 years (759 days) and 3 years (1098 days).

### 3.4 Kingfish

A total of 10 668 kingfish have been tagged in the programme to date and 965 recaptures reported. The recapture rate of 9% is the highest for any species in the programme. The number of kingfish tagged and released in 2001–02 was 751, which is 5% higher than the 10 year average of 715 (Table 1). This season, kingfish were mainly tagged in the waters off east Northland (43%), Coromandel/Bay of Plenty (34%), and the East Coast between Cape Runaway and Gisborne (18%) (Figure 18).

Sixty percent of kingfish were measured on release, many on measuring boards issued by the Ministry of Fisheries for the purpose. The kingfish size distribution is therefore presented as length frequency. Where length at release was not supplied by anglers, it was calculated from the estimated weight as described in the methods section.

Kingfish tagged in the 2000–01 season had a size mode of 95 cm with 40% of tagged kingfish 100 cm or over where as in 2001–02 the size distribution showed modes at 80 and 100 cm with an overall mean of 101 cm (Figure 19). Most of the smaller kingfish were tagged off east Northland or East Coast (statistical areas 002 and 003 or 011 and 012) while most kingfish larger than 95 cm were tagged at White Island or the Three Kings area (statistical areas 10, 47, and 48) (Figure 18).

Most kingfish are tagged over summer and autumn (Figure 20). In 2001–02 the seasonal mode was in January and fewer kingfish were tagged in December 2001 than in the previous season. In December and January, boats fishing at White Island tag most kingfish, and in April and May, fishing effort and tag and release increases in the Three Kings area.

In the 2001–02 season 48 kingfish recaptures were reported (Table 2). Recreational fishers reported 42 of these and commercial fishers 6 (Table 3 & 4). Time at liberty ranged from 1 to 3384 days with a mean of 404 days (13 months). A kingfish tagged at Three Kings Islands was recaptured in the same area after 1870 days (5 years). This fish was estimated to be 15 kg on release and on recapture measured 128 cm, estimated at 27 kg, and was re-released with the same tag in place. A 2.5 kg kingfish tagged at Bird Rock, Bay of Islands, in October 1992 was caught by a spearfisher at Bream Tail, Whangarei, in January 2002. It had moved 54 nautical miles south and measured 120 cm and weighed 16 kg after 9 years 3 months at liberty.

Only two recaptured kingfish moved a significant distance this season. One travelled 210 nautical miles from White Island to Cape Kidnappers in 122 days; the other 205 nautical miles from Lottin Point, East Cape, to Whale (Moutohora) Island, Bay of Plenty. In the 2000–01 season a kingfish tagged at Cape Runaway travelled 170 nautical miles to Hawke Bay in 1101 days while the other kingfish to move that season travelled 360 nautical miles from Tolaga Bay to Wanganui (Figure 23).

Kingfish recaptures tend to be close to the release point. In the programme so far, 93% of recaptures have been within 50 nautical miles of the release point. However, a significant number of kingfish have been tagged close to White Island and most of these are recaptured in that area. The plot of distance against days at liberty for White Island recaptures shows that only a few fish (4%) have moved away from the area (Figure 21). This degree of site fidelity is not as apparent for kingfish released in other areas. A separate plot of distance against days at liberty for fish tagged in all areas excluding White Island shows more dispersal and a greater number of fish moving more than 10 nautical miles (31%) than the White Island fish (Figure 22).

The Hallprint gamefish tags hold well in kingfish if applied correctly. The overall recapture rate for kingfish at 9.1% is the highest for any species in the programme. Very high recapture rates (27%) were recorded for kingfish from White Island in the 1980s (Saul & Holdsworth 1992). Since then overall recapture rates have declined.

### 3.5 Yellowfin tuna

Yellowfin tuna was included as an approved species in the tagging programme for the first time in 2000–01 at the request of Bay of Plenty gamefish clubs and the NZBGFC. The availability of yellowfin to recreational and commercial fishers can vary widely from year to year, and over the last two seasons catches were lower than usual, particularly in the Bay of Plenty. The number of yellowfin tagged was disappointing – just seven fish reported during the 2001–02 season from a total reported in the club records of 260 this season (N.Z. Big Game Fishing Council, pers. comm.).

Of the 17 yellowfin tagged in 2000–01, there was one recapture. A yellowfin estimated at 18 kg released near Motuhora (Whale) Island was recaptured by a tuna longline vessel north of East Cape after 40 days at liberty (25 kg est.). Overall, there have been 8 yellowfin recaptures in the programme from 876 releases – a recapture rate of 0.9%.

### 3.6 Other billfish

Only three swordfish were reported tagged and released in 2001–02. However, one of the most interesting reports for the 2001–02 season was our first broadbill swordfish recapture. This fish was tagged by a Japanese longliner fishing 120 nautical miles north of North Cape in June 1991. At the time, the fish was estimated to be 12 kg and 105 cm long (presumably lower jaw to fork length). It was recaptured in February 2002 by an Australian longliner just to the west of Wanganella Bank and was estimated to be 160 kg whole weight and 205 cm long. Therefore it had travelled a minimum of 250 nautical miles to the west and in 10 years 8 months at liberty had grown about 150 kg and 100 cm.

Blue marlin have been more abundant in New Zealand waters than usual over the last three seasons and are increasingly tagged and released both here and by visiting anglers in the Kingdom of Tonga (Table 1). Of the 68 blue marlin tagged in the 2001–02 season, 21 were tagged in New Zealand and 47 in Tongan waters. The fish tagged in Tonga were generally 120 kg or less while in New Zealand they were larger (Figure 24). In recent seasons a few blue marlin of about 100 kg have been tagged, which is considered smaller than usual for this species in New Zealand waters. It may be that with the increase in number of blue marlin available, anglers have become better at identifying this species, or in some instances they may have misidentified striped marlin. Reports from Australia indicate there were some unusually small blue marlin caught there in 2001–02 (Julian Pepperell, Pepperell Research & Consulting, pers. comm.)

In 2000–01 blue marlin were tagged only in February and March in New Zealand and 36 were tagged between July and December in Tongan waters. In the 2001–02 season 21 blue marlin tagged were in New Zealand between January and April (Figure 25).

There have been three blue marlin recaptures to date. A 200 kg fish released at the Three Kings in April 2000 was recaptured in September 2000 south of Viti Levu, Fiji, by a tuna longliner. This was the first recapture of a New Zealand tagged blue marlin. Previously two Tongan tagged blue marlin had been recaptured in Fijian waters. Interestingly, both these fish had been at liberty for three years. One was double tagged with a Billfish Foundation tag, but this had shed and only the standard Hallprint gamefish tag was found. The overall recapture rate of blue marlin is 0.7%.

### 3.7 General

The number of tags issued and number used in each region in 2001–02 is given in Figure 26. The selection of regions is based on the commonly used gamefish areas. Overall, 3675 tags were issued to clubs and individuals and 2168 (59%) were used in 2001–02.

There were 70 recaptures reported in the 2001–02 fishing season including 48 yellowtail kingfish, 15 mako and 3 blue sharks, 2 striped marlin, and the first broadbill recapture for this programme (Table 2). Of these, 20 (29%) were from commercial vessels with the balance from recreational fishers (Table 3 & 4).

## 4. DISCUSSION

Information from recaptures of tagged fish in programmes such as the New Zealand Cooperative Tagging Programme have contributed considerably to our knowledge of the movement and biology of a range of large pelagic species. For the first time, release and recapture data from the major cooperative billfish tagging programmes around the world, including the New Zealand programme, have been assembled into a single composite database. The results were summarised and presented to the Third International Billfish Symposium in 2001 (Ortiz et al. in press). Worldwide a total of 317000 billfish have been tagged and released with 4122 recaptures reported since 1954. The New Zealand programme has tagged nearly 12000 billfish – mostly striped marlin – for 68 recaptures since billfish tagging became widely accepted here in 1988.

The number of striped marlin tagged in the 2001–02 season (751) was down by 12% from the previous season and is half the number tagged in the peak season of 1998–99. This decline appears to be a result of a decrease in the availability of striped marlin, because anglers maintained a tagging percentage of almost two-thirds of all marlin caught.

Support for the concept of tag and release is strong in the recreational fishery. Anglers were prepared to tag marlin regardless of size. Fifty nine percent of all striped marlin tagged were estimated to exceed the voluntary 90 kg size limit adopted by the New Zealand Big Game Fishing Council, and encouraging numbers of the much larger blue marlin were also tagged.

In 2001–02 a striped marlin was recaptured after 11 months close to its release point. This is the third longest time at liberty for striped marlin in this programme and only the second to be recaptured in New Zealand the following season. Most striped marlin recaptures (83%) have been made within 5 months of release. The question as to why few long-term striped marlin recaptures are made has continued to cause debate. Internationally, tagging programmes are tending to switch to the Billfish Foundation type tag with its hydroscopic surgical nylon head. This tag has had higher recapture rates in white marlin and blue marlin than steel headed tags. However, striped marlin recapture rates are highest for the National Marine Fisheries Service programme (1.4%), which uses a tag similar to those used in New Zealand with a stainless steel anchor (Ortiz et al. in press).

Several hundred New Zealand marlin have been double tagged with Billfish Foundation tags and the standard Hallprint gamefish tag with a stainless steel dart anchor. Three double tagged marlin have been recaptured and in two cases the Billfish Foundation tags had been shed. Accordingly, there would need to be new and compelling evidence that the Billfish Foundation type tags were better to justify switching to them, as they are more expensive and require a different applicator. In Australia, the national New South Wales Gamefish Tagging Program is about to switch to Billfish Foundation style tags.

The recapture of a striped marlin just 2 hours after being tagged and released is significant. It demonstrates the ability of these fish to withstand the stress of capture and to recover quickly.

The value of long term recaptures is highlighted by recapture of a broadbill swordfish this season after 10 years 8 months. This fish was estimated by Japanese longline fishers at 12 kg when it was tagged and the length estimate of 105 cm matches the lower jaw fork length for a fish of that weight. Size estimation of small fish is often more accurate than for large fish and this size equates to a swordfish between one and two years old (Ward & Elscot 2000). The average maximum size for male swordfish is about 130 kg (Wilson & Dean 1983). Therefore, we can say that this swordfish probably was a 12 year old female when it was recaptured at an estimated weight of 160 kg and 205 cm. This information is very useful in ageing studies in this region. Of even greater benefit for validating the current ageing study would have been the crew that recaptured the swordfish keeping the first few spines from the anal fin. An Australian study is using thin sections of the spine that show growth rings that are thought to be laid down annually, so can be used in ageing.

Scientists in New Zealand are also interested in ageing mako sharks. Reading rings laid down in shark vertebrae may help determine the age of these fish. Scientists also look for ways of determining if one or more of those rings are laid down each year. Taking hard parts from fish that have been tagged for a long time is one way of checking the ageing technique.

The number of sharks tagged and released has declined over the last 5 years. This reflects an overall decline in the number of sharks caught by recreational anglers most of sharks are tagged and released (NZ Big Game Fishing Council, pers. comm.). However the gamefish tags appear to last well in sharks and long-term recaptures are being reported each year. The proportion of mako tag returns from commercial vessels has increased since the development of the domestic tuna longline fisheries in New Zealand and in other South Pacific island states (Holdsworth & Saul 1998).

Recaptures of fish that have been at liberty for long periods offer clues to growth rate and longevity. Kingfish grow to 40 kg or more in New Zealand with two fish caught by recreational fishers weighing 52 kg (N.Z. Big Game Fishing Council records). It is reasonable to believe that these fish are considerably older than the individual in this recapture, which was probably 10 or 11 years old.

The longest term recapture of any fish in this programme is for a kingfish, tagged in 1985 (13.5 kg est.) and again with a new tag in 1996 (24 kg est.). It was recaptured again and kept in 1999. It had been at liberty for 5365 days (14 years 8 months) and weighed 31 kg (131 cm measured). On each occasion it was recaptured at Volknor Rocks, White Island.

Kingfish growth has been estimated using a length-based maximum likelihood approach (GROTAG) (Francis 1988) for fish between 50 and 100 cm ((Hartill & Davies 1999). The gamefish tagging policy for 2000–01 and 2001–02 (Appendix 1) recommends that fishers be encouraged to tag kingfish over 100 cm to help collect data on growth of larger fish. Kingfish 100 cm and over represent 46% of releases and 58% of recaptures.

There has been considerable interest from the international research community in the New Zealand billfish release and recapture data. Last season, Eric Prince and Mauricio Ortiz from NMFS in Miami, Florida, compiled data from five tagging programmes to produce a global overview of the major constituent-based billfish tagging programmes in the world's oceans. This season there have been two data requests actioned, one from the Bureau of Rural Sciences Canberra, for striped marlin data and one from Michael Hinton at IATTC, La Jolla, for a report on the stock structure of marlins in the Pacific.

Cooperative tagging programmes have their limitations. Tagging is spread out over a long period and more fish tend to be tagged in areas where recreational effort is high. It is also difficult to control the tagging event and quality of reporting on release and recapture.

Although the incidence of non-reporting of tag releases is low, it continues to be a frustration. Again this season, two tag recoveries were invalidated because the tag report card was not handed in and could not be tracked down despite our best efforts to do so. Anglers are urged to complete their tag report cards and hand them in at the first opportunity, preferably immediately after returning to port after fishing. Fishing clubs are also encouraged to keep accurate records of anglers to whom each tag is issued. In this way the loss of valuable information can be minimised.

Commercial fishers continue to provide valuable input into this programme by reporting tag recaptures. The recent expansion of tuna longline fisheries throughout the Pacific island states has substantially boosted the number of tag returns received in the past few seasons, as has the increase in the number of domestic tuna longline vessels. Internationally, the tuna longline fleets are the main sources of tag returns from programmes like this one, and their continued cooperation is important to the long-term success of the project.

## **5. ACKNOWLEDGMENTS**

Thanks to all those that participate in this programme by releasing or reporting of tagged fish. The NZ Big Game Fishing Council and all affiliated clubs are thanked for their cooperation and the purchase and distribution of tags. The Ministry of Fisheries provided funding for this project. Thanks to Julian Pepperell (Pepperell Research & Consulting, Australia) for reviewing this paper.

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**Table 1: Number of fish tagged and released by species, and season and recapture totals by species as at 30 June 2001.**

Season	BEM	BKM	BWS	KIN	MAK	SHA	SAI	SSF	STM	SWO	YFN	OSP	Total
1974-75			1		9								10
1975-76				1	17	2			3		1		24
1976-77			1	1	34				2				38
1977-78				15	58				7				80
1978-79	2		1	107	152	1			18			5	286
1979-80			26	22	129	3			17				197
1980-81		1	7	7	116	2			2			7	142
1981-82			99	30	185	3			11			17	345
1982-83			18	55	151	4			6		2	11	247
1983-84			15	54	220	7			9		6	9	320
1984-85			10	143	98	4			0		25	2	282
1985-86			23	318	211	1			2		8	6	569
1986-87			12	365	177	31			2		7	22	616
1987-88	1	1	91	689	505	47			97	6	13	82	1532
1988-89	1	0	122	371	370	32			371	4	63	116	1450
1989-90	7	4	87	427	424	26		3	365	4	140	100	1587
1990-91	0	2	90	528	417	32	4	7	229	5	24	51	1389
1991-92	5	2	128	389	353	40	0	1	241	20	39	38	1256
1992-93	11	1	64	693	352	24	5	9	386	36	13	80	1674
1993-94	20	2	162	1100	667	19	5	17	929	3	104	41	3069
1994-95	29	4	175	1444	1531	23	9	29	1206	10	215	28	4703
1995-96	46	6	163	643	1158	30	4	15	1104	3	110	12	3294
1996-97	26	5	343	416	920	36	4	5	1302	4	33	9	3103
1997-98	24	5	724	364	518	54	6	1	898	0	3	4	2601
1998-99	43	2	276	311	754	40	2	6	1541	2	19	8	3004
1999-00	64	3	314	818	398	56	11	3	791	2	27	40	2527
2000-01	71	1	203	606	277	72	8	1	851	6	17	4	2117
2001-02	68	3	163	751	329	66	11	13	751	3	7	3	2168
<b>Total</b>	<b>418</b>	<b>42</b>	<b>3318</b>	<b>10668</b>	<b>10530</b>	<b>655</b>	<b>69</b>	<b>110</b>	<b>11141</b>	<b>108</b>	<b>876</b>	<b>695</b>	<b>38630</b>
<b>Recaptures</b>	<b>3</b>	<b>1</b>	<b>55</b>	<b>965</b>	<b>288</b>	<b>41</b>	<b>0</b>	<b>0</b>	<b>63</b>	<b>1</b>	<b>8</b>	<b>18</b>	<b>1444</b>
<b>Recapture rate (%)</b>	<b>0.7</b>	<b>2.4</b>	<b>1.7</b>	<b>9.0</b>	<b>2.7</b>	<b>6.3</b>	<b>0.0</b>	<b>0.0</b>	<b>0.6</b>	<b>0.9</b>	<b>0.9</b>	<b>2.6</b>	

BEM	blue marlin	SAI	sailfish
BKM	black marlin	SSF	shortbill spearfish
BWS	blue shark	STM	striped marlin
KIN	kingfish	SWO	broadbill swordfish
MAK	mako shark	YFN	yellowfin tuna
SHA	other shark species	OSP	all other species

**Table 2: Number of fish recaptured by species and season.**

Season	BEM	BKM	BWS	KIN	MAK	STM	SWO	YFN	SCH	SHA	OSP	Total
1976-77				1	2							3
1977-78					3							3
1978-79				7	6							13
1979-80				3	3						1	7
1980-81				2	3							5
1981-82				2	8							10
1982-83			1	11	5							17
1983-84				9	1							10
1984-85				10	7							17
1985-86				56	10							66
1986-87				92	9				3	1		105
1987-88				77	8				1	0	3	89
1988-89			2	91	13	1			1	0	3	111
1989-90			0	45	10	2			4	2	0	63
1990-91			3	37	7	1		1	3	0	1	53
1991-92			3	31	12	0		0	0	1	3	50
1992-93			2	43	3	3		0	2	0	0	52
1993-94			1	54	10	4		1	4	1	0	75
1994-95			2	86	16	6		0	0	0	1	109
1995-96		1	1	71	32	6		3	1	0	1	116
1996-97		0	4	52	35	5		1	2	0	1	100
1997-98	1	0	9	26	17	12		1	2	0	1	69
1998-99	0	0	10	20	15	14		0	2	2	0	63
1999-00	1	0	11	57	23	5		0	4	1	2	104
2000-01	1	0	3	29	15	2		1	0	3	1	55
2001-02	0	0	3	48	15	2	1	0	0	1	0	70
<b>Total</b>	<b>3</b>	<b>1</b>	<b>55</b>	<b>965</b>	<b>288</b>	<b>63</b>	<b>1</b>	<b>8</b>	<b>29</b>	<b>12</b>	<b>18</b>	<b>1444</b>

BEM	blue marlin	SCH	school shark
BKM	black marlin	STM	striped marlin
BWS	blue shark	SWO	broadbill swordfish
KIN	kingfish	YFN	yellowfin tuna
MAK	mako shark	OSP	all other species
SHA	other shark species		

Species included in SHA

bronze whaler  
 porbeagle shark  
 sevengill shark  
 thresher shark

**Table 3: Recaptures of tagged fish reported by recreational fishers by species and statistical area, (see figure 8) for the 2001–02 season.**

	Statistical area									Total	
	003	005	009	010	012	014	020	041	047		048
Blue shark							1				1
Kingfish	1	1	10	25	1	1		1	1	1	42
Mako shark	2							1	1		4
Sevengill shark	1										1
Striped marlin			1								1
Total	4	1	11	25	1	1	1	2	2	1	49

**Table 4: Recaptures of tagged fish reported by commercial fishers by species and statistical area, (see figure 8) for the 2001–02 season. 999 denotes recaptures outside New Zealand fisheries statistical areas.**

	Statistical area							Total
	002	009	004	037	033	047	999	
Blue shark			1		1		1	3
Kingfish		6						6
Mako shark	3			1		1	6	11
Striped marlin	1							1
Broadbill swordfish							1	1
Total	4	6	1	1	1	1	8	22

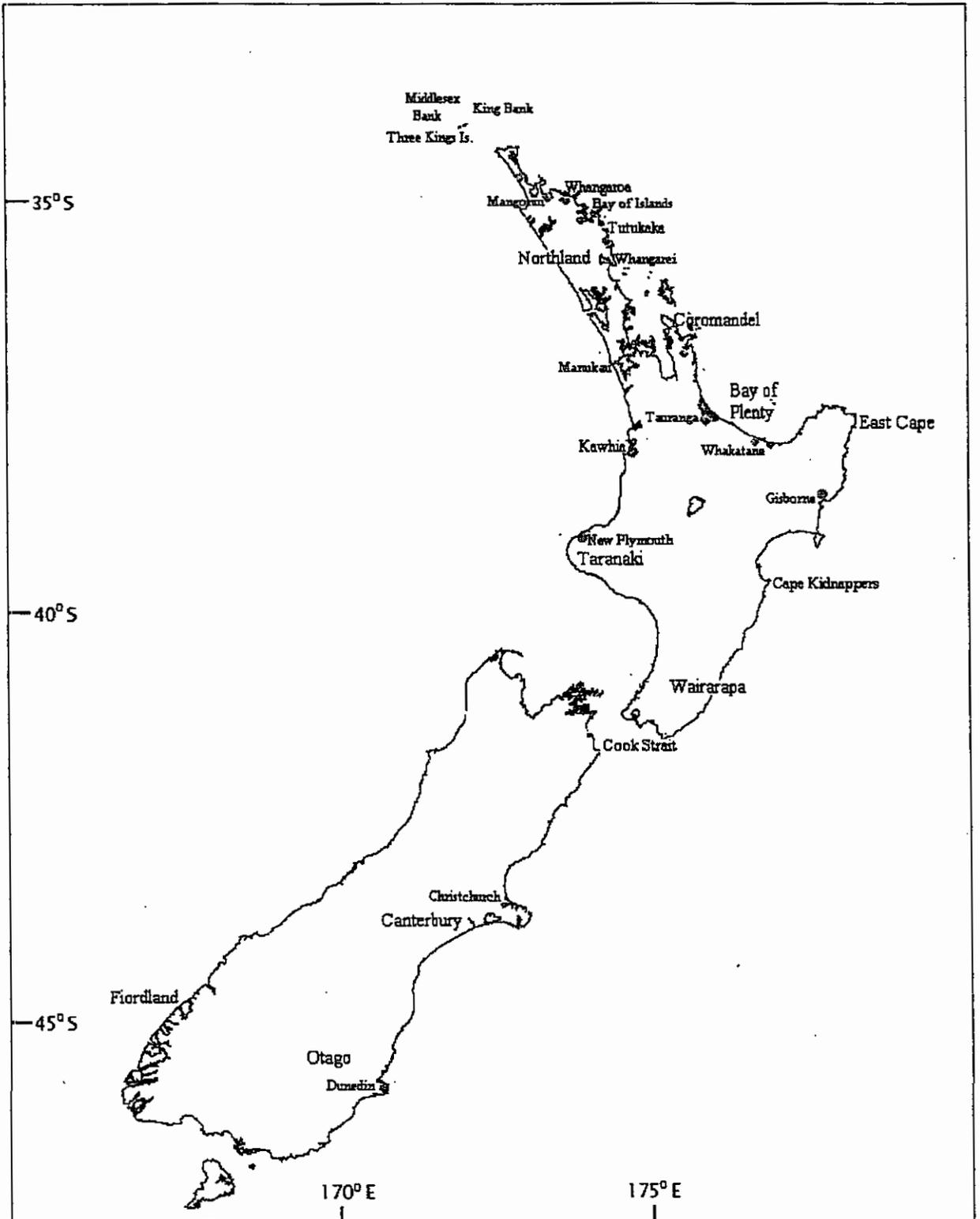


Figure 1: New Zealand fishing locations and regions.

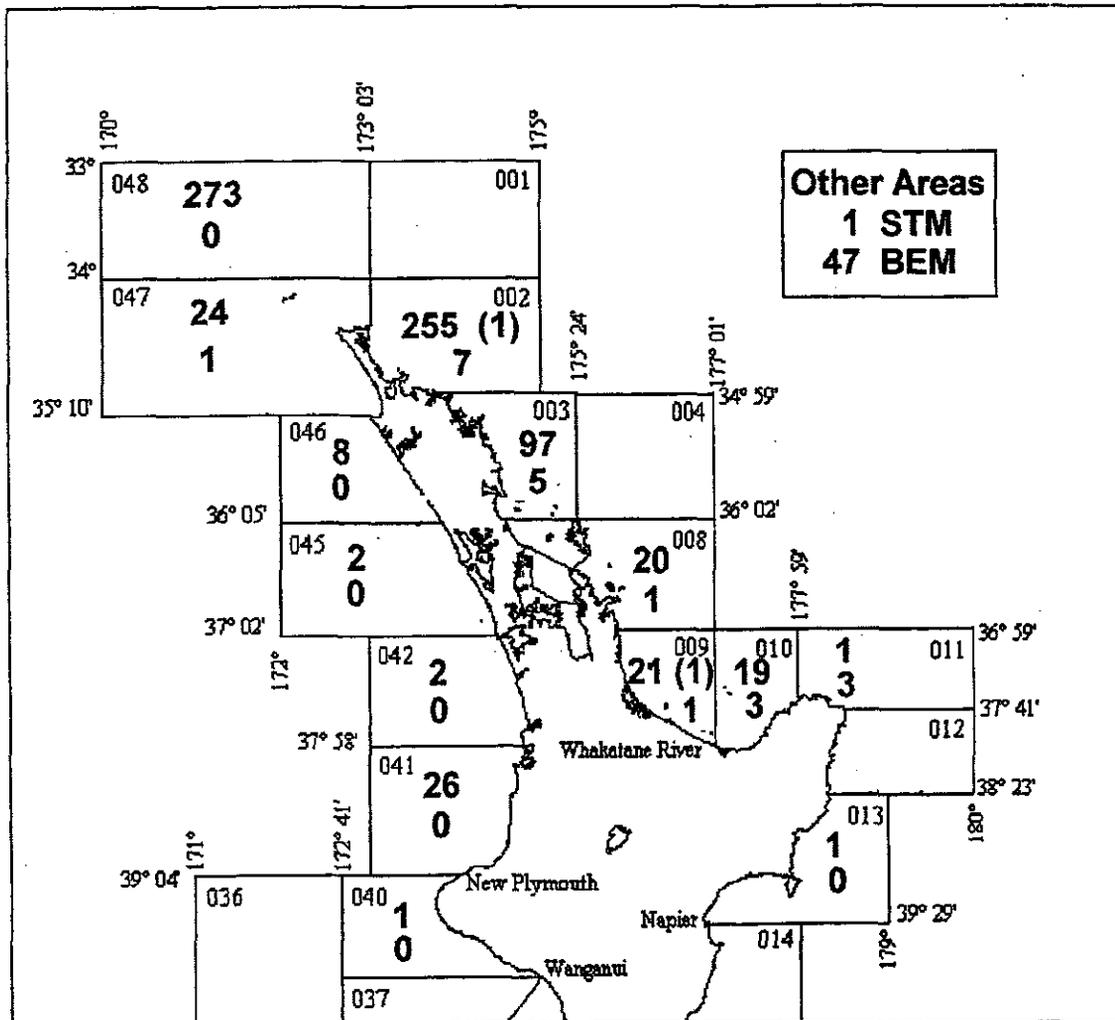


Figure 2: Marlin tagged and released. Numbers of striped marlin (STM) (top number) and blue marlin (BEM) (lower number) released in the 2001–02 season by statistical reporting area (3 digit code) and numbers of recaptures (in parentheses).

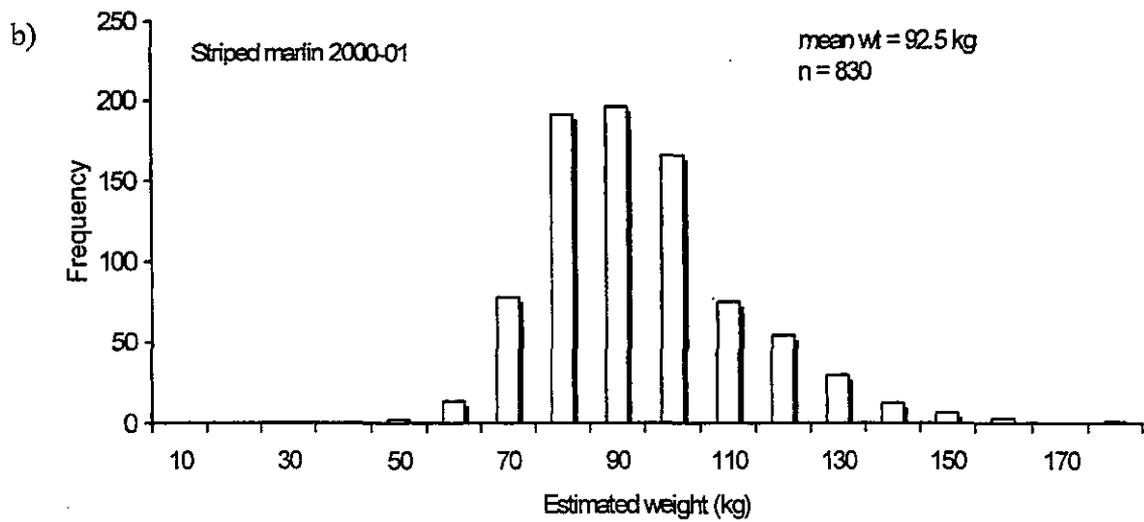
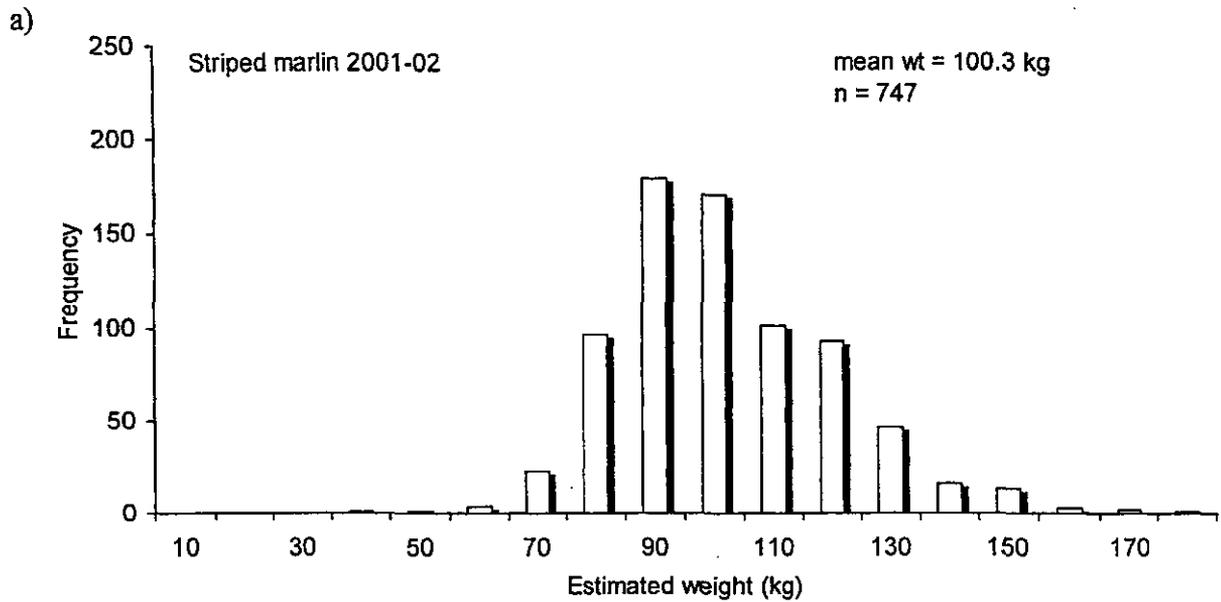


Figure 3: (a) Striped marlin estimated release weight frequency 2001-02; (b) Striped marlin estimated release weight frequency 2000-01.

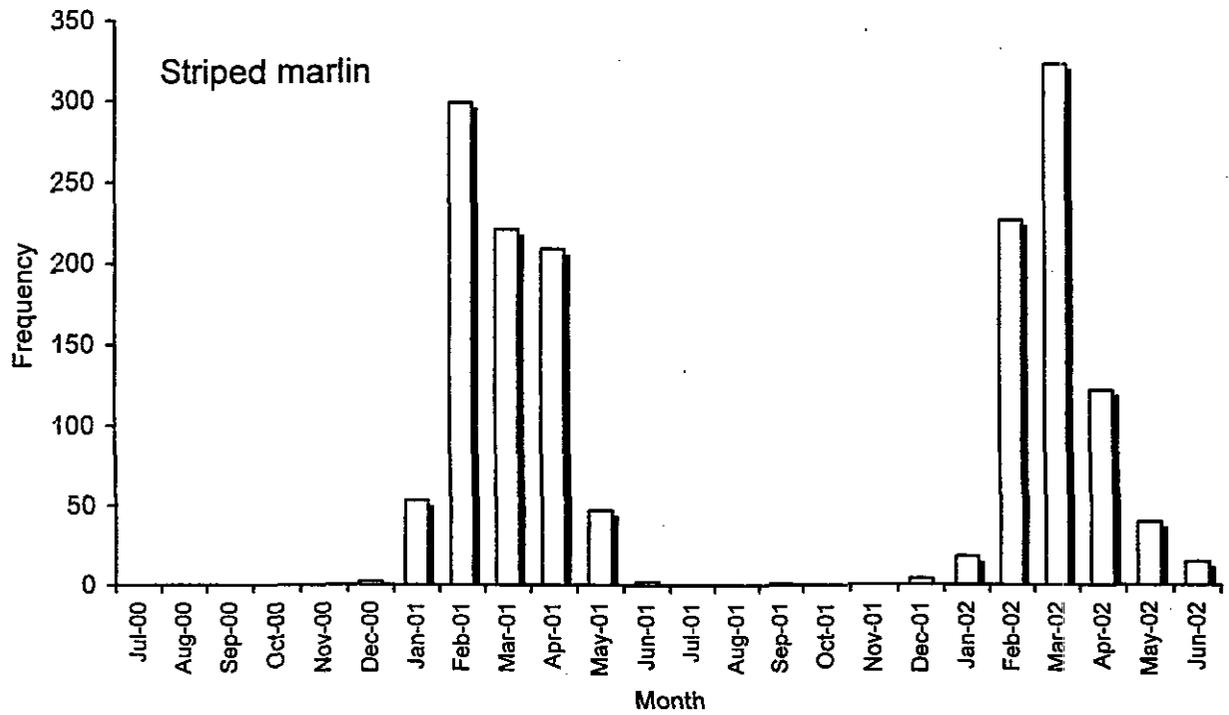


Figure 4: Number of striped marlin released by month during 2000–01 and 2001–02.

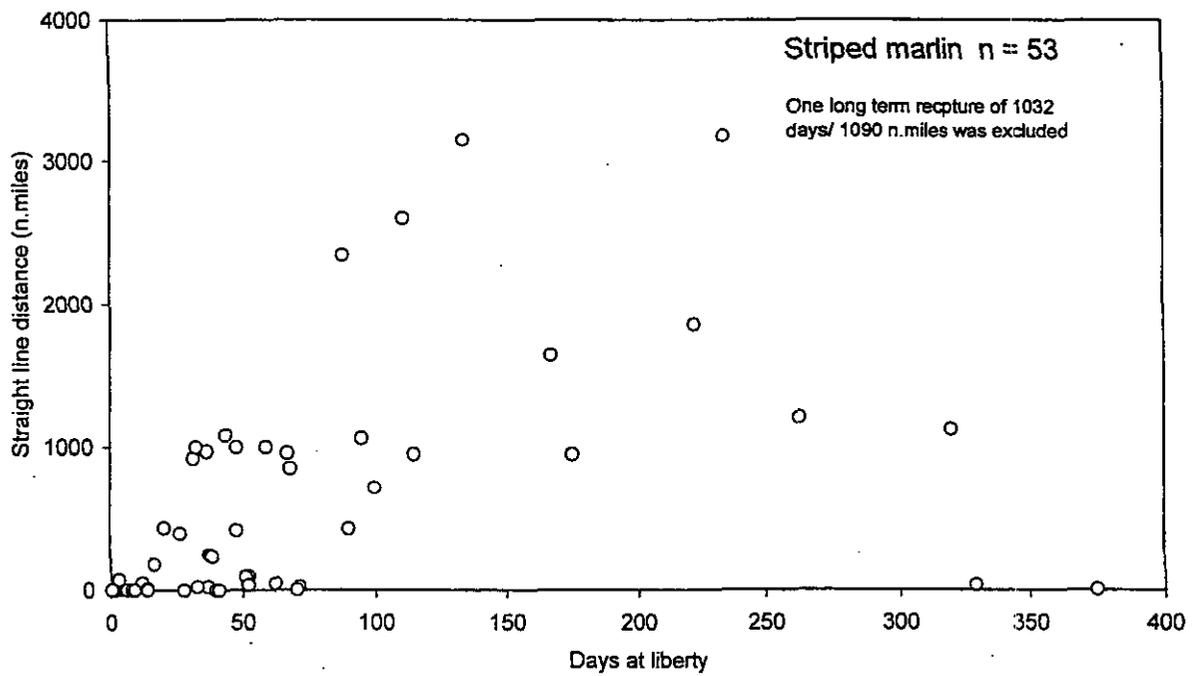
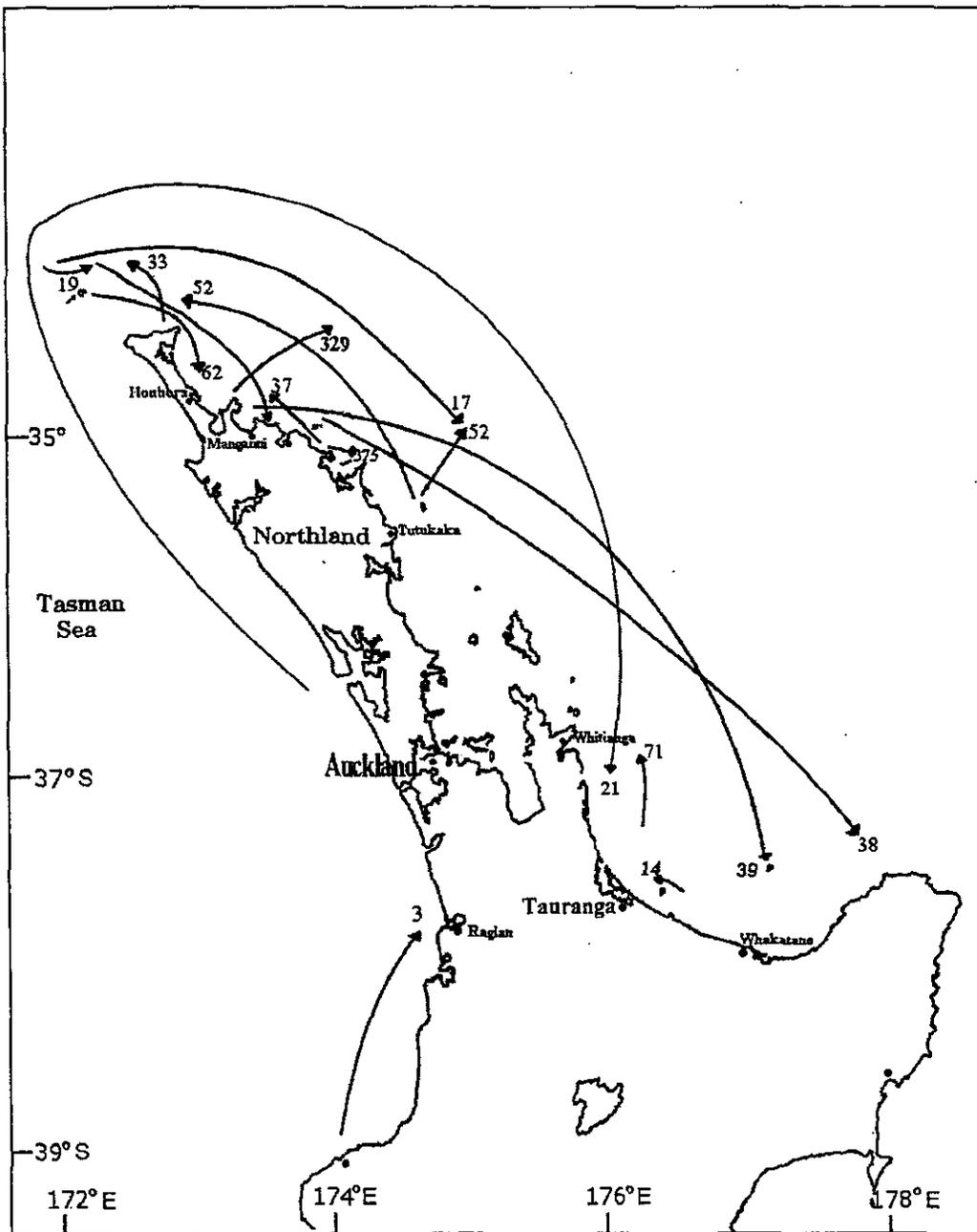


Figure 5: Striped marlin days at liberty and minimum distance travelled at recapture.



**Figure 6: Striped marlin movements indicated by recaptures in New Zealand waters - all seasons combined. Lines connecting release and recapture points do not indicate actual route but shortest distance. Number of days at liberty are indicated near the recapture point.**

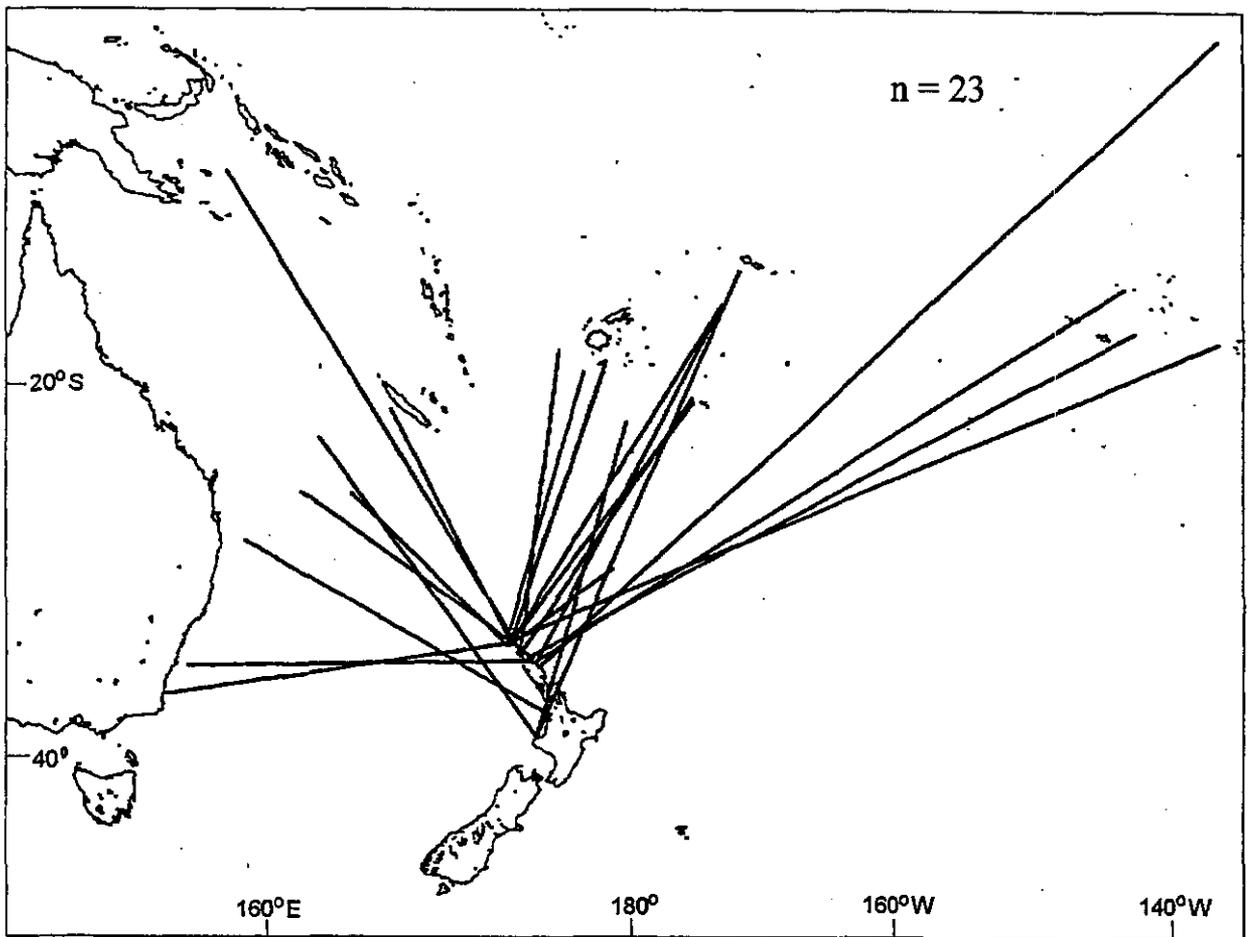


Figure 7: Long distance movements of striped marlin recaptured by July 2001.

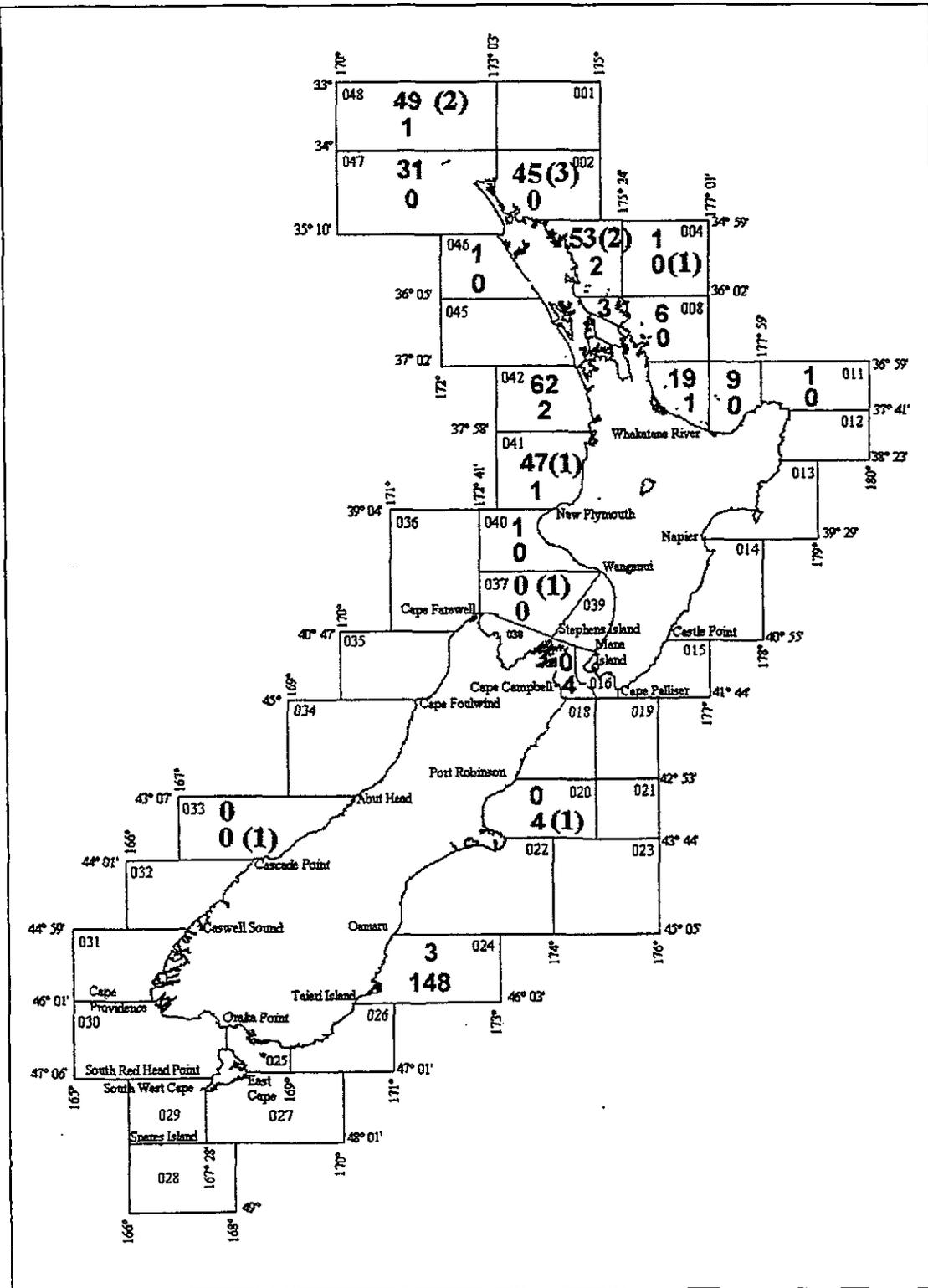


Figure 8: Sharks tagged and released and recaptured in the 2001–02 season. Numbers of mako shark (top number) and blue shark (lower number) released by statistical reporting area (3 digit code) and numbers of recaptures (in parentheses).

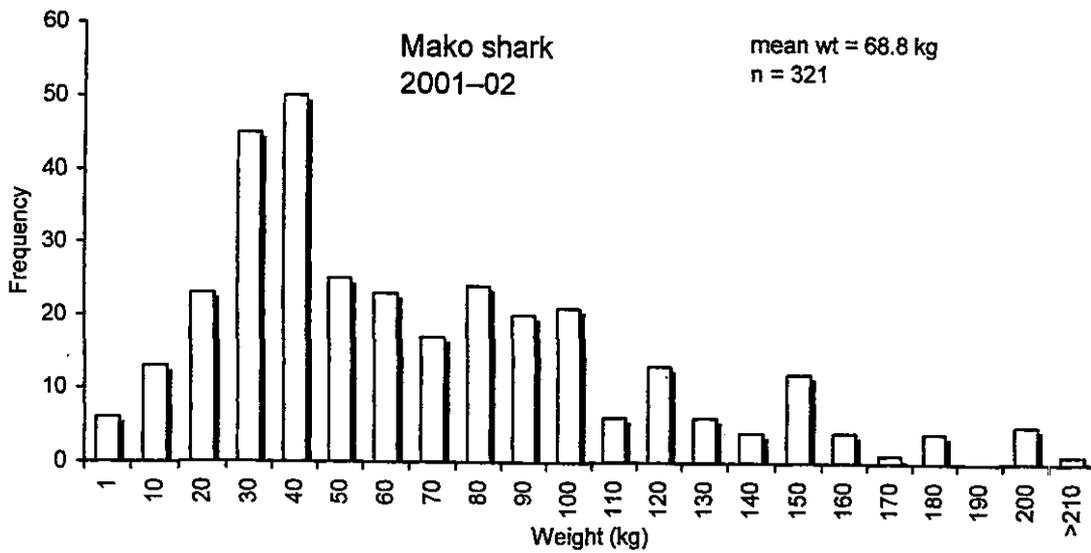


Figure 9: Mako shark estimated release weight frequency 2001-02.

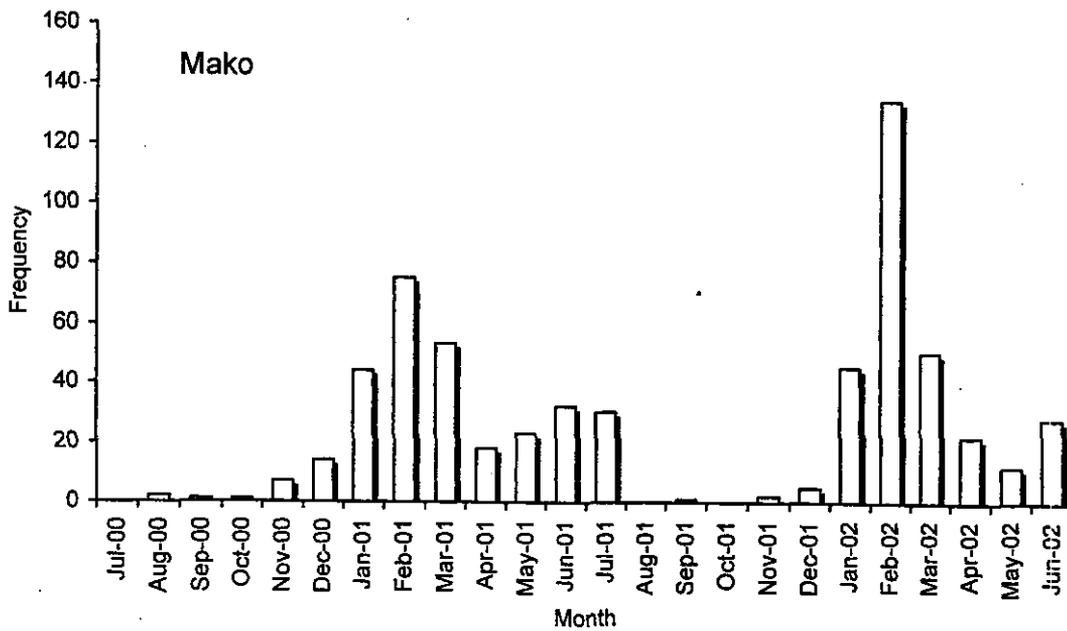
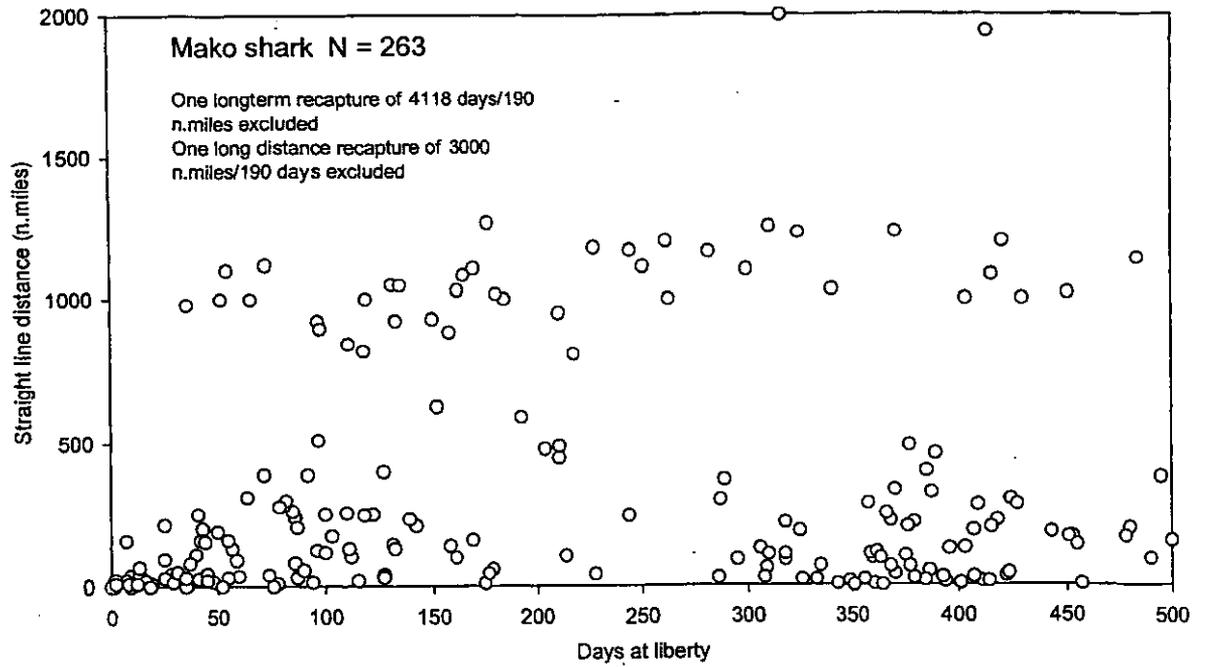
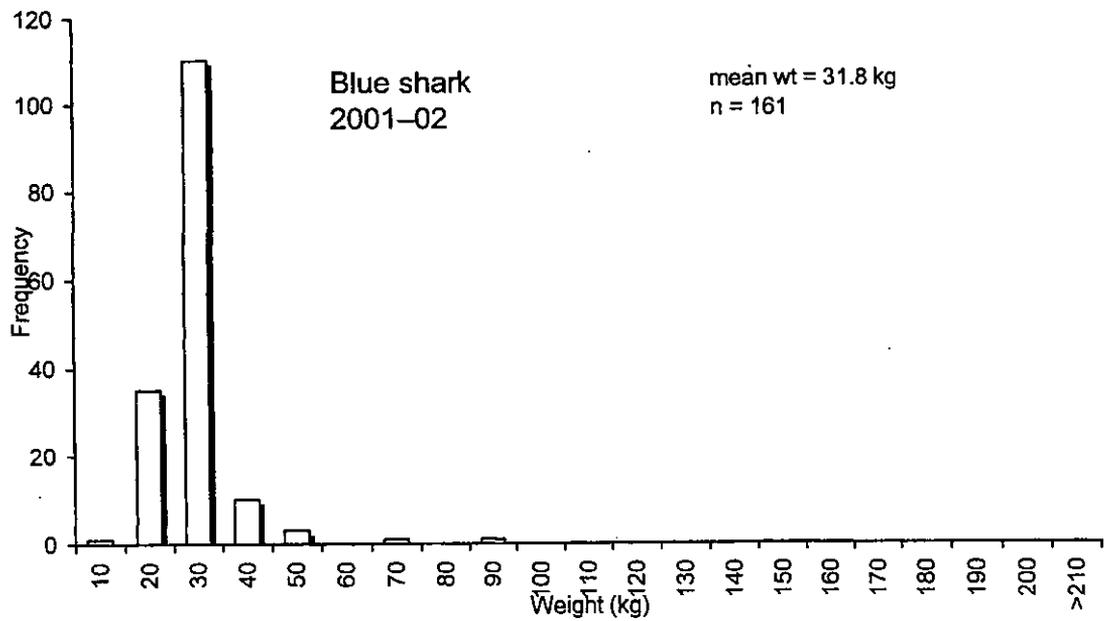


Figure 10: Number of tagged mako sharks released by month during the 2000-01 and 2001-02 seasons.



**Figure 11: Mako shark days at liberty and minimum distance travelled at recapture.**



**Figure 12: Blue shark estimated release weight frequency 2001-02.**

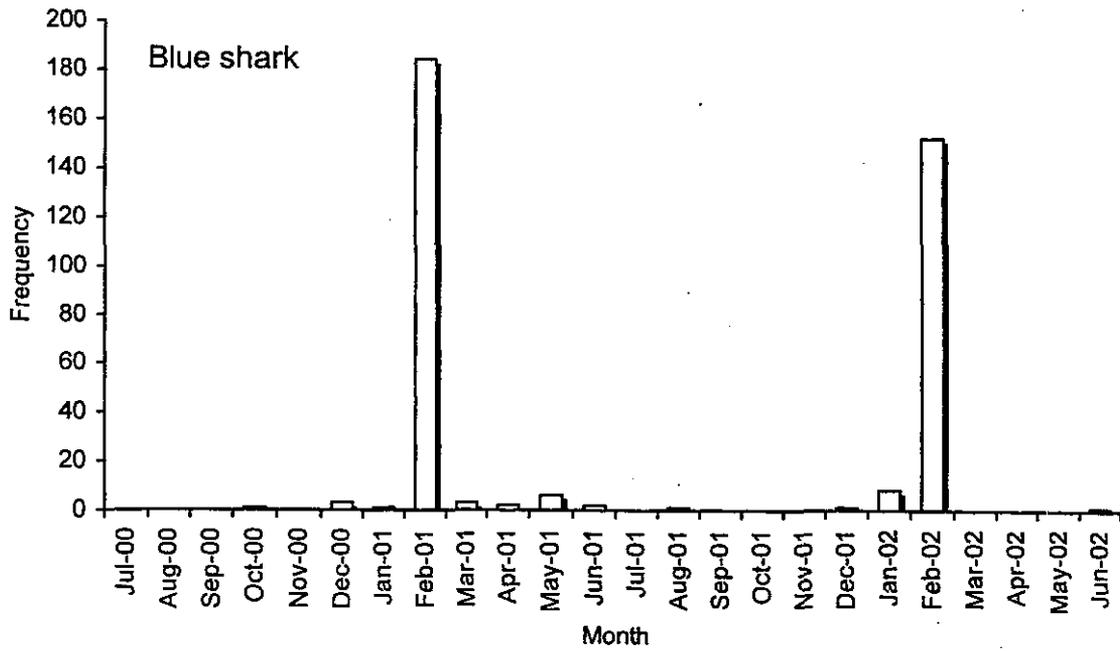


Figure 13: Number of tagged blue sharks released by month during the 2000–01 and 2001–02 seasons.

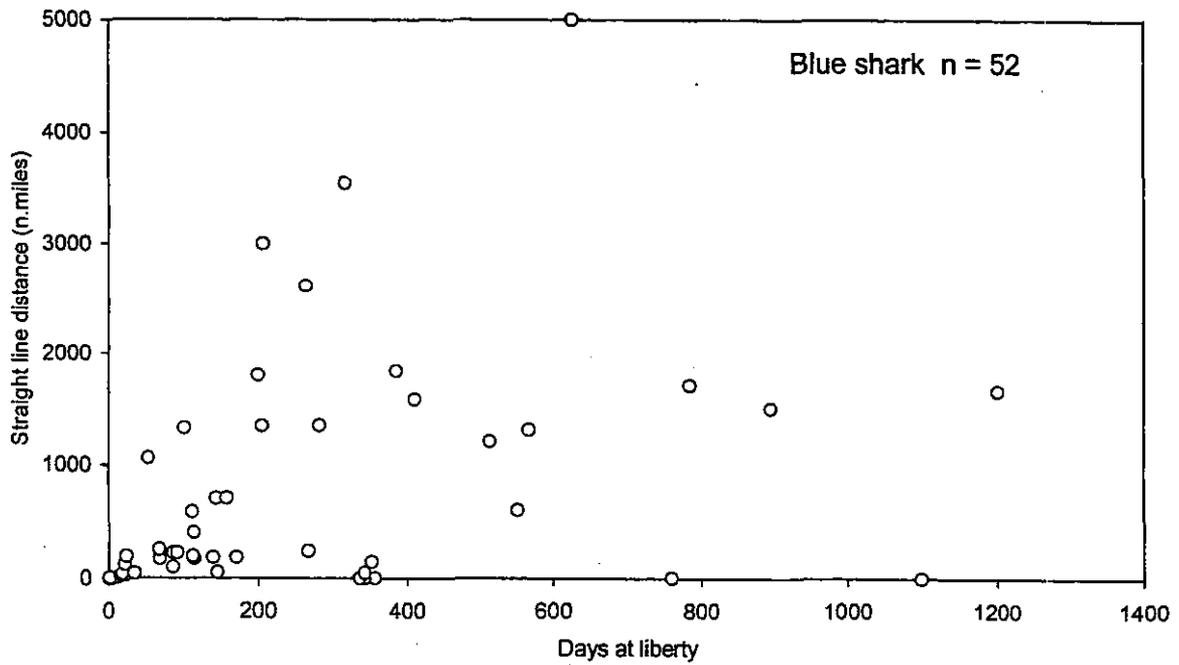


Figure 14: Blue shark days at liberty and minimum distance travelled at recapture.

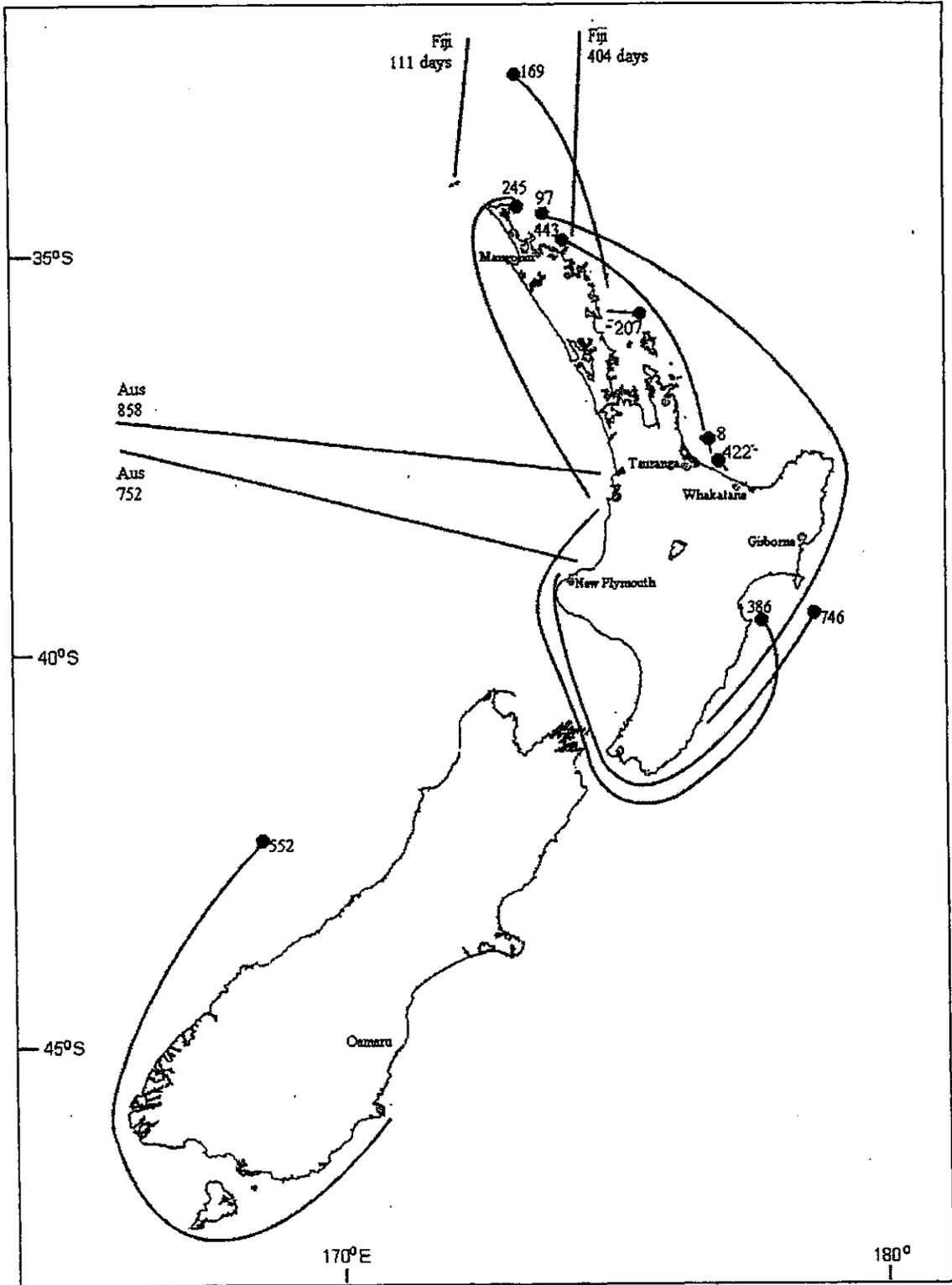


Figure 15: Mako movements indicated by recaptures in the 2000–01 season. Lines connecting release and recapture points do not indicate actual route but shortest distance. Number of days at liberty are indicated near the recapture point.

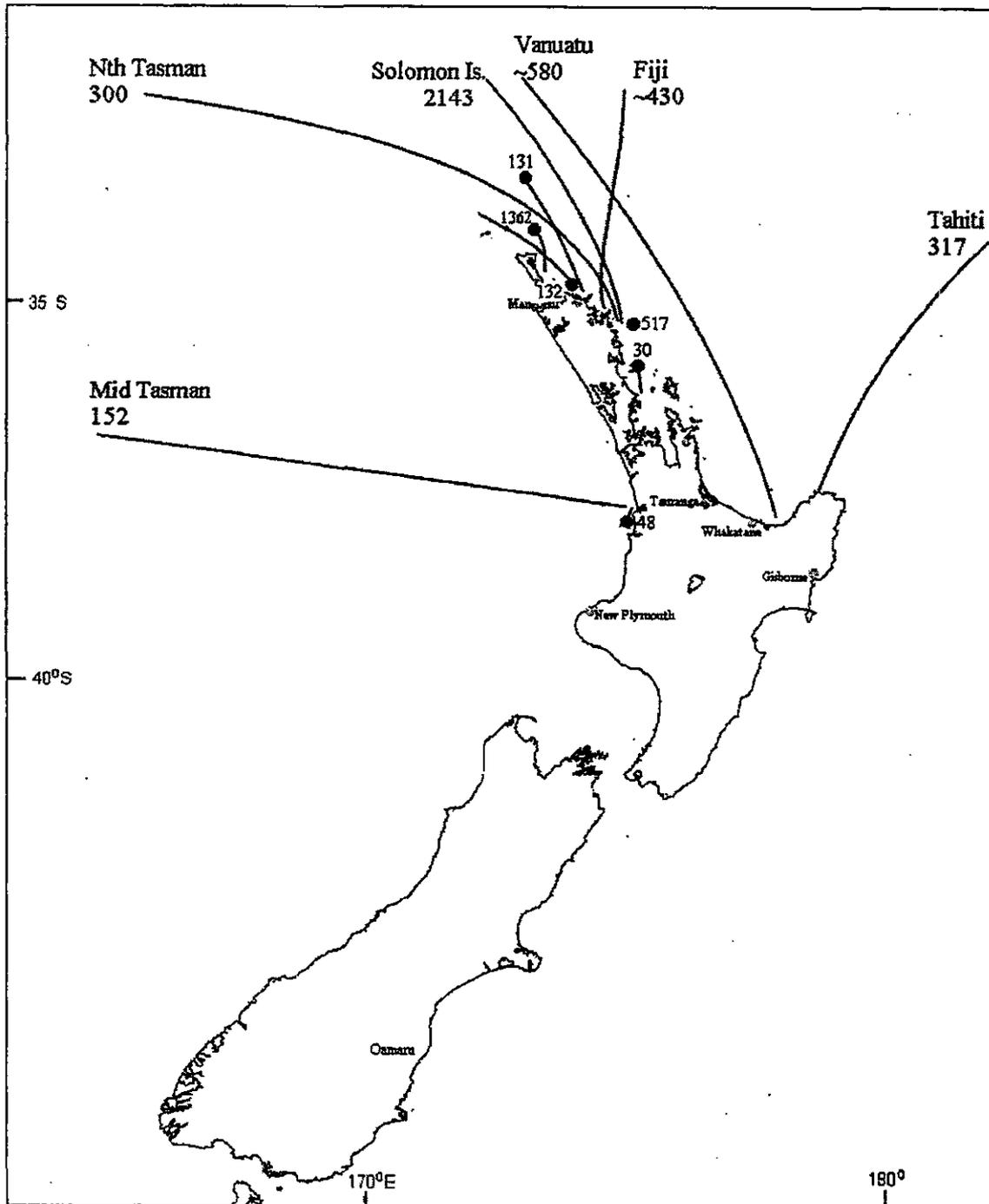


Figure 16: Mako movements indicated by recaptures in the 2001–02 season. Lines connecting release and recapture points do not indicate actual route but shortest distance. Number of days at liberty are indicated near the recapture point.

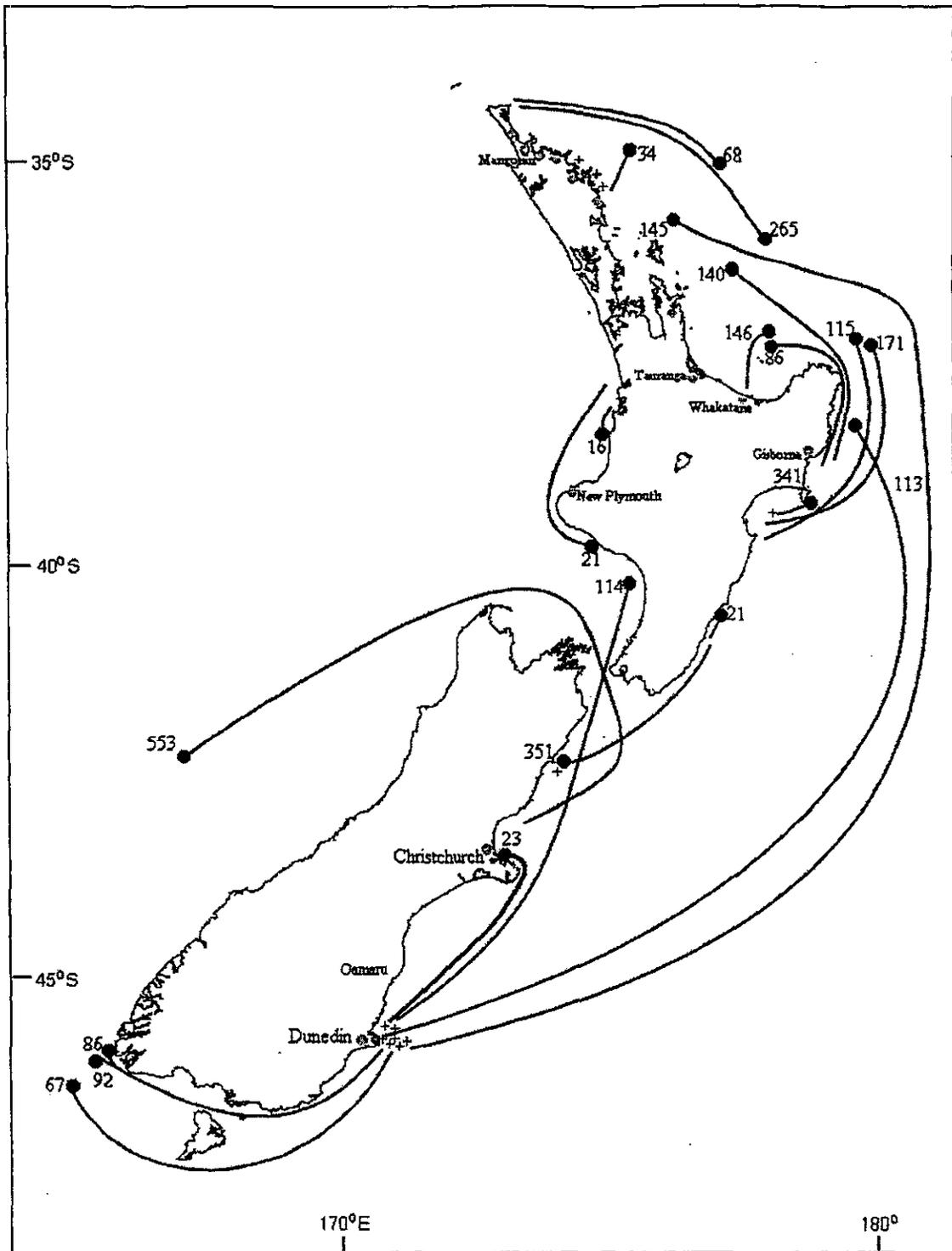


Figure 17: Blue shark movement indicated by recaptures in New Zealand waters – all seasons. Lines from release and recapture points do not indicate actual route but shortest distance. Number of days at liberty are indicated near the recapture point.

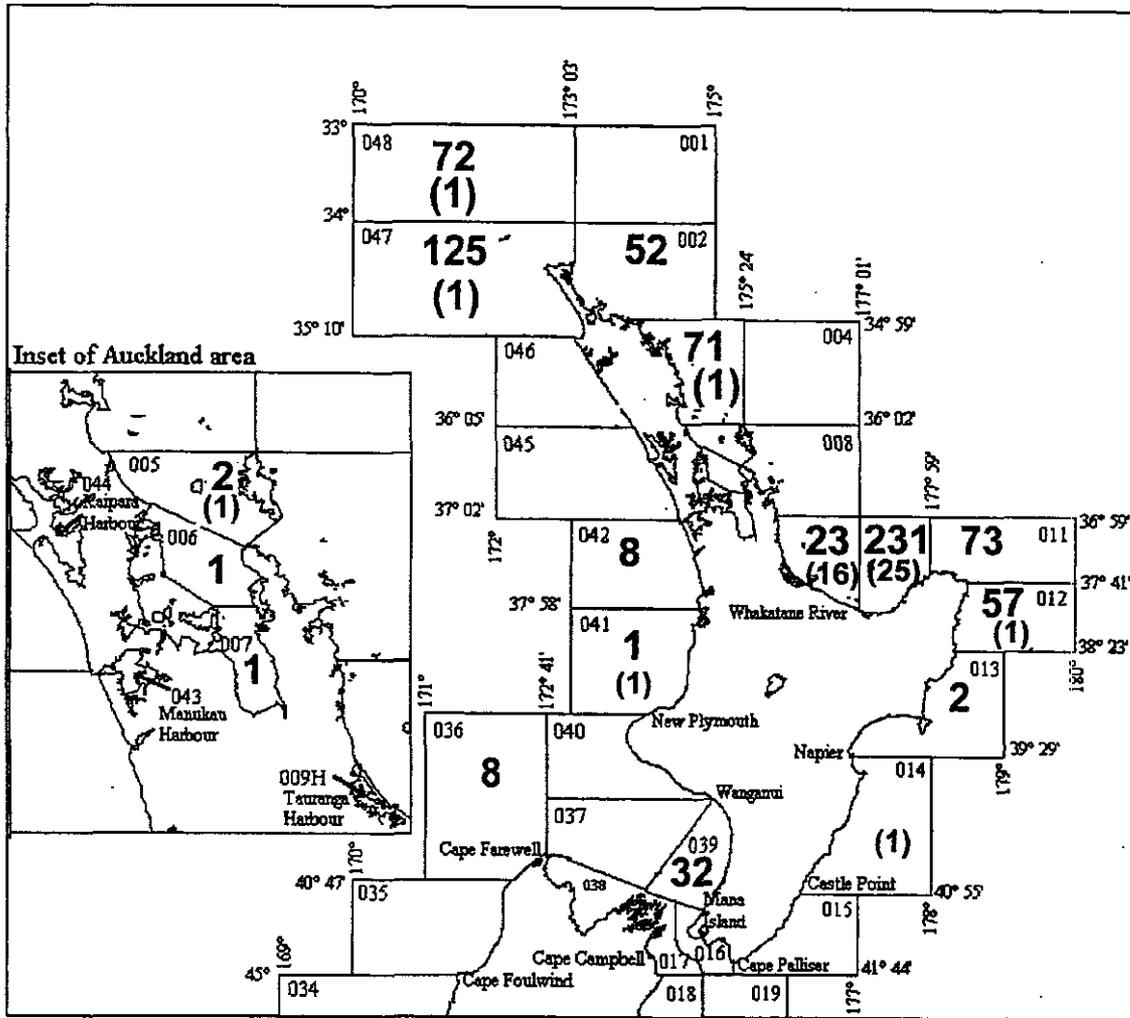
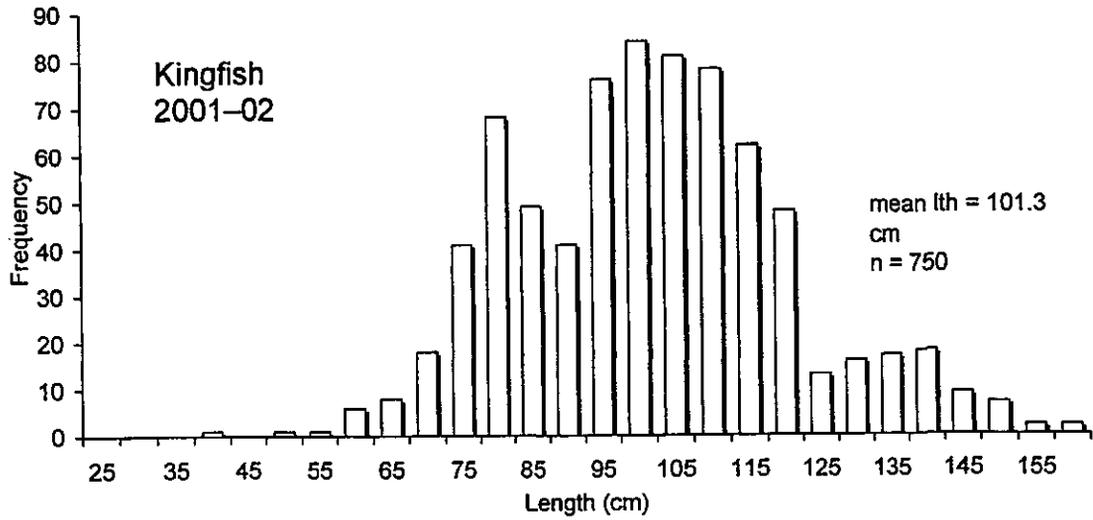
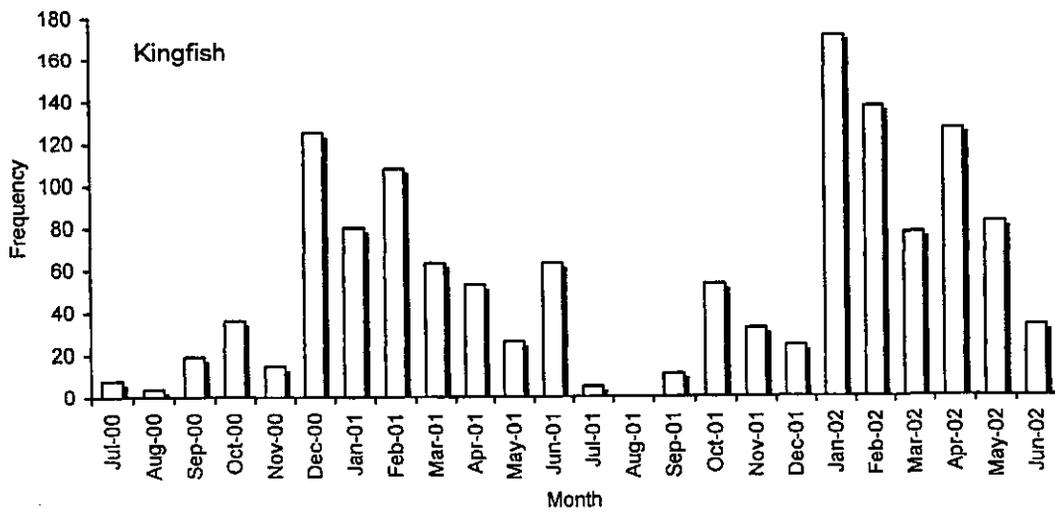


Figure 18: Numbers of kingfish released, and numbers recaptured (in parentheses), by statistical reporting area (3 digit code) for the 2001–02 season.



**Figure 19: Kingfish release length frequency in the 2001-02 season.**



**Figure 20: Number of tagged kingfish released by month during the 2000-01 and 2001-02 seasons.**

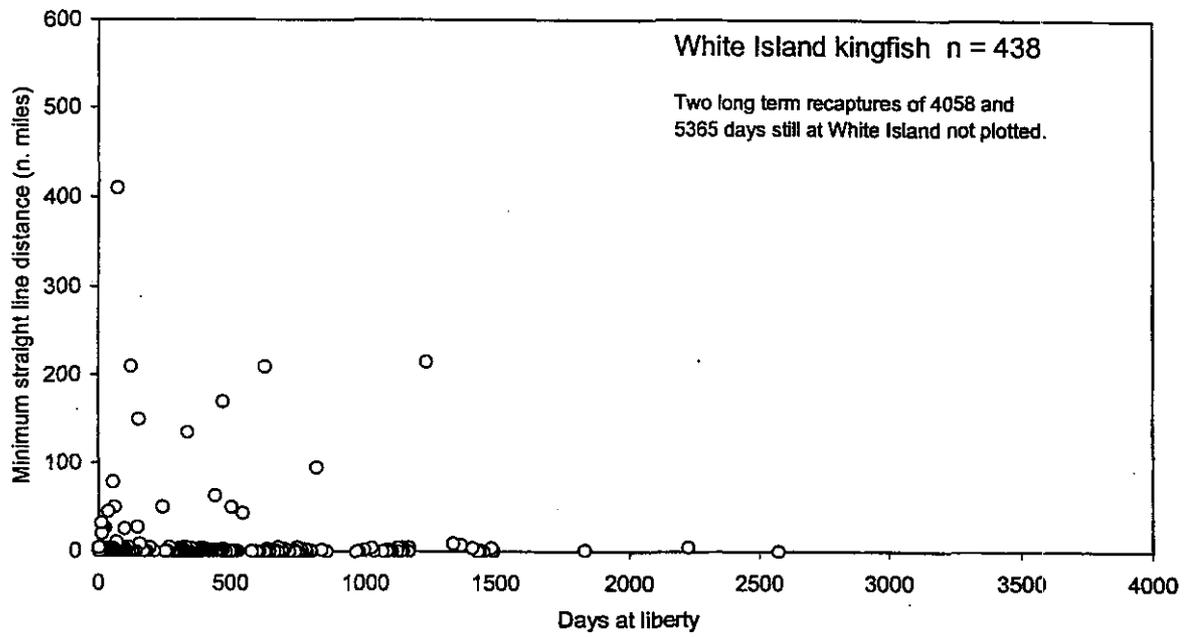


Figure 21: Kingfish released at White Island days at liberty and minimum distance travelled at recapture.

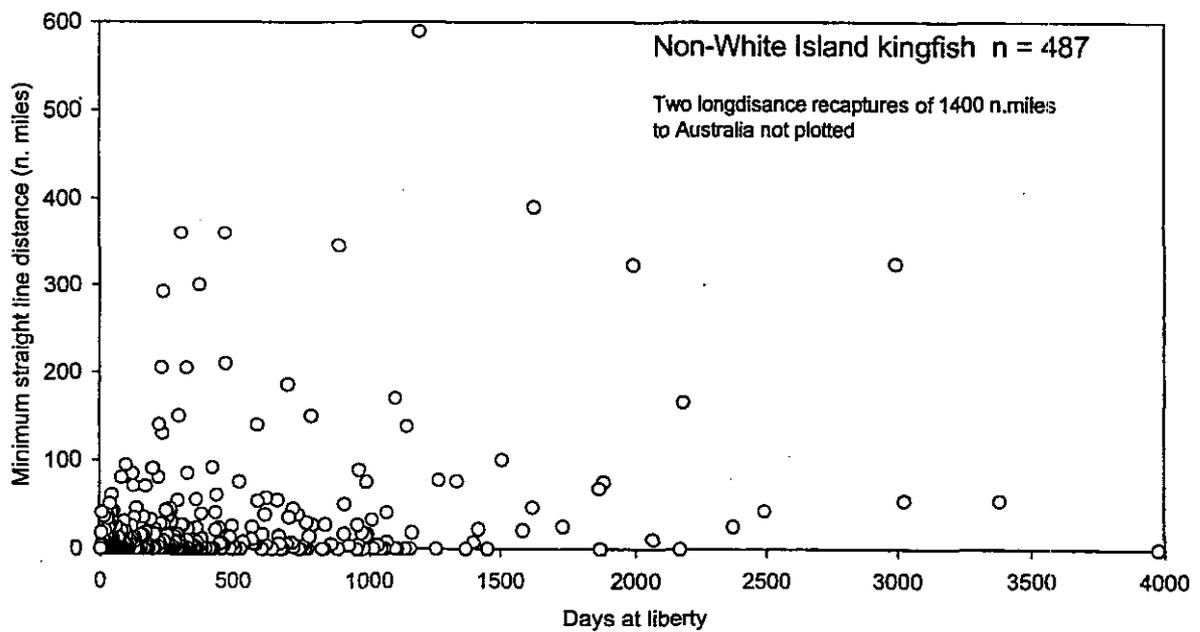


Figure 22: Kingfish not released at White Island days at liberty and minimum distance travelled at recapture.

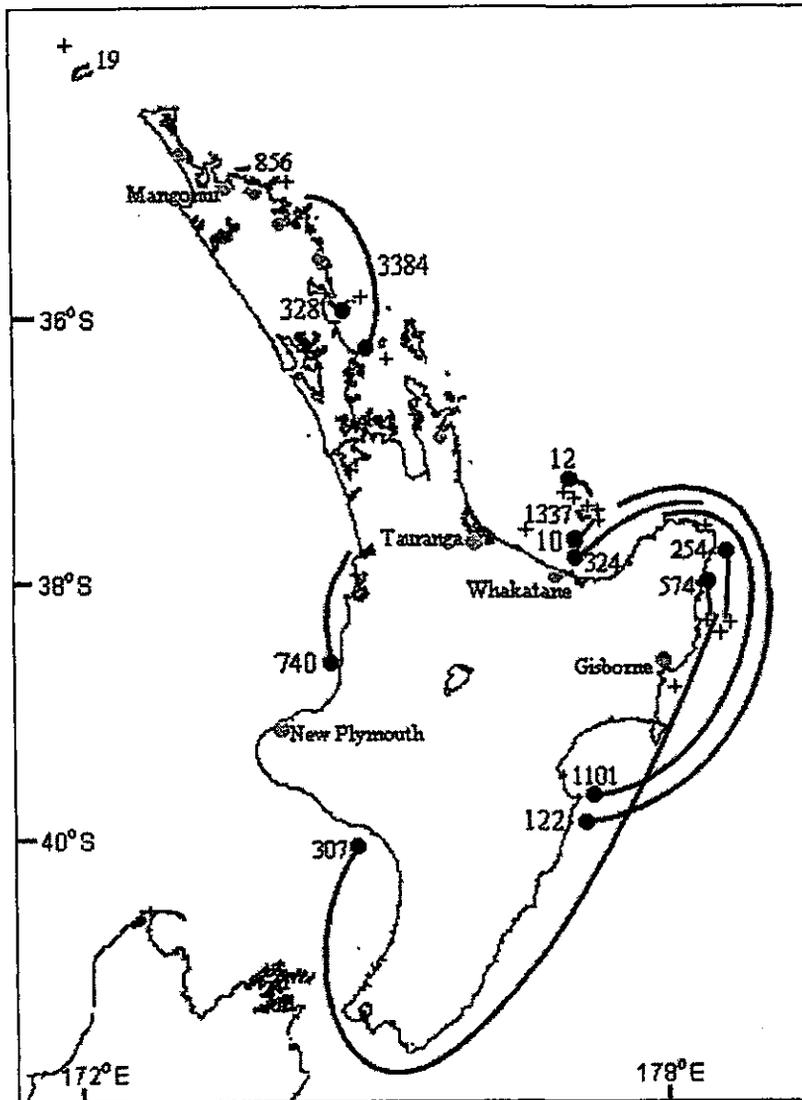


Figure 23: Kingfish movement indicated by recaptures in the 2000–01 and 2001–02 seasons. Number of days at liberty are indicated near the recapture point for fish that moved. Crosses indicate recaptures in the same location.

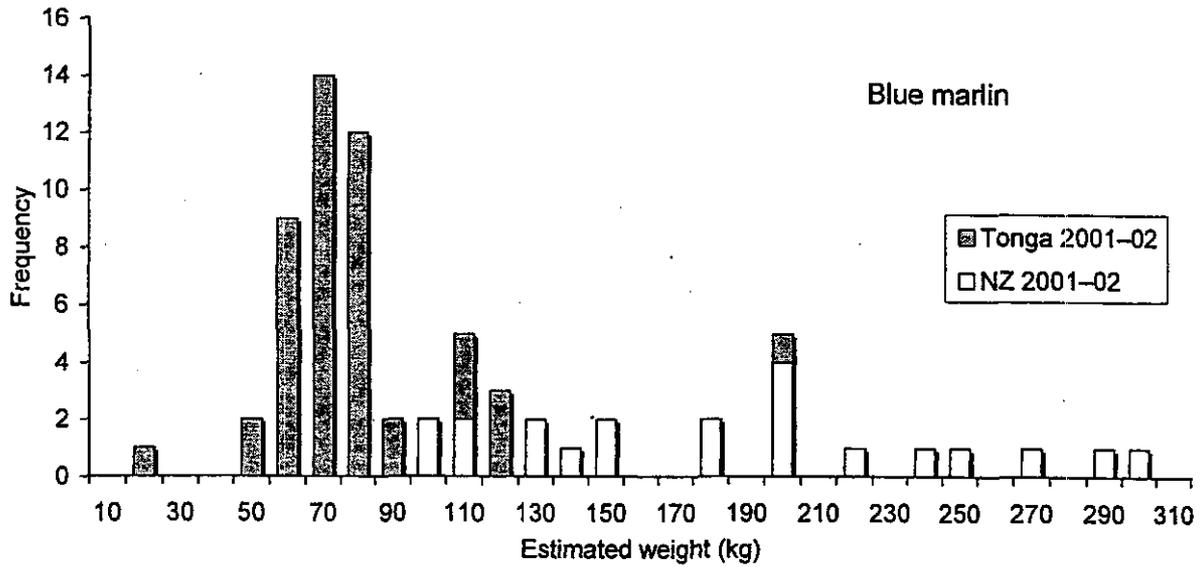


Figure 24: Blue marlin estimated release weight frequency 2001-02 for New Zealand and Tonga.

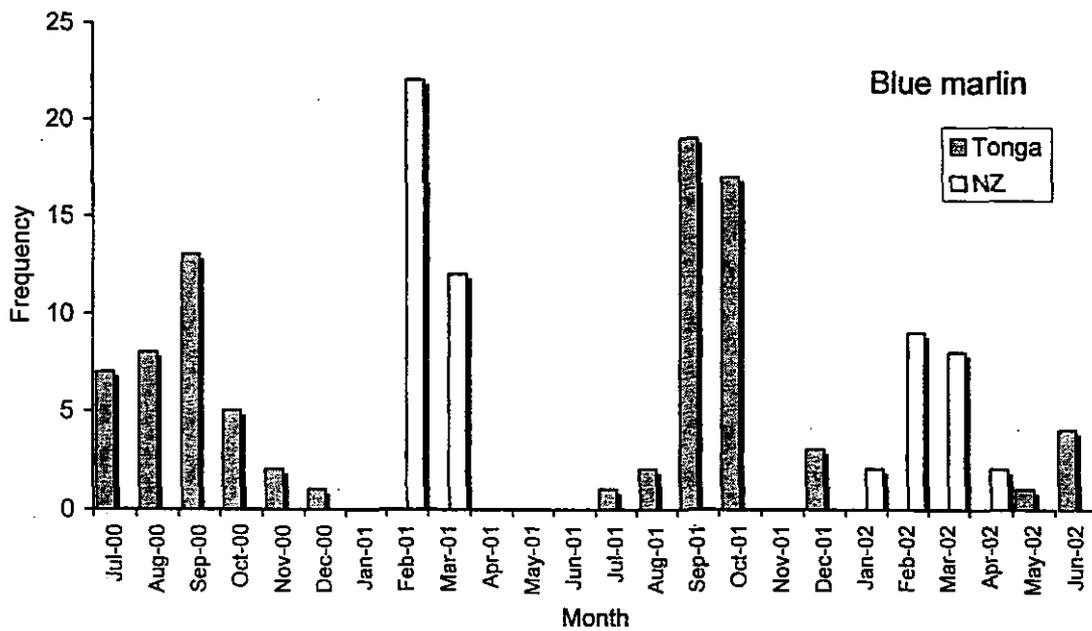


Figure 25: Number of blue marlin released by month in Tongan waters (solid bars) and New Zealand waters (open bars) during the 2000-01 season.

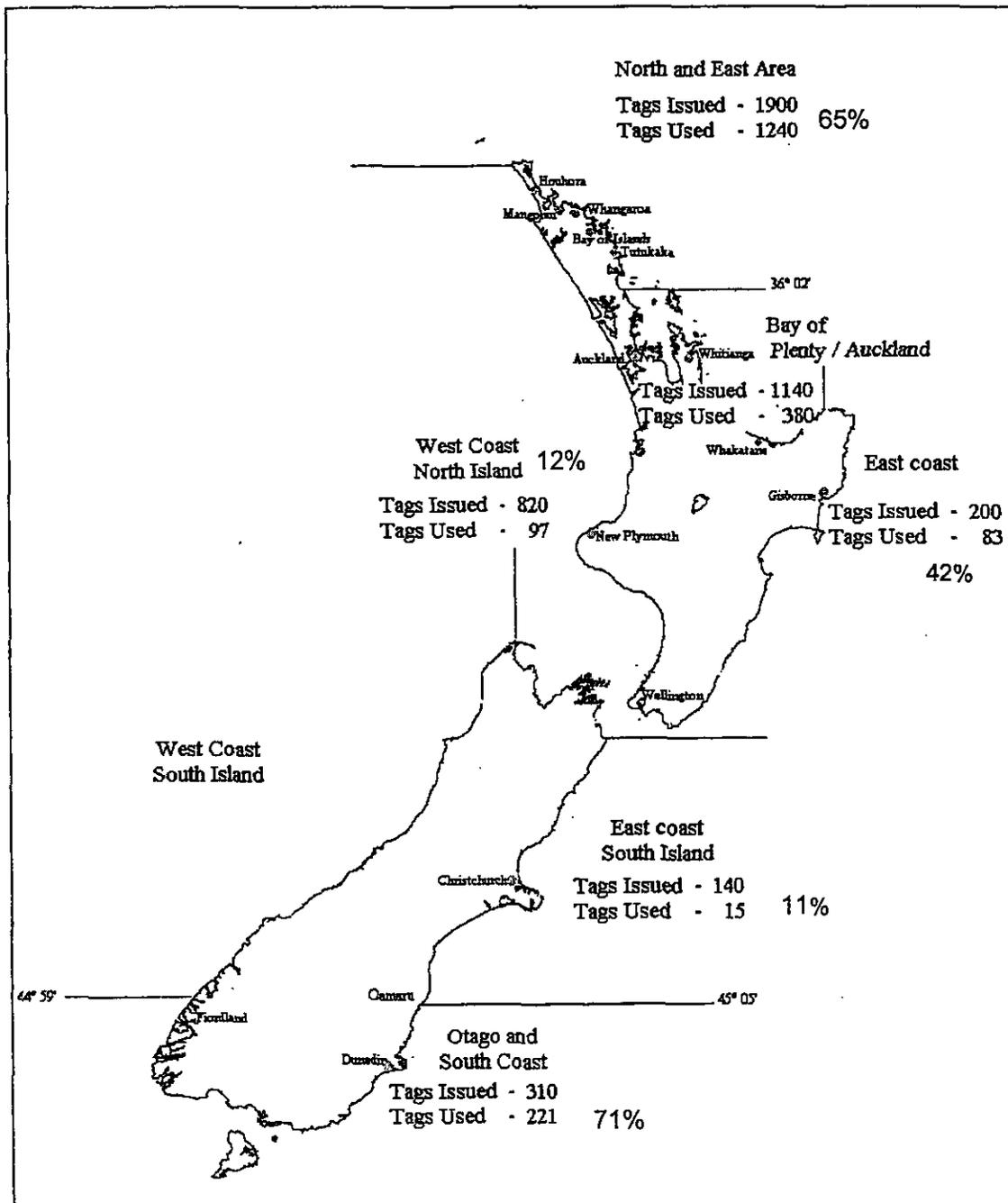


Figure 26: The number of tags issued to clubs and individuals and the number reported used by region for the 2001-02 season. The percentage of tags used can be influenced by the number of tags issued in previous seasons.

## APPENDIX 1.

### **New Zealand Gamefish Tagging Policy 2001–02**

The purpose of this policy statement is to clarify the objectives of the gamefish tagging programme (Ministry of Fisheries research project PEL2000/01). The policy will be reviewed in October 2002.

This gamefish tagging programme is a cooperative project between the Ministry of Fisheries, the New Zealand Big Game Fishing Council, its affiliated clubs and anglers, commercial fishers and the current fisheries research provider.

Cooperative tagging programmes provide information on the size and distribution of fish released by recreational fishers. Recaptures provide information on movement, time at liberty, displacement rates, and in some circumstances growth rates of the species involved. Widespread tagging and a large number of recaptures may help fisheries managers define a species' stock structure for management purposes.

Last year striped marlin, mako shark, blue shark and yellowtail kingfish have been the focus of the programme. These species were selected on the basis that *either* there was potential to tag substantial numbers of fish and make sufficient recaptures to provide useful data; and/or they were species of national or international significance or concern. These criteria are still valid. A trial to test angler acceptance of yellowfin tuna tag and release will continue in 2001–02 to provide information on the movement of fish tagged in New Zealand.

#### **Aims and objectives**

##### **Striped marlin**

- ⊕ Recreational fishers will be encouraged to tag and release 50% or more of their total annual striped marlin catch and to check fish carefully for existing tags before release.
- ⊕ Commercial fishers will be encouraged to return tags from recaptured marlin.

##### **Objectives**

- ⊕ To increase our knowledge of the nature and range of migration by striped marlin tagged in the SW Pacific.
- ⊕ To increase our knowledge of the movement striped marlin within New Zealand waters.

##### **Mako and blue shark**

- ⊕ Recreational fishers will be encouraged to tag and release mako and blue sharks. Recaptured sharks should be landed, measured and reported.
- ⊕ Commercial fishers will be encouraged to report recaptured mako and blue shark.

##### **Objectives**

- ⊕ To increase our knowledge of the nature and range of migration by mako and blue sharks tagged in the SW Pacific.
- ⊕ To increase our knowledge of growth and longevity of mako and blue sharks in the Pacific.

### **Yellowtail kingfish**

- ⊕ Recreational fishers will be encouraged to measure and tag kingfish over 100 cm in length. Recaptured kingfish should be measured and reported.
- ⊕ Commercial fishers will be encouraged to measure and report recaptured kingfish.

### **Objectives**

- ⊕ To increase our knowledge of movement of tagged kingfish.
- ⊕ To improve our knowledge of kingfish growth

### **Yellowfin tuna**

- ⊕ Anglers will be encouraged to participate in a trial to test the feasibility of including yellowfin tuna in the programme on a longer-term basis.
- ⊕ The target proportion of yellowfin catch tagged in the 2000–01 season will be 20% of total catch reported in the NZ Big Game Fishing Council yearbook.
- ⊕ Commercial fishers may voluntarily tag small yellowfin that they already catch and release. Regardless, their cooperation in the recapture phase would be important for the success of the trial.

### **Objectives**

- ⊕ To increase our knowledge of the nature and range of migration by yellowfin tagged in the SW Pacific.
- ⊕ To increase our knowledge of the movement of yellowfin in New Zealand waters.

All fish selected for tagging should be in good condition and New Zealand gamefish tagging programme tags must be used. Billfish may be double tagged with a New Zealand tag and a tag from another programme. Tag numbers from second tags should be recorded in the comments section of the tag report card.