

New Zealand Fisheries  
Assessment Report  
2011/23  
May 2011  
ISSN 1175-1584 (print)  
ISSN 1179-5352 (online)

## New Zealand billfish and gamefish tagging, 2009–10

J. C. Holdsworth  
P. Saul

# **New Zealand billfish and gamefish tagging, 2009–10**

J. C. Holdsworth  
P. Saul

Blue Water Marine Research  
P O Box 402081  
Tutukaka  
Northland 0153

**New Zealand Fisheries Assessment Report 2011/23**  
**May 2011**

**Published by Ministry of Fisheries  
Wellington  
2011**

**ISSN 1175-1584 (print)  
ISSN 1179-5352 (online)**

©  
**Ministry of Fisheries  
2011**

Holdsworth, J.C.; Saul, P. (2011).  
New Zealand billfish and gamefish tagging, 2009–10.  
*New Zealand Fisheries Assessment Report 2011/23.*

This series continues the informal  
New Zealand Fisheries Assessment Research Document series  
which ceased at the end of 1999.

## EXECUTIVE SUMMARY

**Holdsworth, J.; Saul, P. (2011). New Zealand billfish and gamefish tagging, 2009–10.**

*New Zealand Fisheries Assessment Report 2011/23.*

Release and recapture data for the 2009–10 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 2789 fish were reported as tagged and released. Shark and yellowtail kingfish numbers were up on recent seasons, while billfish and yellowfin tuna were down. According to New Zealand Sport Fishing Council club catch records, very high percentages of the total recreational catch of mako (90%) and blue sharks (92%) were tagged rather than landed. The average size of mako tagged in the last three seasons has been about 50 kg. This is 20 kg less than the early 2000s. Most of the fish encountered are juveniles with few large females, which are important for maintaining the reproductive potential of the population.

There were 809 striped marlin reported as tagged and released inside New Zealand fisheries waters in the 2009–10 season. This was similar to the 2007–08 season but down on the 1058 reported last season. The number of yellowtail kingfish tagged (1317) in 2009–10 was substantially higher than the long-term average. The increase was in part due to a kingfish monitoring project running this season in east Northland, Hauraki Gulf and Bay of Plenty which encouraged selected recreational fishers to measure all kingfish caught and provided free tags. This season the percentage of kingfish measured and recorded as they were tagged and released was 88%.

A total of 61 recaptures was reported in the 2009–10 fishing season. These comprised 47 (78%) yellowtail kingfish, 2 (3%) striped marlin, 2 (3%) blue sharks, 7 (12%) mako sharks, 1 hammerhead shark, and 2 southern bluefin tuna. Both striped marlin were recaptured in New Zealand waters, one 20 nautical miles away after two days at liberty and one 50 nautical miles south after 26 days.

One yellowtail kingfish was recaptured in Jervis Bay, New South Wales, both juvenile southern bluefin tuna were recaptured in fish farms in South Australia, a mako shark was recaptured in Fiji, and a blue shark tagged in Otago waters was recaptured east of the Kermadec Islands. All these fish were more than 1000 nautical miles from where they were tagged.

The average growth of five mako sharks at liberty for more than five years was estimated at 15.8 cm per year, while blue sharks recaptured after more than 2 years grew at 16.4 cm per year. These estimates need to be regarded with care as it is not possible to measure fish on release so the fish length or weight is estimated by eye and sometimes the recapture weight is estimated not measured.

A copy of this report is available on line at <http://fs.fish.govt.nz/Page.aspx?pk=61&tk=209>

## 1. INTRODUCTION

### 1.1 Overview

This gamefish tagging programme is a cooperative project between the Ministry of Fisheries, the New Zealand Sport Fishing Council, its affiliated clubs, and anglers. Cooperative tagging programmes provide information on the size and distribution of fish released by recreational fishers. Recaptures provide information on distance and direction of movement, time at liberty, and in some circumstances the average migration rate (displacement rate) of the fish involved. Recaptures are obtained from recreational and commercial fishers. Commercial fishers around the South Pacific often provide some of the most interesting tag returns.

The New Zealand Cooperative Gamefish Tagging Programme was initiated by the Ministry of Agriculture and Fisheries in 1975 following requests from gamefish clubs. 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). 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 Sport Fishing Council (formerly New Zealand Big Game Fishing Council) has supported the programme since its inception and has purchased and distributed all tags through gamefish clubs since 1992. Administration of the data was put out to competitive tender by the Ministry of Fisheries in 2000. This report is the annual gamefish tagging report for the 2009–10 season prepared by Blue Water Marine Research as a reporting requirement for the Ministry of Fisheries, project TAG2009/01.

### 1.2 Description of the fishery

The recreational fishery for large pelagic species is very important for many New Zealanders and attracts tourist fishers from around the world. The fishery operates mainly over the warm summer and autumn months. Striped marlin (*Kajikia audax*) is the mainstay of the gamefishery on the Northland east coast, 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 yellowtail kingfish (*Seriola lalandi*) have historically been caught in large numbers, although several poor yellowfin seasons have seen an increase in targeting of striped marlin and blue marlin.

Shark species have become increasingly important as a recreational target species in southern regions. 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 (*Prionace glauca*) 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. Large Pacific bluefin feed on spawning aggregations of hoki (*Macruronus novaezealandiae*) that are targeted by commercial trawl vessels offshore between July and September.

Marlin species are also a bycatch of the commercial surface longline fishery that mainly 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 Expert panel review

In July 2009 an international panel of scientists reviewed the gamefish tagging programme and made recommendations to the Ministry of Fisheries. The 2010–11 season which started on 1 July will see the some new incentives introduced and more user friendly reports to participants. These include:

- \$1000 lucky draw for a fisher who returns a tag and information in 2010–11;
- A reward T-shirt or hat for each angler who tagged a fish that gets recaptured;
- A polo shirt with GameTag logo for the angler who reports a tag recapture;
- Recapture letter to anglers and skippers involved with release and recapture;
- More tagging information on the NZ Sport Fishing website;
- Results for 2009–10 season widely distributed in a user friendly format;
- A new project to produce a synthesis of all the tagging programme results since 1975.

## 2. METHODS

The tags used in the gamefish tagging programme up to 2005 all had printed yellow streamers with a stainless steel dart anchor. In 2005, 1000 tags with the nylon double-barbed anchors were purchased for billfish. These plastic head intra-muscular tags – type PIMA – require a different applicator tip 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 request information on the species, date, location, length, 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. (Holdsworth & Saul 2003).

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, location, growth, movement, and time at liberty of the fish. A copy of the recapture letter and a reward T-shirt is also sent to the angler who tagged the fish.



**Figure 1: Tag types used in the GFTP from top down:  
Floy FH-69 1975 to 1985  
Hallprint SSD 1986 to present  
Hallprint PIMA nylon leader 2005  
Hallprint PIMA wire leader 2007 to present**

### 3. RESULTS

#### 3.1 Striped marlin

There were 809 striped marlin tagged and released inside New Zealand fisheries waters in the 2009–10 season. This was similar to 2007–08 season but down on the 1058 reported in 2008–09. A further 597 striped marlin were landed in gamefish club records (Roz Nelson, N.Z. Sport Fishing Council, pers. comm.). Using NZSFC records only, it is estimated that 56% of recreationally caught striped marlin were tagged and released in 2009–10. There were no striped marlin tagged outside New Zealand fisheries waters in 2009–10 for the GFTP.



Photo by Sue Tindale

#### Striped marlin highlights 2009–10

February was the peak tagging month in all regions with 54% of 2009–10 striped marlin tagged then (Figure 2). Numbers tagged dropped off in March in the Three Kings area, west coast North Island, and Bay of Plenty. March and April were good months in east Northland, but many fish caught in April were hooked on baits and a higher proportion of gut hooked fish were landed.

There were two recaptures reported in New Zealand this season. The first was caught on 7 February 2010 on a boat skippered by Richard Baker (NZSFC President) off Stephenson Island. It had been tagged two days earlier northeast of Cape Karikari from the vessel *Tangalooma* and was estimated to be 170 cm and weigh 80 kg. It was recaptured about 20 nautical miles southeast from where it was tagged.

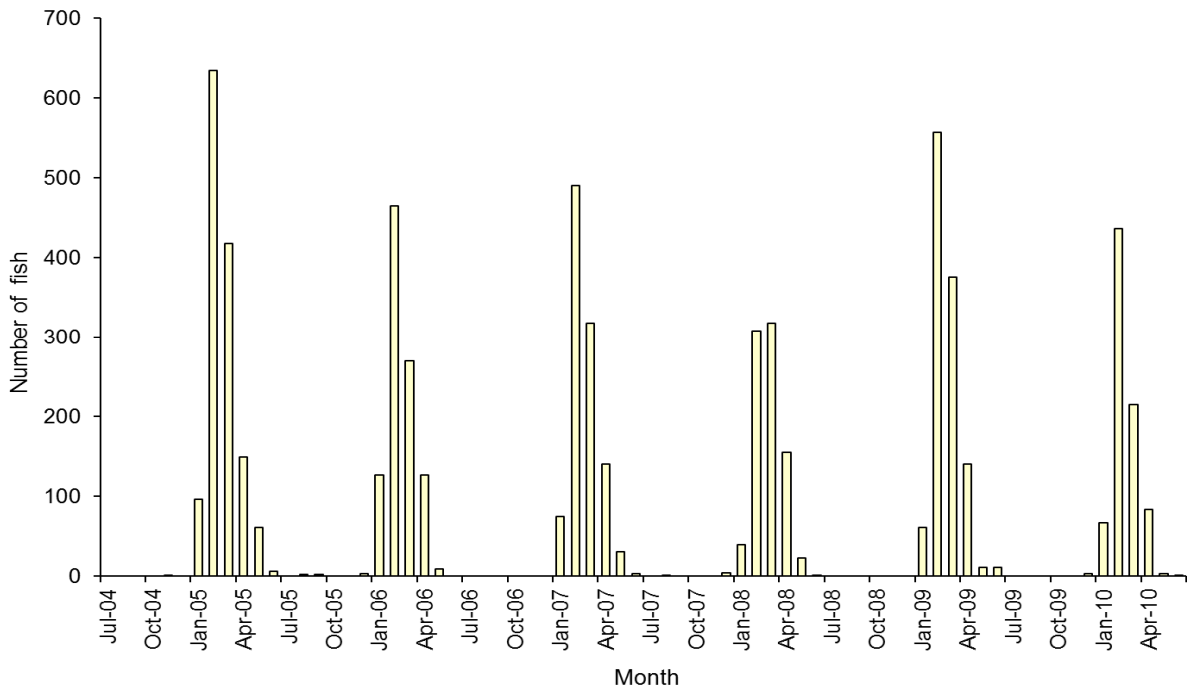
A marlin tagged from the vessel *Renown* off Stephenson Island, Whangaroa, on 28 March 2010 was recaptured on 23 April off Elizabeth reef, north of Tutukaka, amongst a patch of fish that seemed to persist for several weeks. It was recaptured by Murray Jordon fishing from the boat *Fishing Rights* and like many of the fish at that time it was hooked on a live bait. It was estimated at 110 kg on release and weighed 94.6 kg on recapture, and had part of an old marlin bill embedded in its flesh but was otherwise in good condition. It had been at liberty for 26 days and had travelled 50 nautical miles southeast from where it was tagged.

#### Trends

The number of striped marlin tagged in 2009–10 season was down on the previous season and below the average number tagged in the 10 previous seasons. Recaptures were also down compared to the last two seasons (Table 1).

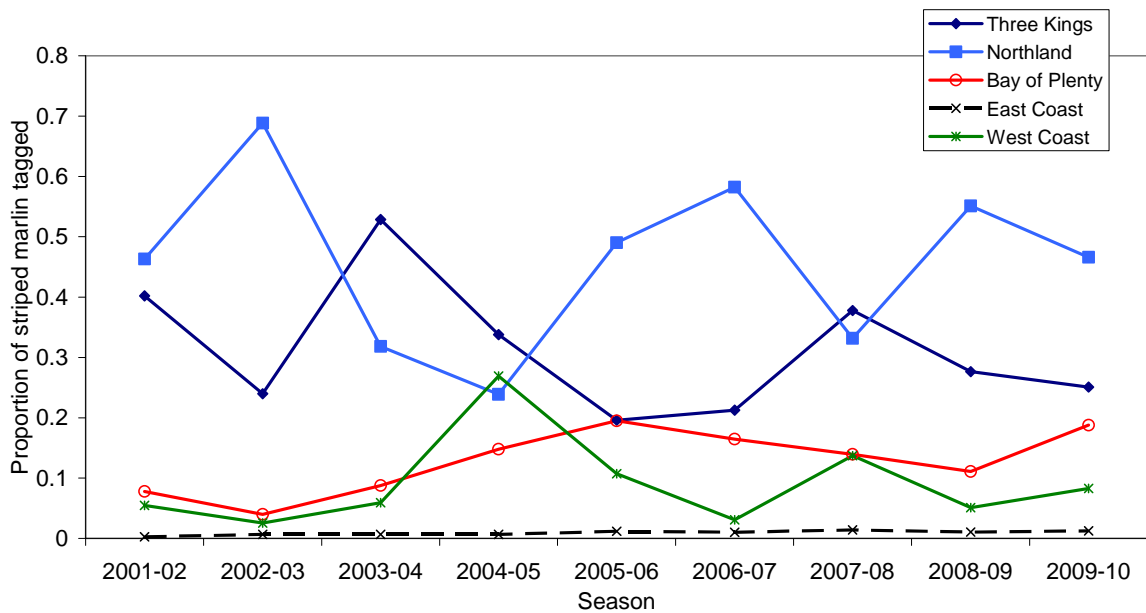
**Table 1: New Zealand Sport Fishing Council records of the number of striped marlin tagged and recaptured by season and the percentage tagged.**

	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	Average 2000 to 2009
NZ EEZ	787	851	771	671	1 051	1 348	923	964	806	1 058	809	923
Outside EEZ	4	0	1	6	308	9	69	62	0	29	0	44
% tagged	66	65	61	58	63	61	59	58	61	59	57	61
Recaptures	5	2	2	2	5	4	1	0	3	3	2	3



**Figure 2: The number of striped marlin tagged by month in New Zealand fisheries waters.**

Most striped marlin are tagged in February which is generally our warmest month. Tag tallies were down for all months in 2009–10 compared to the mid 2000s. Often vessels fishing the King Bank and Middlesex Bank, north of New Zealand, tag a large number of striped marlin particularly later in the season. In 2009–10 good numbers of marlin were caught in this area in February, but this did not continue. East Northland waters provided 46% of striped marlin tagged in New Zealand in 2009–10, which is also the average proportion since 2002. The Three Kings area provided 25% of tagged fish in 2009–10 (Figure 3).

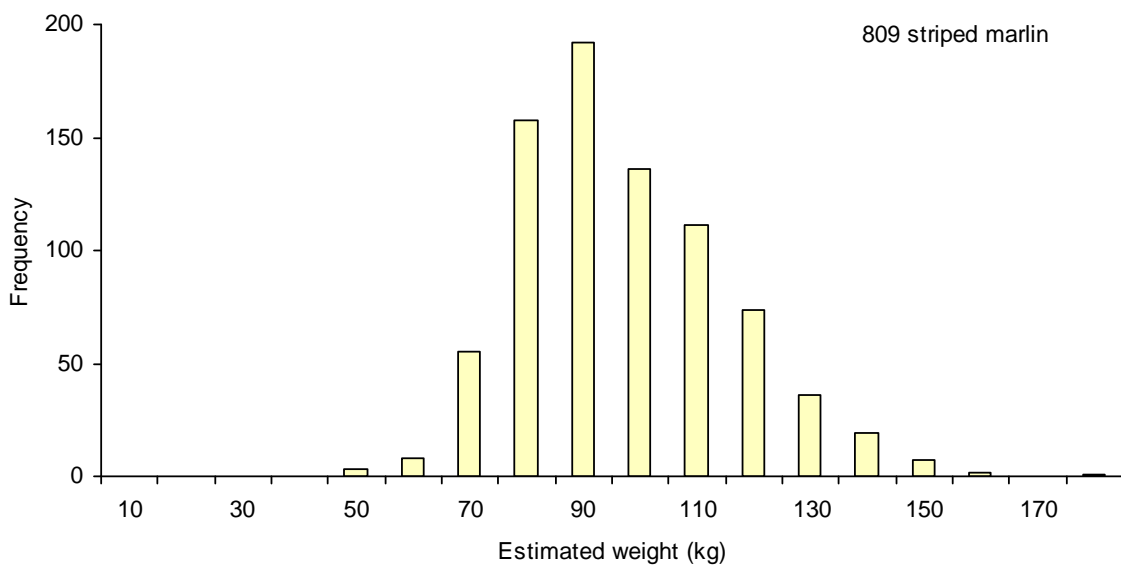




**Figure 3: The proportion of striped marlin tagged by region and season.**

The proportion of marlin tagged and released in the Bay of Plenty has increased since the early 2000s, while tallies from the west coast of the North Island are quite variable. There were 15 striped marlin tagged off Taranaki in 2009–10.

Striped marlin estimated release weights for 2009–10 are plotted in Figure 4 and show a mode in the 90 kg size class. There has been an increasing trend in the estimated sizes of tagged striped marlin over the past four years. Between 2005–06 and 2009–10, the proportion of striped marlin tagged at estimated weights of less than 90 kg has steadily declined from 45% to 28%, while the proportion estimated at greater than 100 kg has increased from 35% to 48%. While there are obvious difficulties around the unknown accuracy of weight estimates, the trend in the reported data is still worthy of note.



**Figure 4: Numbers of striped marlin by estimated weight on release in 2009–10.**

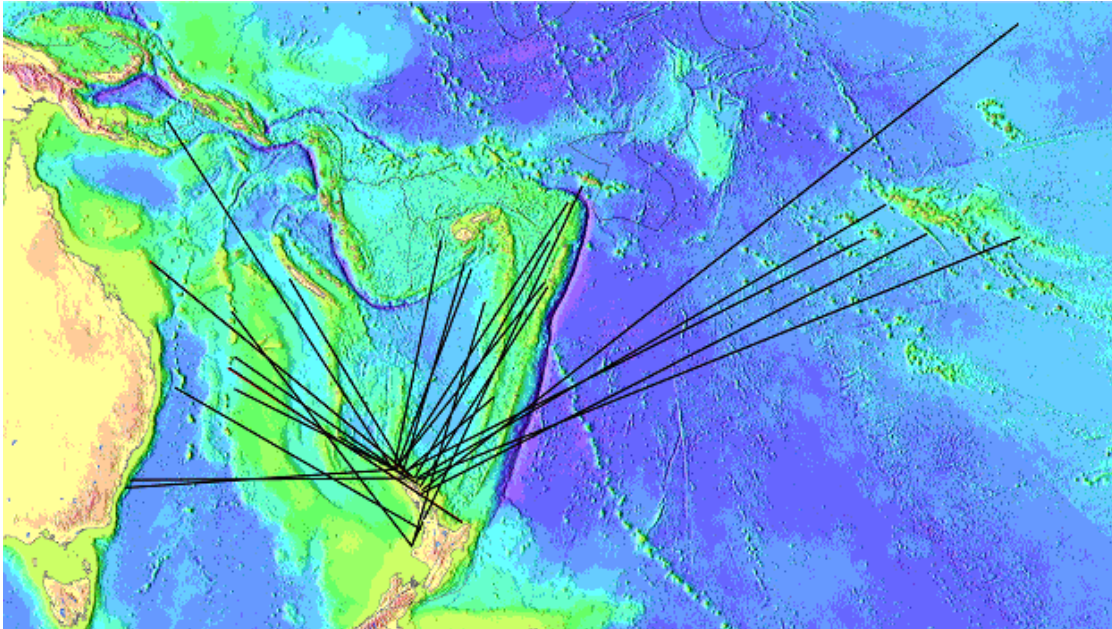
This season the two recaptured striped marlin were weighed on recapture and both release estimates were about 15 kg over the actual weight. Generally it is believed that fishers are quite good at estimating fish weights close to the 90 kg voluntary minimum which applies to most fishing tournaments.

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 weight was estimated both times and a mean difference of 10.9 kg (s.d. 9.45) when the fish were weighed on recapture. On 10 occasions fishers have estimated the same weight on release and recapture and on six occasions the release estimate has been within 4 kg of the actual recapture weight. A plot of recapture weight vs release weight is shown in Appendix B Figure B3.

### **Movement**

Long-distance recaptures for striped marlin show a wide spread of locations across the southwest Pacific Ocean and Tasman Sea (Figure 5). 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. Most striped marlin have been recaptured within 10 months of release, but to date

three fish have been recaptured in New Zealand the following season, all relatively close to where they were released.



**Figure 5: Long distance movements of striped marlin in the gamefish tagging programme, 1988-2010.**

Fisheries managers believe that there is a separate southwest Pacific stock based on tagging data, slight genetic differences, and spawning areas. Spawning is known to occur in the Coral Sea – between Queensland and New Caledonia – and in French Polynesia. Juveniles stay in warmer water between 15 and 20 degrees south. After spawning in November and December, adult marlin move into higher latitudes where food is more plentiful. Striped marlin feed on a wide range of species. In New Zealand squid and jack mackerel are common prey along with saury, pilchard, and Ray’s bream.

### **Growth**

The problems measuring the size of fish while still in the water mean that tag and recapture is not a good means of collecting growth rates for this species. New Zealand has contributed samples from landed recreational catch to a southwest Pacific study on age, growth, and maturity of striped marlin. The study has validated annual growth rings in the dorsal fin spines and used daily growth rings in the otoliths (balance bones) of small fish to establish where the first growth ring should be. It was hard to get samples of small striped marlin because they are not often taken by longline or purse seine vessels which target tuna. Eventually some were obtained from New Caledonia, Fiji, and Tahiti.

Small striped marlin grow incredibly fast. The study estimated the age of the youngest fish, which weighed 4 kg and measured 1120 mm Lower Jaw–Fork Length, to be just 130 days old. The oldest striped marlin sampled was a 168 kg fish from New Zealand (2871 mm LJFL) was over 8 years old (Kopf et al. 2009). Females grew to a larger maximum length, weight, and age compared to males, but there were no significant differences in growth curve parameters. Growth remained rapid during the first two years of life, during which time both sexes achieved 75–80% of maximum body length (Kopf et al. 2010).

### 3.2 Yellowtail kingfish

The number of yellowtail kingfish tagged and released in New Zealand fisheries waters during 2009–10 was 1317, substantially up on the previous season and also well above the average of the previous 10 years (Table 2). A kingfish monitoring project started in 2010 in FMA1 (North Cape to Cape Runaway) with the objective of collecting 2000 lengths and 500 sets of otoliths from the recreational fishery. The 60 anglers involved were issued with free tags and a measuring board as part of the incentive to participate. There were 810 kingfish tagged (62%) in FMA1 in 2009–10. Most (88%) were measured before release. There were 47 recaptures reported, one of which was from NSW, Australia. Overall, the recapture rate for kingfish is 7.2%.



**A 20 kg tagged kingfish recaptured in Jervis Bay, Australia by a spearfisher (Photo supplied by Geoff Buchanan)**

#### **Yellowtail kingfish highlights 2009-10**

The number of kingfish tagged by month varies with effort. Thirty nine percent were tagged in February and March and 17% in June. Also, 32% of recaptures were made in February and March and a further 18% in January.

The kingfish recaptured in Australia was tagged on 18 October 2003 northwest of White Island in the Bay of Plenty, New Zealand, from the vessel *Pursuit*. It measured 99 cm fork length and was estimated to weigh 14 kg. When recaptured by spearfisherman Geoff Buchanan it had travelled 1350 nautical miles (calculated as shortest distance by sea) and had grown to 20 kg, but looked skinny. The length was 133 cm overall which is about 125 cm fork length. When recaptured after 6 years 1 month (2220 days) it had grown about 26 cm (4.3 cm per year) in length and increased by at least 6 kg in weight since it was tagged. This is the third recapture of a New Zealand tagged kingfish in NSW. The other two were smaller fish. One was recaptured at Whale Island, Sydney, after 5 years 10 months and the other northwest of Montague Island after just 10 months at liberty.

By coincidence the kingfish with the longest time at liberty in 2009–10 was also tagged northwest of White Island from *Pursuit* and weighed exactly 20 kg on recapture. It was tagged and released on 14 February 2000, measured 108cm and was estimated to weigh 15 kg. When it was recaptured on 12 March 2010 on the knolls east of Mayor Island in 235 m of water it measured 122.5 cm and weighed 20 kg. Therefore the tag was attached for 10 years and 1 month (3679 days). The fish had moved less than 30 nautical miles, grown 14.5 cm, and increased about 5 kg in weight during this time. Long-term recaptures of measured fish give good information on growth rates. There have been only three longer term recaptures of kingfish, the longest being 14 years 8½ months.

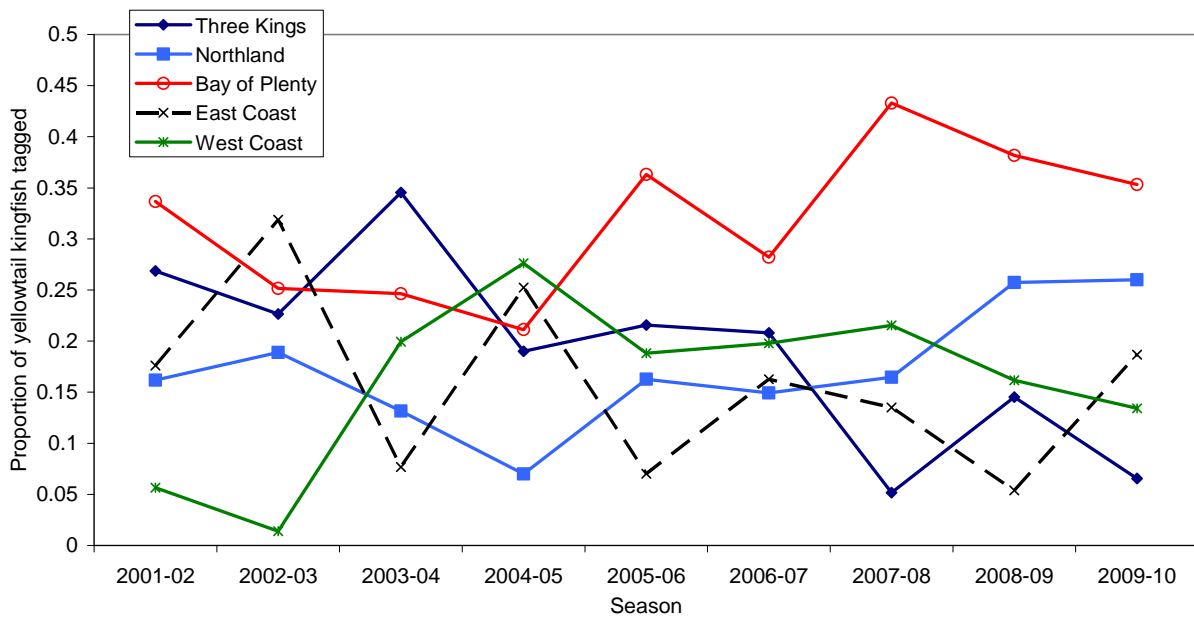
Fourteen kingfish tagged at White Island and Volkner Rocks were recaptured in 2009–10. They all moved less than 3 nautical miles and were at liberty for between 5 and 1470 days. Half of these recaptures were within 66 days of release while the other half were between 2 and 4 years at liberty. This is a familiar pattern of residency for White Island kingfish. When they do move, it is usually to other offshore reef systems like Rangitira Knoll or Ranfurly Banks.

**Table 2: The number of yellowtail kingfish tagged and recaptured by season since 1999–2000.**

	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	Average 2000 to 2009
NZ EEZ	818	606	778	646	771	806	1 016	961	1 110	660	1 317	817
Recaptures	57	29	48	27	32	38	53	38	55	43	46	42

Occasionally tagged kingfish show movement from one side of the North Island to the other. A 9 kg fish tagged off Raglan, west coast, in November 2008 was recaptured in March 2010 off the wharf in Houhora Harbour on the northeast coast of the North Island. This is a distance of 266 nautical miles if the route around North Cape was used. In 2008–09 a kingfish tagged off Raglan in April 2006 was recaptured at Kawau Island in the Hauraki Gulf after 969 days. There have been just three other tagged kingfish known to have done this and one that went east to west from over 1 200 kingfish recaptures in the programme to date.

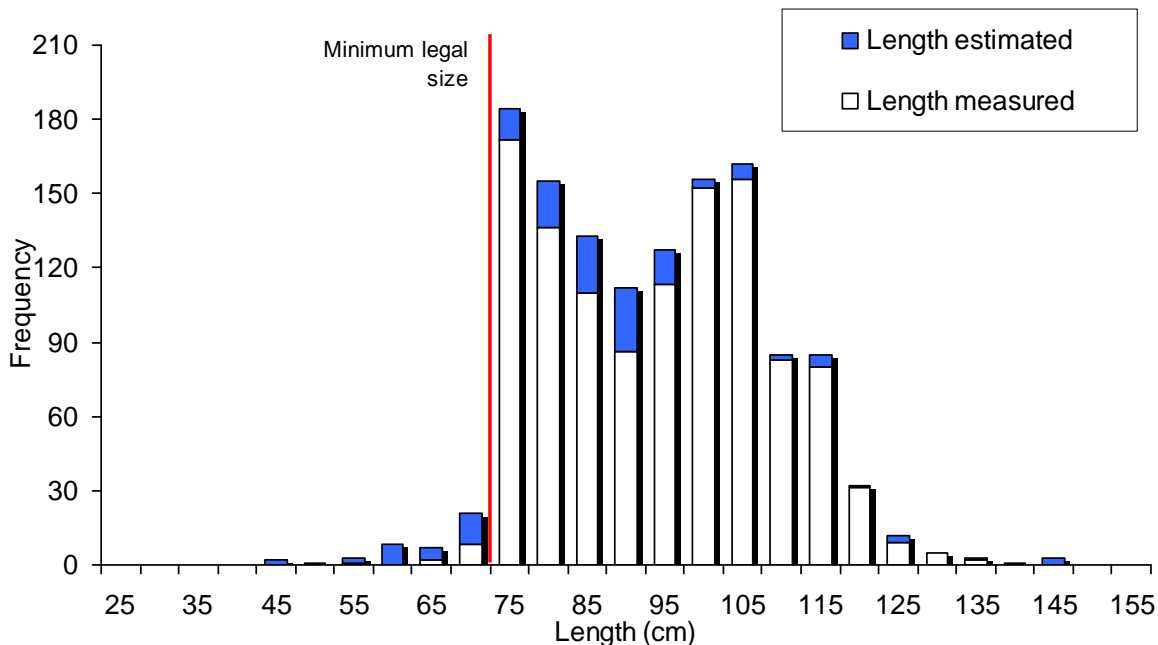
Trends in the proportion of annual kingfish releases by region are shown in Figure 6. For the last five seasons over a third of releases are from the Bay of Plenty. There has been an increase in the proportion tagged in east Northland waters and a significant decrease in the proportion tagged in the Three Kings area. The proportion tagged on the west coast of the North Island and East Cape area have declined a little (Figure 6).



**Figure 6: The proportion of yellowtail kingfish tagged by region and season since 2001–02.**

Fishers from Nelson and Marlborough have recently started targeting kingfish in the outer Marlborough Sounds. They are interested in encouraging catch and release and have started tagging fish which will help describe movement and recapture rates. Most tagging has occurred since June 2010 and will be covered in future reports.

Kingfish should, if possible, be measured before release because this gives a more consistent index of size and (if measured on recapture) growth. The great majority (88%) of tagged kingfish in 2009–10 were measured, nose to tail fork, before release.



**Figure 7: Yellowtail kingfish length frequency for fish measured on release (white bars) and those with estimated release lengths in 2009–10.**

The length of kingfish tagged in 2009–10 ranged from 48 to 149 cm (Figure 7). Small numbers of sublegal kingfish continue to be tagged, but the vast majority of cooperating anglers only tagged kingfish over the current minimum legal size of 75 cm as requested. Most of the fish between 75 and 95 cm are tagged in coastal locations, while fish between 100 and 120 cm generally come from offshore at locations like Three Kings, White Island, and Ranfurly Banks. Offshore anglers targeting larger fish either don't catch many fish less than 100 cm, or choose not to tag them. As part of the kingfish monitoring project more skippers had purpose-made kingfish measuring boards and they were encouraged to provide accurate length at release.

### Growth

Growth rates can be estimated from tag and recapture data. This is most easily and accurately recorded as changes in length, measured under the fish on a flat surface, nose to tail fork (measuring over a fish with a tape can add 2 or 3 cm due to the curve of the body). It is best practice when measuring in centimetres to round down to the nearest centimetre, not up to a length the fish hasn't reached yet. Short-term recaptures can give an idea of measurement error and occasionally fish are smaller on recapture than was reported on release.

The last time the GROTAG model (Francis 1988) was run with New Zealand kingfish data was in 2004. It predicted that on average a 50 cm fish would grow 11 cm in one year and a 100 cm fish would grow 5 cm per year (McKenzie et al. NIWA, unpublished results). There was a seasonal effect with growth fastest during February and slowing over winter.

Ageing fish at different lengths is another way of inferring growth rates. A NIWA study collected and aged kingfish from the recreational catch in 2002–03. Most of the fish came from White Island and the Ranfurly

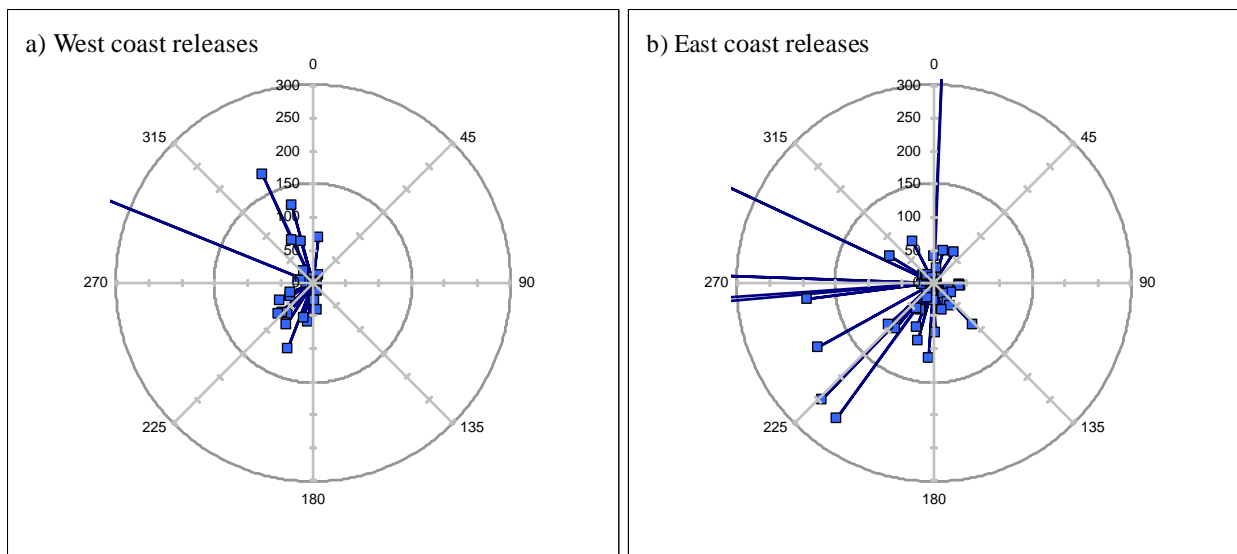


Banks. They found kingfish length varies quite a lot with age but over half 6 year old fish are over 75 cm (the legal size for recreational fishers) and an average length for a 10 year old fish was 98 cm. The largest and oldest kingfish reach about 140 cm and 25 years old (McKenzie NIWA, unpublished results). A few exceptional fish (found only in New Zealand) get bigger.

In 2010 two tagged kingfish were recaptured at White Island during the Tauranga One Base – a 15.2 kg fish had been at liberty for 4 years and had grown from 98 cm to 109 cm – the second was a 15.7 kg fish which had been at liberty for 8 years and had grown from 75 cm to 110 cm. Both these growth rates fit quite well with the predicted length and weight increases for the time at liberty from the age and growth model. It is important in all ageing studies to use several methods to check the growth estimates made from annual rings. The Ministry of Fisheries has contracted the collection of length and ages of kingfish in FMA 1 during 2010. This includes a wide range of fisheries and fishers from east Northland, Hauraki Gulf, and Bay of Plenty. Results should be available in 2011.

**Movement**

Kingfish with release and recapture locations can be plotted as the distance and bearing from a central release point. These are called polar plots and can summarise all movements at once. The data have been separated for fish tagged off the west coast (mostly Raglan and the Three Kings area) and the east coast of New Zealand (Figures 8a and b).



**Figure 8: Distance (nautical miles) and bearing from release points for yellowtail kingfish tagged on the west coast (left) and east coast (right) for all recaptures more than 30 days at liberty.**

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 8b).

### 3.3 Mako and blue shark

There were 396 mako and 70 blue sharks reported as tagged and released inside New Zealand fisheries waters in the 2009–10 season. This was an increase in mako numbers but a decrease in blue shark numbers over recent seasons. There were few mako and blue sharks reported as landed in gamefish club records this season (Roz Nelson, N.Z. Sport Fishing Council, pers. comm.). Using NZSFC records only, it is estimated that over 90% of mako and blue sharks caught by recreational fishers associated with sport fishing clubs were tagged and released in 2009–10. There were no mako and blue sharks tagged for this programme outside New Zealand fisheries waters in 2009–10. The overall recapture rate for mako is 2.7 %.

Mako sharks can and do leap out of the water as demonstrated by this large female (right) free jumping. (Photo: Evan Daysh).



#### **Mako and blue shark highlights, 2009–10**

The seven recaptures reported in 2009–10 were the highest for the last six years. Three of these fish were caught outside the New Zealand EEZ.

- The first in July 2009, 390 nautical miles northwest of East Cape by a Spanish longliner. It was tagged off Whangamata 438 days earlier.
- The second, recaptured in December by commercial fishers in Fiji, was about 40 kg. It had moved 1085 nautical miles in 299 days.
- The third was caught by a longliner in New Caledonia in February, 940 nautical miles north of its release point off Raglan after 744 days.
- There was also a late report from the 2008–09 season of a tagged mako recaptured south of Lord Howe Island in the mid Tasman by a Japanese longliner. This fish had been at liberty for 493 days and was 745 nautical miles from where it was released off Manukau Harbour.

The mako sharks recaptured in New Zealand waters were at liberty for between 12 and 313 days. The longest movement was for a fish tagged near White Island and recaptured by Eric Wellington near Tutukaka (165 nautical miles in 86 days).

There were two blue shark recaptures in 2009–10. Both moved about 1000 nautical miles north.

- The first was a 43 kg fish tagged in February 2009 off Otago Heads which was caught again five and a half months later east of the Kermadec Islands by a Spanish longliner.
- The second fish was tagged in January 2010 near Cape Brett and was recaptured in Fiji. It had been at liberty for just over 3 months.

#### **Trends**

The 2009–10 fishing season saw the highest number of mako sharks tagged and released since 1999–2000 (Table 3). Generally mako sharks are caught as a bycatch of other sport fisheries, particularly off the North

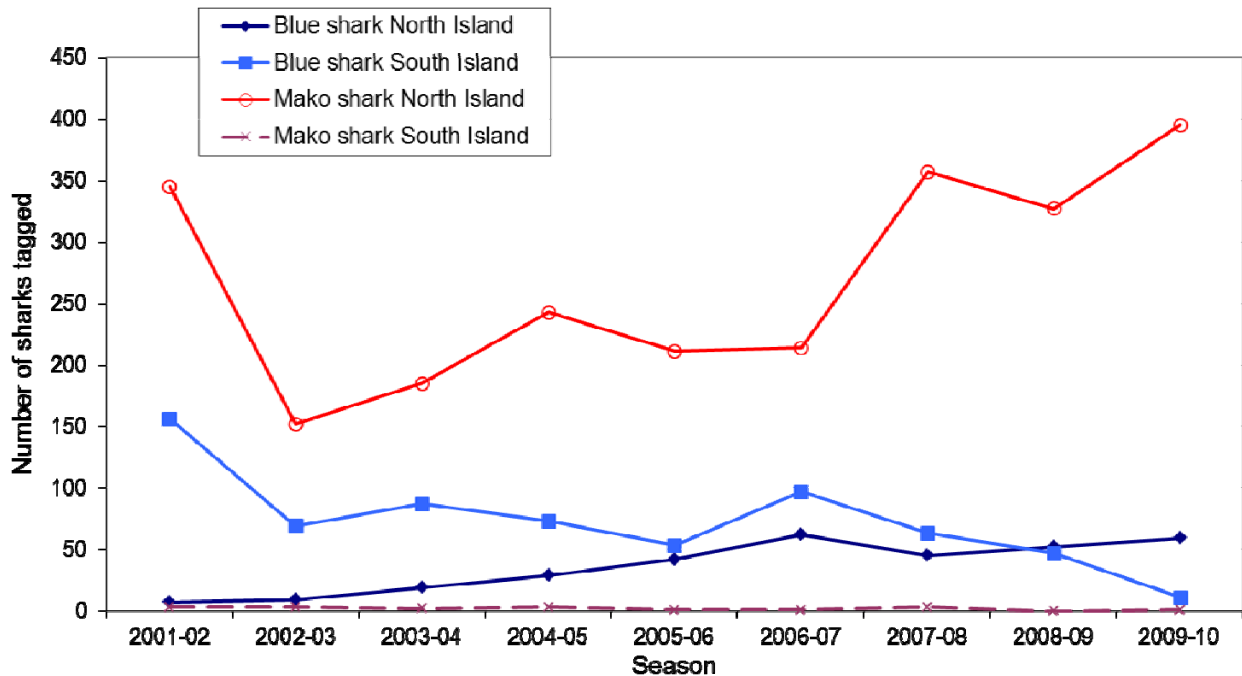
Island. Probably abundance has improved from the low points in the early 2000s. The number of sharks caught and released without being tagged is unknown.

**Table 3: The number of mako and blue sharks tagged, the percentage tagged according to New Zealand Sport Fishing Council Records, and the number recaptured by season.**

	1999-	2000-	2001-	2002-	2003-	2004-	2005-	2006-	2007-	2008-	2009-	Average 2000 to 2009
Mako shark	00	01	02	03	04	05	06	07	08	09	10	
NZ EEZ	398	277	346	155	188	241	193	150	294	284	396	253
% tagged	54	52	69	59	70	80	81	82	87	87	90	72
Recaptures	23	15	16	9	9	6	3		2	5	7	10
Blue shark												
NZ EEZ	314	203	163	78	106	102	95	157	108	101	70	143
% tagged	80	79	62	72	85	80	76	91	90	89	92	81
Recaptures	11	4	3		2	2	1	2	3	4	3	4

Blue shark numbers tagged in the North Island have increased, but they are still a less common bycatch than they were in the 1990s. The number of blue sharks tagged in the South Island over the last three years has declined due to a reduction in effort by fishers who have targeted sharks off Otago Heads for a number of years. At the same time there has been a gradual increase in blue sharks tagged off the North Island (Figure 9), so overall, the number of blue sharks tagged has been about 100 fish since 2003–04 (Table 3).





**Figure 9: The number of mako and blue sharks tagged by region and season.**

Most mako were tagged between January and May 2009 with a very strong mode in February, when more than three times as many mako were tagged as in any other month. This peak is associated with the NZSFC National Contest which runs over nine days in late February each year, and which encourages the tag and release of various species.

The average weight of mako tagged in the last three seasons has been about 50 kg. This is 20 kg less than in the early 2000s. Most of the fish encountered are juveniles with few large females, which are important for maintaining the reproductive potential of the population. Although there were more sharks tagged in 2009–10 there were fewer large fish encountered that previously (Figures 10 and 110).

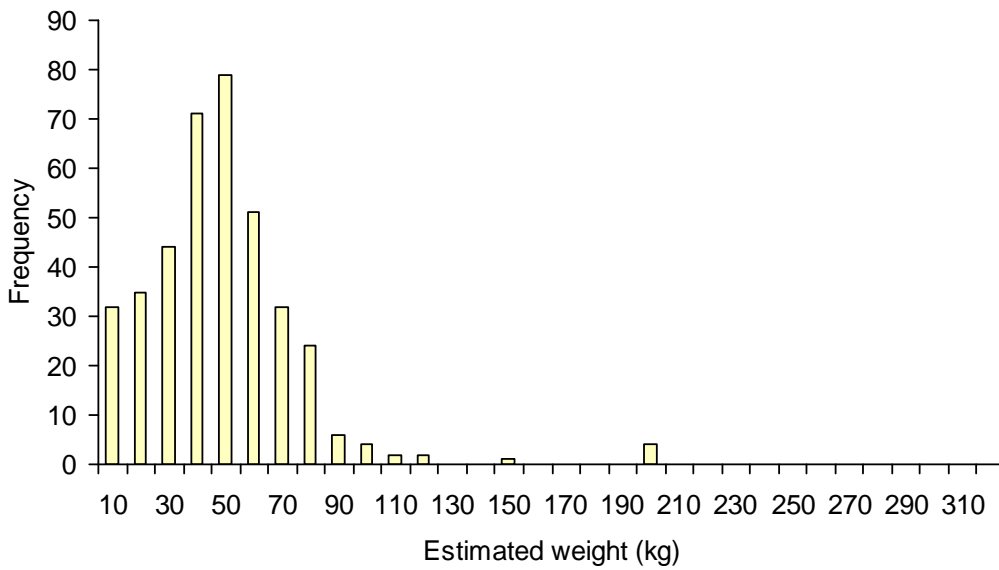


Figure 10: Release weights of mako sharks for the 2009–10 season (n=387).

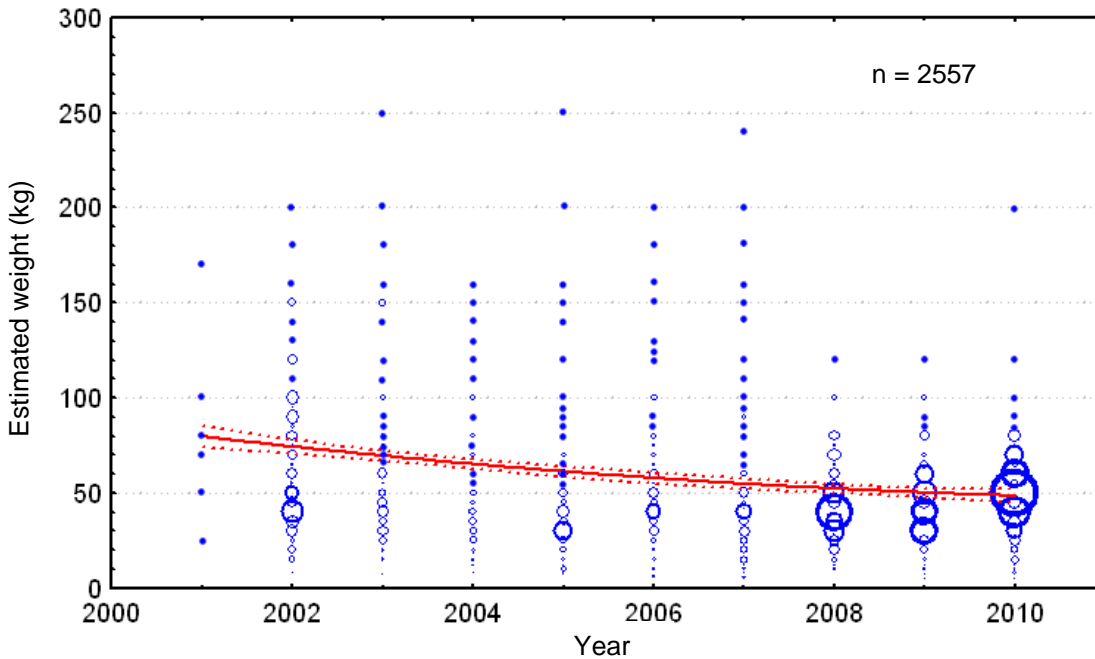


Figure 11: Weights of mako sharks estimated on release by season since 2000–01. Larger circles equate to more fish at that weight, polynomial trend line of average weight with 95% confidence intervals.

### Growth

There have been a number of long-term recaptures of mako and blue sharks in the gamefish tagging programme. These give an insight into growth and longevity. Five mako have been at liberty for five years or more. They were between 80 and 140 cm (7 to 30 kg) when tagged and released and between 177 and 297 cm on recapture. Some lengths had to be calculated from estimated weight. On average these fish grew 13.8 cm per year over 6.9 years. At one end of the scale a 15 kg fish at liberty for five years six months was weighed at

91 kg on recapture. The longest term recapture is 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. It was recaptured between New Caledonia and Vanuatu in January 2009 and reported by a Fijian observer on a Chinese longliner. It was a large female measuring 297 cm (estimated 260 kg) and contained 8 unborn young. This fish grew 15.8 cm and about 23 kg per year on average.

Blue sharks tend to grow faster and produce more young than mako. There have been fewer tagged and released and consequently fewer recaptures than for mako. There are five blue shark recaptures between 2 and 3.3 years at liberty. These fish were all less than 45 kg on release and grew on average 16.4 cm per year. Care is needed with shark growth rates as it is not possible to measure fish on release and sometimes estimates are also supplied on recapture.

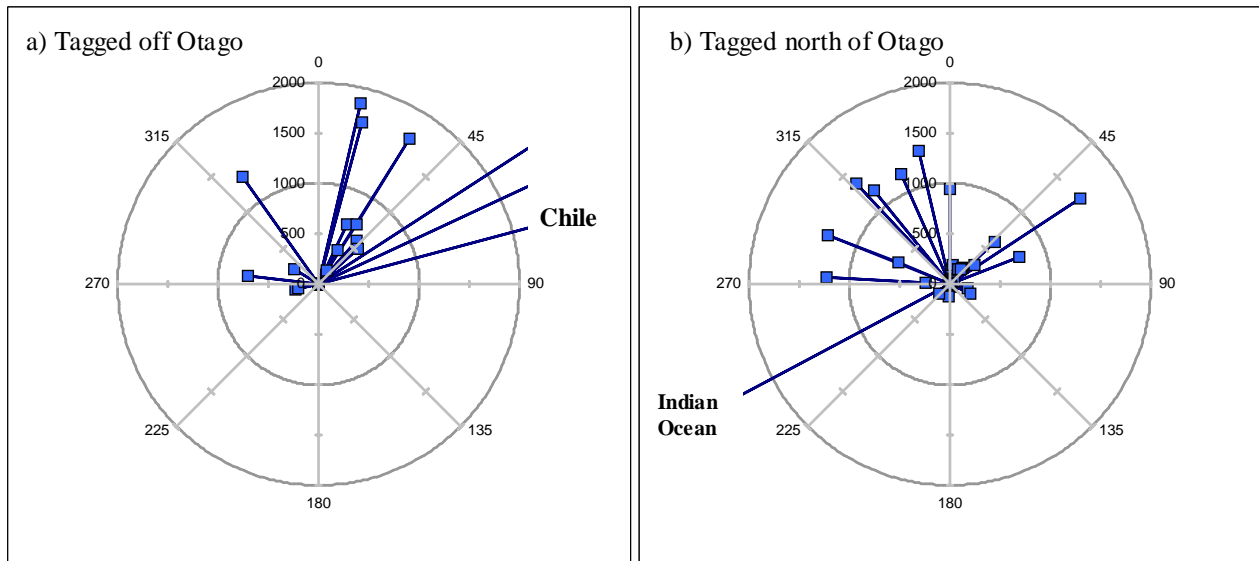
### **Movement**

The gamefish tags hold well on sharks and, as noted above, some long-term recaptures have been made. Rather than getting increased dispersion for longer times at liberty, as would be the case if movement was unstructured or random, we see some fish recaptured close to their release points in following seasons. It is possible that a few fish do not leave New Zealand, but the general pattern emerging is for fish to move north into the subtropics ( $10^{\circ}$  to  $25^{\circ}$  S) in autumn and south in spring, in a similar way that marlin, and yellowfin, and skipjack tuna do.

In many ways the distribution of recaptures of mako sharks tagged in New Zealand is similar to that for striped marlin. They seldom stray into equatorial waters to the north, or past French Polynesia to the east or Australia to the west. Mako have tended to be recaptured in Fiji and New South Wales more often than striped marlin, but this may be due to the methods of fishing in those areas.

Blue sharks also appear to be at home in the subtropical south Pacific, with recaptures from Australia, New Caledonia, Vanuatu, Fiji, Tonga, Cook Islands and French Polynesia. However, they have strayed farther afield with single recaptures from the southeastern Pacific off Chile and the Indian Ocean, southwest of Perth. Most blue shark recaptures have been made north of the release points as shown by plotting the distance and bearing of recapture sites (Figure 12). This may in part be due to the large number of sharks tagged in southern New Zealand with little pelagic fishing effort south of there. In the polar plots (Figure 12) we have split Otago tagged fish from the rest. There is a tendency for blue sharks to be recaptured northeast of the release location. The simple explanation is that the land mass of New Zealand guides them in that direction. There are a few exceptions of fish recaptured on the west coast of the South Island in the same season.

Few blue sharks tagged north of Otago moved very far south either. The furthest was about 120 nautical miles down the west coast of the North Island in 21 days and the fish that travelled 3105 nautical miles WSW to the southern Indian Ocean in 207 days. There is a tendency for long distance movement of fish tagged in northern areas to be in the northwest segment of the plot (Figure 12b).



**Figure 12: Distance (nautical miles) and bearing from release points for blue shark tagged off Otago (left) and north of Otago (right) for all recaptures more than 30 days at liberty.**

### 3.4 Other species

Each year, anglers tag and release a number 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 2009–10 was 71, up on the low numbers recorded in recent seasons (see Appendix A).

There was one hammerhead shark recaptured in 2009–10. It was tagged off Tutukaka by a recreational fisher after 10 minutes on the line and was recaptured 1 hour later by another vessel in the area. The fish was released again with a second tag implanted.

A few commercial fishers have been tagging small swordfish and southern bluefin tuna caught on surface longlines. Two juvenile southern bluefin tuna tagged in New Zealand were reported from fish farms in Port Lincoln, South Australia. Both fish were tagged in late May 2009 at Hokitika Trench off the southern west coast of New Zealand, and were recaptured by purse seine vessels off South Australia. On release, the first fish measured 109 cm and was estimated to weigh 20 kg and when the tag was removed in March 2010 it measured 118 cm and weighed 34.4 kg. The second fish measured 109 cm and was also estimated to weigh 20 kg. It was recaptured on 11 January 170 nautical miles west of Port Lincoln, released into the farm on 7 February, and harvested on 11 July 2010 weighing 32 kg and measuring 120 cm. These are impressive growth rates of 9 cm over 9 ½ months and 18 cm for a fish at liberty for 8 ½ months and then in a farm for 5 months.

The Secretariat for the Pacific Community (SPC) tagged albacore in New Zealand in 2009 and is encouraging all fishers to measure fish and report recaptures to the New Zealand Ministry of Fisheries. Any fisher finding an albacore bearing a white tag should keep the whole fish in the freezer. There is a US\$100 reward for these fish which are used in validating age and growth.

#### 4. DISCUSSION

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

The 2009–10 season was relatively strong overall with 2789 fish reported as tagged and released and 61 recaptures. Shark and kingfish numbers were up on recent seasons, while billfish and yellowfin tuna were down. The long-term and long distance recaptures probably stand out as most interesting, but all recaptures are valuable for building a better picture of the fish and fisheries.

This is an annual report focusing on the results and updates for the 2009–10 season. Following a review of the Gamefish Tagging Programme (GFTP) by an independent panel of experts (the review panel) the layout and presentation of these reports has been changed to provide more accessible information for participants. Overall there will be more feedback on the objectives and results of the GFTP to those taking part. New incentives have been introduced in the 2010–11 season to reward fishers for returning tags while at the same time giving greater recognition to the role of the tagger. The Ministry of Fisheries has also commissioned a synthesis report which will draw together information from all years and discuss what more can be achieved.

While acknowledging the conservation ethic in tag and release, the review panel suggested more focus on research objectives and methods of efficiently achieving those in the future. This may incorporate the use of electronic tags or change the emphasis from one species to another.

Internationally, for the shark and billfish species, in particular, there is relatively poor information on which to base management. In some countries commercial catch is not recorded at all, or multiple species are combined into a single figure. The Scientific Committee of the Western and Central Pacific Fisheries Commission 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 (NPOA) 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 tagged and released, which should assist in the research and conservation of these species.

The type of information collected from long-term voluntary tagging helps determine growth and stock boundaries of a species. In some cases information on growth and longevity is available, but there can be problems with tag shedding and size estimation of fish which make this difficult. Tag recaptures have revealed movement of New Zealand tagged fish into the fishing zones of a number of neighbouring countries, and catches have been reported by a variety of fishing nations, large and small. Unfortunately, reporting rates are unknown but may not be high.

There are a number of other cooperative tagging programmes operating in the southwest Pacific, run from Australia, Tonga, and USA. Some tagging from commercial fleets is also happening with conventional and electronic tags. Researchers draw all this information together when undertaking stock assessments. In future, more information sharing across programmes will be encouraged.

Your feedback on the GFTP and this report is encouraged. The programme will need to change to provide good value for all those involved: fishers, NZSFC, scientists and government. You can email or post to [John@bluewatermarine.co.nz](mailto:John@bluewatermarine.co.nz) or [info@fish.govt.nz](mailto:info@fish.govt.nz) Ministry of Fisheries, PO Box 19747, Avondale, Auckland.

## 5. ACKNOWLEDGMENTS

Thanks to all those who participated in this programme by releasing or reporting tagged fish. The New Zealand Sport Fishing Council and all affiliated clubs are thanked for their cooperation and the purchase and distribution of tags. Particular thanks to Roz Nelson, secretary of the NZSFC, for compiling catch information and keep track of clubs and tags. The Ministry of Fisheries provided funding for this project, “Management of data from the gamefish tag recapture programme” TAG2009/01.

## 6. REFERENCES

- Francis, R.I.C.C. (1988). Maximum likelihood estimation of growth and growth variability from tagging data. *New Zealand Journal of Marine and Freshwater Research* 22: 42–51.
- Holdsworth, J.; Saul, P. (2003). New Zealand billfish and gamefish tagging, 2001–02. *New Zealand Fisheries Assessment Report 2003/15*. 39 p.
- Kopf R.K.; Drew K.; Humphreys R.L Jr. (2010). Age estimation of billfishes (*Kajikia spp.*) using fin spine cross-sections: the need for an international code of practice. *Aquatic Living Resources* 23(1): 13–23.
- Pepperell, J. G. (1990). Australian cooperative gamefish tagging programme, 1971–1986. In: Parker et al. (eds), Fish-marking techniques. *American Fisheries Society Symposium* 7: 765–774.
- Saul, P.; Holdsworth, J. (1992). Cooperative gamefish tagging in New Zealand waters, 1975–90. *New Zealand Fisheries Technical Report No. 33*. 24 p.

## Appendix A: Tables for all years

**Table A1: Number of fish tagged and released by species and season, and the mean number of releases for the 10 seasons previous to 2009–10, 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
2009-10	32	3	70	1 317	396	71	14	809	12	8	30	7	2 769
Total	353	34	4 135	17 980	12 445	1 145	186	18 771	201	91	1 244	711	57 296
10 year Average	25	2	143	817	253	61	8	923	9	21	47	8	2 299
BEM	blue marlin	KIN	kingfish	SSF	shortbill spearfish	TOR	Pacific bluefin						
BKM	black marlin	MAK	mako shark	STM	striped marlin	YFN	yellowfin tuna						
BWS	blue shark	SHA	other shark species	SWO	broadbill swordfish	OSP	all other species						

**Table A2: 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	12	1					1		29	2			45
2009-10	17						2	1					20
Total	593	47		3	5		132	20	504	3	53	42	1 402

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



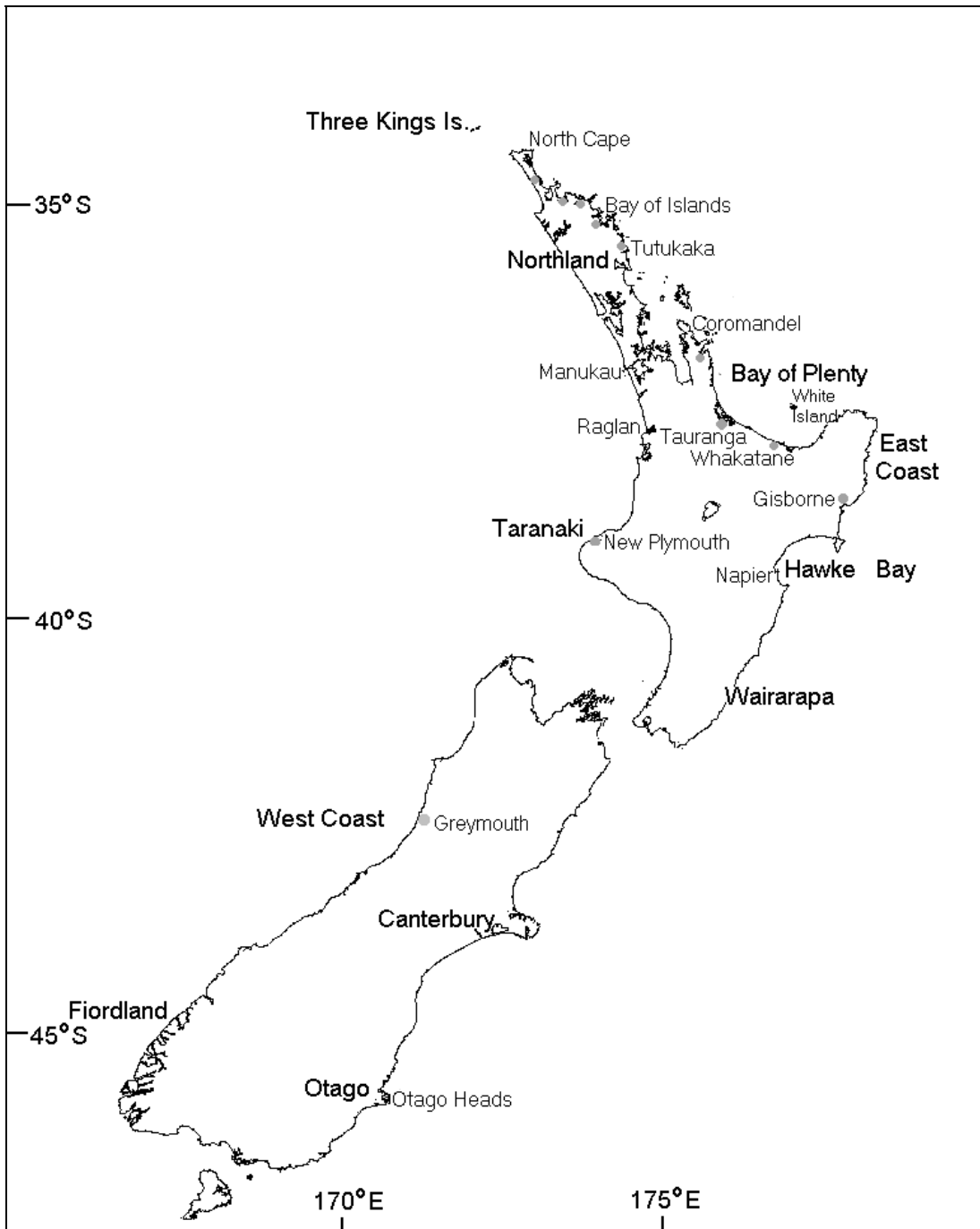
**Table A3: Number of fish recaptured by species and season and overall recapture rate by species.**

Season	BEM	BKM	BWS	KIN	MAK	SHA	SSF	STM	SWO	TOR	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		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	38		1					1		43
2007-08			3	55	2	2	1	3			1		67
2008-09			4	43	5	2		3		2		2	61
2009-10			3	46	7	1		2				2	61
Total	7	1	73	1 292	330	56	1	83	2	2	15	24	1 825
Releases	946	81	4 135	17 983	12 450	1 145	206	19 275	204	91	1 297	753	
Recapture rate (%)	0.7	1.2	1.8	7.2	2.7	4.9	0.5	0.4	1.0	2.2	1.2	3.2	

**Table A4: 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		1					13
2002-03	1	2	1		1	2				1				1				1	10
2003-04	1	1	1	1	1	5		1			1				1	2			14
2004-05						2								1	1				5
2005-06			1					1						1	1				5
2006-07														1		1	1		3
2007-08	1			1				2				2			1	1		1	8
2008-09	1	1		1	2	1		3				1			1				10
2009-10			2	1	1	2		2					2						9
<b>Total</b>	<b>11</b>	<b>5</b>	<b>8</b>	<b>7</b>	<b>5</b>	<b>31</b>	<b>1</b>	<b>8</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>17</b>	<b>4</b>	<b>4</b>	<b>3</b>	<b>7</b>	<b>1</b>	<b>3</b>	<b>120</b>

**Appendix B:**



**Figure B1: Location of the main areas of gamefish tagging in New Zealand.**

a)

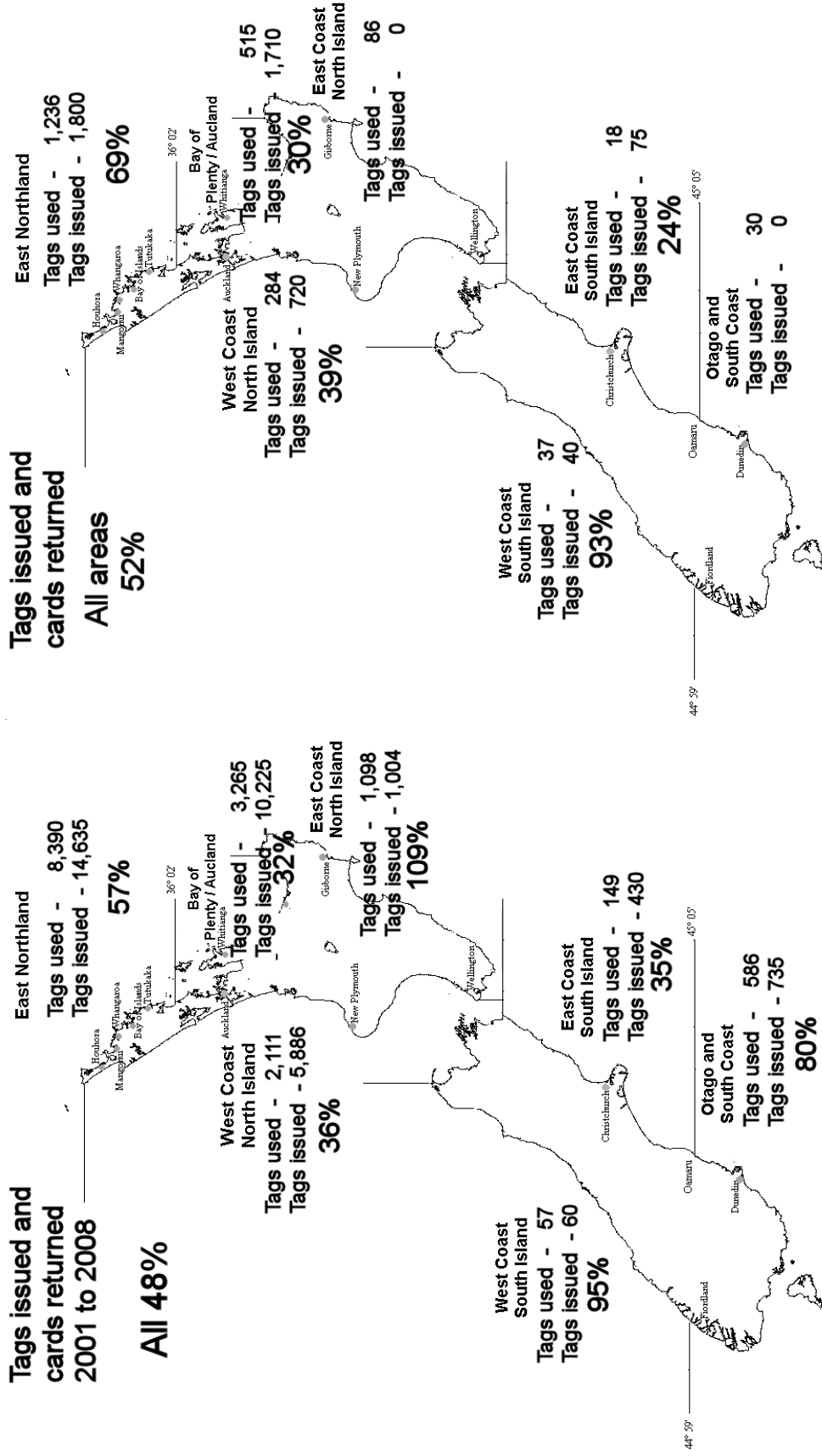


Figure B2: The number of tags issued to clubs and individuals and the number reported used by region for 2001-02 to 2007-08 combined (a) and for the 2008-09 season (b). The percentage of tags used can be influenced by the number of tags issued in previous seasons.

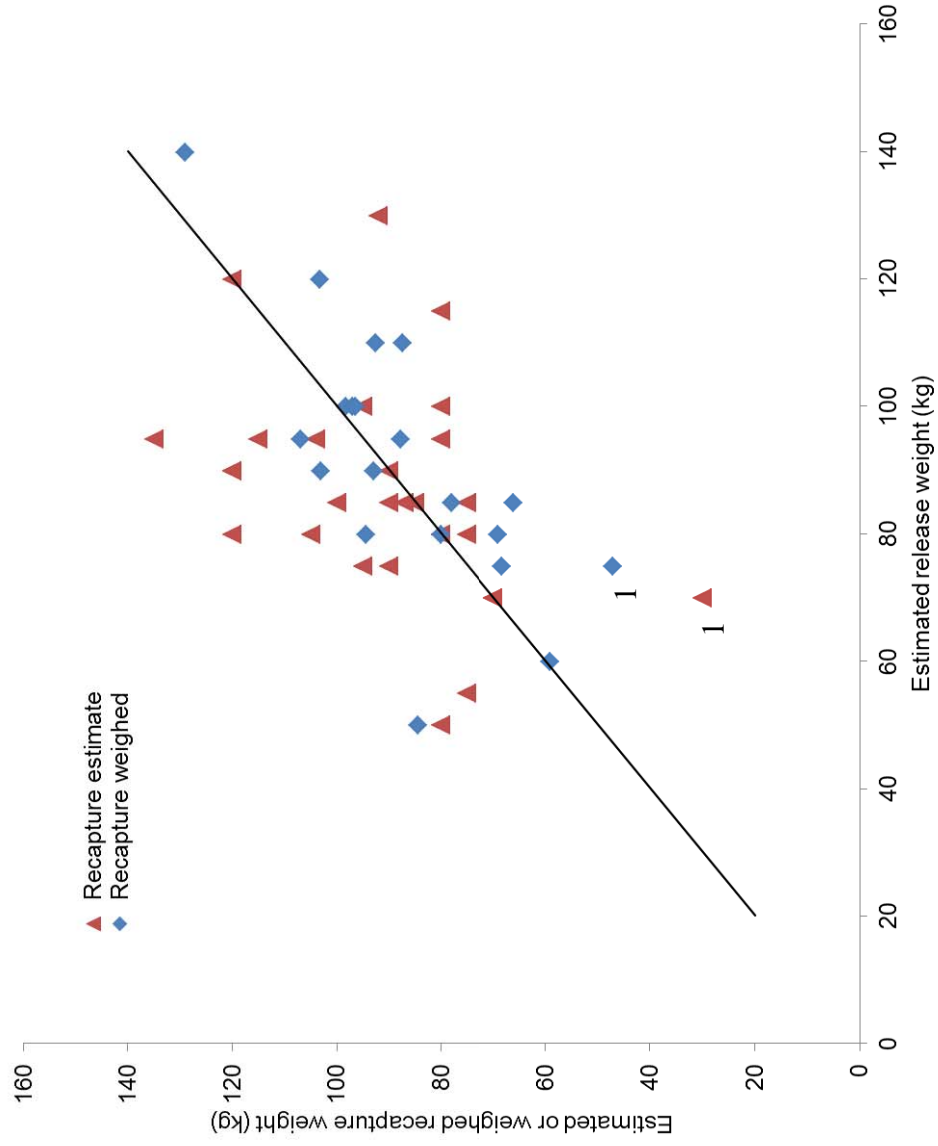


Figure B3: Striped marlin release and recapture weights for individual fish at liberty for less than 6 months (Note 1: Recaptured by surface longliners, probably processed weight).