

New Zealand billfish and gamefish tagging, 2008–09

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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 (*Kajikia 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 targeted 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 2008–09 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 2248 fish were reported tagged and released. The number of striped marlin tagged (1058) was the highest since 2004–05, and the second highest in the past 10 tagged striped marlin has increased in each of the last four seasons. Catches on the west coast of the North Island fell in 2008–09 after improving considerably the season before, with very few fish caught off Taranaki. Fishing for striped marlin was significantly more successful on the east coast of Northland, with excellent fishing off Whangaroa, the Bay of Islands, and Tutukaka. The number of striped marlin tagged in the Three Kings area was 25% of the national total, in line with the five-year average.

The number of mako and blue sharks tagged remained significantly below the long-term average, as has been the case for the last five years. Club catch records indicate very high percentages of the total recreational catch of mako (85%) and blue sharks (88%) were tagged rather than landed. The number of kingfish tagged (660) in 2008–09 was substantially lower than the long-term average, but the percentage of kingfish measured on release remained high at 81%.

A total of 59 (2.6%) recaptures was reported in the 2008–09 fishing season. Of these 43 (73%) were yellowtail kingfish, 3 (5%) striped marlin, 4 (7%) blue sharks, 5 (8%) mako sharks, and 2 (3%) other sharks. One striped marlin, one mako shark, and three blue sharks were recaptured more than 1000 nautical miles from where they were tagged. A mako shark recaptured after almost 10 years by a tuna longline vessel between New Caledonia and Vanuatu was a 297 cm pregnant female. In another first for the tagging programme, a blue shark that had been recaptured and re-released was caught for a second time after 666 days, in the Coral Sea.

Some unusual kingfish recaptures were recorded, including one which moved from the west coast of the North Island to Lord Howe Island, off the Australian east coast. Two other kingfish tagged off the North Island west coast were recaptured on the east coast : one in the Hauraki Gulf and one at an unknown location but likely to have been in Hawke Bay since it was landed there by a local vessel.

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, cooperative tagging programmes aim 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 subsequently 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 the 2008–09 season prepared by Blue Water Marine Research as the final reporting requirement for the Ministry of Fisheries, project TAG2006/01. An independent review of the gamefish tagging programme in New Zealand was undertaken in July 2009 and the review panel's recommendations will be taken into account when setting objectives and reporting requirements in future.

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. On the North Island southeast coast, fishing clubs are established from Gisborne to Wairarapa (Figure 1). Striped marlin (*Kajikia audax*) (Collette et al. 2006) is the mainstay of the gamefishery on the Northland east coast (Figure 1), with blue marlin (*Makaira nigricans*), 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 yellowtail kingfish (*Seriola lalandi*). In the Bay of Plenty (Figure 1), yellowfin tuna and large yellowtail kingfish were the main pelagic gamefish sought, although several poor yellowfin seasons have seen an increase in targeting of striped marlin and blue marlin.

Shark species become increasingly important with distance south. Gamefishing has developed on the west coast of the North Island over the last 16 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 off Canterbury, Otago, and Fiordland (Figure 1), with blue shark abundant and therefore the primary target species, along with porbeagle shark (*Lamna nasus*) and occasionally southern bluefin tuna (*Thunnus maccoyii*). There is a developing seasonal (winter) fishery for Pacific bluefin tuna (*Thunnus orientalis*) off the central west coast of the South Island, accessed from the ports of Greymouth and Westport. This fishery is associated with large spawning aggregations of hoki (*Macruronus novaezealandiae*)

that are targeted by commercial trawl vessels offshore between July and September.

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 (*Thunnus obesus*) and southern bluefin tuna. 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 allowed to be landed 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 willing to tag 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 15 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 there was potential to tag substantial numbers of fish and make sufficient recaptures to provide useful data, or they were species of national or international significance or concern (Saul & Holdsworth 1992). 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 up to 2005 all had 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 (G 53501) until March 2004 (G 92500). Since then tags were supplied with wire extending 35 mm up the tag. The tag number

was printed lower on the tag and was over the area with wire. If the tag broke above the wire, as before, the tag number would remain.

In 2005, 1000 tags with the nylon double-barbed anchors were purchased for billfish. This type of tag head was developed by The Billfish Foundation (USA) and the NMFS and has been widely used on billfish in the USA and more recently in Australia. These plastic head intra-muscular tags – type PIMA – were purchased from Hallprint with the new prefix N and carried on the tag numbering sequence from the G series tags (N 102501 to N 103500). A different applicator tip is required from that used with the stainless steel tag anchors. Both tag types are currently in use.

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, size, and weight 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 and sex – 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 most – with the exception of kingfish – 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 give a more accurate record 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 inside New Zealand fisheries waters in the 2008–09 season was 1058, a substantial increase (35%) on the 2007–08 season (963) and 9% higher than the average of the previous 10 years (971) (Table 1). A further 731 striped marlin were reported as landed in gamefish club records (Roz Nelson, N.Z. Big Game Fishing Council, pers. comm.). Using NZBGFC records only, it is estimated that 59% of recreationally caught striped marlin were tagged and released in 2008–09. The number of striped marlin landed by fishers and not recorded in 2008–09 is not known. Over the previous five seasons a total of 446 striped marlin had been tagged outside the EEZ, most of these at the Wanganella Banks, south of Norfolk Island in the Tasman Sea. Twenty-nine report cards were received for striped marlin tagged outside New Zealand fisheries waters in 2008–09 (Table 2).

Figure 2 shows the proportion of striped marlin tagging by fisheries statistical areas from 2001–02 to 2007–08 (Figure 2a) compared to the 2008–09 season (Figure 2b). One of the core areas – the King Bank and Middlesex Bank (Area 048) – accounted for the same proportion in each period (25%) of striped marlin tagged. However, east Northland, and in particular Area 003 (Bay of Islands and Tutukaka), were much more productive than in recent seasons with 52% of all striped marlin tagged there. No striped marlin were tagged off Taranaki, unlike in the 2007–08 season, and there was no change in the Bay of Plenty.

The monthly totals of striped marlin tagged over the last five seasons are shown in Figure 3a. As in 2007–08 there were few striped marlin caught in January. There was a strong peak in February, with good catches in March also, but fishing tailed off rapidly in April, with few fish caught after that.

Striped marlin estimated release weights for 2008–09 are plotted in Figure 3b and show a mode in the 90 kg size class in 2008–09. There has been an increasing trend in the estimated sizes of tagged striped marlin over the past four years. Between 2005–06 and 2008–09, the proportion of striped marlin tagged at estimated weights of less than 90kg has steadily declined from 45% to 29%, while the proportion estimated at greater than 100 kg has increased from 35% to 47%. While there are obvious difficulties in using estimated weights in this way, the trend in the reported data is still worthy of note.

Long-distance recaptures for striped marlin show a wide spread of locations across the southwest Pacific Ocean and Tasman Sea (see Figure 3c). Fish tagged in the same season, even in the same month and area, have been observed to travel to completely different regions of the southwest Pacific, but not beyond, after leaving New Zealand.

Three striped marlin were reported recaptured in the 2008–09 season (Table 3). Two were made by sport fishing vessels and one by a commercial tuna longline vessel. The commercial recapture was a marlin tagged off Cape Runaway on April 2008 and estimated at 85 kg. It was recaptured off Brisbane in July 2008, 1105 n.miles from where it was tagged after 224 days.

The second recapture for the season was unusual in two respects. Firstly, it was caught on a live bait whereas the great majority of striped marlin that are tagged off New Zealand are caught on lures. The second unusual aspect was that the fish was re-tagged and released again. The marlin was first tagged at the Middlesex Bank in late February 2009. It was caught again at the King Bank, 23 nautical miles to the west, three weeks later. The tag was removed and a new one inserted before the marlin was freed. It was estimated at 100 kg the first time and at 80 kg on the second occasion.

The third recapture for the season was a short-term one like many in this programme, but was particularly interesting because it was tagged off Whangaroa in March 2009 and moved 150 n.miles southeast to Red Mercury Island where it was recaptured after 18 days. It was estimated to weigh 95 kg on release and weighed 88 kg on recapture.

Release and recapture weights for striped marlin at liberty for less than 6 months showed a mean difference of 15.1 kg (s.d. 14.41) when fish were estimated both times and a mean difference of 10.5 kg (s.d. 8.64) when the fish were weighed on recapture (Table 4). Most striped marlin have been recaptured within 10 months of release, but three fish were recaptured in New Zealand the following season, close to where they were released (Figure 3d).

3.2 Mako shark

The number of mako sharks tagged in New Zealand fisheries waters during the 2008–09 season was 284, which is 5% lower than the average number of makos tagged in the 10 previous seasons (see Table 1) but only two fish less than the previous season. According to NZBGFC records, 85% of all mako sharks caught by gamefish club members in 2008–09 were tagged and released. The number of makos released without being tagged is unknown.

Off northern New Zealand, mako sharks are not normally a target species, but are caught as a bycatch from vessels targeting billfish or tuna. Most are caught on lures but a smaller number are caught on baits. Figure 4 shows the distribution of tagging effort for mako sharks from 2001–02 to 2007–08 (Figure 4a) and for the 2008–09 season (Figure 4b). Most makos were tagged off the northeast coast of the North Island. No mako were tagged off Taranaki, unlike in the 2007–08 season, although fisheries statistical area 042 (Raglan to Manukau Harbour) accounted for 16% of the total. Higher than usual numbers of mako (30% of the total) were tagged in Area 008, east of the Coromandel Peninsula. Taggings of mako off east Northland declined again in 2008–09 but still accounted for 19% of the total.

Most makos were tagged between January and May 2009 with a very strong mode in February, when more than three times as many makos were tagged as in any other month (Figure 5a). This peak is associated with the NZBGFC National Contest which runs over nine days in late February each year, and which encourages the tag and release of various species. The size distribution of makos tagged in 2008–09 shows that most were juvenile fish, with the mode at 40 kg. Very few makos over 100 kg were tagged, and the proportion of these larger fish has decreased over time (Figure 6a). This weight distribution was similar to that in the previous season (Figure 6b). However, because most makos are accidentally hooked on lures with monofilament traces, large ones tend to bite through the trace and escape before they are brought into tagging range. There has been an increase in the proportion of small makos in the recreational catch, and a decline in the number of larger fish tagged since 2000–01 (Figure 6c).

Five tagged mako sharks were recaptured in 2008–09. All five had been tagged by recreational anglers and all were recaptured by commercial fishers, three from Spanish and one from Chinese vessels (Table 5). The most notable was a large female recaptured between New Caledonia and Vanuatu in January 2009 and reported by a Fijian observer on a Chinese longliner. It measured 297cm in fork length and contained 8 unborn young. It had been at liberty for almost 10 years (3624 days) since being tagged off Marokopa, south of Raglan in February 1999. At that time the shark was estimated to weigh 30 kg and measure 130 cm.

A second mako estimated at 30 kg was tagged off North Cape in February 2008 and recaptured off the Kermadec Islands, 570 n.miles to the northeast after 151 days. It measured 136 cm and weighed 26 kg on recapture. A third mako, also estimated at 30kg and tagged in the same area in March 2008 was caught by a

tuna longline vessel 850 n.miles to the east after 141 days. A fourth mako, tagged near Mayor Island in February 2008, was caught on the Louisville Ridge in August of the same year. This shark was recaptured 740 n.miles to the NE after 187 days.

The last mako reported for the season did not leave New Zealand waters but even so moved a considerable distance. It was tagged near White Island in the Bay of Plenty and was caught in a setnet in March 2009, off Opunake on the opposite coast of the North Island. It had moved a minimum distance of 505 n.miles in just 46 days, and measured 105 cm. Over all seasons, the recapture rate for mako sharks in this programme is 2.7% (see Table 3).

3.3 Blue shark

There were 101 blue sharks tagged in New Zealand fisheries waters during the 2008–09 season, amounting to 89% of all blue sharks recorded by members of NZBGFC clubs. Although the 10 year average for this species is 160 per season, this figure is distorted by the higher catches reported in the first two years of the period. Blue shark tag reports fell from a high of 724 in 1997–98 to 163 in 2001–02, (Table 1) and have averaged around 100 per season since that time.

The distribution of blue shark tagging effort by fisheries statistical reporting area is shown in Figure 7. In 2008–09 47% of all blue sharks were tagged off Otago Heads and Kaikoura (Figure 7b). Significant numbers were also tagged off the Wairarapa coast with small numbers being tagged around the rest of the North Island. As in previous years February is when most blue sharks are tagged (Figure 8a). The percentage of blue sharks tagged off Otago, while half the longer-term average, was well up on the 2007–08 season. The estimated weight of tagged blue sharks in 2008–09 had a mode at 40 kg, but very few fish larger than that estimated size were tagged (Figure 8b).

One-third of blue shark recaptures have been recorded from outside New Zealand waters. In some respects, the recapture locations are similar to those reported for striped marlin and mako sharks – Australia, New Caledonia, Fiji, Tonga, French Polynesia (Figure 8c). This may reflect fishing effort in the southwest Pacific, and/or variable tag reporting, rather than distribution of the species. However, 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.

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 8d). 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.

Four blue sharks were reported as recaptured during 2008–09. All these recaptures were made by commercial vessels; three outside the EEZ and one relatively close to the point of release off Poverty Bay. The long-distance recaptures moved a minimum distance between 740 and 1300 n.miles. One of these, caught in the Coral Sea, was notable because it had previously been recaptured and released. It was originally tagged off Tangimoana in fisheries Statistical Area 039 in January 2007. It was caught and re-released by a recreational fisher after 19 days in the same area and released with the same tag intact. It was then caught after 666 days, 1300 n.miles from the tagging location.

A second blue shark tagged off Raglan in February 2008 was recaptured near Vanuatu – a minimum distance of 1100 n.miles in 150 days. Two blue sharks tagged in Area 013 were recaptured. The first of these was

tagged off Poverty Bay in February 2008 and recaptured near New Caledonia after 347 days. The recapture was made by a tuna longline vessel, 1190 n.miles NW of the release location. The local recapture, reported by a domestic tuna longline vessel, was tagged off Mahia Peninsula in late February, 2009 and recaptured off Poverty Bay after 59 days. It was 58 n.miles NE of where it was tagged.

Release and recapture weights for blue sharks at liberty for less than 6 months showed a mean difference of 8.2 kg (s.d. 6.33) when fish were estimated both times and a mean difference of 6.5 kg (s.d. 6.34) when the fish were weighed on recapture (see Table 4). Taggers were either quite accurate or tended to over estimate the size at release. Overall, the recapture rate for blue sharks in the programme is 1.7% (see Table 3).

3.4 Kingfish

The number of kingfish tagged and released in New Zealand fisheries waters during 2008–09 was 660, substantially down on the previous season (1086) and also well below the mean of the previous 10 years (see Table 1). The distribution of tagging effort in 2008–09 (Figure 9b) saw some big changes from recent years. The fall in numbers of kingfish tagged in the far north (Areas 047 and 048) noted in 2007–08 continued, but increased tagging was observed in Areas 003 and 008. Substantial numbers of kingfish were tagged in the Bay of Islands and off Tairua. Kingfish tagging off the west coast of the North Island continued to be significant, with numbers there maintaining the long-term average. However, the most noteworthy change was in Area 010. White Island has long been the centre of kingfish tagging in this programme, but a big decrease in effort there in 2008–09 saw the percentage of the total effort drop from an average 22% to just 5%.

Kingfish were tagged throughout the season, with a very strong mode in February with January, May, and June being the next most productive months (Figure 10a). 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 to 140 cm (Figure 10b). Small numbers of sub-legal kingfish continue to be tagged, mostly above the old MLS of 65 cm, but the vast majority of cooperating anglers tagged kingfish over the current MLS of 75 cm. The great majority of tagged kingfish were measured before release.

Forty-three kingfish recaptures were reported in 2008–09 (see Table 3), bringing the total number of kingfish recaptures reported for this programme to 1246. Recaptured kingfish in 2008–09 ranged from 70 to 160 cm in length at the time of recapture (where measured). Time at liberty ranged from 3 to 2619 days (over 7 years) and displacement ranged from 0 to 856 nautical miles. Seven kingfish were recaptured by a variety of commercial methods, while the remainder were taken by recreational fishers. Two of the recreational recaptures were by speargun, and the rest on lines.

There was one particularly notable recapture of a kingfish this season. This was a fish that was tagged off Gannet Island, west coast North Island, in 2005, and recaptured after 1510 days at Lord Howe Island, off the Australian east coast (Figure 10c). The kingfish was measured at 73 cm on release and 100 cm on recapture.

Recorded movements of kingfish from west coast to east coast or vice versa are rare events, but another example was recorded this season. A kingfish tagged off Raglan in April 2006 was recaptured at Kawau Island in the Hauraki Gulf after 969 days (Figure 10c). It was measured at 80 cm on release and measured 103.5 cm on recapture. The capture site was a minimum distance of 408 nautical miles from where it was tagged.

A third long-distance recapture of a west coast kingfish was recorded, but the exact recapture location is unknown since the tag was discovered in a fish processing facility. It is almost certain that the fish was recaptured in Hawkes Bay, since the processing facility is in Napier, and services vessels from that area. Also a kingfish that was tagged at Rangitira Reef, Bay of Plenty, was recaptured by a spearfisherman at Leigh Reef in the Hauraki Gulf after 744 days. It was measured both times, and increased in length from 103 cm to 111 cm in 2.5 years.

Nineteen recaptures were reported from Statistical Area 010, all of them at White Island or the adjacent reefs. All the other recaptures made near White Island were from fish that had moved 3 nautical miles or less, and were caught after periods at liberty from 273 to 2619 days. Interestingly, there were no short-term recaptures made at White Island in the 2008–09 season. One kingfish did leave White Island. It was recaptured after 773 days, 12 n.miles south of the tagging location.

In the far north, three kingfish that were recaptured after long periods at liberty also showed no movement. They were tagged at the Three Kings Islands and the adjacent banks, and were recovered at or close to the same locations after 710, 2524, and 2529 days.

Cooperating skippers, particularly Rick Pollock from Whakatane, Carl Muir from Tairua, and Richard Hart from Raglan, have measured many kingfish on release. Of all kingfish tagged in 2008–09, 81% were accurately measured before release, and 54 of the recaptured fish were measured both on release and recapture. This has enabled the accumulation of further growth data for this species. Overall, the recapture rate for kingfish is 7.5% for this programme.

3.5 Yellowfin tuna

For the first time since 1981–82 no yellowfin tuna were reported as tagged, and none were recaptured either. Yellowfin were scarce throughout the whole fishery in 2007–08, and even less abundant in 2008–09, with extremely low numbers landed. In past seasons, yellowfin have only been tagged in any quantity only when catches were good. This was certainly not the case in 2008–09.

Overall, the recapture rate for yellowfin tuna is 1.2% for this programme.

3.6 Other billfish

Twenty-four blue marlin were tagged in New Zealand waters in 2008–09. There were also 10 tagged in the Kingdom of Tonga (see Tables 1 and 2). Most blue marlin were tagged between July and September in the Pacific Islands whereas they were tagged between February and April in New Zealand (Figure 11a). The fish tagged in Tonga in the 2008–09 season were generally larger than reported in previous seasons. In New Zealand waters, as is normal, blue marlin were estimated at 170 kg or more in 2008–09 (Figure 11b).

No blue marlin recaptures were reported this season. The overall recapture rate of blue marlin is now 0.8% for this programme (see Table 3).

There were 24 swordfish and 5 shortbill spearfish tagged in New Zealand fisheries waters in 2008–09, with no recaptures of either species in 2008–09.

3.7 Other species

Each year, anglers tag and release a small variety of species that are not considered to be mainstream parts of the programme. Most of these are sharks, including school shark, hammerhead shark, thresher shark, and bronze whaler. The number of “other sharks” tagged in 2008–09 was 50, the same as in the previous season which was the lowest for a number of years (see Table 1)

Two school sharks were recaptured during the season, but there was no tag report card for either. Both were recaptured off the west coast of the North Island; one by a recreational fisher off the north head of the Manukau Harbour and the other by a commercial fisher off Albatross Point, south of Raglan.

Thirty-one Pacific bluefin tuna (*Thunnus orientalis*) were reported tagged off the South Island west coast in the 2008–09 season. An increasing number of anglers appear to be adopting tag and release in this emerging sports fishery. A 279 kg Pacific bluefin was recaptured off Westport in August 2008, but no tag report was received and release information was therefore not available.

3.8 General

Overall, 4375 gamefish tags were issued to clubs and individuals by the NZBGFC in the 2008–09 season. The overall number of tags issued and number used in each region in 2008–09 are given in Figure 12. The selection of regions is based on the commonly fished gamefish areas. For all species, 2248 tag report cards had been handed in for fish tagged in 2008–09. Tag usage is influenced by several factors, including weather, fishing success, and the number of tags previously issued in an area. For example, off Poverty Bay and Hawke’s Bay 86 tags were used in 2008–09, though no new ones were issued. Thus, the percentage of tags used in any season may not relate directly to the number of tags issued. The overall usage rate of 52% in 2008–09 compares very favourably with previous seasons.

Movement of striped marlin, mako and blue shark are summarised in polar plots which depict the distance and direction moved from the tagging location (Figure 13). With all data plotted only the long distance recaptures stand out. Many recaptures for these species have been made in areas 1000 to 1500 nautical miles north and northeast (Fiji, Tonga, Samoa, Cook Islands) or a similar distance northwest and west (New Caledonia, Australia). For striped marlin and mako there are no similar movements in southern quadrants, indicating that these fish are being tagged near the southern extent of their range (Figure 13a and b). Two blue sharks have been recaptured over 4000 nautical miles to the southeast (toward Chile) and to the southwest (southern Indian Ocean) indicating a broader habitat range (Figure 13c). Recaptures within the New Zealand region (less than 500 nautical miles) for striped marlin and mako show mostly movement northwest or southeast (Figure 13d and e). This is probably influenced by the orientation of the upper North Island coast with most of the fishing effort within 100 nautical miles and fish only occasionally moving from one coast to the other. On a larger scale (less than 2000 nautical miles) blue sharks show very little movement south of the release point (Figure 13f). In part this may be due to the proportion tagged off Otago Heads (44%). As with all these plots, the distribution of fishing effort by surface longline fleets will affect the areas where fish are recaptured.

The polar plot of all kingfish with release and recapture locations shows the two trans-Tasman recaptures and the fish recently caught at Lord Howe Island (Figure 14a). Movements around New Zealand (less than 200 nautical miles) have been split into fish tagged off the west coast (mostly Raglan and the Three Kings area) and the east coast of New Zealand (Figure 14b and c). Most fish were recaptured to the north or southwest of release points indicating fish moving along the west coast and within range of New Zealand fisheries. More kingfish have been tagged on the east coast and the direction of their movement was more

varied. Two fish travelled from around East Cape to the west coast of the North Island (Wanganui and Raglan) and generally there is more movement south than north (Figure 14 c). An initial investigation of seasonality of kingfish movement shows all recaptures (all distances) for fish recaptured within 12 months and grouped them by recapture season for the east and west coast (Figure 14e and f). If anything, the west coast plot shows more movement south for autumn and winter recaptures, while the longest movements south on the east coast are in spring and summer.

4. DISCUSSION

The striped marlin fishery in northern New Zealand started slowly in 2008–09, as it did in both the previous two seasons. Fishing conditions were generally favourable through the summer and autumn, and catches of striped marlin were good. However, the almost complete lack of yellowfin tuna in the fishery severely curtailed fishing in the Bay of Plenty in particular. On the west coast of the North Island, catches of striped marlin were steady in the north, but south of Manukau there were very few fish seen. Catches which had been excellent off Taranaki in 2007–08 were reduced to minimal levels and no marlin or mako sharks were tagged at all.

In the far north, marlin catches in Area 048, in particular around the King Bank, were excellent in February and March, but were poor in April and May, historically good fishing months. Balancing this, there was extremely productive fishing off east Northland, with the best fishing for several years.

Three striped marlin tags were recovered in 2008–09. The number of tags returned from striped marlin has varied between 1 and 5 per year over the last 10 years, with the notable exception of 1997–98 and 1998–99, in which 12 and 14 returns were made, respectively. There has been considerable discussion internationally about the possible reasons for the low recapture rates achieved in billfish tagging programmes generally. Tag shedding has been proposed as one reason, and the trial of nylon-headed tags is a response to this. This type of tag head has been shown to improve tag return rates in recreational fisheries for blue marlin and sailfish, but at the time of publication the stainless steel anchors had better recapture rates for striped marlin (Ortiz et al. 2003). The highest recapture rate for this species was 1.3 % from the NMFS Southwest Fisheries Science Center followed by 0.86% for the NSW Fisheries Tagging Programme, 0.52% for the New Zealand programme, and 0.38% for The Billfish Foundation programme using nylon heads only (Ortiz et al. 2003).

No tag recoveries of the PIMA tags in striped marlin have been achieved in New Zealand as yet, but the numbers employed are still small. In 2008–09 just 19 striped marlin were double tagged with both tag types. It is therefore, too early to assess the success or otherwise of the trial use of nylon tag heads in this programme. However, some early problems were experienced with the monofilament tethers breaking either during application or while on the fish, and stainless wire has been substituted in subsequent tag shipments. The return of recovered tags may not be a high priority for some commercial fishers, although New Zealand vessels have a good record of returning tags from various species. Variations in commercial fishing effort outside the New Zealand EEZ may also result in more or fewer tagged fish from New Zealand being recaptured and reported in different years. There has been a decline in the number of tagged fish reported by New Zealand and other commercial vessels in the last 10 years (Table 5). In part this is due to a decrease in the size of the New Zealand fleet and a decrease in the number of sharks tagged and recaptured

The increasing trend in the estimated size of striped marlin over the past four years is interesting, but needs to be treated with caution as the ability of skippers and anglers to accurately estimate the size of large in-water fish is variable. Estimated release weights in 20 of 51 cases were within 5 kg of the

recapture weight (or estimate). However, in 9 of the 51 cases release estimates were 30 to 40 kg different from the recapture weights. Differences tended to be larger when the fish were estimated both times. Data for fish recaptured within six months were used in this comparison and time at liberty did not affect the size of differences.

The number of mako sharks tagged and released in 2008–09 remained just below the 10 year average. There is very little target fishing for sharks by Northland and Bay of Plenty anglers, but most recreationally caught mako sharks have historically been taken in these regions. Almost all mako sharks are taken accidentally on lures being trolled for tuna or billfish. The number of recaptures is also low, probably as a result of fewer fish being tagged and released. Mako recaptures peaked in 1995–96 and 1996–97, coinciding with seasons in which record numbers of mako sharks were tagged.

The number of blue sharks tagged remained static, and below the 10 year mean. This mean, however, is inflated due to the higher catches obtained in the first two years of the period. The mode of estimated weight of tagged blue sharks declined to its lowest ever level in 2006–07 (30 kg), and remained there through 2007–08, but increased to 40 kg in the current fishing year. The number tagged is dominated by the fishery off Otago Heads and Kaikoura during February, when blue sharks are targeted during a national game fishing contest.

The Scientific Committee of the WCPFC supported dedicated shark research programmes (WCPFC Executive Summary SC2-2006) especially for species that rank highly in the Ecological Risk Assessment. New Zealand has now developed its own National Plan of Action for sharks that will help identify species at risk in New Zealand waters (New Zealand NPOA Sharks, Ministry of Fisheries, Wellington). A large proportion of the recreational shark catch is now tagged and released, which should assist in the research and conservation of these species. A draft fisheries plan for highly migratory species is currently under development in New Zealand. One of the proposed objectives is to maintain the reproductive potential of pelagic sharks. This places emphasis on releasing large female sharks.

The number of kingfish tagged in this programme decreased in the 2008–09 season. Good numbers of kingfish continue to be tagged off Raglan, on the North Island west coast. These kingfish have behaved differently, showing more movement than those tagged and recaptured on the east coast. Of five kingfish recaptured this season after tagging off Raglan, the smallest amount of displacement after tagging was 19 n.miles. The others moved 55, 408, and 856 n.miles, and one fish landed on a trawl vessel moved at least 75 n.miles. In contrast, all 21 kingfish recaptured at White Island (Area 010) were tagged there. The number of kingfish tagged in Area 008 has increased dramatically in the past two seasons, so that it now ranks as one of the more important tagging locations for this species.

Striped marlin, and mako and blue shark recaptures from this programme show quite a wide distribution across the subtropical and temperate waters of the southwest Pacific. They are mostly recaptured by surface longline vessels targeting swordfish, and bigeye, yellowfin, and albacore tuna. The number of recaptures reported in an area is likely to be affected by the fishing effort in that area and the reporting rate of the vessels present. While acknowledging that this information is fisheries dependent, there have been almost no recaptures in the New Zealand and Australian gamefish tagging programmes outside the southwest Pacific for these species. The exceptions are two blue sharks that moved a considerable distance east and west respectively. A number of recaptures for these species have been made relatively close to their release site after one or two years at liberty. This indicates foraging site fidelity in New Zealand waters for some individuals at least.

Conventional tagging programmes from recreational fisheries can provide useful qualitative data on distribution and movement of these species.

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 and for supplying catch tallies. The Ministry of Fisheries provided funding for this project, “Management of data from the gamefish tag recapture programme” TAG2006/01.

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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 2008–09, for fish tagged inside the New Zealand EEZ only.

Season	BEM	BKM	BWS	KIN	MAK	SHA	SSF	STM	SWO	TOR	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	778	346	69	13	771	3		7	3	2 176
2002–03	6	1	78	646	155	54	14	671	3		76	2	1 706
2003–04	8		106	771	188	64	8	1 051	2		184	6	2 388
2004–05	29	5	102	806	241	61	7	1 348	6		81		2 686
2005–06	17	2	95	1 016	193	76	11	923	5	7	5	4	2 354
2006–07	26	2	157	961	150	61	14	964	16	14	8	6	2 379
2007–08	29		108	1 110	294	50	8	806	25	31	21	7	2 489
2008–09	24	2	101	660	284	50	5	1 058	24	31		9	2 248
Total	321	31	4 065	16 663	12 049	1 074	172	17 962	189	83	1 214	704	54 527
Previous 10 year Mean	26	2	160	782	300	60	8	971	7	17	44	8	2 374

BEM	blue marlin	SSF	shortbill spearfish
BKM	black marlin	STM	striped marlin
BWS	blue shark	SWO	broadbill swordfish
KIN	kingfish	TOR	Pacific bluefin
MAK	mako shark	YFN	yellowfin tuna
SHA	other shark species	Other	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	53						15	2	6				76
2003-04	78	18		1	1		15	4	308		12	1	438
2004-05	69	3			1		6	3	9		4		95
2005-06	45						7	1	69			6	128
2006-07	45						12	4	62	1		2	126
2007-08	39	2					5					8	54
2008-09	10	1					1		29	2			43
Total	574	47		3	5		130	19	504	3	53	42	1 380

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	Other	all other species

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

Season	BEM	BKM	BWS	KIN	MAK	SHA	SAI	SSF	STM	SWO	YFN	Other	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			2			1	43
2003-04			2	32	9	2			5	1	2		53
2004-05			2	38	6	1			4		2		53
2005-06	1		1	53	3	3			1		1	1	64
2006-07	1		2	40		1					1		43
2007-08			3	55	2	2		1	3		1		67
2008-09			4	43	5	2			3			2	59
Total	7	1	70	1 246	323	54	0	1	81	2	15	22	1 822
Recapture rate (%)	0.8	1.3	1.7	7.5	2.7	5.0		0.5	0.44	1.0	1.2	2.7	

Table 4: Difference between estimates or actual weights recorded on recapture for fish at liberty for less than 6 months and the estimated weights recorded on release.

	Blue shark				Mako shark				Striped marlin			
	Estimated on recapture		Weighed on recapture		Estimated on recapture		Weighed on recapture		Estimated on recapture		Weighed on recapture	
Number of records	13		8		51		32		31		20	
	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.
Release weight (kg)	36.4	16.07	34.1	26.81	39.2	22.08	42.0	25.25	86.1	16.52	91	20.30
Recapture weight (kg)	29.7	15.33	29.8	22.35	38.6	20.62	38.7	21.19	90.4	20.54	88.2	16.83
Paired difference (kg)	8.2	6.33	6.5	6.34	12.1	12.07	10.6	10.75	15.1	14.41	10.5	8.64
Minimum difference (kg)	-18		-17		-45		-45		-40		-22.6	
Maximum difference (kg)	7		9		45		25		40		34.4	

Table 5: Reported recaptures by fishing nation for highly migratory species by season (commercial methods only).

Season	Main species BWS, MAK, STM											Other BEM, STN, SWO, THR, YFN						Total	
	Aus	China	Fiji	Japan	Cal	NZ	Solomon	Spain	Tahiti	Taiwan	Tonga	Unknown	Aus	Fiji	Japan	NZ	Tonga		Unknown
1999-00	5	1	1	2		6						11						1	27
2000-01	1		1			8				1		2		1	1	1			16
2001-02	1		1	2		5	1		1			1	1						13
2002-03	1	2	1		1	2					1			1				1	10
2003-04	1	1	1	1	1	5			1						1	2			14
2004-05						2					1			1	1				5
2005-06			1					1					1	1		1			5
2006-07													1			1	1		3
2007-08	1			1				2				2				1		1	8
2008-09	1	1			2	1		3				1				1			10
Total	11	5	6	6	2	29	1	6	2	1	2	17	3	4	3	7	1	3	109

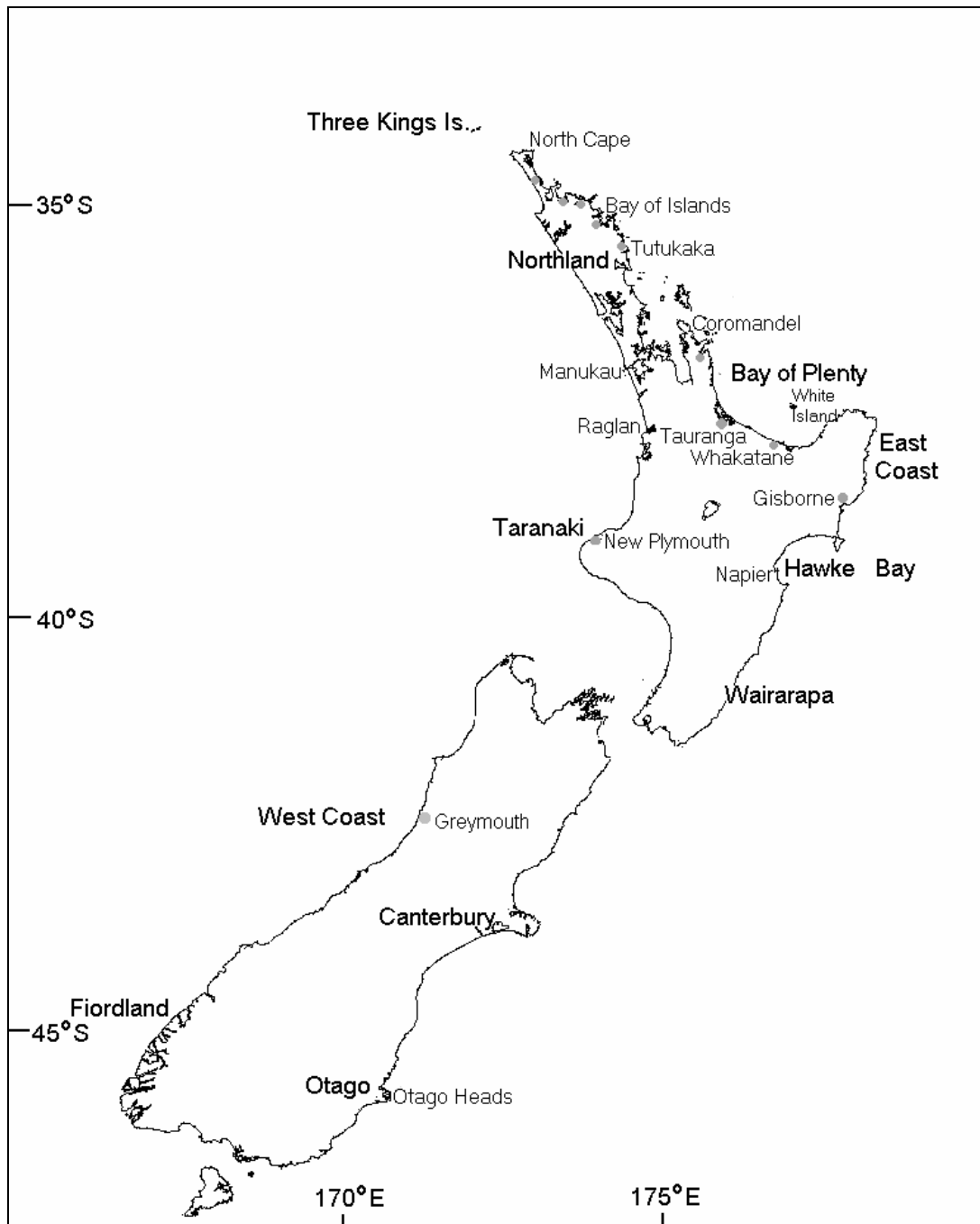


Figure 1: Location of the main areas of gamefish tagging in New Zealand.

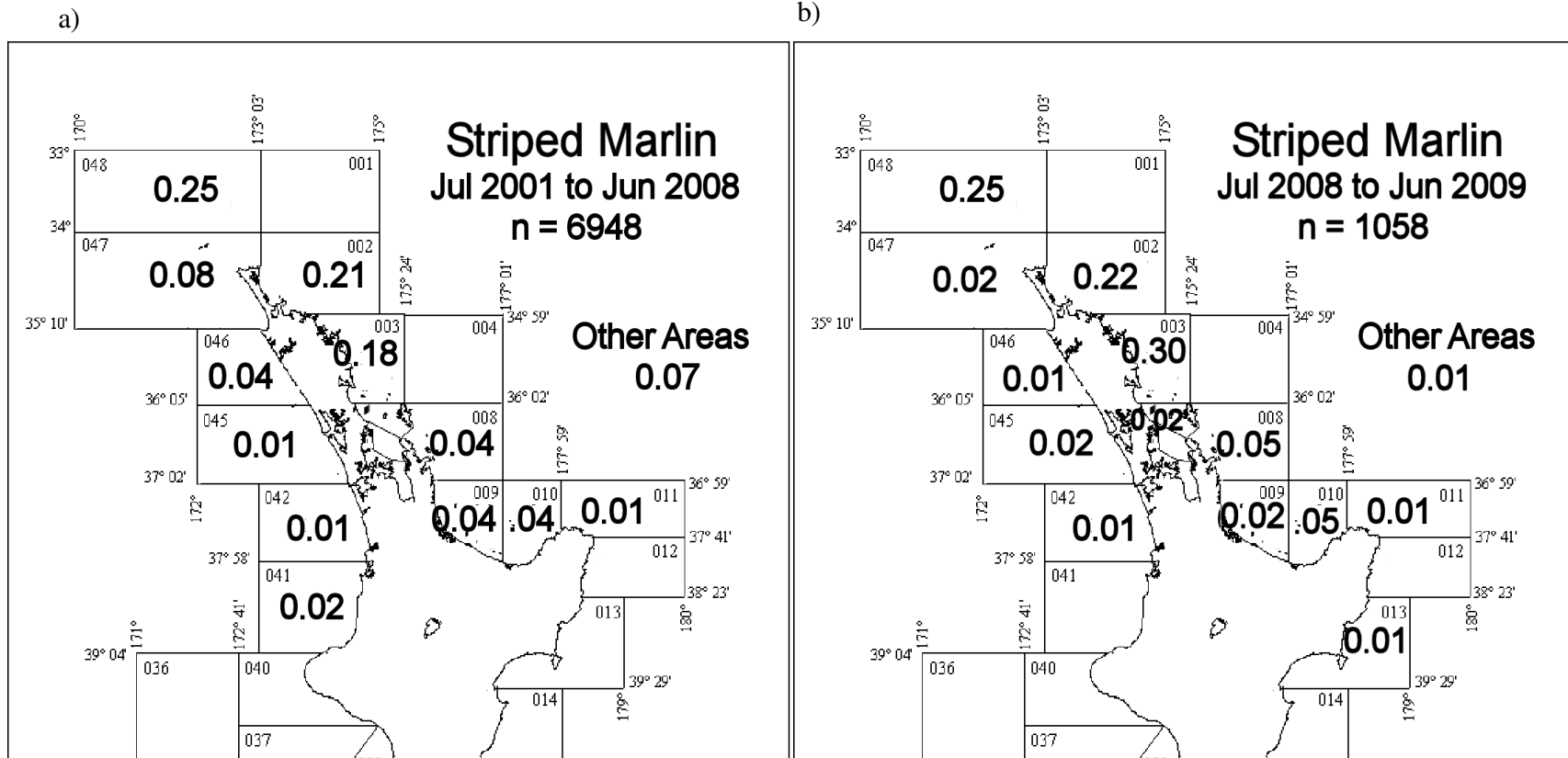


Figure 2: Proportion of striped marlin tagged and released by statistical reporting area for 2001–02 to 2007–08 combined (a) and for the 2008–09 season (b).

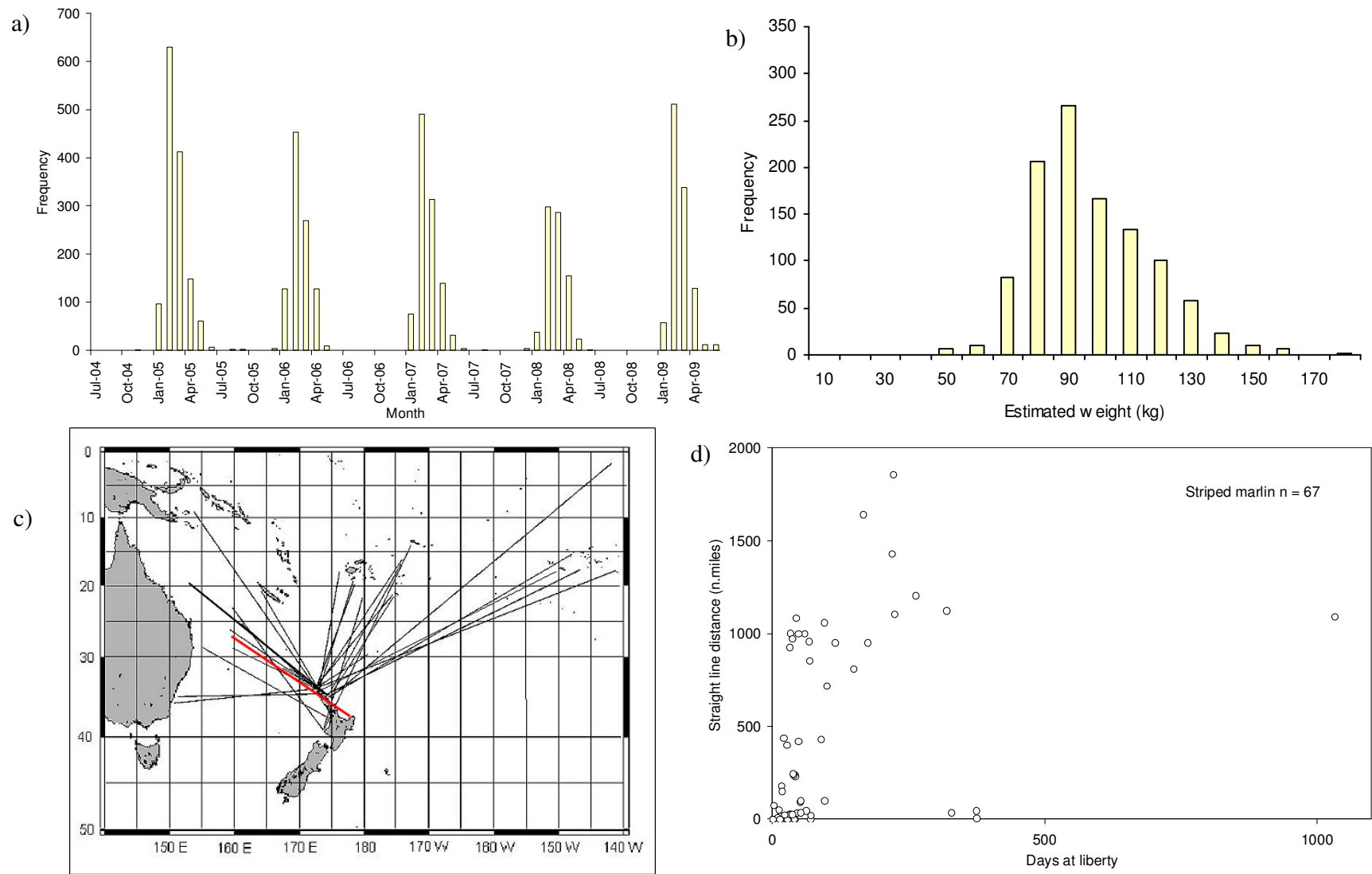
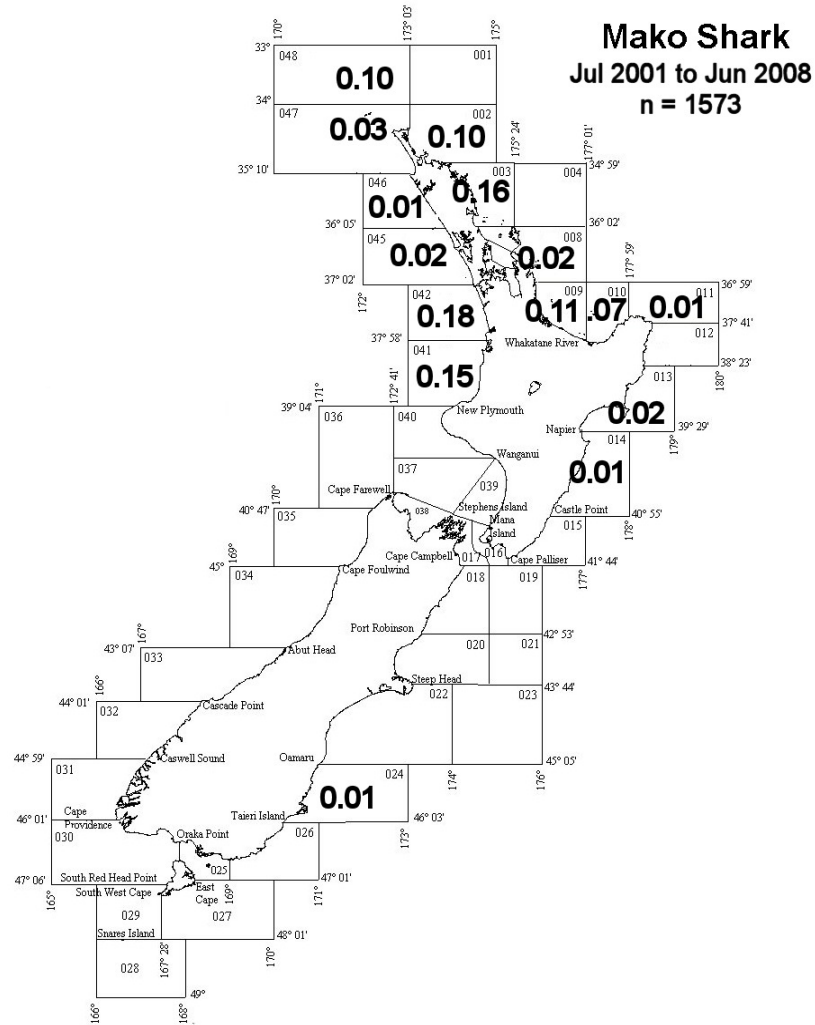


Figure 3: (a) Number of striped marlin released by month, 2002–07; (b) Numbers of striped marlin released by statistical reporting area in 2006–07; (c) Long distance movements of tagged striped marlin; (d) Striped marlin recapture rate by fishing year.

a)



b)

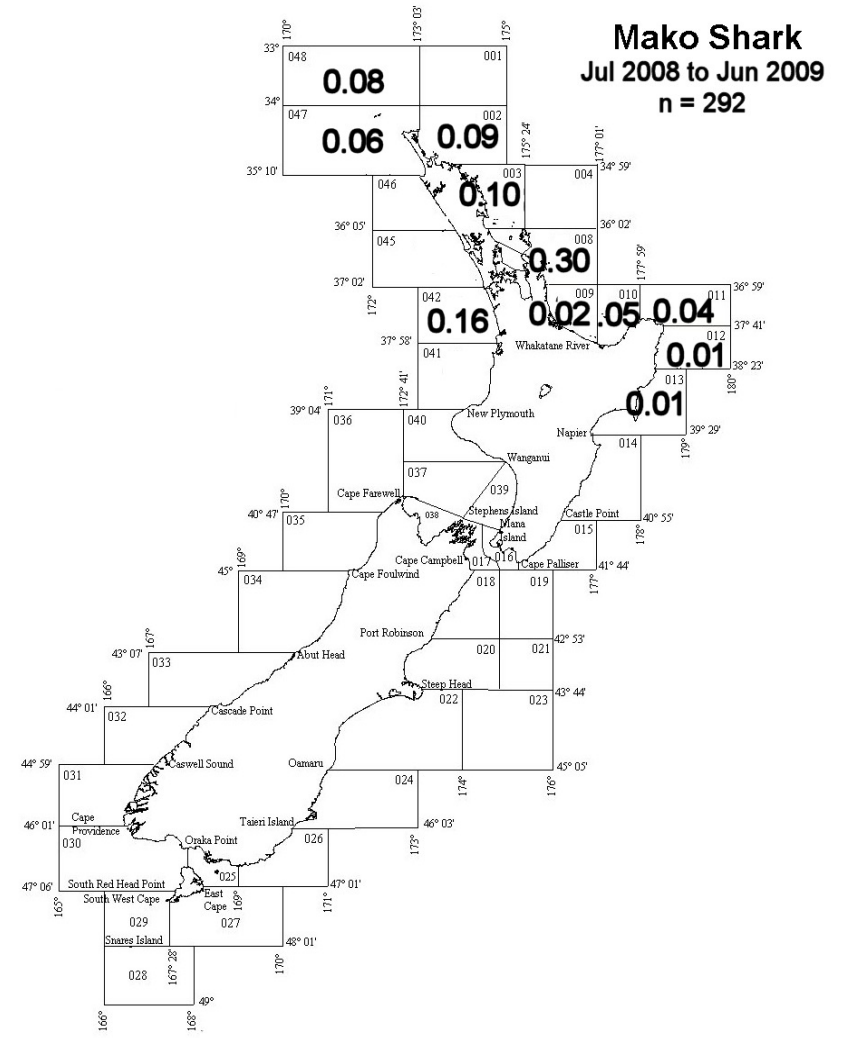


Figure 4: Proportion of mako sharks tagged and released by statistical reporting area for 2001–02 to 2007–08 combined (a) and for the 2008–09 season (b).

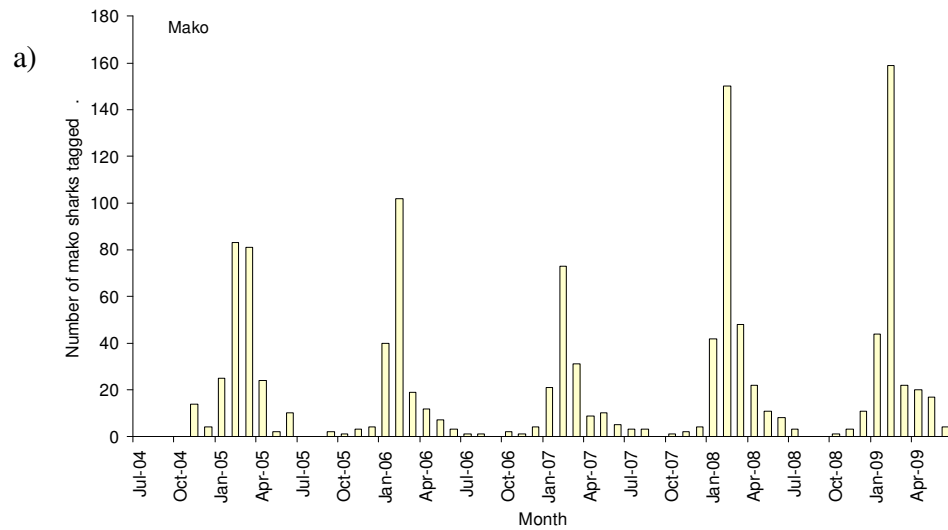
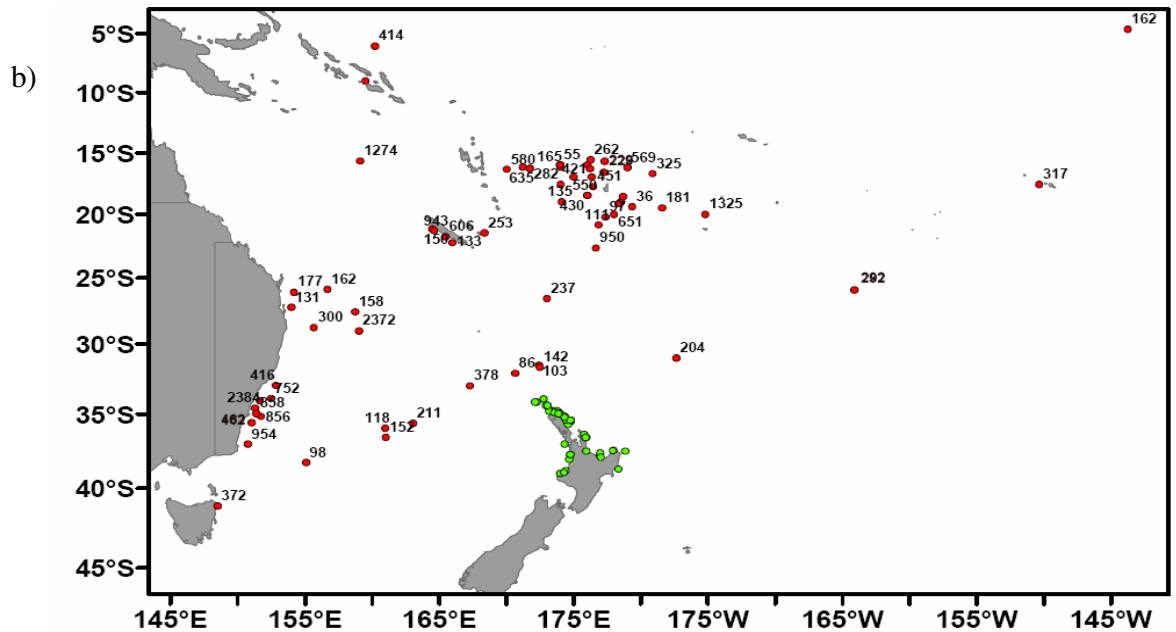


Figure 5: (a) Number of tagged mako sharks released by month, 2004–09; (b) Long distance movements of tagged mako sharks for all seasons combined (number of days at liberty next to recapture point).



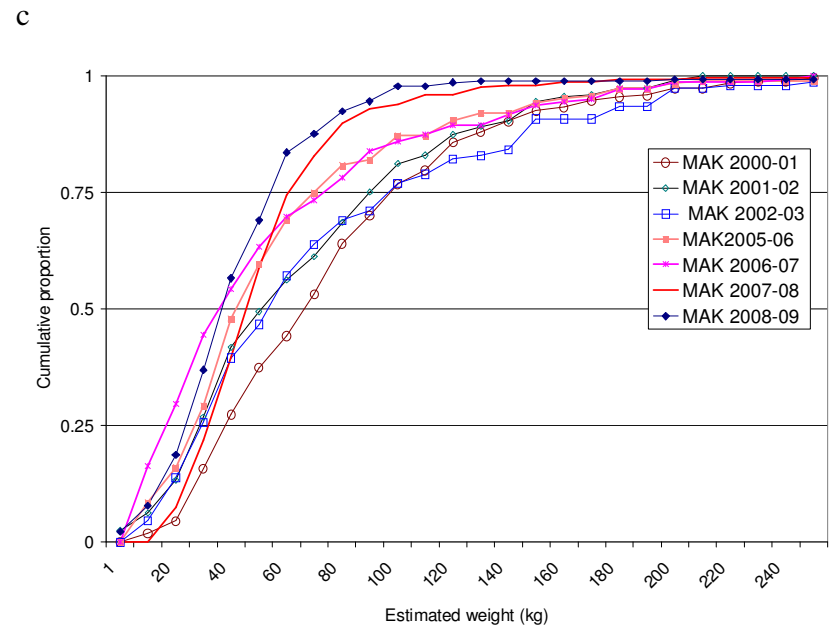
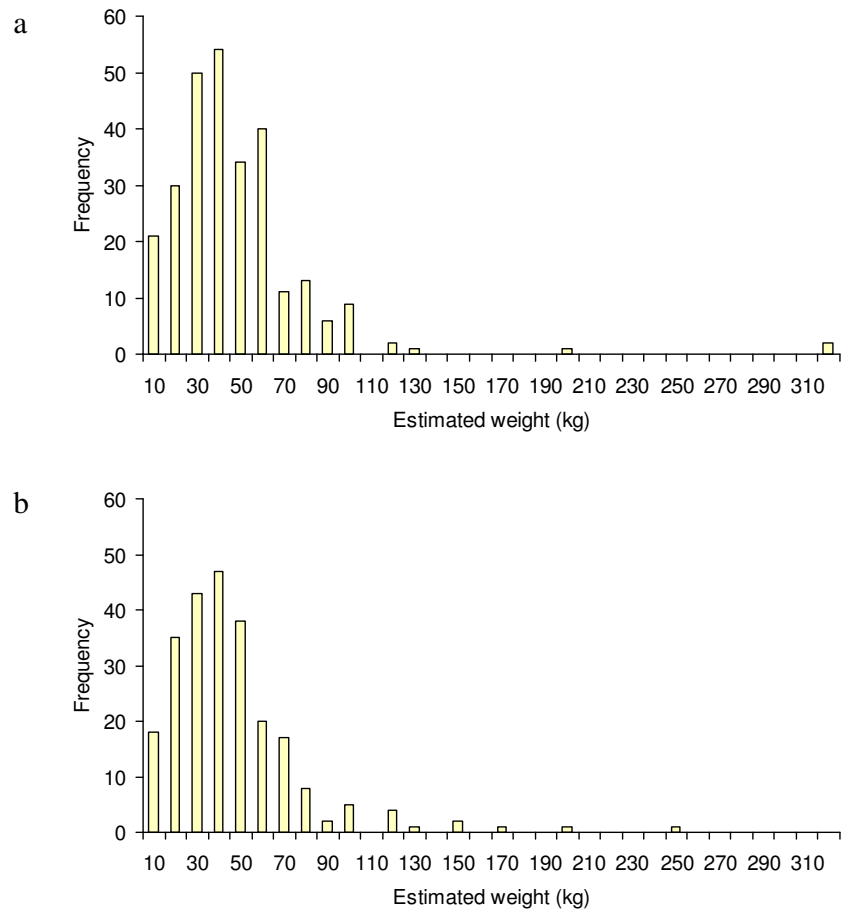
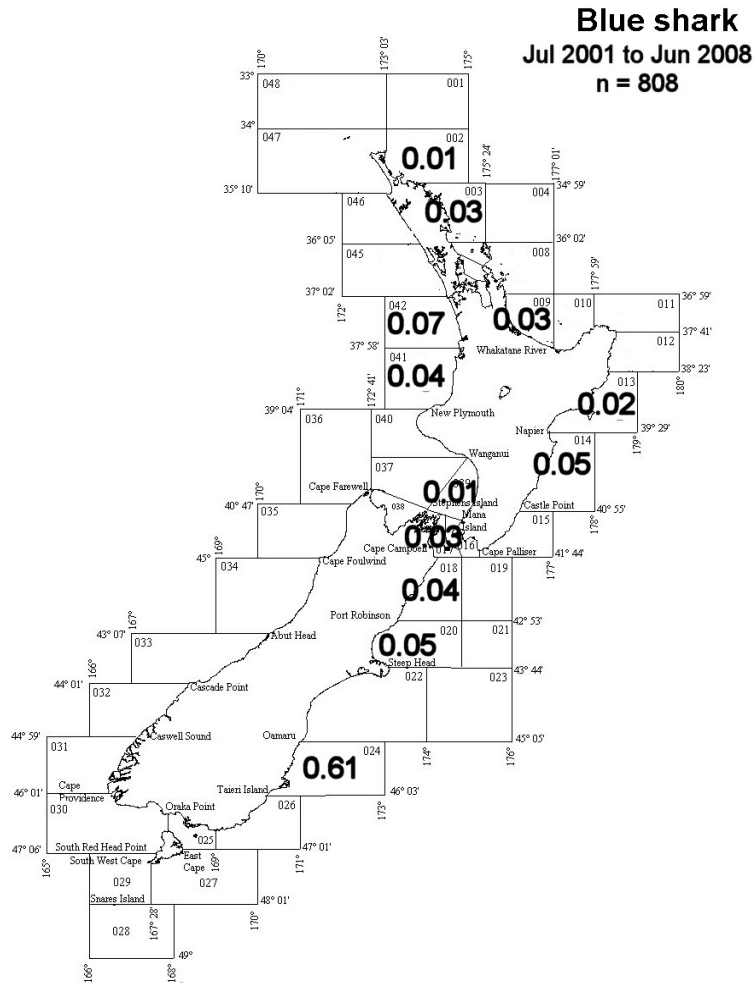


Figure 6: (a) Mako shark estimated release weight frequency, 2008–09; (b) Mako shark estimated release weight frequency, 2007–08; (c) Cumulative proportion of mako weights by season since 2000–01.

a)



b)

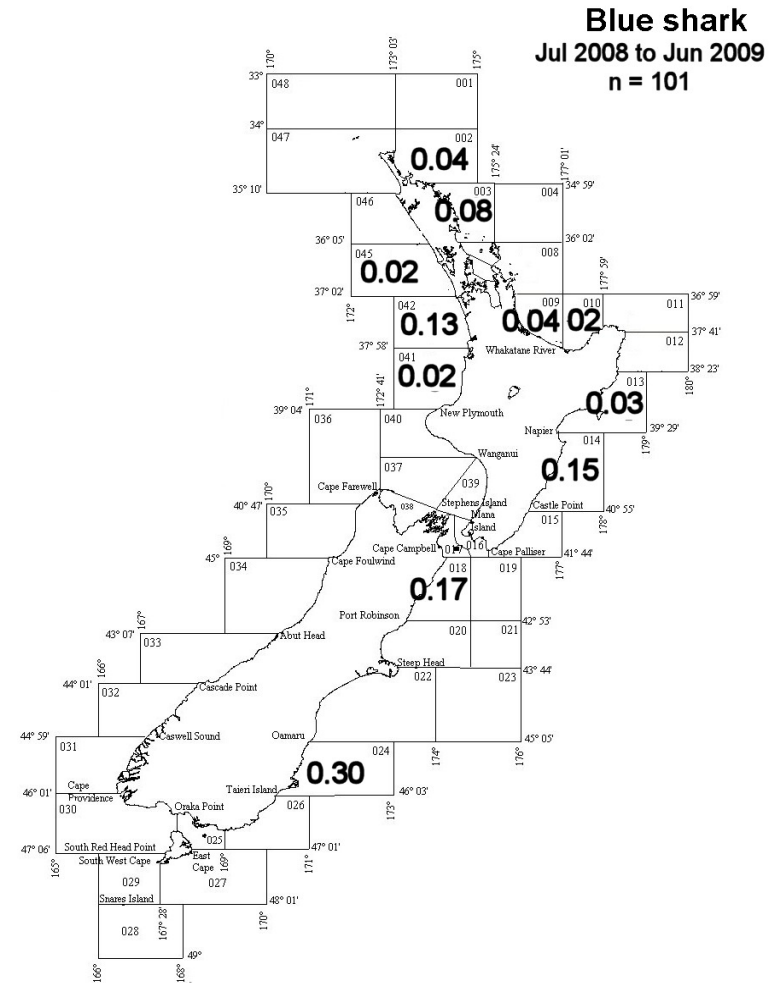


Figure 7: Proportion of blue sharks tagged and released by statistical reporting area for 2001–02 to 2007–08 combined (a) and for the 2008–09 season (b).

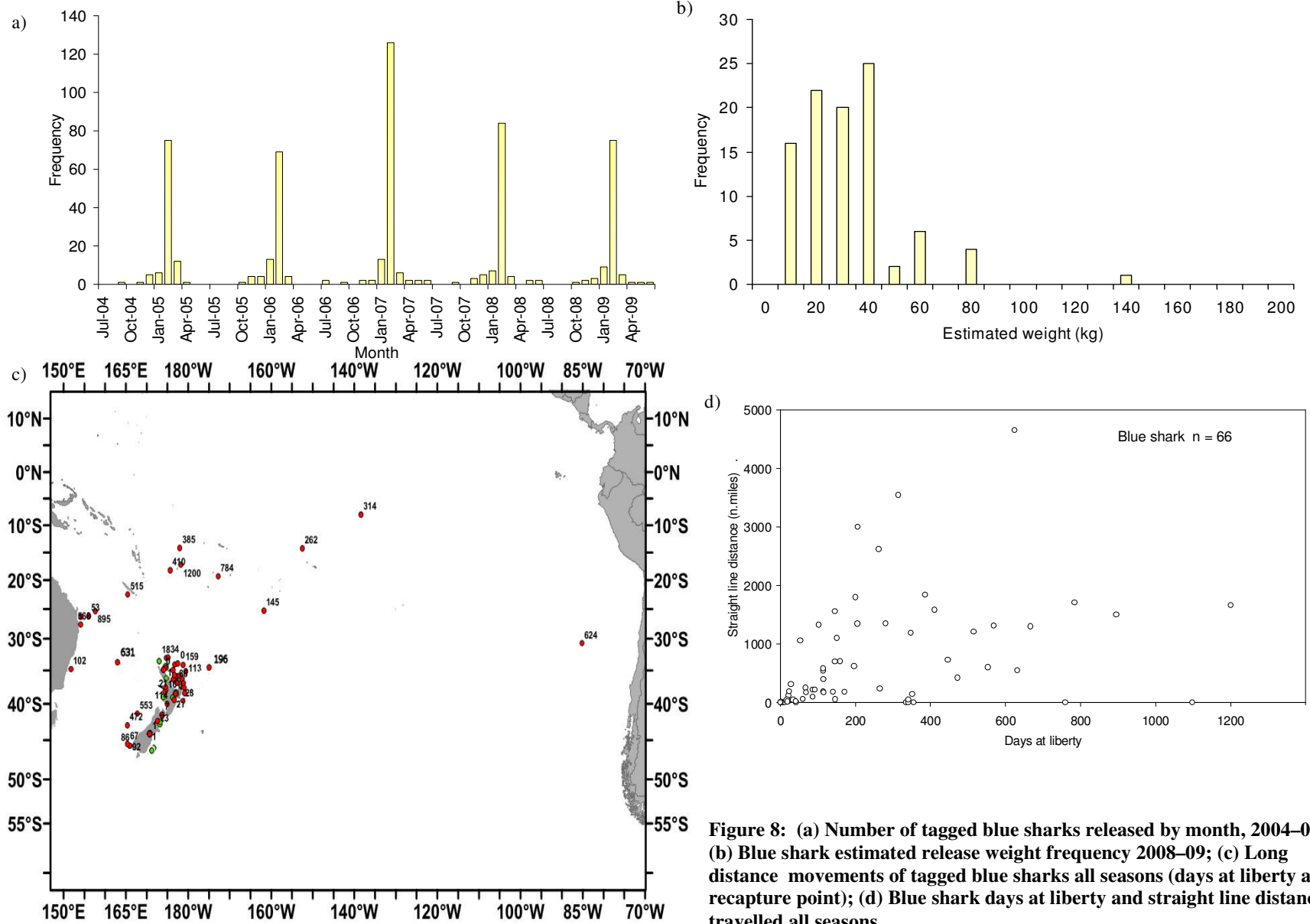
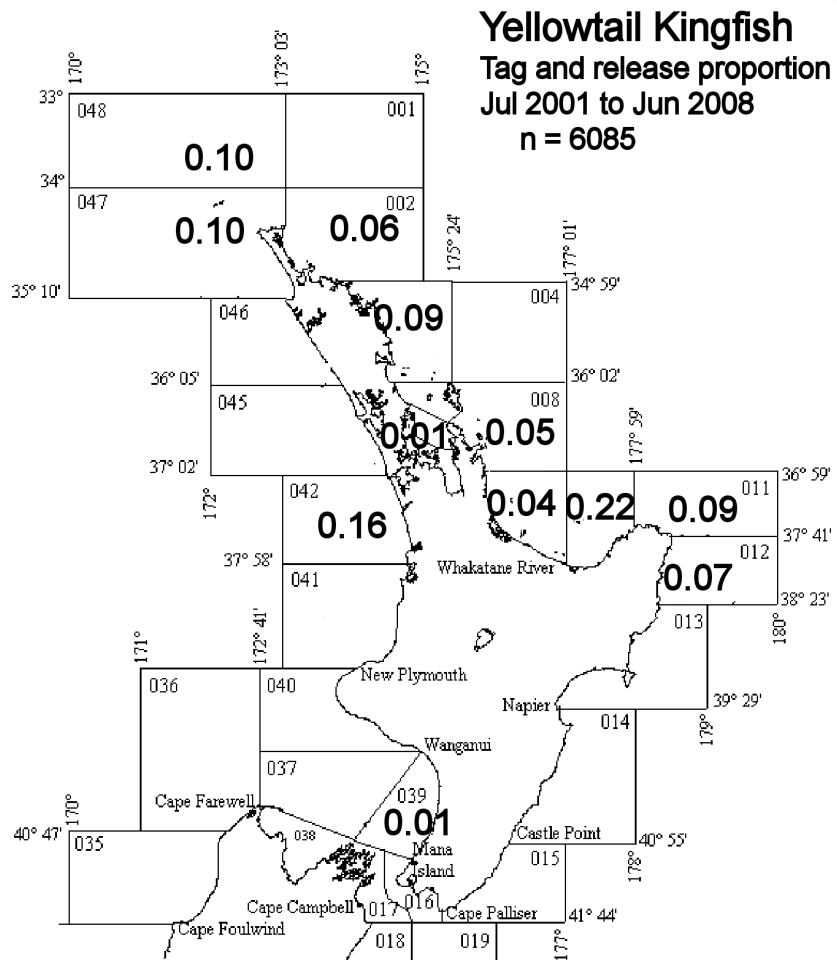


Figure 8: (a) Number of tagged blue sharks released by month, 2004–09; (b) Blue shark estimated release weight frequency 2008–09; (c) Long distance movements of tagged blue sharks all seasons (days at liberty at recapture point); (d) Blue shark days at liberty and straight line distance travelled all seasons.

a)



b)

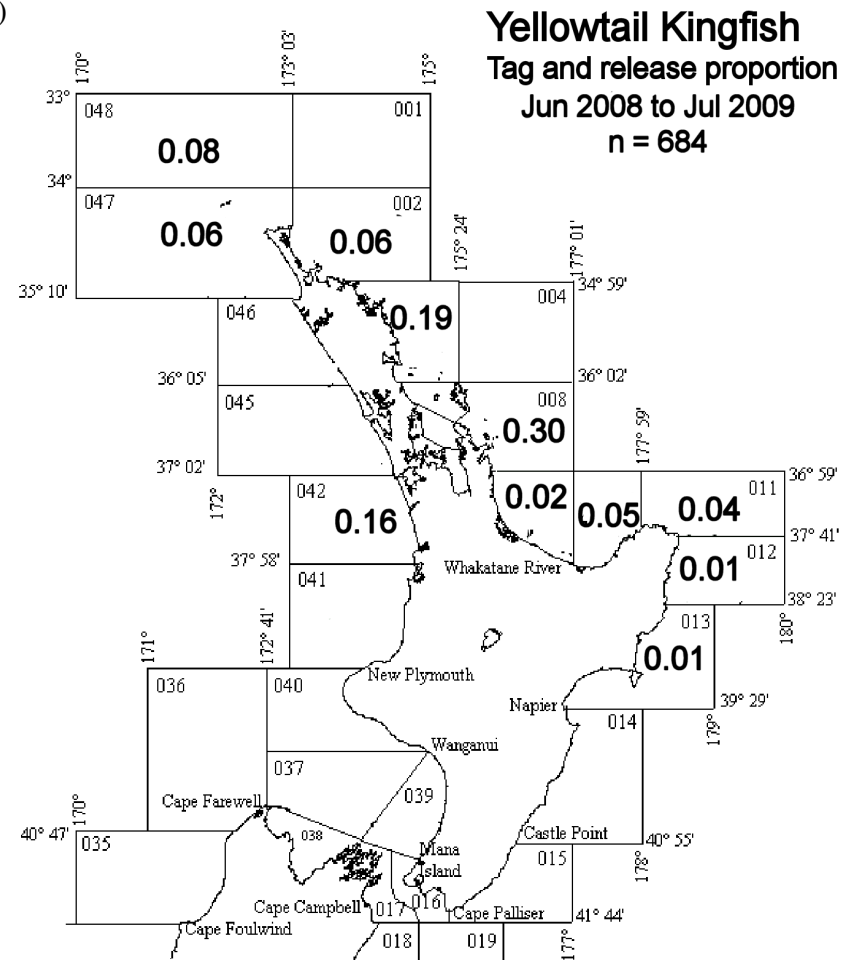


Figure 9: Proportion of yellowtail kingfish tagged and released by statistical reporting area for 2001–02 to 2007–08 combined (a) and for the 2008–09 season (b).

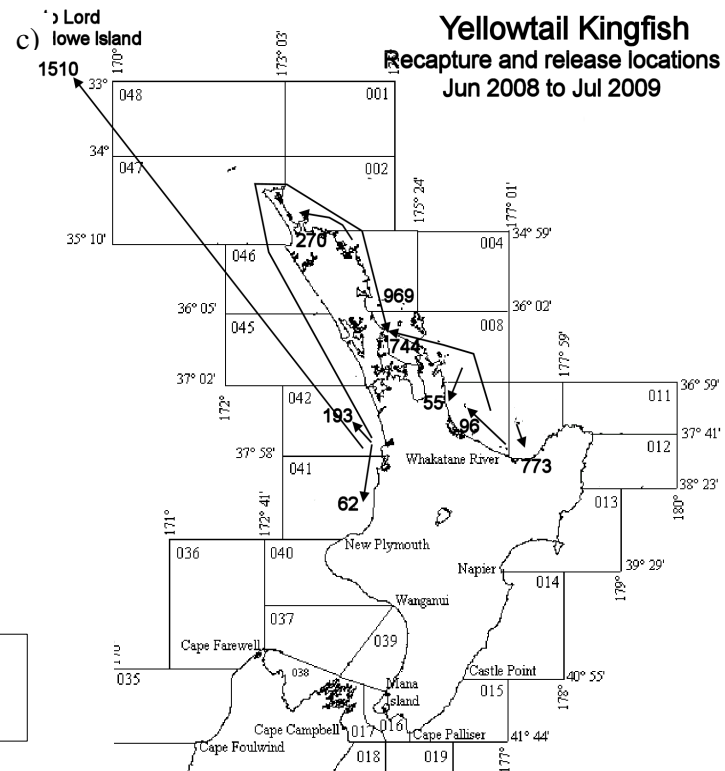
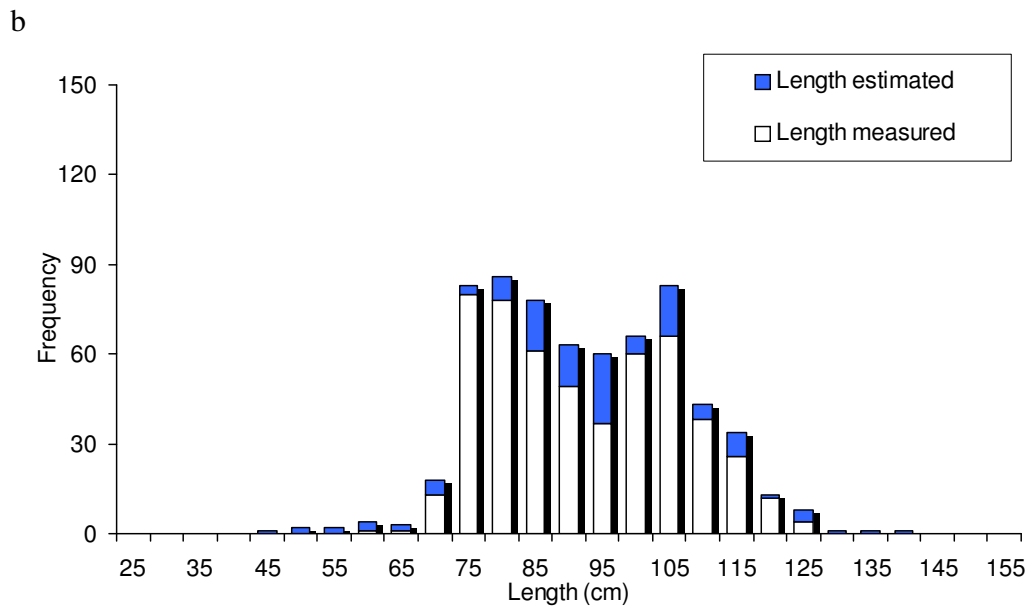
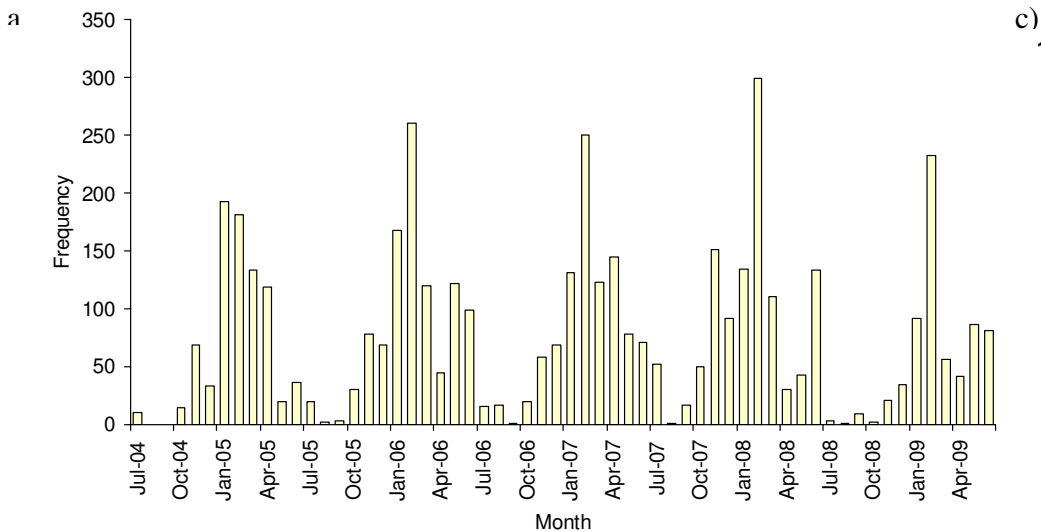


Figure 10: (a) Number of tagged kingfish released by month, 2002–07; (b) Kingfish release length frequency in the 2008–09 season.; (c) Kingfish recaptures >10 nautical miles from release locations reported in 2008–09 (days at liberty near recapture location).

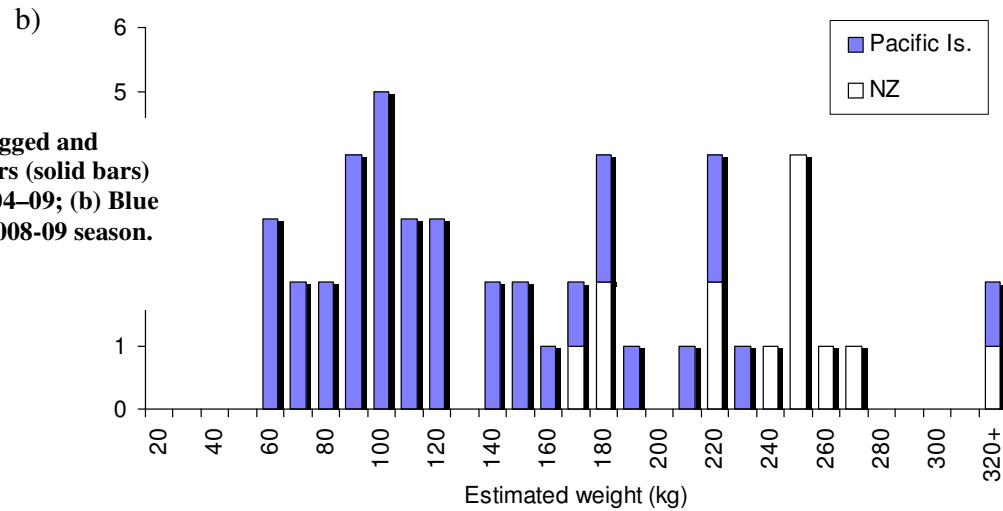
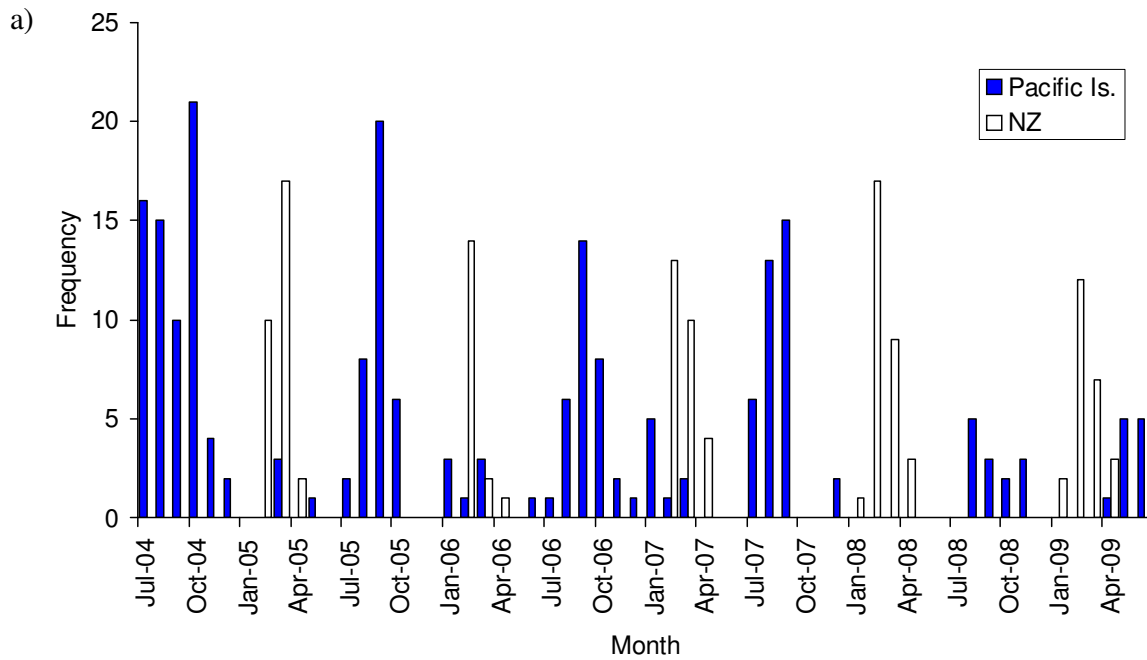


Figure 11: (a) Number of blue marlin tagged and released by month in Pacific Island waters (solid bars) and New Zealand waters (open bars) 2004–09; (b) Blue marlin release weight frequency in the 2008–09 season.

a)

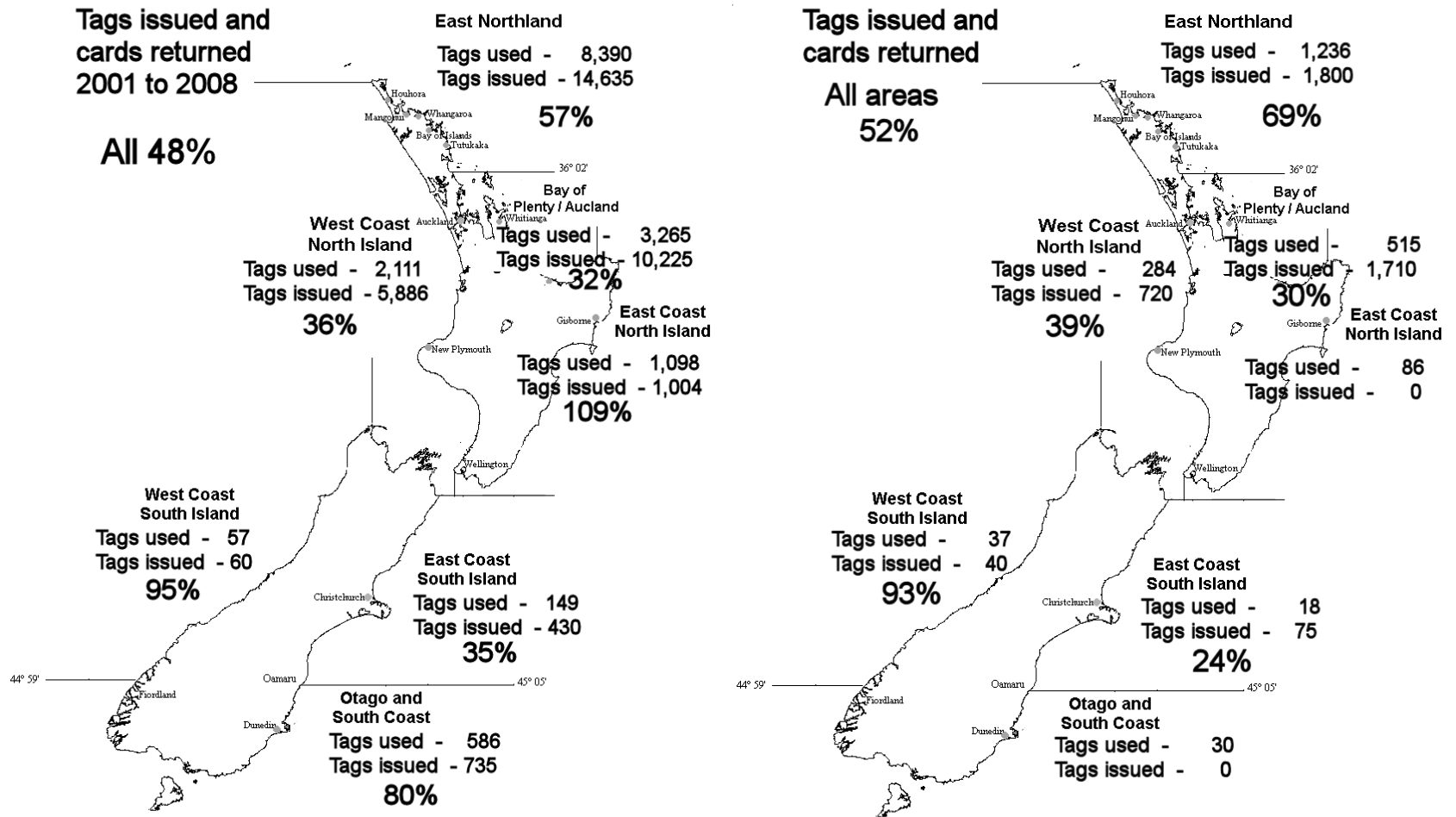


Figure 12: The number of tags issued to clubs and individuals and the number reported used by region for the for 2001-02 to 2007-08 combined (a) and for the 2008-09 season (b). The percentage of tags used can be influenced by the number of tags issued in previous seasons.

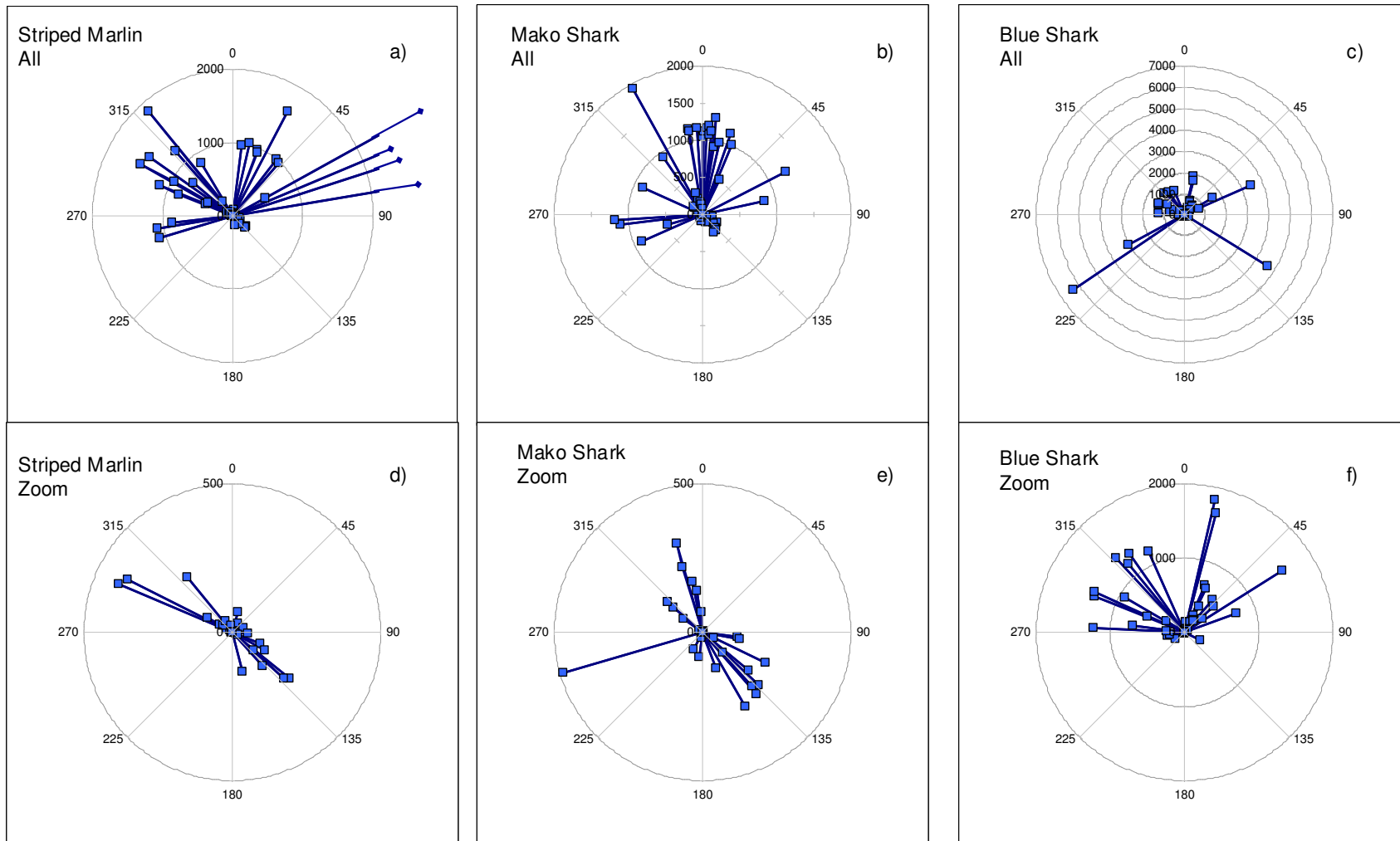


Figure 13: Distance and direction of tagged fish from their release sites, all available data (i.e., both release and recapture position provided) by species on the top row (a, b and c), only recaptures within 500 nautical miles plotted for striped marlin (d), mako sharks (e) and recaptures within 2000 nautical miles for blue sharks (f).

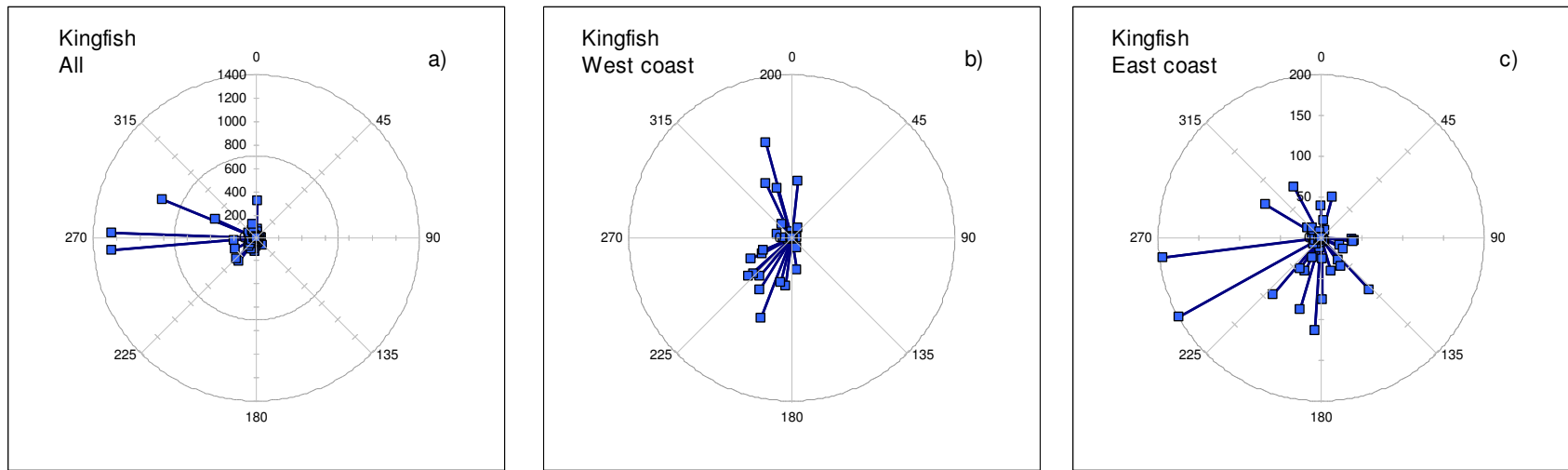


Figure 14: Distance and direction of tagged kingfish from their release sites, all available data (i.e., where release and recapture position provided) (a), and by east and west coast release locations (b and c). Movement of kingfish at liberty for less than a year by season of recapture for the east and west coast (d and e).

