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2004–05

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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. The species that form the focus of the programme are striped marlin (*Tetrapturus audax*), mako shark (*Isurus oxyrinchus*), blue shark (*Prionace glauca*), yellowfin tuna (*Thunnus albacares*), and yellowtail kingfish (*Seriola lalandi*). 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. However, 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 2004–05 season (July to June fishing year) are summarised in this report and compared with those from previous seasons. Particular recaptures that provide growth or movement information of significance or interest are described.

This season 2707 fish were reported tagged and released. The number of striped marlin (1313) tagged increased in 2004–05 compared to recent seasons. The number of mako and blue sharks tagged has been significantly lower than the long-term average for the last three years.

A total of 52 recaptures was reported in the 2004–05 fishing season, including 38 yellowtail kingfish, 5 mako sharks, 4 striped marlin, 2 blue sharks, and 2 yellowfin tuna. Time at liberty ranged from 2 days for a kingfish in the Bay of Plenty to 2354 days (6 years 5 months) for an 18 kg kingfish caught off Gisborne. Distance between release and recapture points ranged from less than 1 nautical mile, recorded for 21 kingfish and a blue shark, to 1560 nautical miles (2886 km) by a blue shark, which was recaptured off the Cook Islands.

## 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. Similar programmes had been established by New South Wales Fisheries in 1973 and by Woods Hole Oceanographic Institute, USA, in 1954. Although the tags supplied in New Zealand were initially intended for billfish, it was accepted that a variety of gamefish species would be tagged (Saul & Holdsworth 1992).

Generally the aims of cooperative tagging programmes are to provide basic information on movement and migration patterns; age, growth, and longevity; and stock structure for defining management units (Ortiz et al. 2003). These programmes have gained widespread support from recreational anglers and provide the only logistically and economically feasible way to tag large numbers of billfish (Pepperell 1990).

The New Zealand Big Game Fishing Council (NZBGFC) has supported the programme since its inception and has purchased and distributed all tags through gamefish clubs since 1992. Administration of the data remained with the Ministry of Agriculture and Fisheries until 1996, when the Ministry of Fisheries was formed. The administration for the gamefish tagging programme was initially contracted out to the National Institute of Water and Atmospheric Research (NIWA) and in 2000 was put out to competitive tender by the Ministry of Fisheries.

This report is the annual gamefish tagging report for 2004–05 season prepared by Blue Water Marine Research as part of the reporting requirements for the Ministry of Fisheries, project PEL2003/01.

### 1.2 Description of the fishery

The recreational fishery for large pelagic species is very important for many New Zealanders and contributes to tourism in New Zealand. The fishery operates mainly over the warm summer and autumn months. Striped marlin (*Tetrapturus audax*) is the mainstay of the gamefishery on the Northland east coast (Figure 1), with blue marlin (*Makaira nigricans*), and small numbers of 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, and there is a year round fishery for kingfish (*Seriola lalandi*). In the Bay of Plenty (Figure 1), yellowfin tuna and large yellowtail kingfish are the main pelagic gamefish sought, though at times striped marlin and blue marlin are targeted. On the North Island east coast, fishing clubs are established from Gisborne to Wairarapa (Figure 1). Shark species become increasingly important with distance south. Gamefishing has developed on the west coast of the North Island over the last 14 years with, at times, a very productive marlin and tuna fishery accessed from the west coast harbours and beaches, as far south as Taranaki. In the South Island, the gamefishery is centred around Canterbury, Otago, and Fiordland (Figure 1), with blue shark (*Prionace glauca*) abundant and therefore the primary target species, along with porbeagle shark (*Lamna nasus*) and occasionally southern bluefin tuna (*Thunnus maccoyii*).

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.

Marlin species are also a bycatch of the commercial surface longline fishery that targets bigeye and southern bluefin tuna (*Thunnus obesus* and *T. maccoyii*). Within the New Zealand Exclusive Economic Zone (EEZ),

commercial fishers are obliged by regulation to release all billfish, except swordfish, alive or dead. This regulation includes a provision that live billfish should be tagged if possible, and previously tagged marlin recaptured by commercial fishers are permitted to be boated and brought to port for scientific study.

### **1.3 Background**

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 the species of interest. Collection of tag report cards has been greatly assisted by the fishing clubs, most of which keep accurate records of captures and require that tag report cards are handed in at the completion of successful trips.

For the last 12 years striped marlin, mako shark, blue shark, and yellowtail kingfish have been the focus of the programme. These species were selected during a review of the programme in 1992 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.

In October 2000, fishers and stakeholder groups were consulted on the scope and objectives of the programme and the resulting Gamefish Tagging Policy (Holdsworth & Saul 2003) was circulated to clubs and organisations. It was recommended that tagging of striped marlin, mako shark, blue shark, and kingfish continue, and that in future yellowfin tuna be included. Objectives included increasing knowledge of the nature and range of migration of striped marlin, yellowfin tuna, and mako and blue sharks tagged in the southwest Pacific, and improving knowledge of kingfish growth and movement.

## **2. METHODS**

The tags used in this programme have all been printed yellow streamers with a stainless steel dart anchor. Between 1975 and 1984, Floy FH-69 billfish tags supplied by the US National Marine Fisheries Service (NMFS) were issued with the prefix H before the tag number. During 1985, 1000 modified Floy tags were issued (model FH-69A, prefix G). Since 1986, the Hallprint billfish tags have been used (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. A modified Hallprint tag with stainless wire extending the full length of the tag was issued from December 1996 onward. The new tag type started with serial number G 53501.

The process of tagging gamefish has been described by Saul & Holdsworth (1992). Numbered tag report cards are issued with each tag. They collect information on the species, date, location, and size of the fish tagged. More recent tag cards have included a space for latitude and longitude of release, the skipper's phone number, and tick boxes for capture method and whether the hook was removed before release.

The individually numbered tags are printed with the address of the Ministry of Fisheries, Auckland office and the words "Please measure or weigh – Reward". Tag cards and recapture reports are passed on to the contractor for entry into the database. The fisher reporting a recaptured fish is sent a printed polo shirt as a reward, along with a letter describing the release date and location, growth, movement, and time at liberty of the fish. A copy of the recapture letter is also sent to the skipper and angler who tagged the fish.

Data presented in this report are variously summarised by species and season, month, and area. This year the fish tagged by season and species have been summarised separately for fish tagged inside New Zealand fisheries waters (Table 1) and fish tagged outside New Zealand fisheries waters (Table 2). New Zealand gamefish clubs have always used an austral fishing season from 1 July to 30 June the following year. The tagging database and this report also use this definition of fishing season.

Large, lively fish are not easy to weigh and many are not removed from the water during tag and release. Therefore, weights are estimated by skipper or crew in most cases. Estimated weights have been summarised by 10 kg weight class rounded down as in previous NIWA gamefish tagging reports (Hartill & Davies 1999, 2000, 2001). For example, the 10 kg weight class includes fish from 10 to 19 kg.

More than half of the kingfish tagged are measured (fork length) by anglers before release. These data are more accurate records of the size of fish than estimated weights. The size distribution of tagged kingfish has been summarised by 5 cm length classes; lengths are rounded down. For kingfish records where the length was not measured, the estimated weight was converted to length using the following formula derived from the length weight relationship of Walsh et al. (2003), where length is in centimetres and weight is in grams:

$$\text{Length} = 3.3154 \text{Weight}^{0.3621}$$

Distances moved are expressed as minimum possible travel distances in nautical miles as this remains the standard measure in marine navigation. Where straight lines between release and recapture positions cross landmasses, the shortest distance by sea was calculated.

### **3. RESULTS**

#### **3.1 Striped marlin**

The number of striped marlin reported as tagged and released in the 2004–05 season was 1311 inside New Zealand fisheries waters, which is an increase over the previous season (2003–04, 1047) and significantly higher than the average of the previous 10 years (1017) (see Table 1). A further 810 striped marlin were reported as landed in gamefish club records (Roz Nelson, N.Z. Big Game Fishing Council, pers. comm.) It is estimated that 62% of recreationally caught striped marlin were tagged and released in 2004–05, down slightly from the previous season (65%). The number of striped marlin landed by fishers and not recorded in 2004–05 is not known.

The monthly totals of striped marlin tagged over the last five seasons are shown in Figure 2a. February was the peak month for striped marlin releases, followed by March. Catch normally peaks in March and tails off in May and June as the water cools. This season the first striped marlin caught by a recreational fisher in New Zealand waters was taken off the Bay of Islands in November 2004, the earliest ever recorded. However, no further captures were made until January 2005.

A summary of marlin tagged within Ministry of Fisheries statistical areas (Figure 2b) differs from the distribution in previous years. Fishing was better than average on the west coast of the North Island and also in the Bay of Plenty, while fewer striped marlin were released in the vicinity of the Three Kings Islands than in recent seasons. Statistical areas 047 and 048 accounted for 41% of striped marlin releases, while areas 002 and 003 (east Northland) accounted for 23%. This is a marked reduction from 2003–04, when these four areas contributed 83% of the striped marlin release total. The main increase was observed in area 046, where 158 striped marlin were released, while catches were good as far south as Taranaki on the west coast. The Bay of

Plenty from Coromandel Peninsula to Cape Runaway accounted for 15% of striped marlin, compared with 9% in 2003–04 (Figure 2b).

Striped marlin release weights for the last four seasons are plotted in Figure 3a and show a mode at 90 kg, and a broad distribution of estimated weights from 60 to 130 kg in 2004–05. This distribution is similar to that recorded in 2002–03 although there were more fish in the 70 and 80 kg size classes in 2003–04. This difference is also evident in the plot of cumulative proportions of weight frequency which is otherwise very similar for the last four seasons (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 clubs for contests or trophies. The proportion of striped marlin tagged and released that were estimated as 90 kg or larger was 74% in 2001–02, 68% in 2002–03, and 66% in 2003–04. In 2004–05 the proportion estimated as 90 kg or larger was back up to 72% (Figure 3).

Four tagged striped marlin were recaptured during 2004–05. A striped marlin tagged on 9 February 2005 at Cape Brett was recaptured on 26 March 2005 off Stevenson Island, Northland. On release, this fish was estimated at 90 kg; it weighed 103 kg on recapture and had moved about 34 nautical miles from its release point after 45 days at liberty. The second recaptured fish was tagged off Mayor Island, Bay of Plenty, on 25 February 2005 and also carried satellite tags, which showed it headed northeast for a while and then northwest. The satellite tag (PAT) popped off 200 nautical miles north of North Cape after 22 days on the fish. A tuna longline vessel recaptured this marlin 23 nautical miles northeast of North Cape on 7 April 2005. This fish had been at liberty for 41 days and was caught 240 n. mile from its release point. However, the satellite track from SPOT tag locations indicates this fish travelled at least 600 nautical miles in that time.

The third striped marlin was tagged at the King Bank on 21 March 2005 after 20 minutes on the line. It was caught on a lure from the vessel *Primetime* and was estimated to weigh 130 kg. It was recaptured on 15 April 2005 also on King Bank. This fish was estimated to weigh 92 kg using a tape to help estimate the weight. Therefore this fish had been at liberty for 25 days and has stayed in or returned to the area in which it was released.

The fourth striped marlin recaptured this season was caught by a recreational angler on the charter vessel *Pursuit* at the King Bank, Three Kings, on 26 April 2005. This fish had been tagged 96 days earlier after 30 minutes on the line, off Flat Island, Whangaroa. The fish was estimated at 90 kg on release and had travelled a minimum distance of 100 nautical miles. It was retagged and released with an estimated weight of 120 kg. The tag head was close to coming out of the fish and experienced charter boat skipper Rick Pollock was not sure if the tag would have stayed in place much longer.

There have been two reports of striped marlin being caught with broken tags and no number (the new tag construction does not allow it to break below the number) and one fish retagged without retrieving the existing tags.

Long-distance recaptures for striped marlin show a wide spread of locations across the southwest Pacific and Tasman Sea (see Figure 2c). Fish tagged in the same season, even in the same month and area, can travel to different regions of the southwest Pacific when they leave New Zealand.

About a quarter of striped marlin recaptures have been made within 20 nautical miles of their release points up to 10 weeks after release (see Figure 2d). There is also a cluster of eight recaptures with displacement of about 1000 nautical miles between 5 and 10 weeks after release. Some fish have travelled further (up to 3250 nautical miles), and two fish have been recaptured back in New Zealand waters after a year (see Figure 2d). Overall the recapture rate is 0.5 % (Table 3) and most striped marlin (84%) have been recaptured within 5 months of release.



## 3.2 Mako shark

The number of mako sharks tagged in New Zealand fisheries waters during the 2004–05 season was 234, down significantly (-62%) from the average number of makos tagged for the 10 previous seasons, but up slightly on the number tagged in 2003–04 (187) (see Table 1). According to NZBGFC records, 80% of mako sharks caught were tagged and released by gamefish club members in 2003–04. The number of makos released without being tagged is unknown.

Generally, makos are not a target species in northern New Zealand but are caught as a bycatch in areas fished for billfish or tuna. Most makos tagged in 2004–05 were caught off the North Island from New Plymouth on the west coast around to Whakatane on the east coast (Figure 4). Statistical area 041, off Taranaki, was the most productive; 44% of the mako sharks tagged were caught off the west coast of the North Island, with 22% released off east Northland and 19% in the Bay of Plenty (Figure 4).

Most makos were tagged between January and July 2001–02 with a seasonal mode in February (Figure 5a). There were generally fewer fish in all months in 2002–03, but releases follow a similar seasonal pattern. In 2003–04 more makos were tagged in January than other months, unlike the previous two seasons which showed a strong mode of releases in February. In 2004–05 the peak month for mako releases was February, closely followed by March (Figure 5a).

The size distribution of makos tagged in 2004–05 shows that most makos tagged were estimated to be 80 kg or less, with a mode at 30 kg (Figure 5b). A few large makos about 250 kg or more were also tagged.

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 5d). 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. Most of the points in this band represent movement into the subtropics and reports from tuna longline vessels based in Fiji, and other Pacific island nations. However, 11 long distance recaptures in this band are for mako that were caught in temperate Australian waters (south of 30° S).

Five tagged mako recaptures were reported in 2004–05, the lowest number since the 1992–93 season (Table 3). This is not surprising, since release numbers in recent seasons have also declined markedly. There was also one mako tagged by a Spanish tuna longliner on an exploratory fishing trip in August 2004. Time at liberty for these fish ranged from 83 to 950 days and just one was recaptured outside the New Zealand economic zone in 2004–05 (Figure 5c). Three small mako sharks (estimated 20 to 40 kg) tagged off Raglan were recaptured. The first was tagged in February 2002 and was recaptured in September 2004 south of Tonga by a tuna longline vessel. This fish travelled a minimum distance of 1125 nautical miles and was measured at 246 cm on recapture. A mako tagged in April 2004 was recaptured off North Cape in January 2005 by a tuna longline vessel. A third Raglan shark tagged in November 2004 was recaptured nearby (Gannet Island) 83 days later.

Two mako sharks tagged in February and March 2003 were recaptured this season. The first, tagged at the King Bank, was recaptured 762 days later in the same area in March 2005. The other mako was released off the Manukau harbour entrance and was recaptured 722 days later off Castle Point. The former fish was estimated at 150 kg on release and 250 kg on recapture, the latter was estimated to be 57 kg on release and 85 kg on recapture. Both fish were retagged and released again. The release data for the mako tagged by the Spanish vessel was lost when the vessel was wrecked on a reef in the Cook Islands. This fish was recaptured in Mercury Bay by a recreational fisher in April 2005, retagged, and released. Overall, the recapture rate for mako sharks on the programme is 2.8% (Table 3).

### 3.3 Blue shark

There were 97 blue sharks tagged in New Zealand fisheries waters during the 2004–05 season, fewer than during the 2003–04 season (106) (see Table 1). The average for the previous 10 years for this species is 255 per season. Seventy-two blue sharks were tagged off Otago Heads, predominantly in February (Figures 6 and 7a). Most blue sharks tagged in 2004–05 were estimated at between 10 and 40 kg (Figure 7b). In previous seasons, release weights were higher, between 30 and 50 kg.

The distribution of tagged blue shark recaptures plotted as distance travelled against days at liberty shows a group of 12 recaptures close to their release points in the first month after release, then another group of 5 recaptures close to the release points after one year (Figure 7d). As with mako sharks, there is also a band of recaptures between 1200 and 1800 nautical miles for fish at liberty from 3 months to 3 years. One-third of blue shark recaptures have been recorded from outside New Zealand waters. In some aspects, the recapture locations are similar to those reported for striped marlin and mako sharks – Australia, New Caledonia, Fiji, Tonga, French Polynesia (Figure 7c) – but there have also been two other more extensive movements. One shark travelled to the Indian Ocean (40° 21' S, 109° 20' E), a minimum travel distance of 3100 nautical miles from Tutukaka, east Northland, in 206 days and the other travelled 4630 nautical miles east, almost to Chile (31°16' S 85°10' W), in 624 days.

In the 2004–05 fishing season two blue shark recaptures were reported. Last season a blue shark tagged in Pegasus Bay, Canterbury, on 26 February 2004 was recaptured 28 days later by a tuna longliner in Hawke Bay. A blue shark tagged in the same area on the same day and by the same crew was recaptured south of the Cook Islands by a Spanish longline vessel in July 2004. This fish had been at liberty for 145 days and travelled a straight line distance of 1560 nautical miles. The second blue shark reported in 2004–05 was tagged in early March off Motiti Island, Bay of Plenty, and recaptured in the same area 41 days later. Overall, the recapture rate for blue sharks on the programme is 1.7% (Table 3).

### 3.4 Kingfish

The number of kingfish tagged and released in New Zealand fisheries waters during 2004–05 was 801, 18% higher than the mean number tagged in the previous 10 seasons and 4% more than in 2003–04 (see Table 1). Most kingfish are tagged over summer and autumn. In 2004–05, tagging numbers were highest between January and April (Figure 8a). The most important areas for kingfish tagging were 042, off the North Island west coast, where 27% of releases were made; areas 011 and 012 (East Cape) where 26% of kingfish were released; areas 047 and 048 (Three Kings) 18%; and area 010 (White Island) 12% (Figure 8b). There has been an increase in the number of kingfish tagged on the west coast of the North Island and in the Three Kings area over the last two years. Seventy-seven percent of tagged kingfish were measured on release in 2004–05, up from 60% over the previous two seasons. Kingfish size distribution is 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.

The size of kingfish tagged ranged from 45 cm to 160 cm, with most fish between 65 and 120 cm (Figure 8c). The length distribution was broad this season with modes at 65 to 70 cm and also between 95 and 100 cm. Most of the larger fish in 2004–05 were tagged at White Island and the Three Kings area, while the increase in tagging of small fish came mostly from a few anglers from Raglan on the west coast of the North Island. Anglers have been asked not to use gamefish tags on kingfish less than 65 cm fork length, which had been the minimum legal size. In January 2004, a new kingfish minimum legal size of 75 cm was introduced for recreational fishers. There were 158 kingfish less than 75 cm tagged and released in 2004–05.

In the 2004–05 season 38 kingfish recaptures were reported (Table 3). Time at liberty ranged from 2 to 2354 days (6 years 5 months) and displacement ranged from 0 to 230 nautical miles.

Fifteen kingfish tagged at White Island, Bay of Plenty, were recaptured. Eleven of these fish were recaptured at White Island or associated reef systems this season. One kingfish was recaptured about 10 nautical miles away (toward Kohi Point) after 3 years 7 months at liberty. This fish was measured at 99 cm on release and was about 120 cm and 20 kg on recapture. Two other fish also measuring 99 cm on release at White Island were recaptured elsewhere. One was recaptured on the Ranfurly Bank in February 2005 after 813 days at liberty and was remeasured at 115.5 cm; the other was recaptured in January 2005 by a trawler in Hawke Bay after 1497 days at liberty and was remeasured at 114.5 cm.

Six kingfish tagged at the Three Kings Islands and three tagged at the King Bank were recaptured in 2004–05. All were recaptured close to their release point and days at liberty ranged from 31 to 1053 with an average across the nine fish of 580 days (1 year 7 months). Over the previous two seasons there were two recaptures of Three Kings kingfish off the North Island. Two kingfish tagged from the vessel *Pursuit* measuring 107 cm were recaptured by the same vessel, the first after 31 days was remeasured at 107 cm, and the second after 698 days was remeasured at 114 cm. A measuring board was used for all four measurements. Two large kingfish were also recaptured at the Three Kings Islands. They were estimated at 35 and 36 kg on release in March 2003 and May 2002 and on recapture on the 28 and 30 March 2005 they were estimated to be 30 and 32 kg respectively. Both fish were re-released with new tags.

In 2004–05 five kingfish tagged off Raglan and Gannet Island were recaptured. Three fish measuring 73, 83.5, and 86 cm were recaptured in the same location after 383, 19, and 26 days at liberty. One kingfish tagged in January 2004 (83 cm) was recaptured 64 nautical miles north in November 2004 (87 cm). The fifth kingfish (75 cm) was tagged in January 2005 and recaptured 28 days later 60 nautical miles south (78 cm).

A kingfish tagged from Bert Lee's vessel *Osprey* in February 1998 north of Gisborne was recaptured 6 nautical miles away after 2354 days at liberty (6 years 5 months). It was measured at 83.5 cm on release and 110 cm on recapture and estimated 18 kg in August 2004. Overall, the recapture rate for kingfish is 8.2% for this programme (Table 3).

### 3.5 Yellowfin tuna

Only 80 yellowfin tuna were tagged in the 2004–05 season, well down on the 184 released in 2003–04. Most were estimated to be 15–35 kg on release (Figure 9a,) which is larger than those tagged last season. The main areas where yellowfin were tagged were the Three Kings, east Northland, and the Bay of Plenty (Figure 9b). Gamefish clubs reported landing and weighing 1050 yellowfin in 2004–05 and the same clubs reported tagging 69 yellowfin (Roz Nelson, NZBGFC, pers. comm.) giving a 6% tagging rate. Undoubtedly, some yellowfin would have been taken by non-club members or not recorded, but these numbers are unknown.

Two yellowfin recaptures were reported in 2004–05. The first was tagged and released from *Major Tom II* in March 2003 off the Bay of Islands and recaptured in August 2004 by a Japanese tuna longliner in the mid Tasman Sea in a similar area to three other yellowfin recaptures (Figure 9c). This fish was at liberty for 507 days (1 year 5 months) and was recaptured 600 nautical miles from its release point. This fish was estimated at 25 kg on release and weighed 33 kg (134 cm) on recapture. The second yellowfin reported this year, also tagged from *Major Tom II* in February 2003, was recaptured in the Fiji area by a tuna longline vessel some time in 2004 (date not supplied). This fish was tagged north of Cape Karikari and was estimated at 10 kg on release. It measured 52.5 cm on recapture and had moved about 900 nautical miles north (Figure 9c). Overall, the recapture rate for yellowfin tuna is 1.0% for this programme (Table 3).

### **3.6 Other billfish**

Compared with the earlier years of the programme, blue marlin have been tagged in greater numbers over the last four seasons, mainly by anglers in the Kingdom of Tonga (see Tables 1 and 2). Of the 91 blue marlin tagged in the 2004–05 season, 29 were tagged in New Zealand between January and May (Figure 10a). Most blue marlin were tagged between July and October in the Pacific Islands (Figure 10a). The fish tagged in Tonga were generally estimated at 150 kg or less, while in New Zealand they were estimated at 150 kg or more in 2003–04 (Figure 10b). No blue marlin recaptures were reported this season. The overall recapture rate of blue marlin is now 0.8% for this programme (Table 3).

Last season a swordfish estimated at 90 kg and measuring 1650 cm from the lower jaw to the tail fork was recaptured in June 2004 by a tuna longliner off Gisborne. This fish had been tagged by a commercial fisher 80 nautical miles northeast of East Cape in February 1996 and was estimated at 20 kg at the time. Therefore, this fish had been at liberty for 3047 days (8 years 4 months) and was recaptured 113 nautical miles from its release point and grew an estimated 70 kg during this time.

The growth rate for this fish is slower than that reported for the only other swordfish recapture for the programme to date. This fish was recaptured in February 2002 by an Australian longliner near the Wanganella Bank and had been tagged from a Japanese longline vessel north of New Zealand. It was estimated to weigh 12 kg on release and 160 kg on recapture 10 years and 8 months later (Holdsworth & Saul 2003). The overall recapture rate of swordfish is now 1.7% for this programme (Table 3).

### **3.7 General**

Overall, 4823 tags were issued to clubs and individuals by the NZBGFC in the 2004–05 season. The number of tags issued and number used in each region in 2004–05 is given in Figure 11. The selection of regions is based on the commonly fished gamefish areas. In some South Island regions tags issued in previous seasons have been used. To the end of July, 2627 tag report cards had been handed in for fish tagged in 2004–05.

## **4. DISCUSSION**

The 2004–05 season was an excellent one for striped marlin, with over 1300 tagged and released in New Zealand fisheries waters – the second-highest tally ever for this programme. NZBGFC records show that the tagging percentage decreased slightly from 65% in 2003–04 to 62% this season. As in 2003–04, there were four striped marlin reported recaptured.

The weight distribution of tagged striped marlin in 2004–05 (Fig.3) was similar to those in the 2001–02 and 2002–03 seasons, with a mode at the 90 kg size class. Compared to the previous season there were more fish in all size classes from 80 kg to 130 kg, but a noticeable skewing towards the larger size classes. It is tempting to speculate that this represents the smaller fish from the previous season returning to New Zealand waters, but to date there are too few recaptures made in successive seasons to sustain this proposition. It is unknown what proportion of one season's striped marlin return to New Zealand the following year. Some certainly do, because two tagged striped marlin have been recaptured close to their release points (5 and 35 nautical miles) the following year.

The release weight of striped marlin is estimated with the fish in the water and some of the recapture weights are also estimated. This season two recaptured fish tagged by experienced charter skippers had quite different weights estimated on recapture. A comparison of the estimated release weights with actual weight on recapture is given in the 2002–03 tagging report (Holdsworth & Saul 2004). Data from 16

recaptures showed that fish 100 kg and less were estimated on release to within 15 kg of their recapture weight. Striped marlin estimated to weigh 110 kg or more tended to be over-estimated. The average error was 9.5 kg (Holdsworth & Saul 2004). Actual fish weights may vary after release as the fish puts on or loses condition, but the weight distributions plotted in Figure 3 is based solely on estimated weights and may have an unknown bias.

All four striped marlin recaptures reported in 2004–05 were made in New Zealand waters. Again, Rick Pollock from *Pursuit* has reported that the tag was close to falling out of a marlin they recaptured after 96 days at liberty. Three other marlin were caught with tags but no numbers retrieved. Occasionally fish smokers report retrieving tag heads with no number from marlin. In some instances these tags were placed at the time of capture and cut off when the decision was made to keep the fish and it was boated. However, there have been others that are discoloured and have obviously been in the fish for a long period. Tag failure or tag shedding appears to be a problem with striped marlin that contributes to relatively low recapture rates world wide. Over 90% of striped marlin recaptures are within a year of release and unlike other billfish recovery percentages suggest that the stainless steel headed tags have superior retention to nylon anchor tags (Ortiz et al. 2003). However, the New Zealand tagging programme recapture rate of 0.5% is lower than that of most other programmes for this species. Tag shedding, initial mortality, natural mortality, and non-reporting could all contribute to this. In comparison, the combined tag loss for from these factors is not as great for blue sharks with 1.7% recaptured, mako sharks 2.8%, kingfish 8.2%, and school shark 13.1%.

The number of mako sharks tagged and released this season was higher than in the previous two years, but remained well below the long-term average. Anglers again reported very few sightings of mako sharks, particularly in the areas off the northeast of the North Island, where they were formerly common. The number of recaptures is also low, probably as a result of fewer fish being tagged and released. The catch of mako sharks on surface longlines has been increasing (Ayers et al. 2004).

The number of blue sharks tagged decreased slightly in 2004–05 over the previous season. The number tagged is influenced by the fishing conditions off Otago Heads during February, when blue sharks are targeted during a national gamefishing contest; 72 of the 97 blue sharks were tagged off Otago Heads, with the remaining blue sharks being released in a widespread variety of locations around the North Island. There were two blue shark recaptures in 2004–05. The greatest straight line distance covered by any fish in the programme in 2004–05 was a blue shark recaptured near the Cook Islands, 1560 nautical miles from its release point, after 145 days at liberty.

Most kingfish were once again tagged from three or four boats. Over three-quarters of tagged kingfish were measured on release. In some cases, crew had been specifically supplied with tags and used measuring boards to measure fork length on release and recapture. Much of our best information on kingfish growth has come from the White Island area, where there is a resident population of large fish with a relatively high recapture rate. Rick Pollock, the skipper of the charter vessel *Pursuit*, has made a significant contribution to a number of kingfish research projects and stands out in his contribution to the tag and release programme. Almost a third of the 13 000 kingfish on the tagging database have come from his vessels and almost all have been measured. He has reported hundreds of recaptures, occasionally the same fish for the second or third time. The increase in kingfish tagged off Raglan, on the North Island west coast, was a feature of the 2004–05 season, comprising smaller fish than those tagged near White Island. These were also measured on release, however, and five recaptures already reported indicate that continued tagging in this area may become of similar value to the longer-standing tagging in the eastern Bay of Plenty.

There has been sufficient data collected from long-distance recaptures to discuss the dispersion of four fish species from New Zealand, and who we share these highly migratory species with. In the southwestern Pacific Ocean, mako, blue shark, and striped marlin are mostly taken as a bycatch on surface

longline vessels targeting bigeye, yellowfin, and albacore tuna. These vessels are the main source of tag returns from outside New Zealand fisheries waters (200 nautical mile EEZ). Ninety-three mako sharks have been recaptured outside New Zealand waters and 49 have been reported from Fijian waters. Most of the rest of the reported mako recaptures come from New Caledonia, Australia, and the Tasman Sea west of New Zealand. Blue shark recaptures come from similar areas to the north and northwest of New Zealand, but of 22 offshore recaptures 4 have travelled northeast or east and one was recaptured southwest of Perth, indicating a broader distribution than shown by New Zealand tagged makos. Striped marlin also seem to fan out into the subtropical southwest Pacific in what appear to be three main directions: northwest to the north Tasman Sea; north to Fiji, Tonga, and Samoa; and northeast to French Polynesia. Although there have only been seven long-distance yellowfin tuna recaptures four of these have come from international waters in the mid Tasman Sea north west of New Zealand, an area fished by vessels from Australia, Japan, and Chinese Taipei in recent years (Western and Central Pacific Fisheries Commission Tuna Fishery Yearbook 2005). Also fishing in the waters of the island nations in the southwest Pacific are vessels from China, Korea, and the Philippines as well as domestic fleets mainly out of New Caledonia, Vanuatu, Fiji, Tonga, Cook Islands, Samoa, American Samoa, and French Polynesia.

## 5. ACKNOWLEDGMENTS

Thanks to all those who participated in this programme by releasing or reporting tagged fish. The New Zealand 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, "Management of data from the gamefish tag recapture programme" PEL2003/01.

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**Table 1: Number of fish tagged and released by species and season, and the mean number of releases for the 10 seasons previous to 2003–04, for fish tagged inside the New Zealand EEZ only.**

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			1	107	152	1			18			5	284
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					25	2	282
1985–86			23	318	211	1			2		6	4	565
1986–87			12	365	177	31			2		5	18	610
1987–88	1	1	91	689	505	47			97	6	13	82	1 532
1988–89	1		122	371	370	32			371	4	63	116	1 450
1989–90	1	2	87	427	424	26		2	365	4	139	100	1 577
1990–91			90	528	417	32		7	229	5	24	51	1 383
1991–92	1	1	128	389	353	40		1	239	20	39	38	1 249
1992–93	1		64	692	352	24		8	383	36	10	75	1 645
1993–94	10		162	1 100	666	19		17	928	3	92	38	3 035
1994–95	4		175	1 443	1 529	23		29	1 202	10	200	24	4 639
1995–96	7	3	163	643	1 158	30		13	1 102	3	110	5	3 237
1996–97	6	5	343	416	920	36		5	1 301	4	33	9	3 078
1997–98	8	1	724	364	518	54		1	895		3	4	2 572
1998–99	36	1	276	311	754	40		6	1 541	2	17	8	2 992
1999–00	51	2	314	818	398	56		2	787	2	27	40	2 497
2000–01	34		203	606	277	72		1	851	6	17	4	2 071
2001–02	21	2	163	775	346	69		13	768	3	7	3	2 170
2002–03	3	1	78	646	155	54		14	671	3	76	2	1 703
2003–04	8		106	771	187	61		8	1 047	2	184	6	2 380
2004–05	29	5	97	801	234	59		6	1 311	6	79		2 627
Total	222	25	3 599	12 908	11 120	832	0	133	14 167	119	1 178	678	44 981
Previous 10 year Mean	18	2	255	679	624	50		9	1 017	4	67	11	2 734

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 tagged and released by species and season, in the New Zealand gamefish tagging database, for fish caught outside the New Zealand EEZ.**

Season	BEM	BKM	BWS	KIN	MAK	SHA	SAI	SSF	STM	SWO	YFN	OSP	Total
1974-75													
1975-76													
1976-77													
1977-78													
1978-79													
1979-80													
1980-81													
1981-82													
1982-83													
1983-84													
1984-85													
1985-86											2	2	4
1986-87											2	4	6
1987-88													
1988-89													
1989-90	6	2						1			1		10
1990-91		2					4						6
1991-92	4	1							2				7
1992-93	10	1		1			5	1	3		3	5	29
1993-94	10	2			1		5		1		12	3	34
1994-95	25	4		1	2		9		4		15	4	64
1995-96	39	3					4	2	2			7	57
1996-97	20						4		1				25
1997-98	16	4					6		3				29
1998-99	7	1					2				2		12
1999-00	13	1					11	1	4				30
2000-01	37	1					8						46
2001-02	48	1					11		1				61
2002-03	57						15	2	6				80
2003-04	78	18		1	1		15	4	308		12	1	438
2004-05	62	3			1		5	3	2		4		80
Total	432	44		3	5		104	14	337		53	26	1 018

BEM blue marlin  
 BKM black marlin  
 BWS blue shark  
 KIN kingfish  
 MAK mako shark  
 SHA other shark species

SAI sailfish  
 SSF shortbill spearfish  
 STM striped marlin  
 SWO broadbill swordfish  
 YFN yellowfin tuna  
 OSP all other species

**Table 3: Number of fish recaptured by species and season. Total and recapture rate by species.**

Season	BEM	BKM	BWS	KIN	MAK	SHA	SAI	SSF	STM	SWO	YFN	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	4							105
1987-88				77	8	1						3	89
1988-89			2	91	13	1			1			3	111
1989-90			-	45	10	6			2			-	63
1990-91			3	37	7	3			1		1	1	53
1991-92			3	31	12	1			-		-	3	50
1992-93			2	43	3	2			3		-	-	53
1993-94			1	54	10	5			4		1	-	75
1994-95			2	86	16				6		-	1	111
1995-96		1	1	71	32	1			6		3	1	116
1996-97		-	4	52	35	2			5		1	1	100
1997-98	1	-	9	26	17	2			12		1	1	69
1998-99	-	-	10	20	15	4			14		-	-	63
1999-00	1	-	11	57	23	5			5		-	2	104
2000-01	1	-	4	29	15	3			2		1	1	56
2001-02	-	-	3	48	16	1			2	1	-	-	71
2002-03	2	-	-	27	9	2			1	-	-	1	42
2003-04	-	-	2	32	9	2			4	1	2	-	52
2004-05	-	-	2	38	6	1			4	-	2	-	52
Total	5	1	60	1 057	313	46	0	0	72	2	12	19	1 586
Releases	654	69	3 599	12 911	11 125	832	104	147	14 504	119	1 231	704	
Recapture rate (%)	0.8	1.4	1.7	8.2	2.8	5.5			0.5	1.7	1.0	2.7	

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

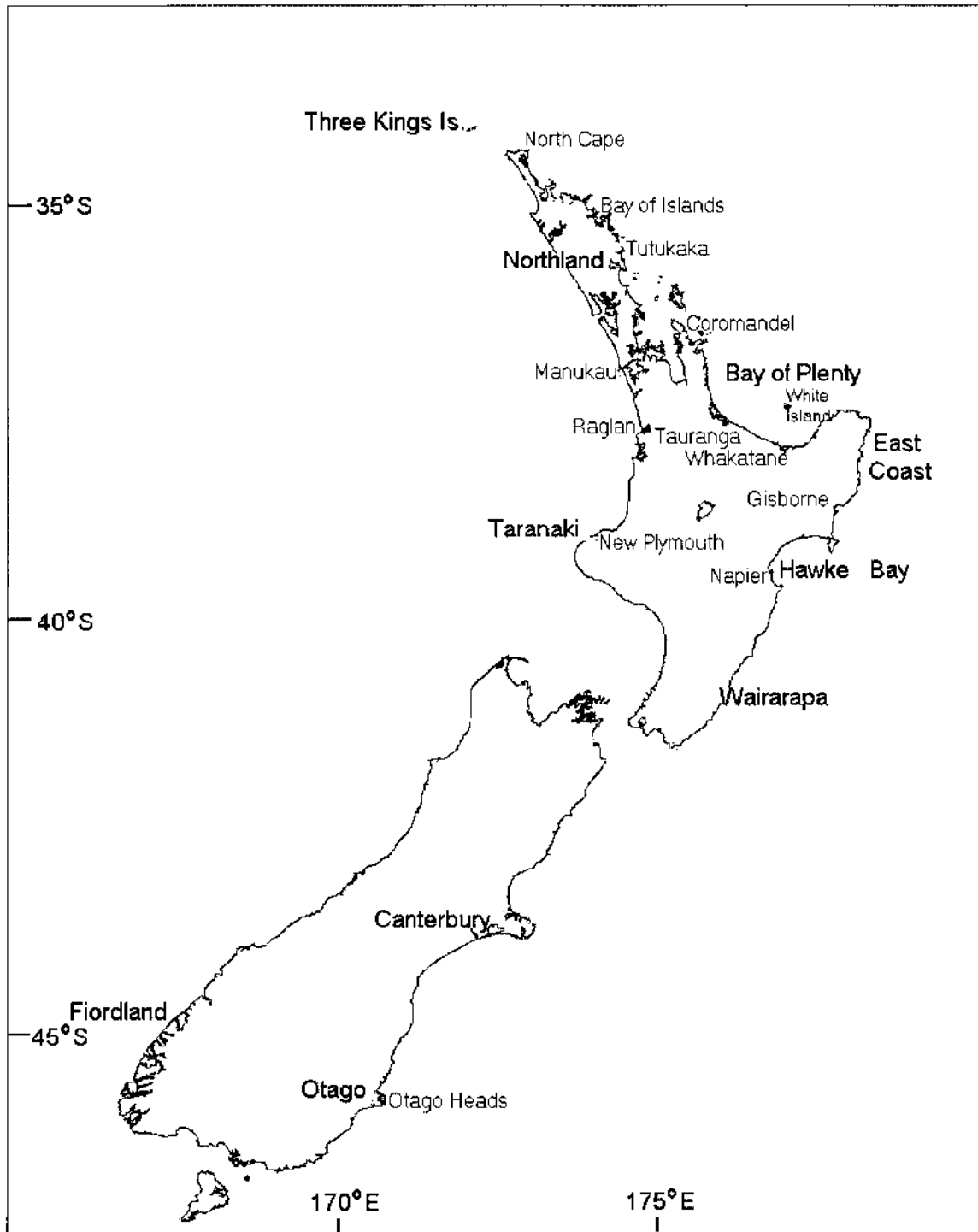
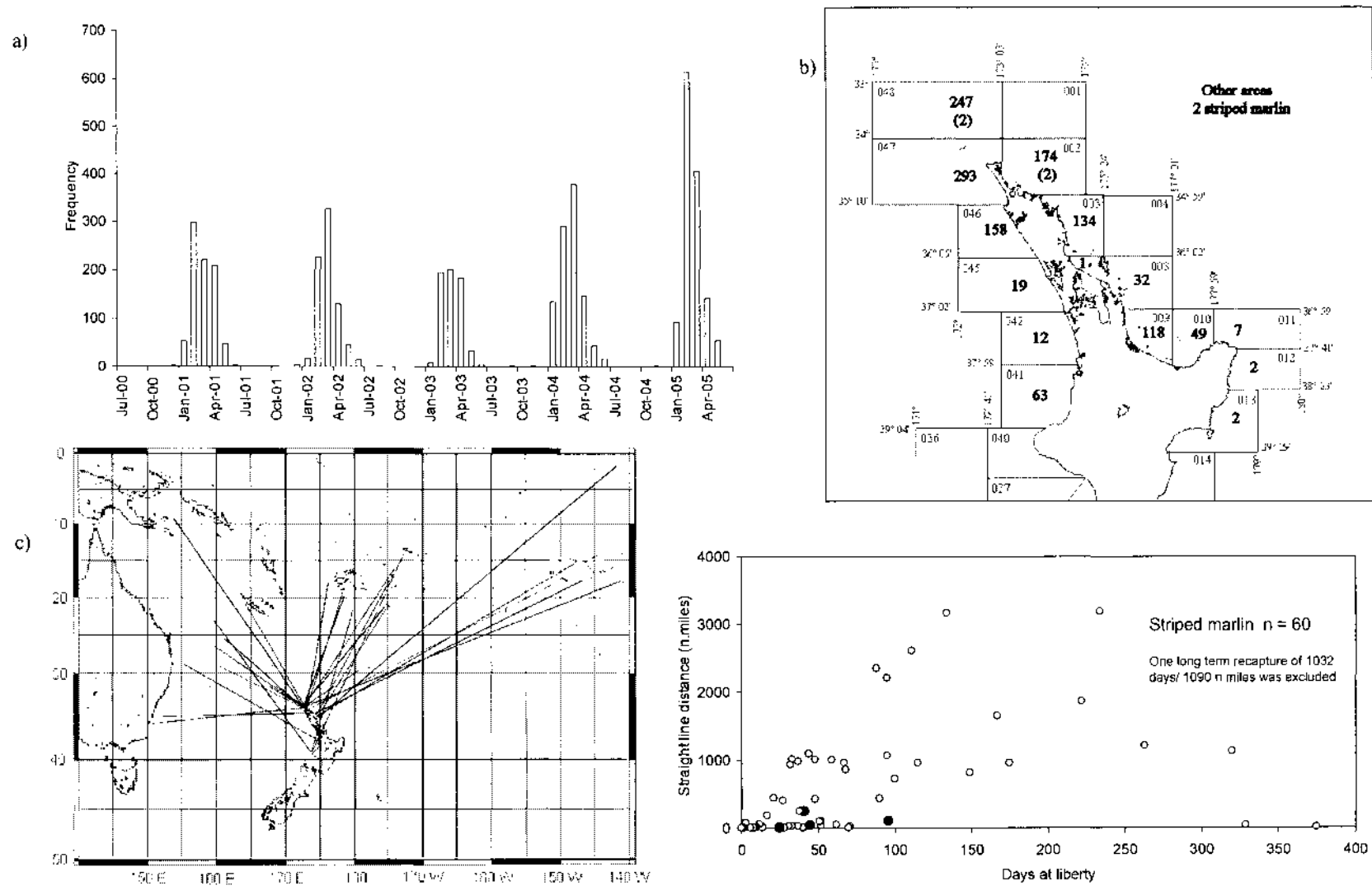
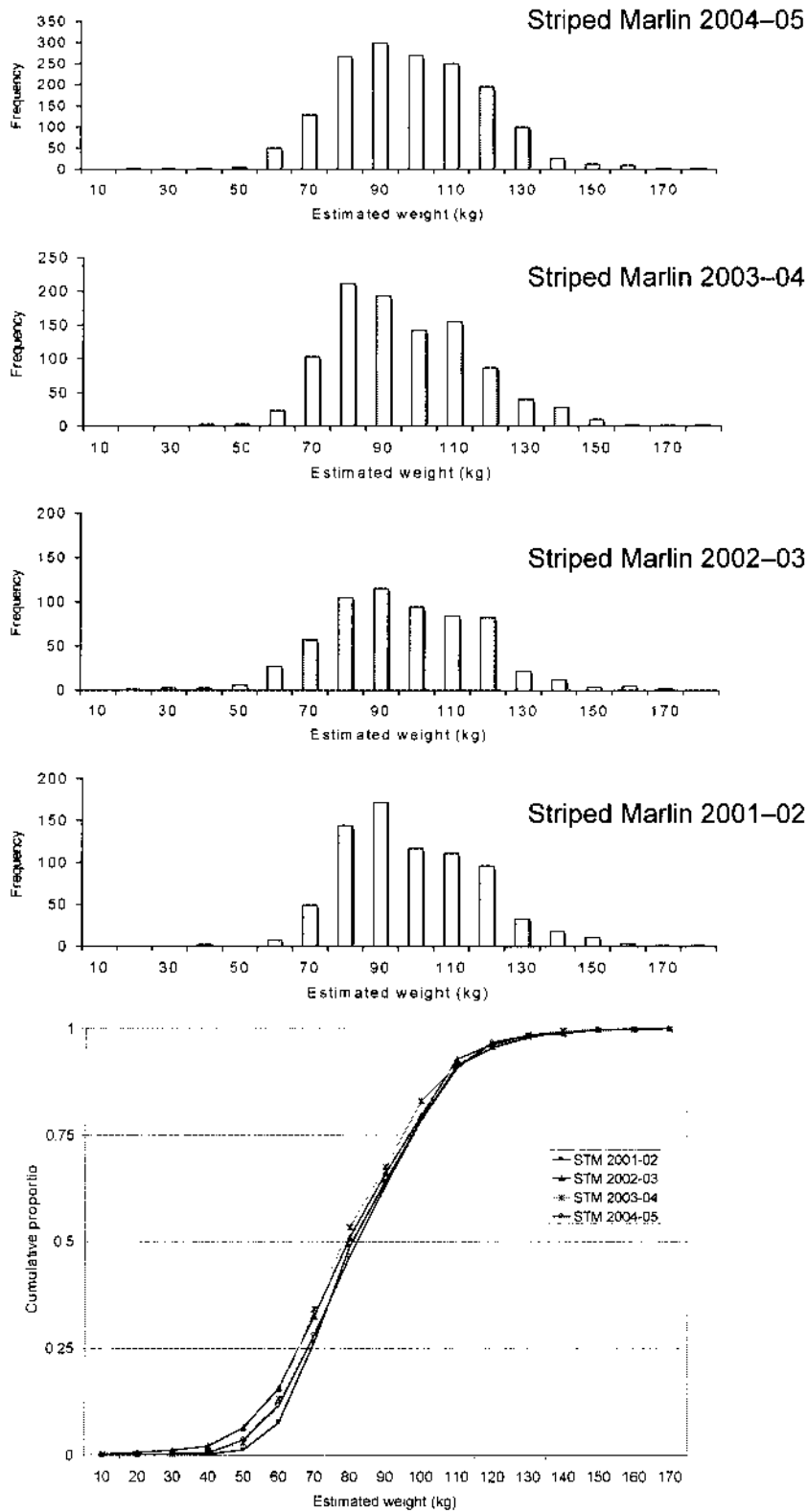


Figure 1: Location of the main areas of gamefish tagging in New Zealand.



**Figure 2: (a) Number of striped marlin released by month 2001–05; (b) Numbers of striped marlin released by statistical reporting area in 2004–05; (c) Long distance movements of tagged striped marlin; (d) Striped marlin days at liberty and straight-line distance travelled, solid markers for 2004–05.**



**Figure 3: (a) Striped marlin estimated release weights by season, 2001-02 to 2004-05; (b) The cumulative proportion of striped marlin estimated release weights by season.**



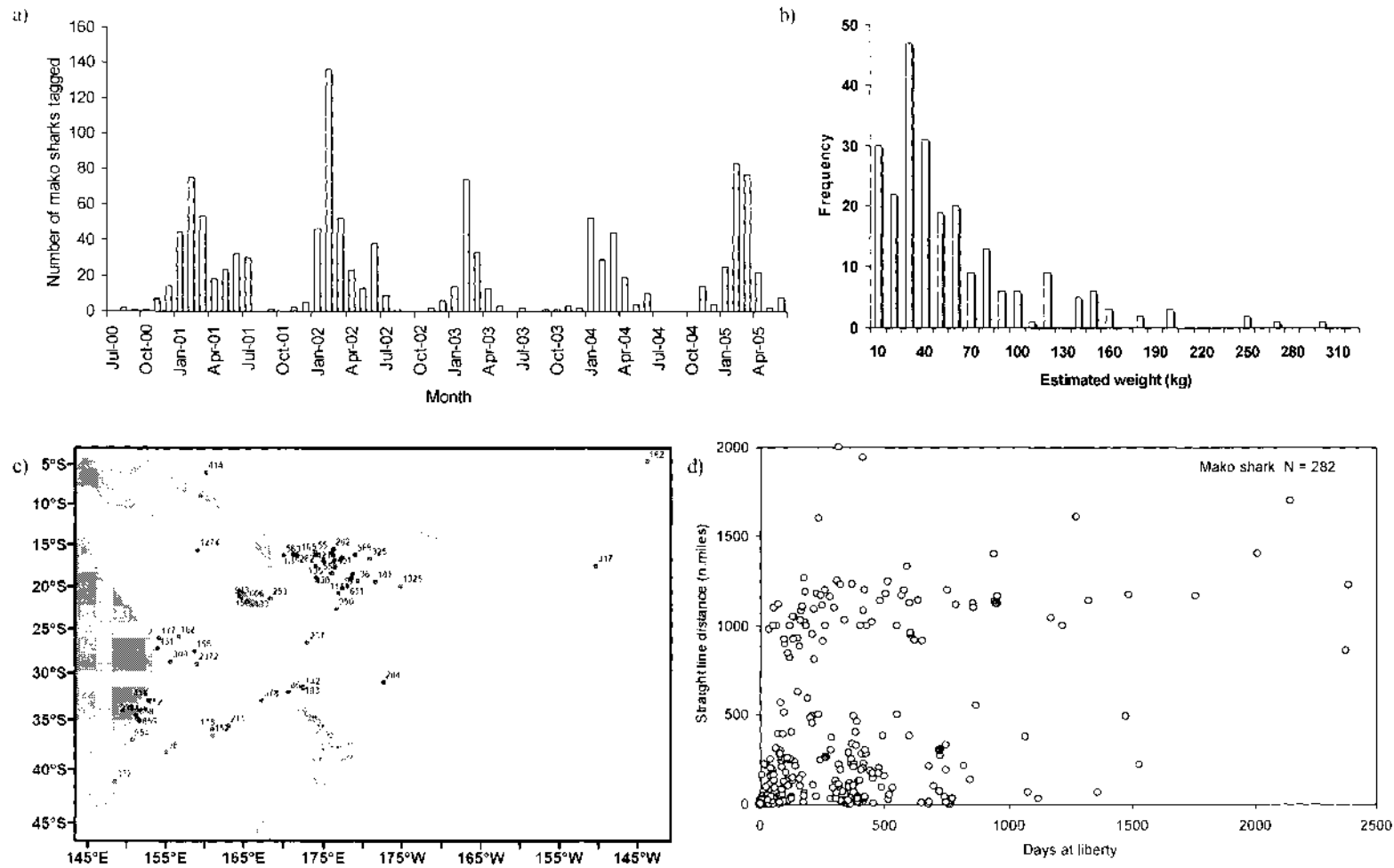


Figure 5: (a) Number of tagged mako sharks released by month, 2001–05; (b) Mako shark estimated release weight frequency, 2004–05; (c) Long distance movements of tagged mako sharks for all seasons combined (number of days at liberty next to recapture point); (d) Mako shark days at liberty and distance travelled for all seasons with solid markers for 2004–05 (one long-term recapture of 4118 days and 190 nautical miles not plotted; one long distance recapture of 3000 nautical miles and 190 days not plotted).

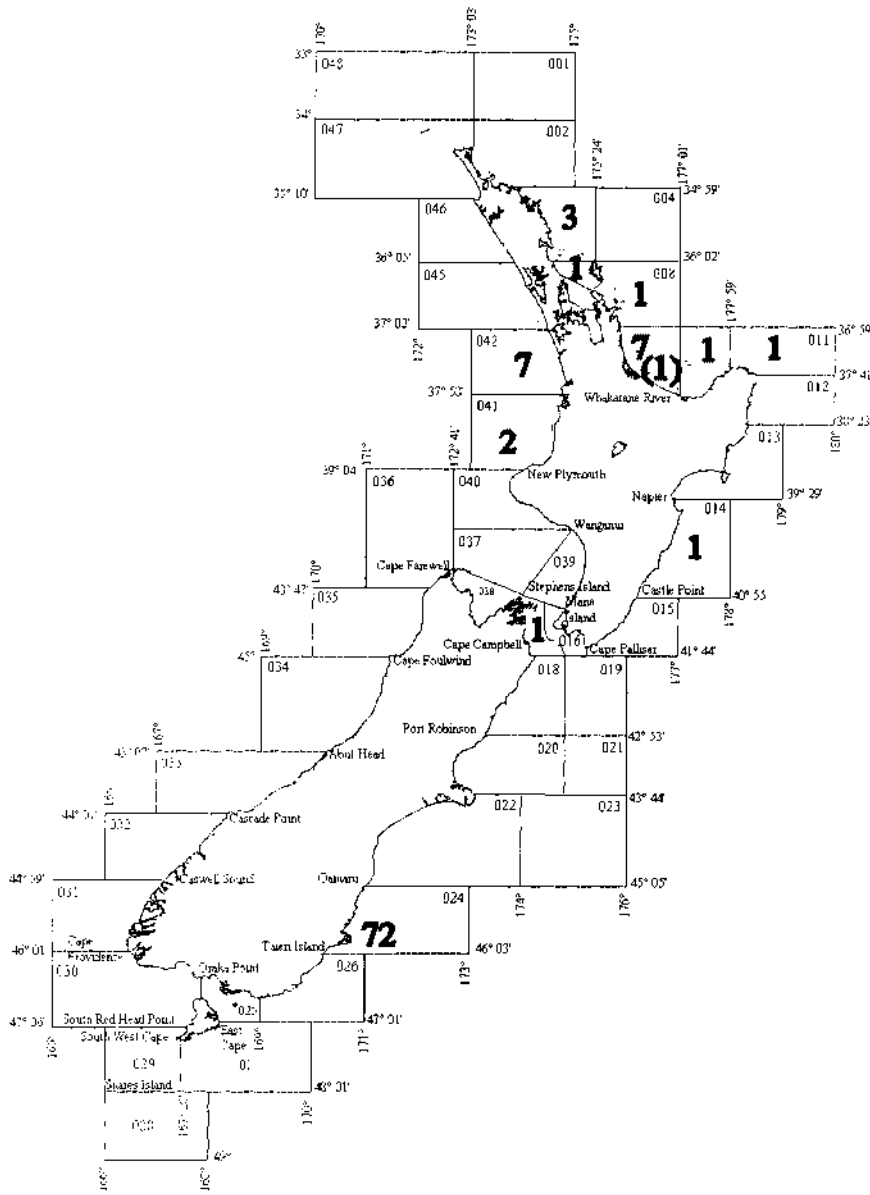


Figure 6: Blue sharks tagged and released by statistical reporting area in 2004-05.



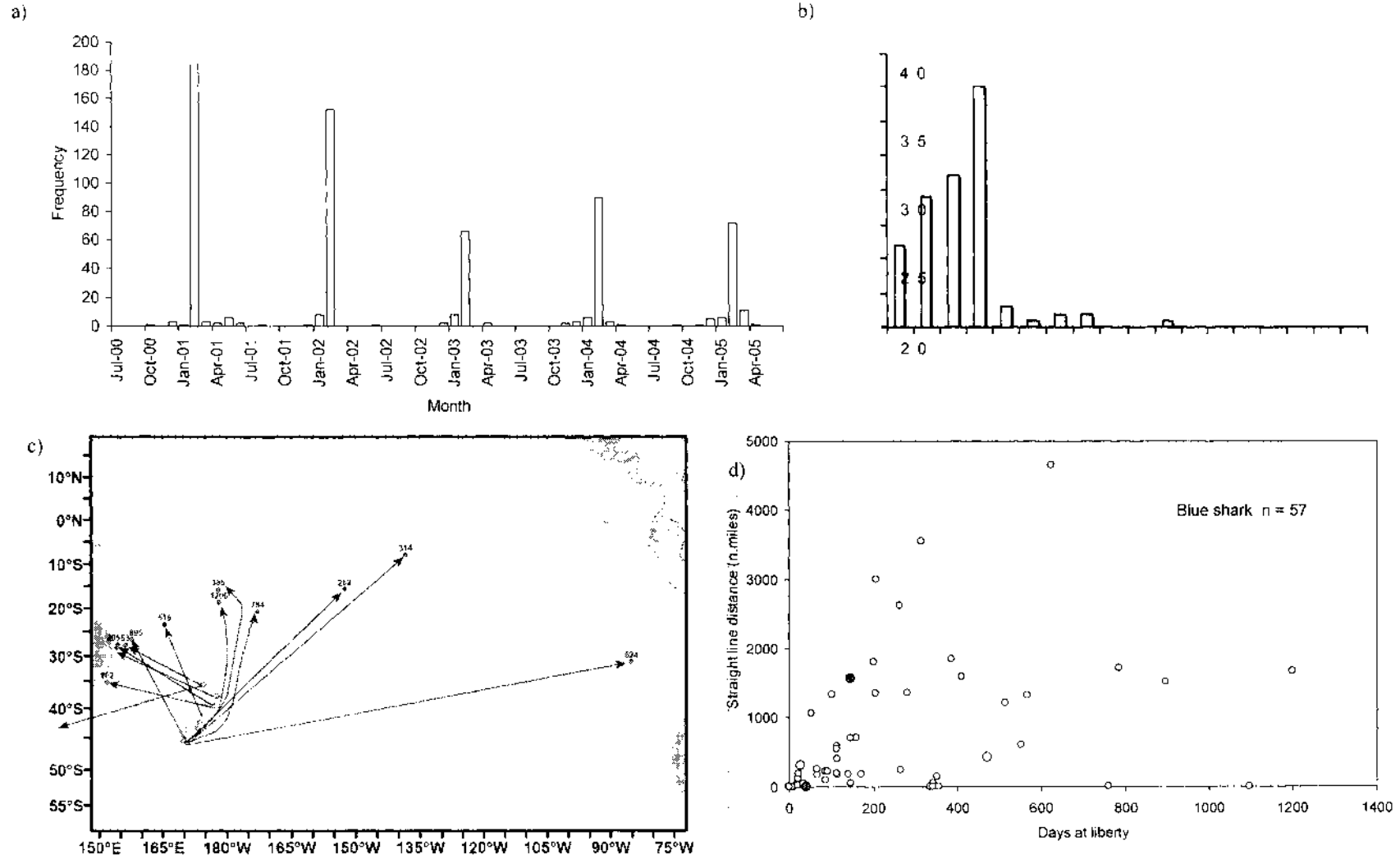


Figure 7: (a) Number of tagged blue sharks released by month 2001–05; (b) Blue shark estimated release weight frequency 2004–05; (c) Long distance movements of tagged blue sharks all seasons (days at liberty at recapture point); (d) Blue shark days at liberty and straight line distance travelled.

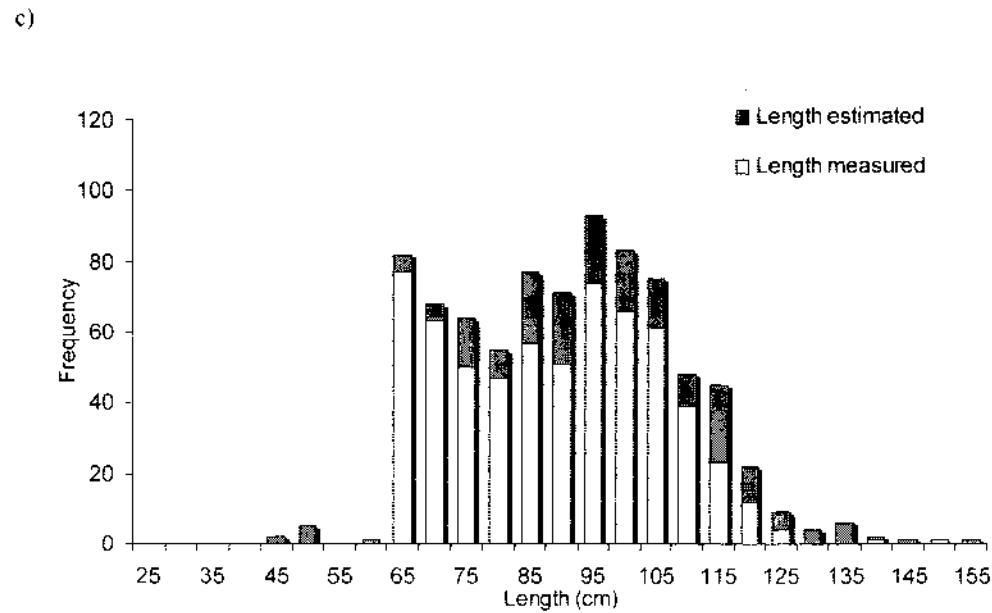
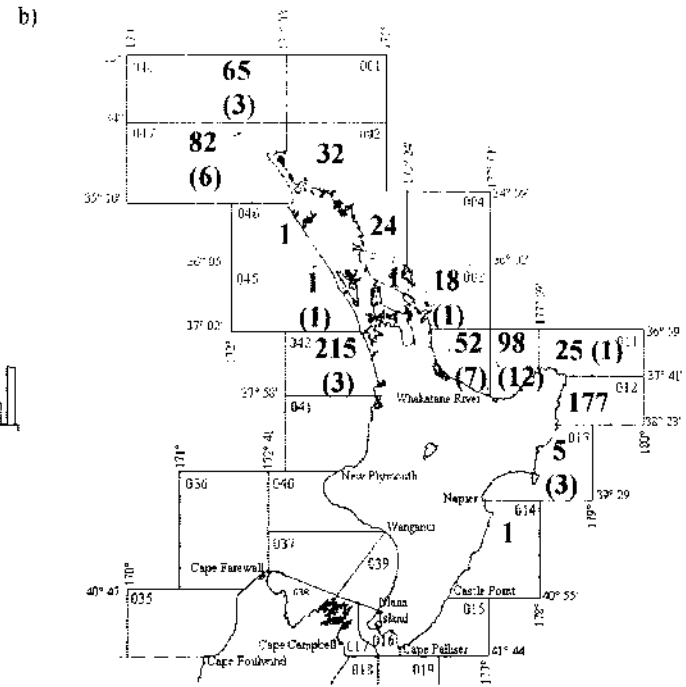
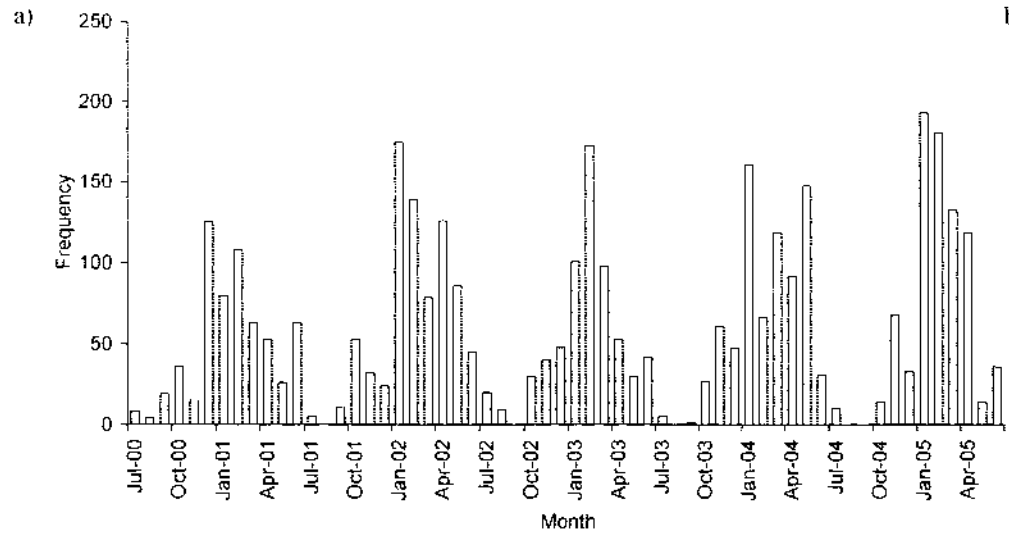


Figure 8: (a) Number of tagged kingfish released by month, 2001–05; (b) Numbers of kingfish released, and numbers recaptured (in parentheses), by statistical reporting area for the 2004–05 season; (c) Kingfish release length frequency in the 2004–05 season.

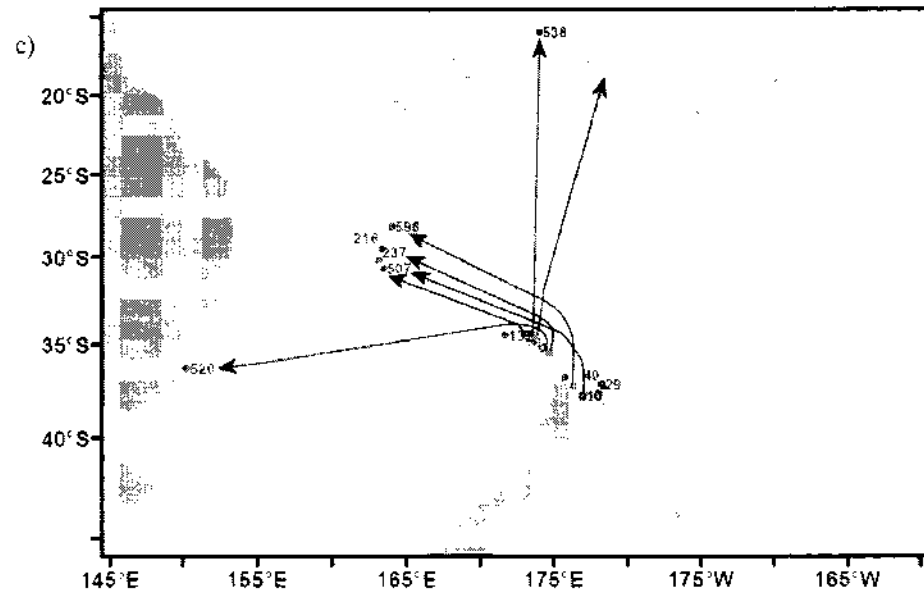
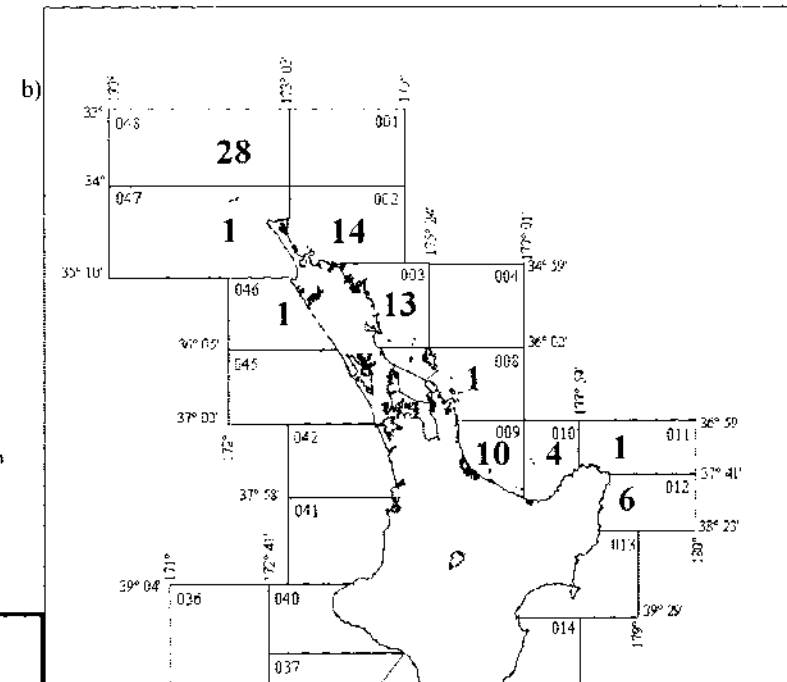
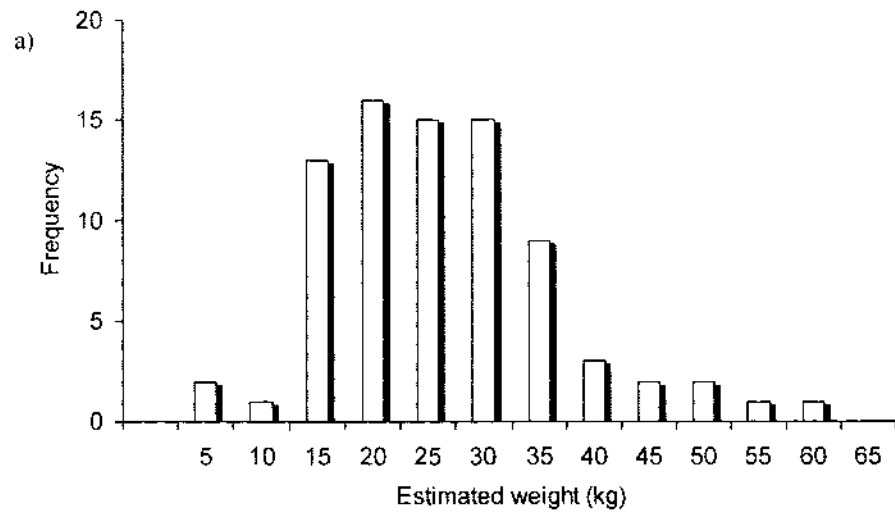
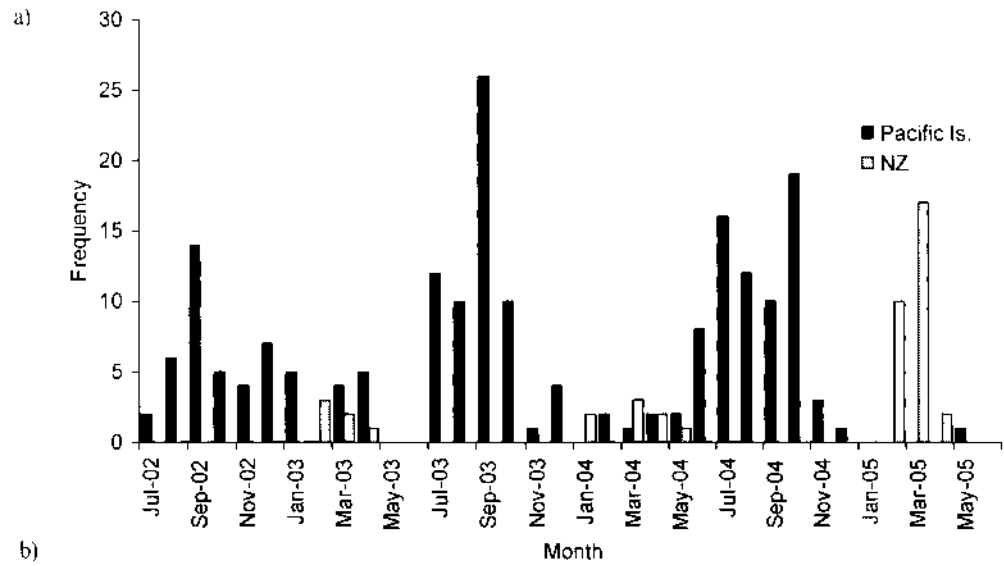
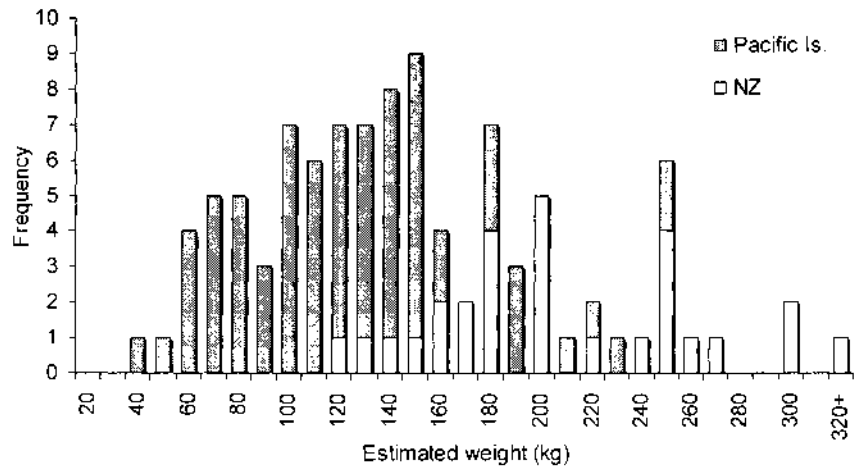


Figure 9: (a) Yellowfin tuna release weight frequency for the 2004–05 season; (b) Numbers of yellowfin tuna released, by statistical reporting area for the 2004–05 season; (c) Long distance yellowfin tuna recaptures with days at liberty near recapture point.



b)



**Figure 10: (a) Number of blue marlin tagged and released by month in Pacific Island waters (solid bars) and New Zealand waters (open bars) 2002–05; (b) Blue marlin release weight frequency in the 2004–05 season.**

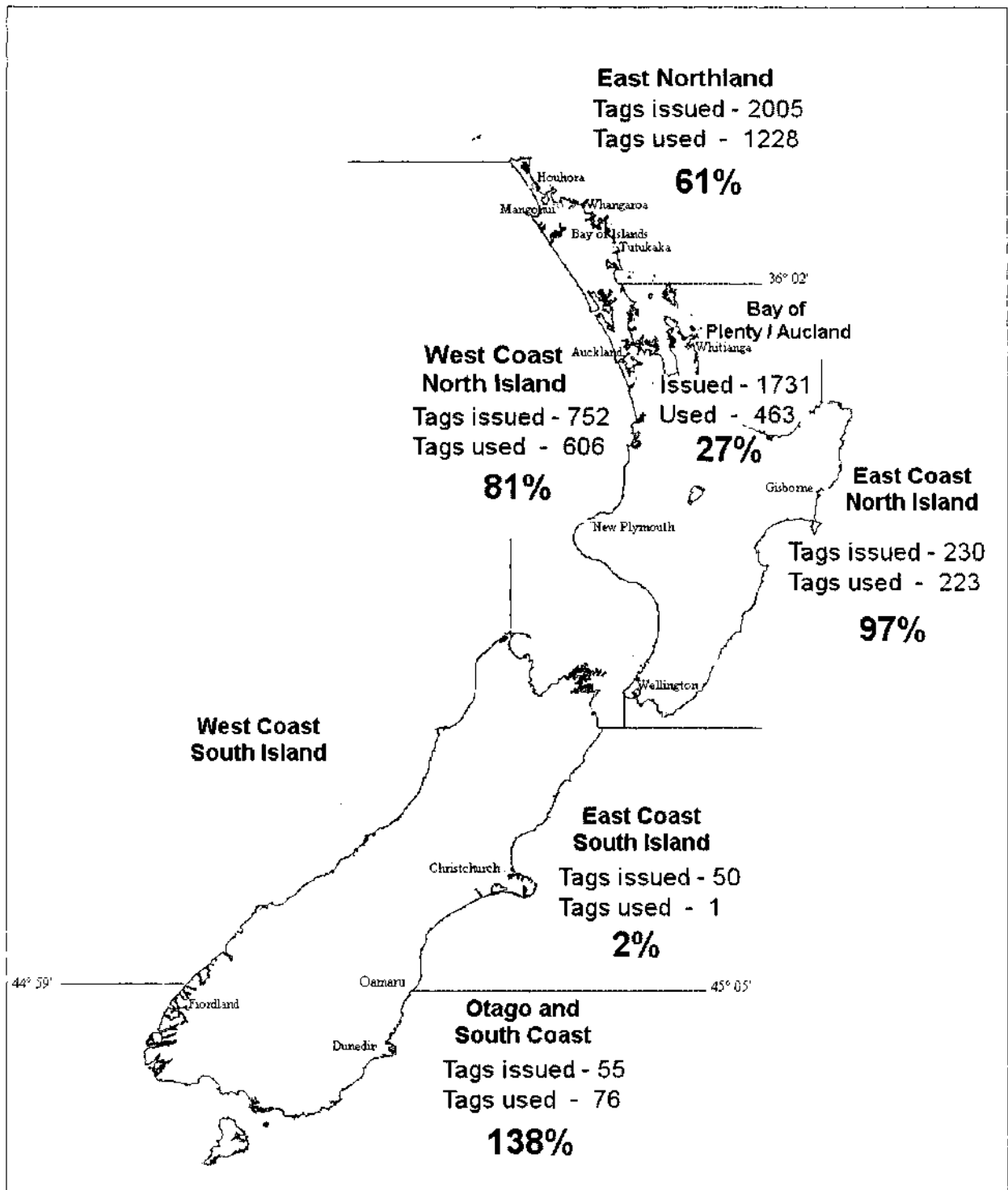


Figure 11: The number of tags issued to clubs and individuals and the number reported used by region for the 2003–04 season. The percentage of tags used can be influenced by the number of tags issued in previous seasons.