



New Zealand Billfish and Gamefish Tagging, 2013–14 to 2015–16

New Zealand Fisheries Assessment Report 2017/14

J.C. Holdsworth
P.J. Saul

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EXECUTIVE SUMMARY

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Release and recapture data for 2013–14 to 2015–16 sport fishing years (July to June) 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.

There were 7467 fish tagged and released in New Zealand over the three years. A further 768 fish were tagged outside New Zealand fisheries waters, mostly striped marlin and blue marlin.

A new record time at liberty was set for striped marlin of 1124 days and a swordfish caught south of Tuvalu set a new record displacement distance of 1360 n. miles for this species in the New Zealand Gamefish Tagging programme (NZGTP).

The seasonality and regional distribution of fish tagged is summarised for the main species from the tagging data base and the number of gamefish landed is updated from New Zealand Sport Fishing Council (NZSFC) records. The combination of data from these sources provides a reasonably complete record of annual recreational catch of billfish, mako and blue sharks. It is indicative of recreational catch, but less complete, for tuna and other large shark species.

The 2015–16 year was atypically warm with mainly easterly quarter winds despite the prediction of an El Nino dominated summer weather pattern. There were extended periods with good fishing conditions on the east and west coast of the North Island. The numbers of striped marlin (1530), bronze whaler (61), hammerhead shark (50) and shortbill spearfish (22) tagged and released for the year were at record or near record levels. Yellowfin tuna are starting to return in the catch records after a 10 year absence and the number tagged is increasing.

1. INTRODUCTION

1.1 Overview

This gamefish tagging programme is a cooperative project between the Ministry for Primary Industries (MPI), the New Zealand Sport Fishing Council (NZSFC), 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 fish growth, distance and direction of movement, time at liberty, and in some circumstances the average migration rate (displacement rate) of the fish involved (Ortiz et al. 2003). 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 Gamefish Tagging Programme (NZGTP) 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. This report summarises the results for the Ministry for Primary Industries, project TAG2013/01, which had the following objectives:

1. To characterise the New Zealand recreational gamefish fishery
2. To collect and key punch tagging and recapture data for gamefish species in the 2013/14, 2014/15 and 2015/16 fishing years.
3. To compile annual summaries of the results of the tag recapture programme for 2013/14, 2014/15 and 2015/16 fishing years and submit a Fisheries Assessment Report for the project.

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 increasing numbers of 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.

Game fishing has developed on the west coast of the North Island over the last 20 years with, at times, a very productive marlin and tuna fishery accessed from the west coast harbours and beaches as far south as Taranaki (Figure 1). Shark species are important as a recreational target species in the southern regions. In the South Island, the game fishery is centred off Canterbury, Otago, and Fiordland, with blue shark (*Prionace glauca*) abundant and therefore the primary target species, along with porbeagle shark (*Lamna nasus*), albacore (*Thunnus alalunga*) and occasionally southern bluefin tuna (*Thunnus maccoyii*). There is a 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 between July and September.

Marlin species are also a bycatch of the commercial surface longline fishery that mainly targets bigeye tuna (*Thunnus obesus*), swordfish and southern bluefin tuna. Within the New Zealand Exclusive Economic Zone (EEZ), commercial fishers are obliged by regulation to release all billfish, except swordfish, whether the fish is alive or dead upon capture. This regulation includes a provision that live

billfish should be tagged if possible, and tagged marlin recaptured by commercial fishers are allowed to be landed and brought to port for scientific study.



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

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 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). Recording latitude and longitude is encouraged for all release and recapture events.

The individually numbered tags are printed with the address of the Auckland office of the Ministry for Primary Industries and the words "Please measure and sex – Reward". The sex of shark species can be readily determined by the presence of claspers on males and this information is mostly relevant for shark species which may segregate by sex for part of the year.

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.

The New Zealand Sport Fishing Council (NZSFC) compiles annual sport fish tallies for the main species from 58 gamefishing clubs around New Zealand. These records are used to provide an estimate of the national landed recreational catch of billfish and shark species in New Zealand waters. These are the best available data for estimating the proportion of catch landed and tagged and released by species.

Catch records for individual fish including fish weight, vessel and capture date will be sourced from six long established gamefish clubs. These are Bay of Islands Swordfish Club, Whangaroa Sport Fishing Club, Whangarei Deep Sea Anglers Club, Tauranga Game Fishing Club, Mercury Bay Ocean Sports Club and Whakatane Sportfishing Club. These records include tagged fish for club members and some captures from non-members who choose to get their fish weighed.

3. RESULTS

3.1 Billfish

The number of all billfish species tagged and released inside New Zealand fisheries waters has increased from 576 in 2013–14 to 1614 in 2015–16. Striped marlin are the main billfish species caught in this fishery and contribute most to this increase (Table 1). The number of blue marlin tagged has been around the average of 33 per year for the last two years, while swordfish were slightly lower than average in those years. The number of shortbill spearfish tagged is variable over the last 10 years with a high of 22 in 2015–16. There were three striped marlin recaptured in 2013–14, two in 2014–15 and seven 2015–16 (Table 1).

Table 1: The number of billfish tagged in New Zealand waters in the last ten years and combined recaptures in the NZGTP database.

Tagged Fish	Year										Average 2006 to 2016
	2006– 07	2007– 08	2008– 09	2009– 10	2010– 11	2011– 12	2012– 13	2013– 14	2014– 15	2015– 16	
Striped marlin	965	806	1058	858	731	663	858	519	1 086	1 530	907
Blue marlin	26	29	24	32	78	50	18	9	37	30	33
Shortbill spearfish	14	8	5	15	21	5	0	6	12	22	11
Swordfish	16	25	24	18	37	51	47	38	24	29	31
Black marlin	2		2	3	1	3	3	4	7	3	3
Billfish recaptures	1	4	3	2	1	1	4	4	1	8	3

The number of billfish recorded as landed by NZSFC affiliated clubs over the last 10 years is in Table 2. The number of swordfish landed has increased consistently since 2010 and now exceeds the number tagged for this species. Blue marlin numbers have been variable over the last 10 years with an average of 97 landed per year. Shortbill spearfish numbers are also variable with between 11 and 74 landed per year. (Dave Lockwood, New Zealand Sport Fishing Council, pers. comm.).

Some billfish were also tagged outside the New Zealand EEZ by NZGTP participants. For the three years 2013–14 to 2015–16, there were 101 blue marlin, 19 black marlin, 7 sailfish, 5 shortbill spearfish, and 631 striped marlin tagged (Appendix A, Table A2). Most of the striped marlin were caught at the Wanganella Banks, 200 nautical miles northwest of New Zealand.

Table 2: The number of billfish landed from New Zealand waters and recorded by NZSFC clubs in the last ten years by species.

Landed Fish	Year										Average 2006 to 2016
	2006 –07	2007 –08	2008 –09	2009 –10	2010 –11	2011 –12	2012 –13	2013 –14	2014 –15	2015 –16	
Striped marlin	688	485	731	607	607	635	744	620	696	900	671
Blue marlin	99	105	88	100	179	78	54	64	102	99	97
Shortbill spearfish	38	25	31	46	74	19	11	25	58	69	40
Swordfish	20	6	9	9	29	34	55	80	87	85	41
Black marlin	2	1	0	4	2	9	2	4	5	4	3

The New Zealand striped marlin season usually extends from January to May. February is consistently the peak month for striped marlin, but the proportion of fish tagged in January increased in 2014–15 and 2015–16 to about 20% of the annual total (Figure 2).

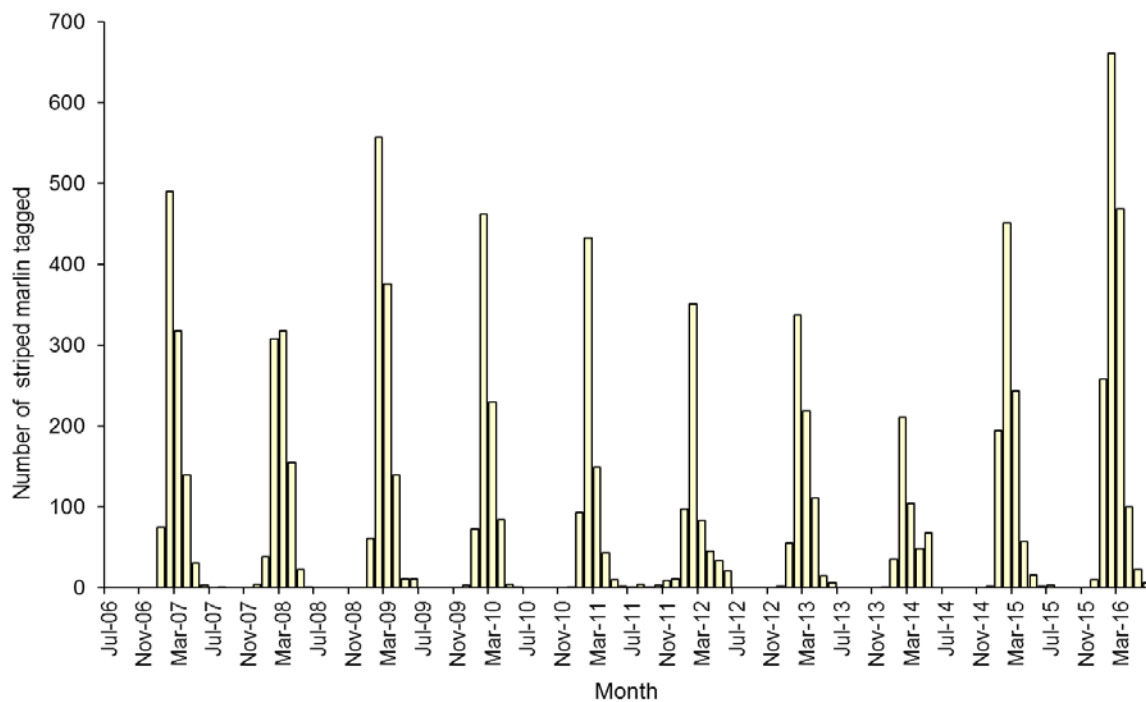


Figure 2: The number of striped marlin tagged by month in New Zealand waters (2006–07 to 2015–16).

Blue marlin prefer the warmest months of February and March in northern New Zealand, while in the Pacific Islands most blue marlin have been tagged in Tongan waters from July to October (Figure 3). Two New Zealand sport fishing boats fished Tongan waters in January to March 2015, outside the usual holiday season, and tagged 52 blue marlin between them.

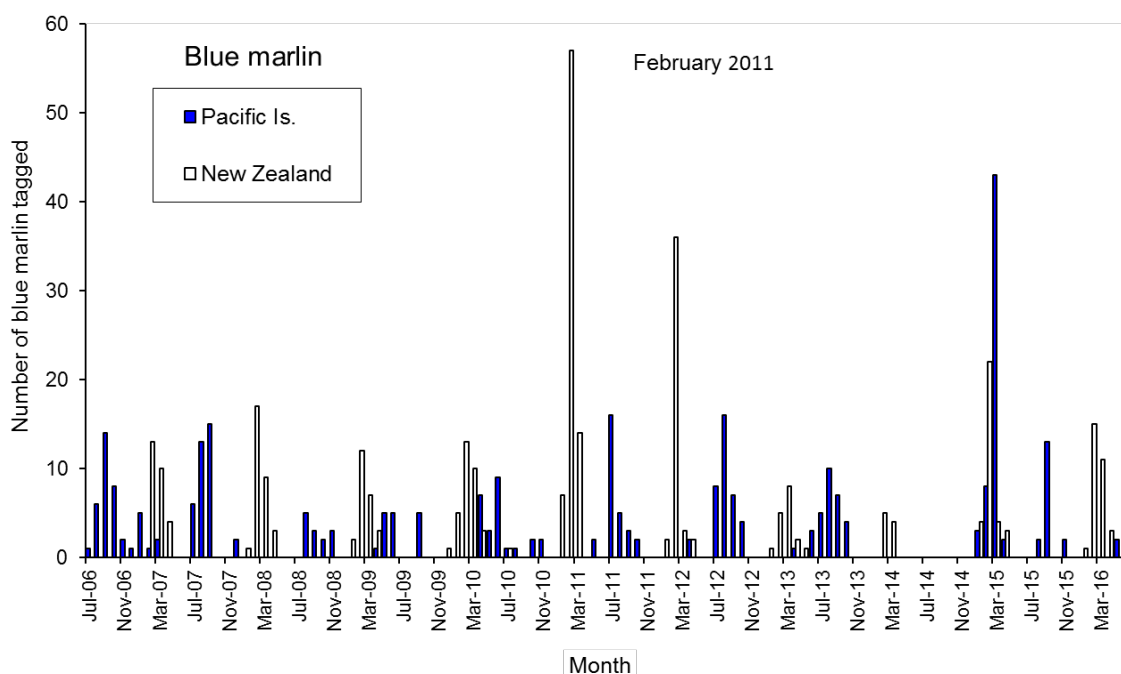


Figure 3: The number of blue marlin tagged by month in New Zealand and Pacific Island waters (2006–07 to 2012–13).

More striped marlin were tagged in the west coast of the North Island in 2015–16 (421) than for any year to date with good numbers from Cape Reinga to Taranaki. The number tagged in the other regions in 2015–16 was also higher than that the previous years. (Figure 4).

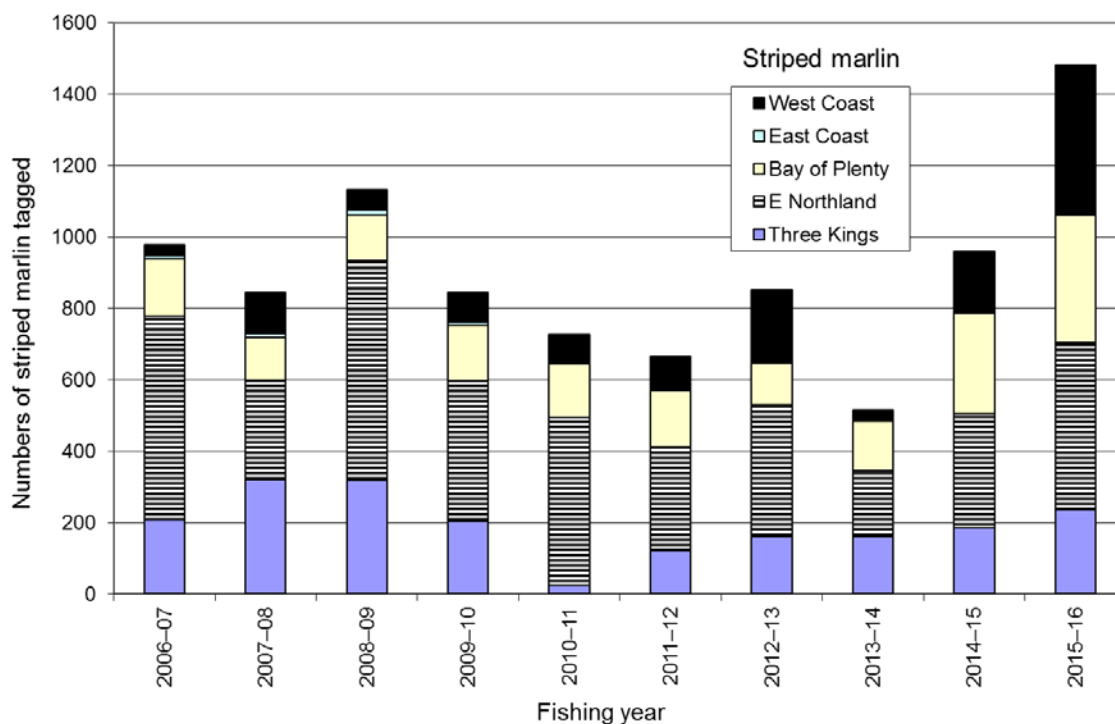


Figure 4: The number of striped marlin tagged by region and fishing year, 2006–07 to 2015–16.

In 2013–14 the mode of the estimated weights was at 90 kg and there were more striped marlin in the 110 and 120 kg size classes (Figure 5). In 2014–15, 27% of tagged fish were in the 80 to 90 kg size class while in 2015–16 there were atypically more 30 to 70 kg striped marlin caught (Figure 5).

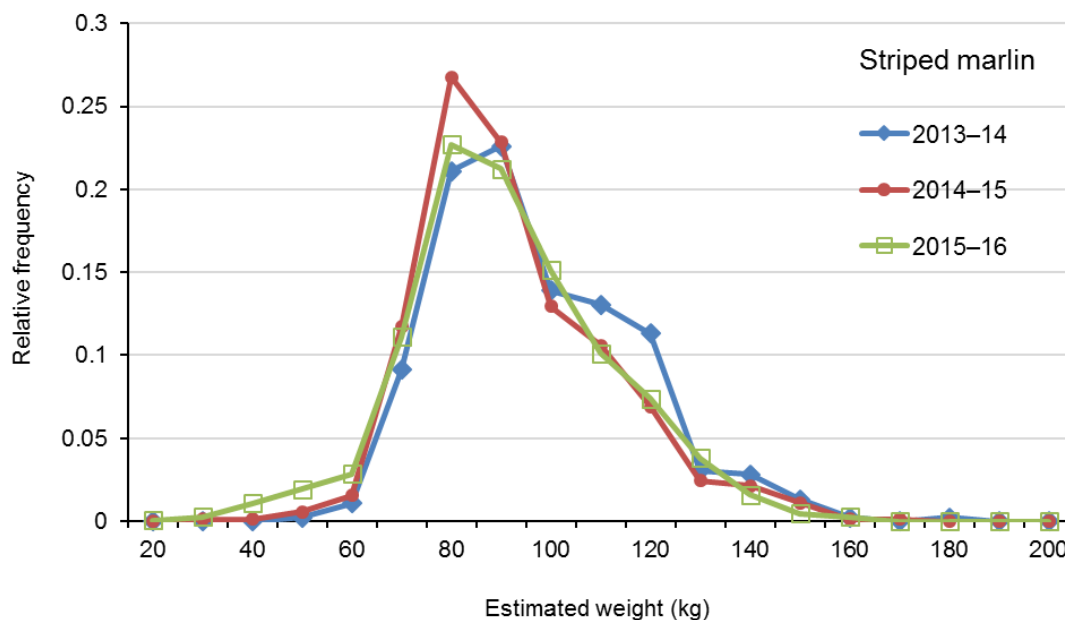


Figure 5: Comparison of the proportion by estimated weight of striped marlin tagged and released 2013–14 to 2015–16.

Estimated release weights for blue marlin are shown in Figure 6. Even in particularly warm years, it is rare for New Zealand anglers to catch blue marlin less than 100 kg in green weight. Blue marlin tagged in Pacific Island fisheries such as Tonga and Samoa are frequently less than 100 kg, but also some larger fish were caught from 2013–14 to 2015–16 (Figure 6).

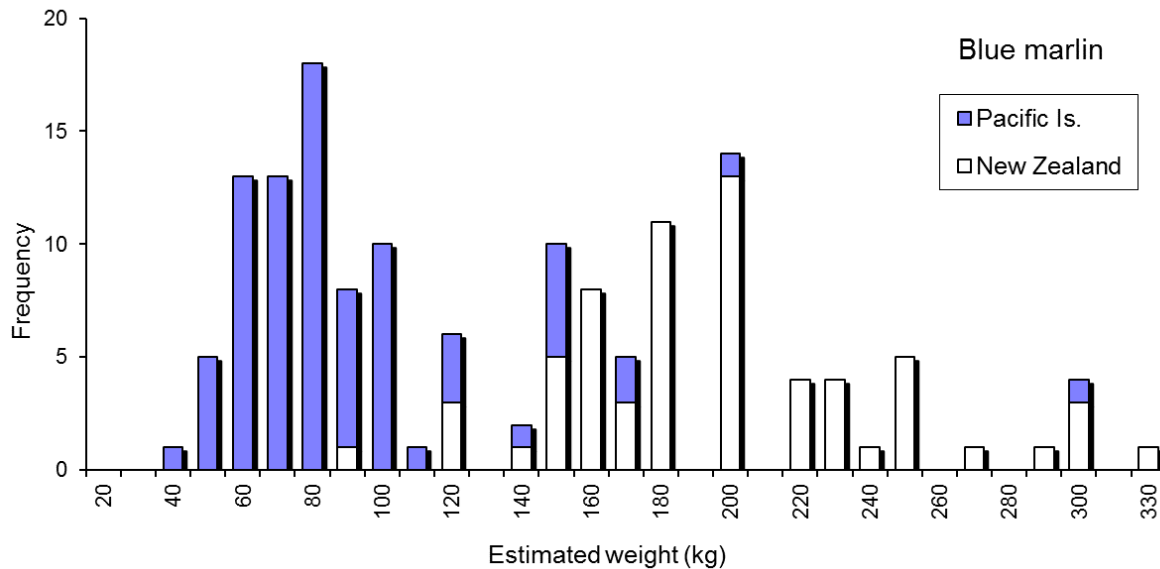


Figure 6: Weight frequency distribution of blue marlin from estimated weight on release 2013–14 to 2015–16.

Billfish recaptures

There were three striped marlin recaptured in 2013–14 with the first in late July 2013 by a surface longliner east of Fraser Island, Australia. This fish had been tagged 86 days earlier at the Wanganella Banks by a New Zealand sport fishing vessel. The two other striped marlin recaptures were by sport fishers from East Northland. A 139 kg marlin was recaptured north of the Bay of Islands on 21 March 2014 after 1124 days (3 years 1 month), setting a new record time at liberty for striped marlin. This fish had been tagged off Stephenson Island just 25 n. miles from where it was recaptured. A marlin tagged off the Mercury Islands BOP was recaptured after 56 days at liberty south of Cape Brett, a displacement distance of 120 n. miles.

A long distance Swordfish recapture was reported south of Tuvalu in September 2013. This 150 kg fish was tagged at the Middlesex Bank in April 2011, so had been at liberty for 877 days (2 years 5 months) and travelled 1360 n. miles north. This is a new record displacement distance for swordfish in the NZGTP.

There was one striped marlin recaptured in 2014–15. A fish tagged off Piha was caught at the King Bank on 25 February 2015, a distance of 230 n. miles in 39 days. There was also a mystery tag found washed up on a beach just outside Coffs Harbour, Australia. This fish had been tagged at the Wanganella Banks in May 2013.

Seven tagged striped marlin were recaptured in 2015–16 all from the Bay of Plenty or East Northland by sport fishers. Five of these had been tagged that season with time at liberty of 20 to 77 days with displacement distances between 10 and 88 n. miles. One marlin had the tag damaged, as the fish was brought aboard, making the number unreadable. A 90.4 kg marlin was recaptured off the Alderman Islands on 12 February 2016 after being at liberty for 392 days, just 10 n. miles from where it was tagged the year before. A swordfish was recaptured by a tuna longliner 190 n. miles west of New Plymouth. It had been tagged at the Garden Patch, off Great Expedition Bay 1505 days (4 years 1 month) earlier. The shortest distance by sea is 350 n. miles.

Movement

Current thinking, based on tagging data, slight genetic differences, and spawning areas, is that southwest Pacific striped marlin constitutes a single stock (Davies et al. 2012). Spawning is known to occur in the Coral Sea, in the Fiji Basin and in French Polynesia (Kopf et al. 2012) Recaptures of tagged striped marlin from the NZGTP have occurred in all three of these areas.

Long-distance recaptures for striped marlin show a wide spread of locations across the southwest Pacific Ocean and Tasman Sea (Figure 7). 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 no striped marlin tagged in the south Pacific have been recaptured beyond the south Pacific to date. However, most striped marlin were recaptured within 10 months of release. Tag shedding is a problem with this species and this may be the reason for the short duration of most recaptures (Ortiz et al. 2003).

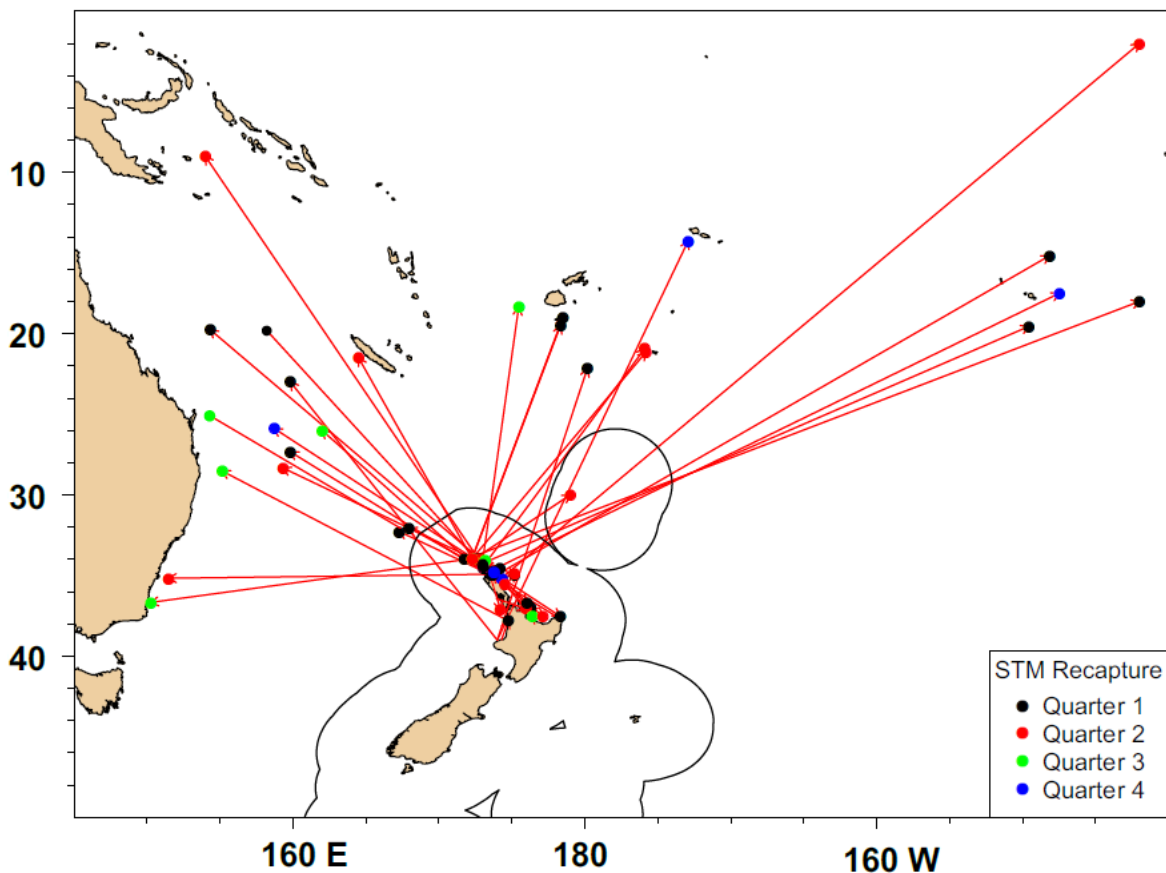


Figure 7: Long distance movements of striped marlin in the gamefish tagging programme, 1988–2016 with recapture location colour coded by quarter (Quarter 1 = Jan-Mar).

New Zealand Sport Fishing Council collects annual catch tallies of fish landed and fish tagged from affiliated clubs. The collective catch is a reasonably complete record of billfish catch in New Zealand as most billfish caught by club members and non-members pass over a club weigh station and are recorded. However, the number of trailer boats launching from remote locations and targeting marlin has been increasing in recent years. This has probably resulted in a higher proportion of landed billfish which are not captured in club records. We estimate this amounts to 15 to 20% of landed striped marlin for the period 2013–14 to 2015–16.

The proportion of billfish tagged by species each year is estimated in Table 3. Over the last 10 years 57% of striped marlin, 51% of swordfish and 46% of black marlin and 24% of blue marlin caught by NZSFC clubs have been tagged and released.

Table 3: The proportion of billfish tagged in New Zealand waters in the last ten years by species from NZSFC landed catch and NZGTP tagging records.

Proportion tagged	Year										Average 2006 to 2016
	2006– 07	2007– 08	2008– 09	2009– 10	2010– 11	2011– 12	2012– 13	2013– 14	2014– 15	2015– 16	
Striped marlin	0.58	0.62	0.59	0.59	0.55	0.51	0.54	0.46	0.61	0.63	0.57
Blue marlin	0.21	0.22	0.21	0.24	0.30	0.39	0.25	0.12	0.27	0.23	0.24
Shortbill spearfish	0.27	0.24	0.14	0.25	0.22	0.21	0.00	0.19	0.17	0.24	0.19
Swordfish	0.44	0.81	0.73	0.67	0.56	0.60	0.46	0.32	0.28	0.25	0.51
Black marlin	0.50	0.00	1.00	0.43	0.33	0.25	0.60	0.50	0.58	0.43	0.46

There are also tagged billfish that are reported direct to MPI and not recorded in NZSFC club records. Tag cards that are not presented to the club until the following season will also not be included in annual club tallies. In 2013–14, which was a poor fishing year, 92% of tagged striped marlin in the NZGTP database were included in club records. In 2014–15 the annual club tally accounted for 83% of NZGTP striped marlin. The NZSFC annual totals of tagged and landed striped marlin are shown in Figure 8.

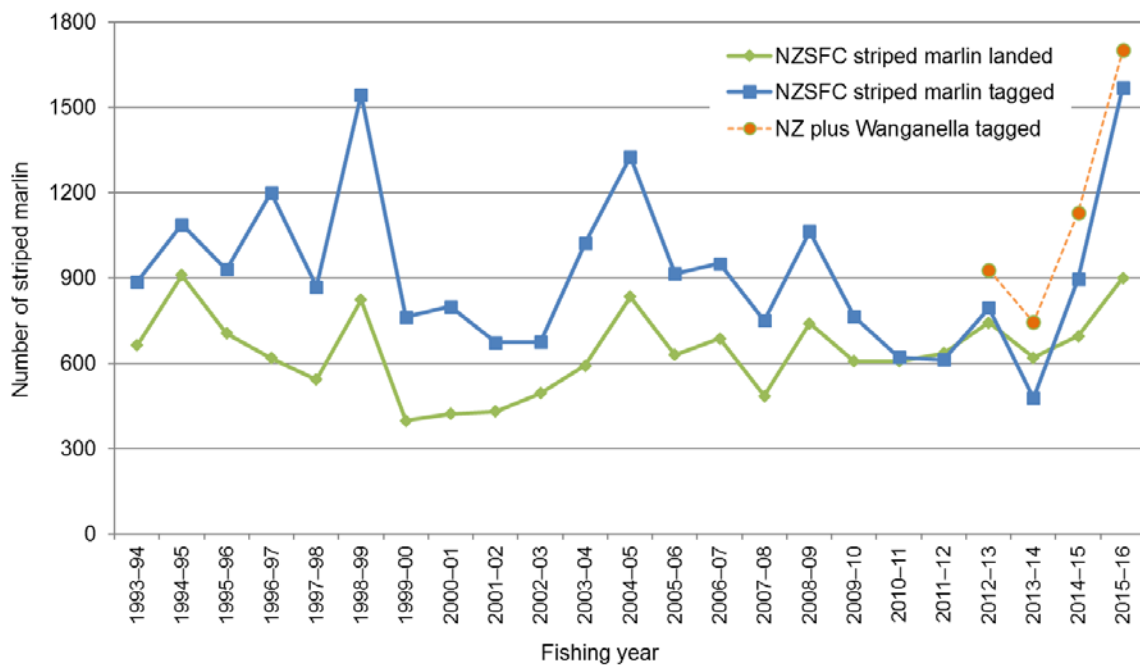


Figure 8: The number of striped marlin landed compared to the number tagged as recorded by NZSFC clubs by fishing year. Striped marlin tagged at the Wanganella Banks are outside the New Zealand EEZ and are added to the number tagged in New Zealand waters.

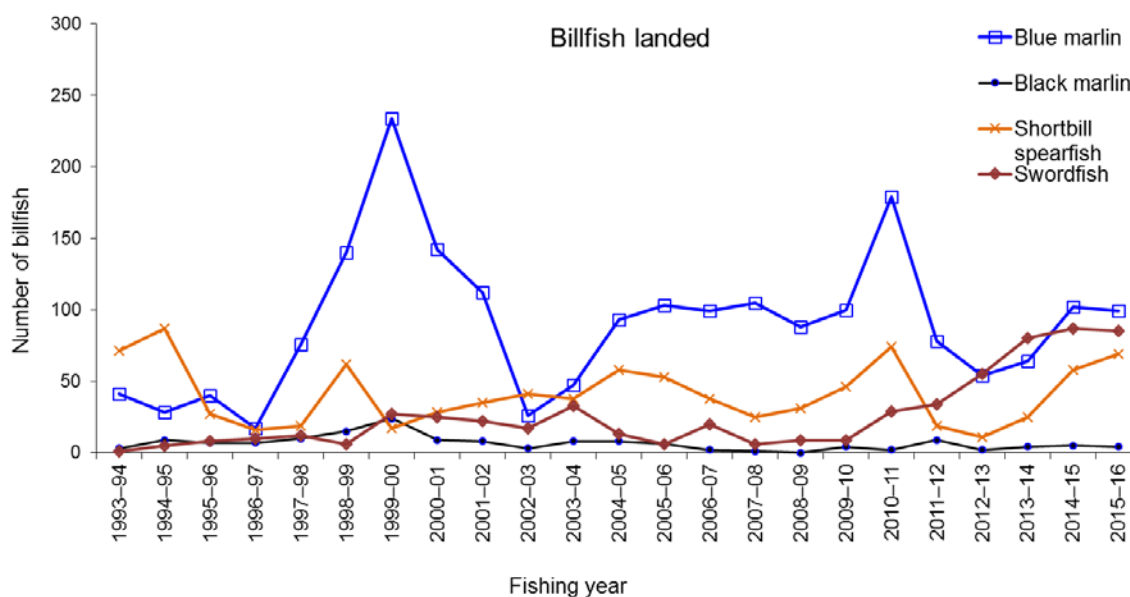


Figure 9: The number of billfish landed (excluding striped marlin) by year (1993 to 2016) from NZSFC records.

Of the other billfish recorded in NZSFC club records blue marlin has dominated the landed catch but numbers of swordfish and shortbill spearfish landed have increased in recent years (Figure 9).

3.2 Yellowtail kingfish

Yellowtail kingfish have been an important component of the NZGTP since its inception, not only are they available year round in New Zealand waters, but they tolerate handling and retain tags well. While they come second behind striped marlin as the most tagged species in the programme they make up over 67 % of all recaptures.

There were 1974 kingfish tagged and released from the period 2013–14 to 2015–16 covered in this report and 87 recaptures (Table 4). The number tagged in these three years was below the 10 year average of 787 kingfish tagged per year.

Table 4: The number of yellowtail kingfish tagged, the number recaptured, and the number landed and recorded by NZSFC clubs over the last ten years.

	Year										Average
Kingfish	2006–07	2007–08	2008–09	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2006 to 2016
Releases	977	1 120	661	1 381	1123	613	761	649	723	602	787
Recaptures	38	55	43	46	54	44	38	31	30	26	41
NZSFC landed	570	626	590	586	583	768	771	835	688	722	673

Generally, most kingfish are tagged between October and June the following year. February is the peak month, as with other species in the NZGTP, but the number tagged in February has become less dominant over the last few years (Figure 10).

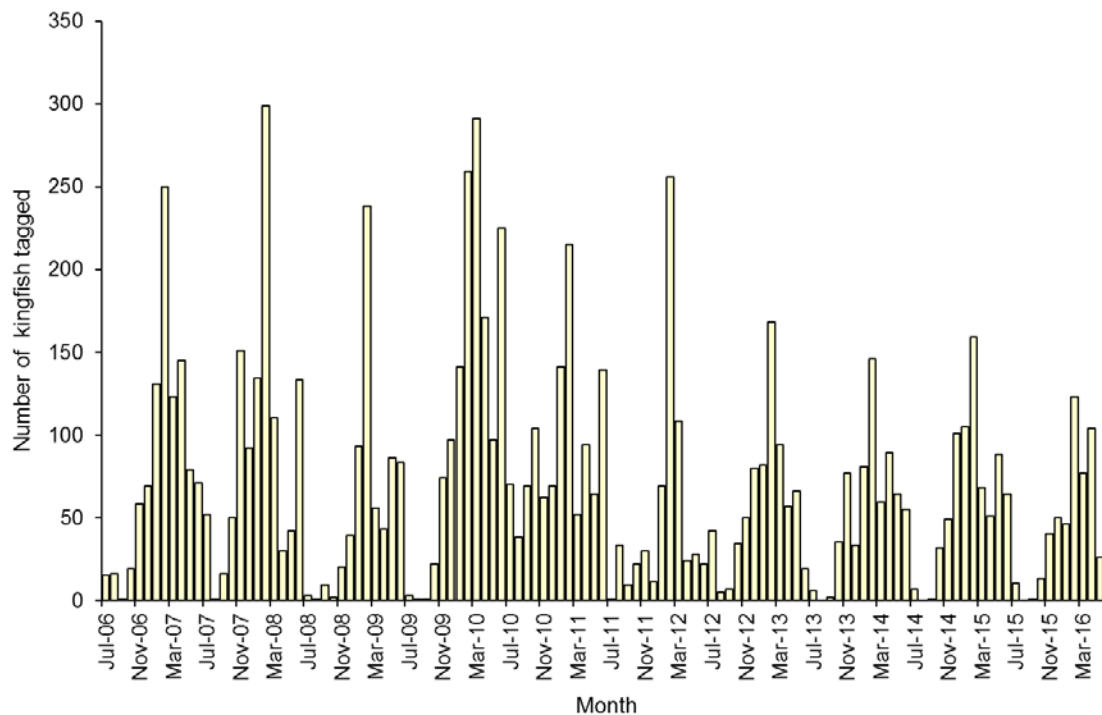


Figure 10: The number of yellowtail kingfish tagged by month 2006–07 to 2015–16.

Trends in the proportion of annual kingfish releases by region over the last 10 years show a decrease in numbers tagged overall, mainly due to decreases in the Bay of Plenty and East Coast regions. The number tagged in East Northland and the Three Kings area in 2015–16 (339) was the third highest for the period shown (Figure 11).

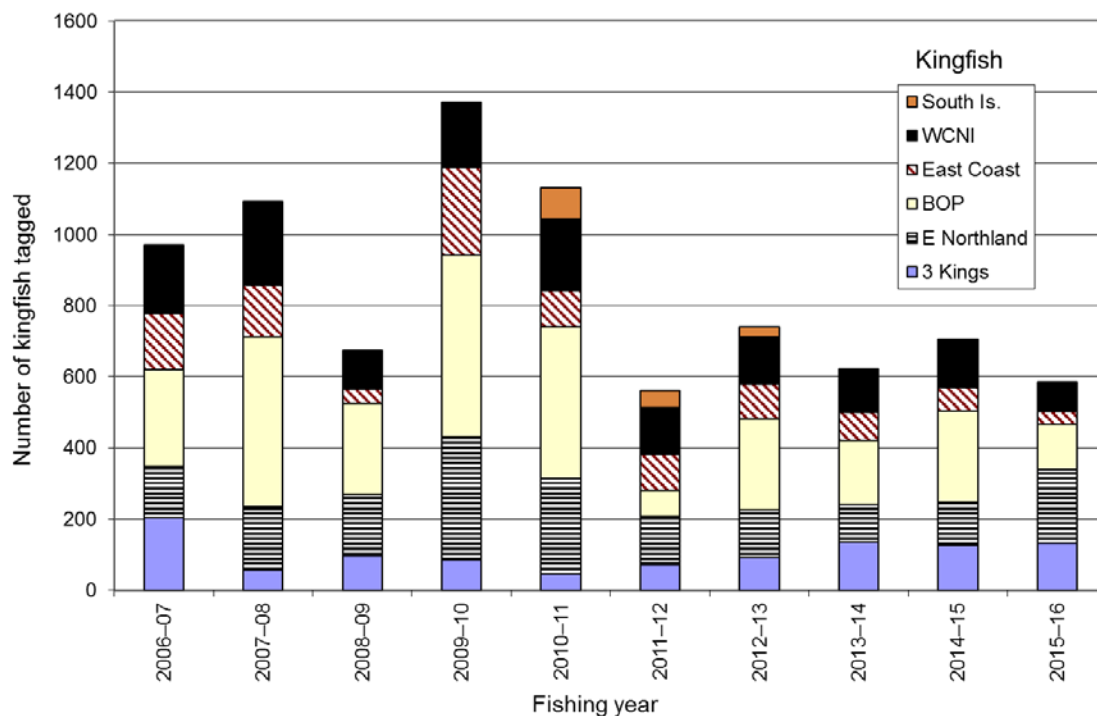


Figure 11: The number of yellowtail kingfish tagged by region and fishing year, 2006–07 to 2015–16.

The great majority of tagged kingfish have been measured (fork length), before release. The length frequency distribution of tagged kingfish has been bimodal for the last three years (Figure 12). The modes at 75 and 80 cm size classes are mainly from inshore fisheries while the mode at 100 and 105 cm size classes are mainly from offshore fisheries. The definition of offshore locations such as White Island and the Three Kings which are outside the 200 m depth contour is detailed in Holdsworth et. al (2016). There were more large kingfish (> 115 cm) tagged in 2014–15 than in the other two years (Figure 12).

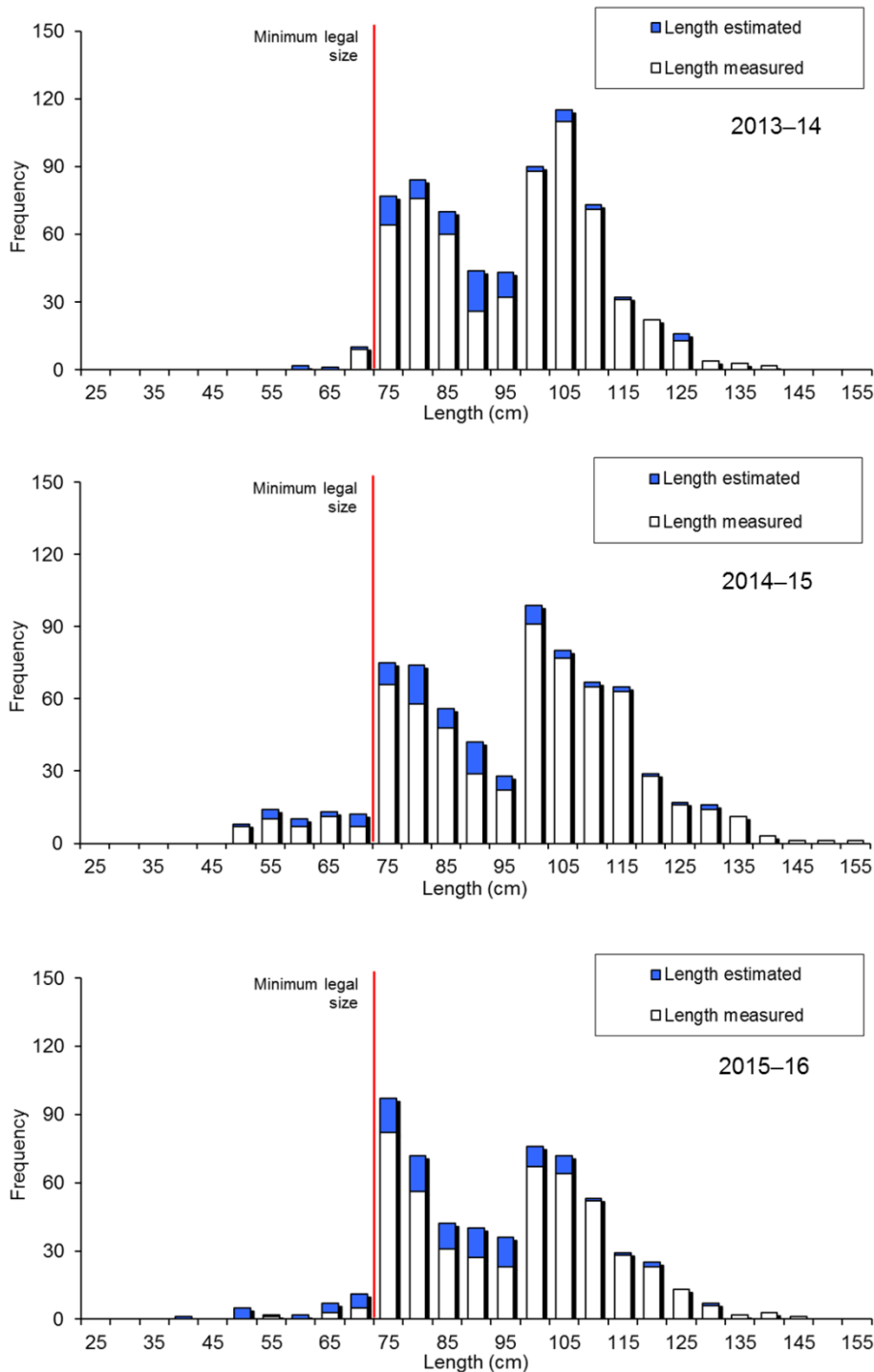


Figure 12: Yellowtail kingfish length frequency for released fish, fish measured (white bars) and those with estimated lengths (blue bars) 2013–14 to 2015–16.

Movement

Even after many years at liberty, most kingfish are caught close to their release location. Ninety four percent of recaptures at liberty for 30 days or more were within 100 nautical miles of the release point (Holdsworth & Saul 2014). Recapture locations of kingfish released by MPI statistical area in the main Northland and North Island west coast fishing locations show a small proportion of recaptures scattered across other regions (Figure 13).

Yellowtail kingfish are also capable of long distance movement, however, with three fish tagged in New Zealand recaptured in New South Wales, Australia. Recaptures have also been reported from Lord Howe Island and Wanganella Banks.

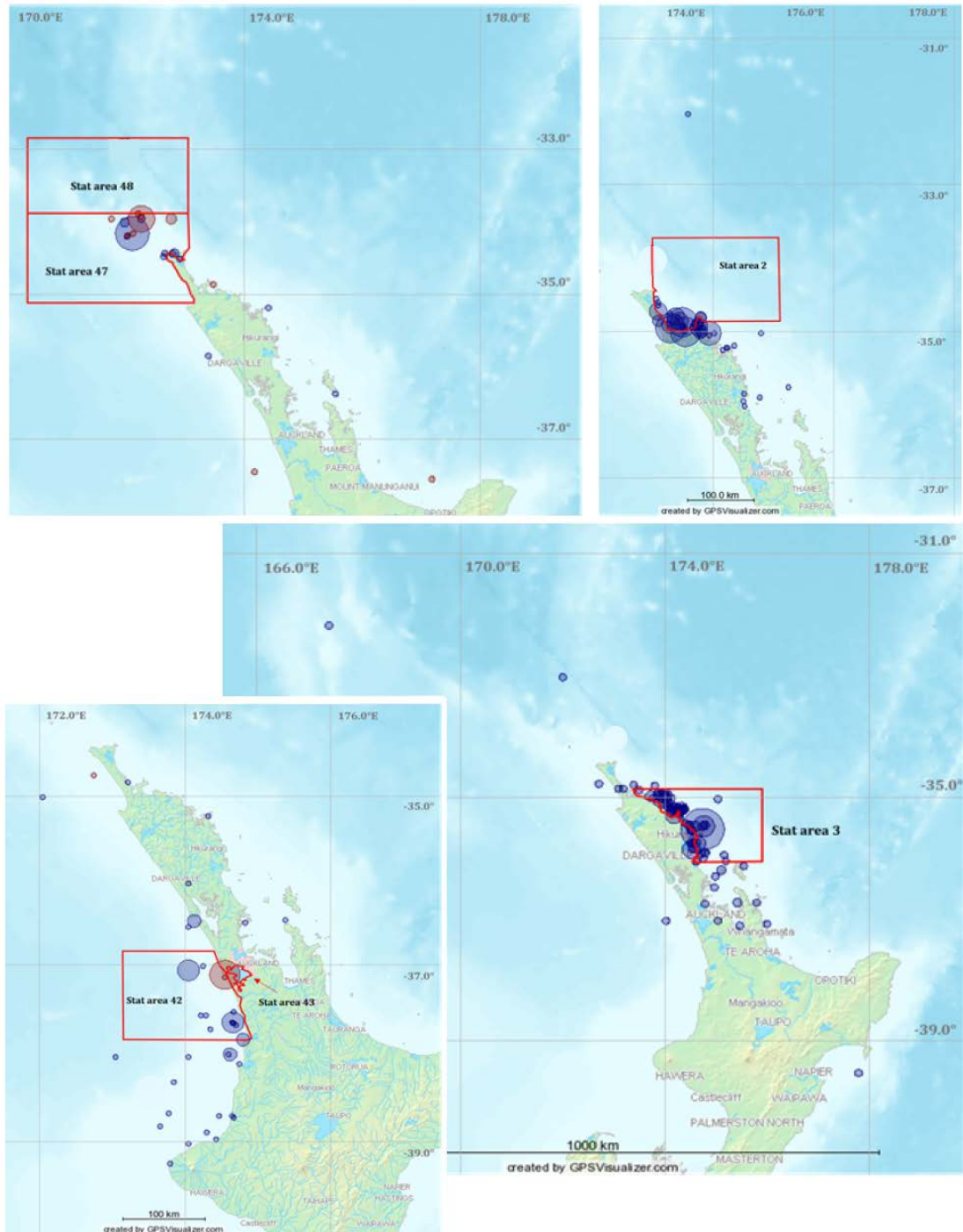


Figure 13: Distribution of recaptures recorded for kingfish released by statistical area (red outline) for Northland and North Island west coast.

Recapture locations from statistical areas in the Hauraki Gulf, Bay of Plenty and East Cape also show a small proportion of fish moving long distances north and south and east to west coast but there is a tendency for more recaptures to the north of release locations (Figure 14). Note however, that recaptures of tagged fish are fishery dependant and even if there is equal movement north and south more recaptures will be made in areas with more fishing effort.

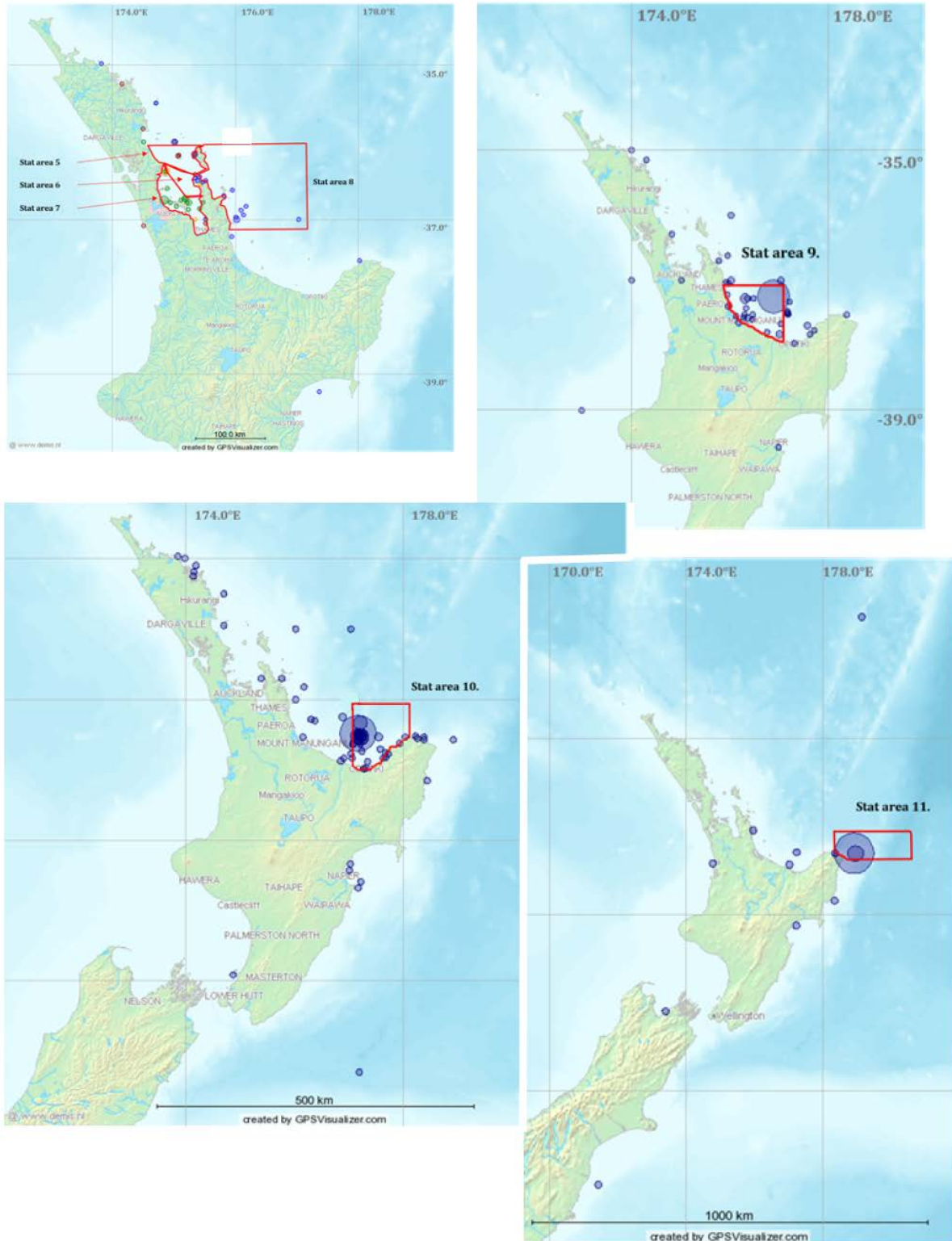


Figure 14: Distribution of recaptures recorded for kingfish released by statistical area (red outline) for Hauraki Gulf, Bay of Plenty and East Cape.

3.3 Mako and blue shark

The number of mako sharks tagged and released inside New Zealand fisheries waters has increased from 367 to in 2013–14 to 554 in 2015–16 (Table 5). The number of blue sharks tagged has been around the average of 126 per year for the last six years, apart from in 2015–16 when it increased to 169 tagged.

Using NZSFC records of landed sharks we estimate that 93% to 97% of mako and 93% to 95% of blue sharks caught by recreational fishers associated with sport fishing clubs were tagged and released for 2013–14 to 2015–16 (Table 5). There were two mako and no blue sharks tagged for this programme outside New Zealand fisheries waters between 2013–14 and 2015–16 (Appendix, Table A3). The overall recapture rate is 2.4 % for mako sharks and 1.8% for blue sharks (Appendix, Table A3).

Table 5: The number of mako and blue sharks tagged in New Zealand fisheries waters, the percentage tagged, and the number recaptured by season.

	Year										Average
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2006 to 2016
Mako	-07	-08	-09	-10	-11	-12	-13	-14	-15	-16	
NZ EEZ Tagged	150	297	285	494	609	488	524	367	439	554	421
% tagged	82	87	87	90	92	92	94	93	97	96	91
Recaptures	0	2	5	7	7	8	11	6	0	2	5
Blue shark	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2006 to 2016
NZ EEZ Tagged	157	108	101	73	128	142	150	124	110	169	126
% tagged	91	90	89	92	91	90	93	93	93	95	92
Recaptures	2	3	4	3	3	4	3	3	0	0	3

The number of mako and blue sharks tagged peaked during the mid-1990s then declined to a low in 2002–03, followed by an increasing trend (Figure 15). Generally mako sharks are caught as a bycatch of other sport fisheries, particularly off the North Island.

While mako sharks take lures, blue sharks form a bycatch when fishing with baits, but very seldom take the artificial lures intended for billfish or tuna. Between 1993–94 and 2001–02 the great majority of blue sharks were tagged by fishers in a small target fishery off Otago.

Most mako sharks were tagged between January and April with a strong mode in February (Figure 16). This peak is associated with the New Zealand Sport Fishing Council Nationals Contest which encourages the tag and release of various species. There were five mako sharks landed and 87 tagged and released in the eight day Nationals in late February 2016.

The number of mako sharks tagged in East Northland and the west coast of the North Island has increased in the last 10 years with fewer tagged in Bay of Plenty and East Coast regions (Figure 17).

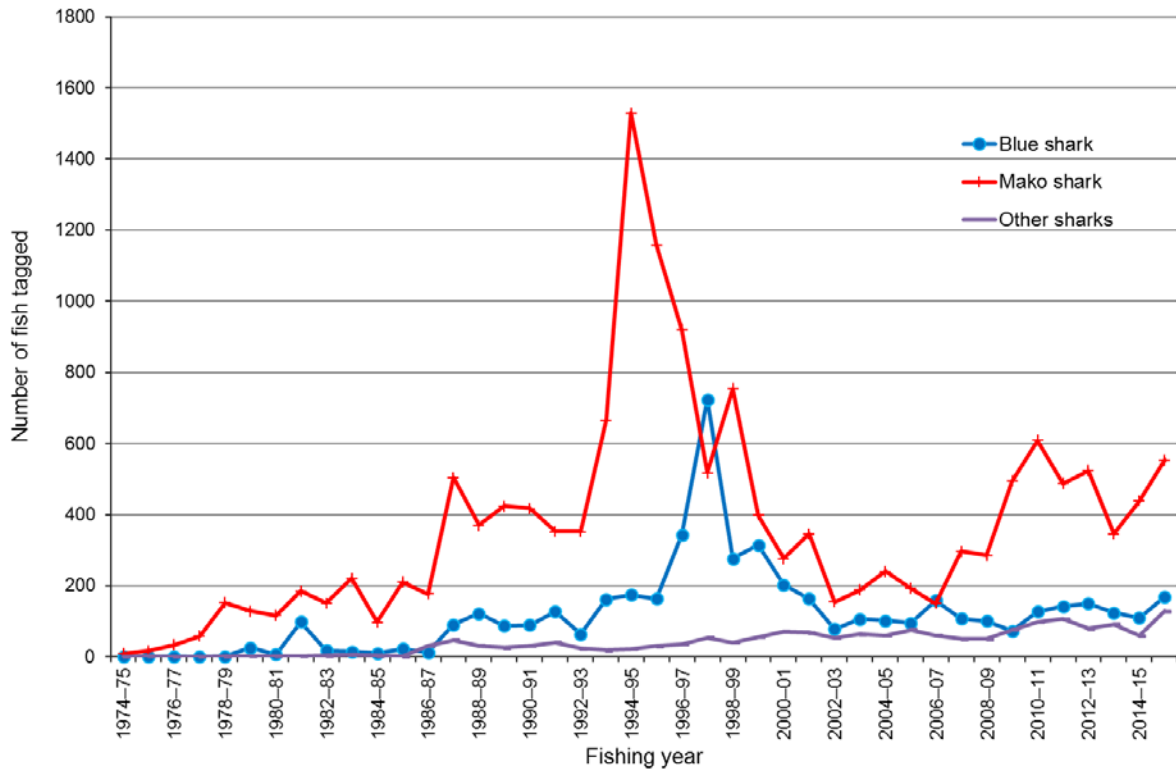


Figure 15: The number of mako and blue sharks tagged 1974–75 to 2015–16.

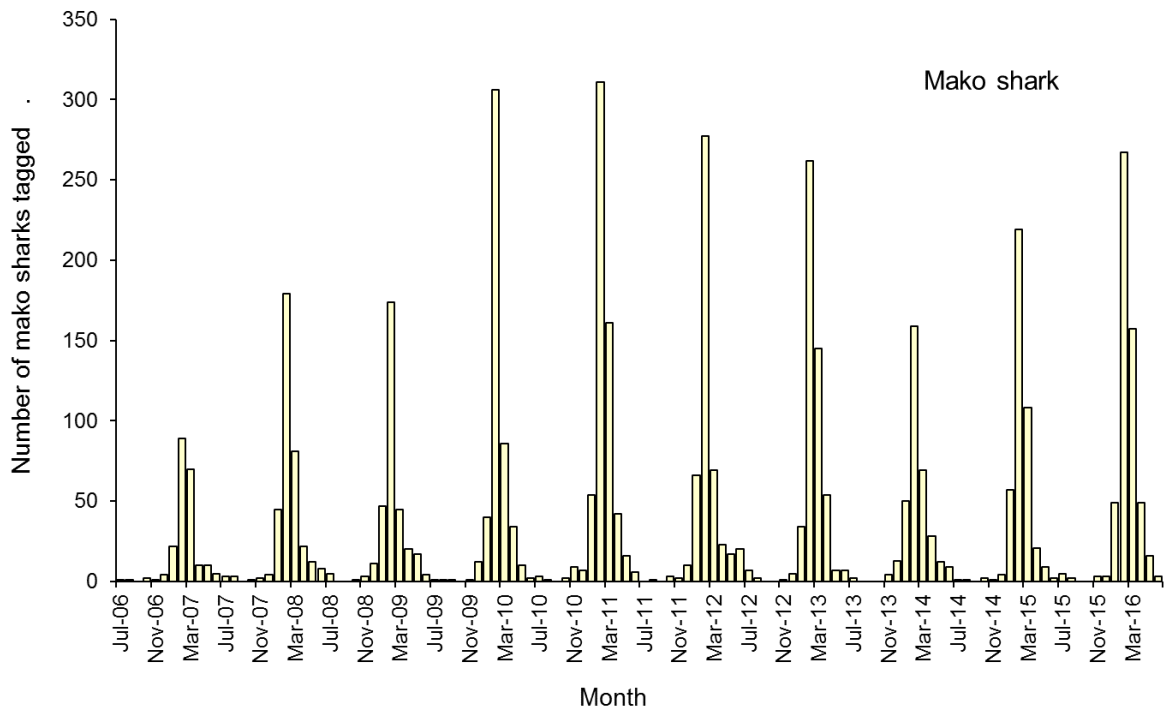


Figure 16: Number of mako sharks tagged by month since 2005–06.

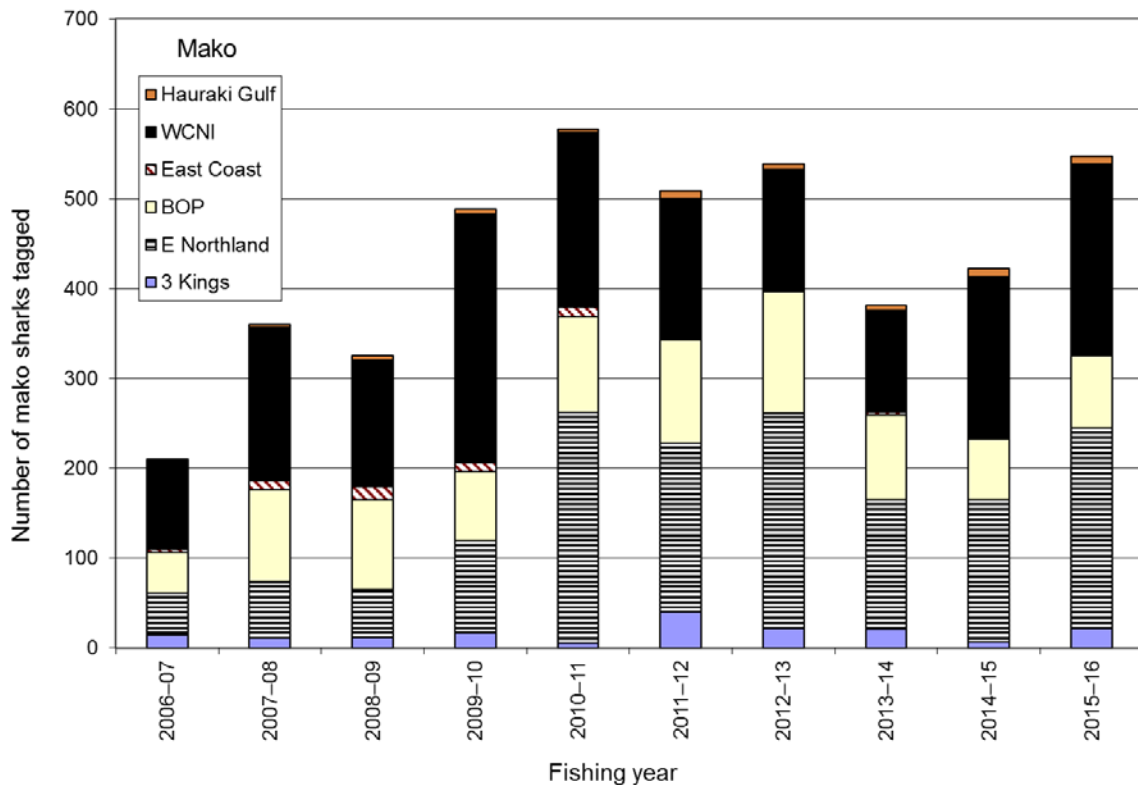


Figure 17: The number of mako sharks tagged by region and fishing year, 2006–07 to 2015–16.

Mako shark recaptures

There were six mako sharks recaptured in 2013–14 two of which were reported by SPC observers in the Solomon Sea. The first was caught in July 2013 off San Cristobal Island after 487 days at liberty and the second in September 2103 off New Britain 951 days (two years 7 months) after being released. A mako tagged off Farewell Spit by a sport fisher was recaptured 205 days later off Fraser Island, Australia. Three makos recaptured north or west of the North Island had been at liberty for between 13 and 891 days. All six sharks were tagged by sport fishers and recaptured and reported by commercial fishers.

There were no mako shark recaptures reported in 2014–15 and two recaptured by commercial fishers in 2015–16. A 50 kg mako shark tagged off the Three Kings Islands was recaptured in March 2016 near South Minerva Reef after 1035 days at liberty. A mako tagged off Kawhia, estimated at 30 kg, was recaptured by a surface longline vessel in June 2016 west of Cape Reinga. This fish had been at liberty for 488 days and was 275 n. miles from where it was released.

There were no blue shark recaptures for the period 2013–14 to 2015–16.

Movement

The gamefish tags hold well on sharks and some long-term recaptures have been made. Rather than getting increased dispersal 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 during summer in following years (Holdsworth & Saul 2014).

In many ways the distribution of recaptures of mako sharks tagged in New Zealand is similar to that of striped marlin. They seldom stray into equatorial waters to the north, or past French Polynesia to the east or Australia to the west. Mako sharks have tended to be recaptured in Fiji and New South Wales more often than striped marlin, but this may be due to the fishing methods in those areas (Figure 18).

To date there have been five mako sharks recaptured after 5 years or more at liberty, with the longest confirmed recapture at 9 years 11 months (3624 days). This fish was caught between New Caledonia and Vanuatu in January 2009 and was reported as a pregnant female with 8 pups. Mako sharks are also capable of relatively rapid disbursement of 15 to 20 nautical miles a day. One fish tagged in March off Whangaroa moved to Fiji in 36 days, a displacement rate of 27.2 nautical miles per day.

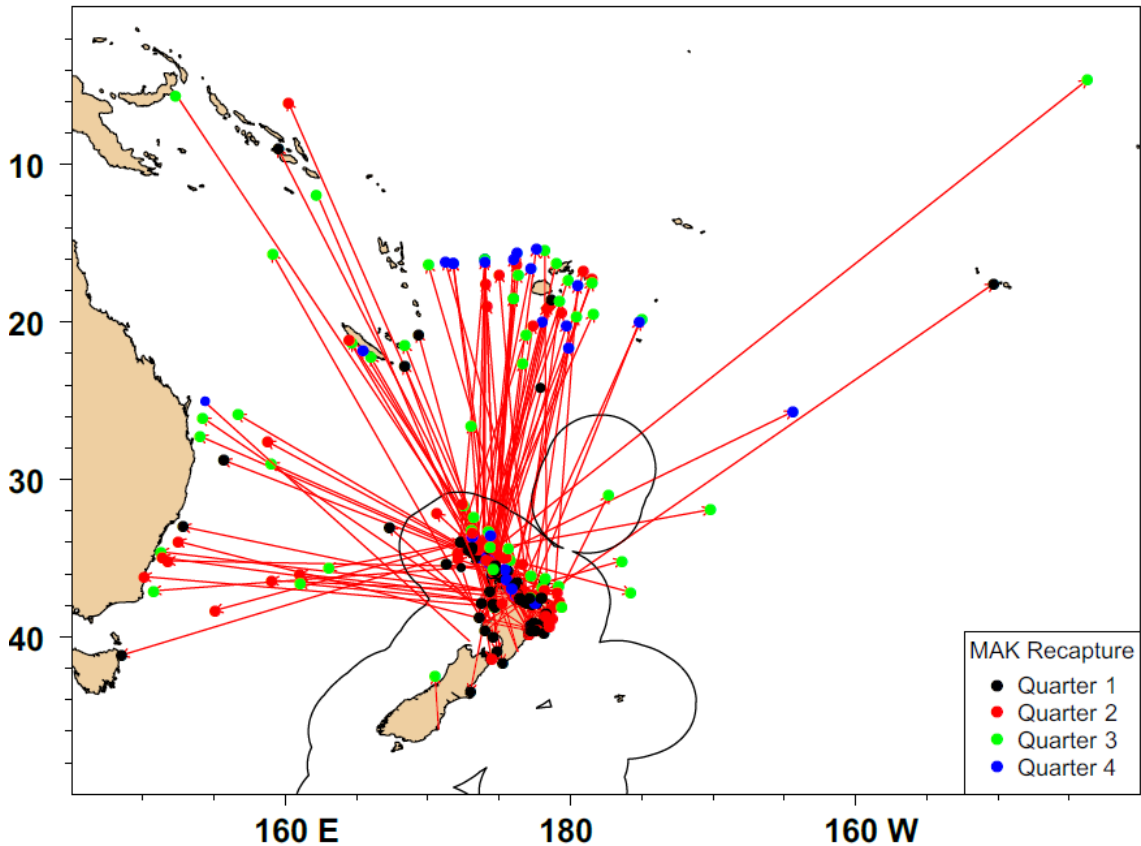


Figure 18: All release and recapture locations of mako sharks in the gamefish tagging programme, with recapture location colour coded by quarter (Quarter 1 = Jan-Mar).

Blue sharks also appear to disperse into the subtropical South Pacific, with recaptures from Australia, New Caledonia, Vanuatu, Fiji, Tonga, Cook Islands and French Polynesia (Figure 19). However, they have strayed further afield with single recaptures from this programme coming from the south-eastern Pacific off Chile and the Indian Ocean, southwest of Perth.

Blue sharks have also been recaptured close to their release point after one year and individual fish have been recaptured at their release location off Otago Heads after two and three years at liberty. Blue sharks have been recaptured further away than any other species in the NZGTP to date but the maximum time at liberty is just 3 years and 3 months and generally displacement rate is not rapid. However, a blue shark tagged off Tutukaka was recaptured after 53 days off Queensland giving the maximum recorded displacement rate to date of 20 nautical miles per day.

3.4 Other shark species

Each year, anglers tag and release a number of species that are not considered to be mainstream parts of the NZGTP. Most of these are sharks, in particular hammerhead shark and bronze whaler. There were 130 “other” sharks tagged in 2015–16, most of which were hammerhead and bronze whalers.

The species composition of tagged sharks in the past six years is provided in Table 6. There were more bronze whaler and hammerhead sharks tagged in 2015–16 than in any other fishing year to date.

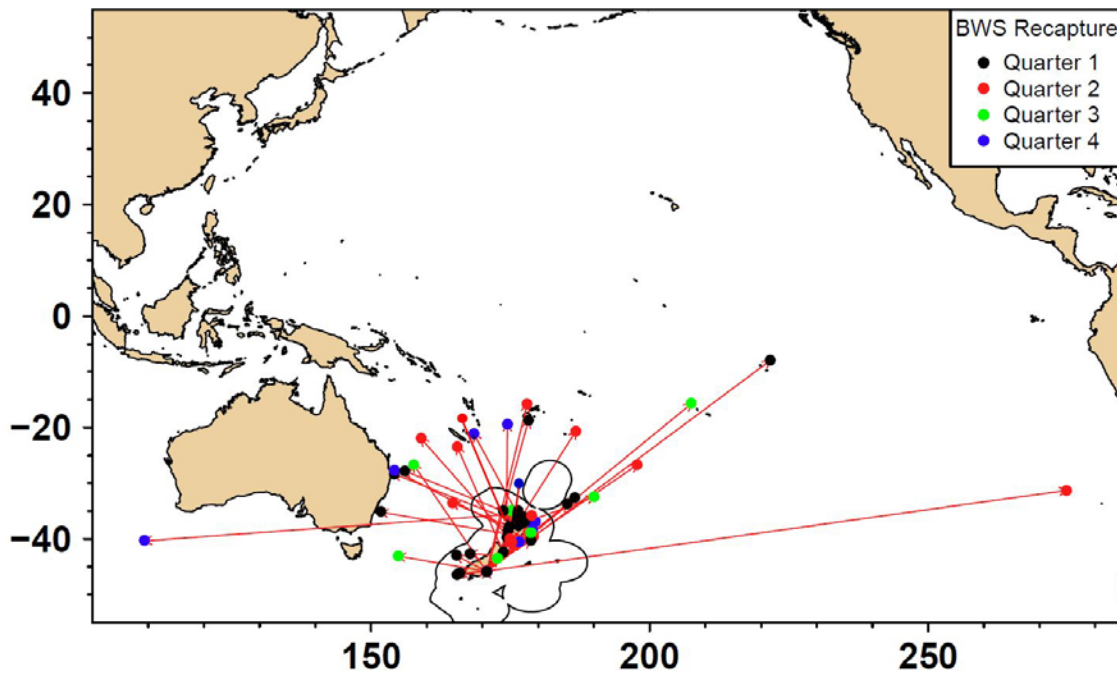


Figure 19: All release and recapture locations of blue sharks in the gamefish tagging programme, with recapture location colour coded by quarter (Quarter 1 = Jan-Mar).

Table 6: The number of “other” sharks tagged in New Zealand waters in the last six years and combined recaptures.

	Year						Average 2010–16
	2010–	2011–	2012–	2013–	2014–	2015–	
Bronze whaler	11	12	13	14	15	16	43
Hammerhead	37	34	40	43	44	61	32
Porbeagle	43	38	19	27	17	50	
Shark unidentified	1	0	1	0	0	1	1
School shark	4	14	5	3	1	1	5
Sevengill	6	0	0	0	0	1	1
Thresher	3	4	4	1	7	3	4
White pointer	8	16	16	11	9	13	12
Total tagged	1	0	0	0	0	0	0
Total tagged	103	106	85	85	78	130	98
Recaptures	3		2	2		3	

Landed sharks

Twenty years ago mako, blue shark and to a lesser extent hammerhead sharks were regularly caught and landed by sport fishers in New Zealand. The number landed declined for all species in the early 2000s (Figure 20). A similar trend is seen in the number tagged (Figure 15).

Most sharks were landed during fishing tournaments or for club trophies. Since the 1990s landed sharks are required to exceed a minimum qualifying weight of 40 kg set by the NZSFC. Some clubs set higher minimum weights, up to 70 kg, for qualifying sharks. Over the last 10 years many clubs have removed prizes for landed sharks altogether, as attitudes toward sharks have changed.

The total number of bronze whalers landed by club members over the last 5 years is 35 (7 per year), while just 27 hammerhead, 8 thresher, and 1 porbeagle sharks have been landed over the last 5 years.

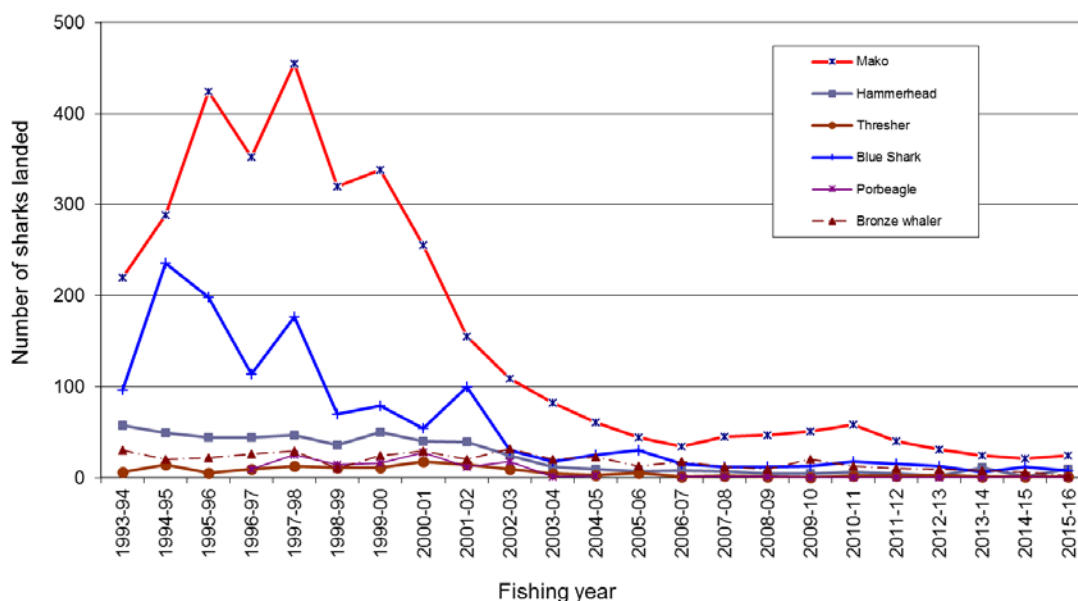


Figure 20: Number of sharks landed and recorded by New Zealand Sport Fishing Council clubs by species since 1993-94.

3.5 Yellowfin tuna

For several years no yellowfin tuna were tagged and released in the NZGTP. In 2014-15 there 14 yellowfin tagged and in 2015-16 there were 62 yellowfin tagged with estimated release weights between 10kg and 65 kg (mean = 32 kg). In recent years, yellowfin have been mainly caught by fishers targeting marlin. The total landed catch from NZSFC clubs and NZGTP records for yellowfin shows the decline in recreational catch since the mid-1990s relative to the total striped marlin catch from the same source (Figure 21).



Figure 21: Estimated total number of striped marlin and yellowfin tuna landed or tagged in New Zealand fisheries waters since 1993-94.

4. DISCUSSION

Cooperative tagging programmes are an effective way of collecting information on large pelagic species, where they travel to, and the fisheries that catch them. In New Zealand a high proportion of the billfish and pelagic sharks caught by sport fishers are tagged and released. The date, location, vessel name, fish size, fight time and release condition have been recorded for most of the 75 000 gamefish tagged in New Zealand waters and outside the EEZ with NZGFP tags. Recapture and reporting of highly migratory fish is a relatively rare event, but over the years a picture of where these fish go and who catches them has developed.

Anglers who tag and release feel they are contributing to research and conservation of stocks, while still getting recognition of their catch. The New Zealand Sport Fishing Council and clubs support the tagging programme by setting minimum sizes for qualifying fish and offering good prizes and trophies for tagged and released fish. The Council and clubs also purchase and distribute the tags, and act as a collection point for tag cards with release information. Projects for Ministry for Primary Industries ensure that the information is used. They fund data management, recapture rewards, analysis and inclusion of this information in Working Group Reports, reports to the Western and Central Pacific Fisheries Commission and Fisheries Assessment Reports such as this.

More broadbill swordfish have been tagged and released over recent years due to increasing fishing effort and reasonable catch rates for sport fishers. The development of daylight fishing for swordfish, where baits are dropped to depths of 400 – 600 metres during the day with breakaway weights has greatly increased the popularity of target fishing for swordfish amongst anglers.

The summer of 2015–16 was atypically warm with mainly easterly quarter winds despite the fact that the Pacific was in an El Nino phase which usually brings cool westerly winds to New Zealand. There were extended periods with good fishing conditions on the east and west coasts of the North Island. The numbers of striped marlin tagged and released (1530) for the year was at near record levels. The number of mako and blue sharks tagged in 2015–16 was also the second highest in the last 16 years. Yellowfin tuna were also caught in reasonable numbers in 2015–16.

The trends in landed catch of billfish are similar to trends in the number tagged. In addition there is a notable increase in the number of shortbill spearfish landed over the last 3 years.

A new record time at liberty for striped marlin was set by a 139 kg fish recaptured north of the Bay of Islands on 21 March 2014 after 1124 days (3 years 1 month).

Seven striped marlin recaptures were reported during the 2015–16 summer. All were recaptured in northern New Zealand waters. One fish was tagged the previous season while the others were recaptured 20 to 77 days after release. It is possible that when conditions are favourable marlin will spend longer in the New Zealand area and remain in range of the recreational fishery.

Two swordfish were recaptured after extended periods at liberty (Appendix Table A4). Both had been double tagged on release with the standard gamefish tag with stainless steel anchor and a new generation billfish tag with a surgical grade nylon anchor. Only the nylon anchored tag was reported from these fish. A double tagged swordfish recaptured after 8 months at liberty in 2012 also had shed the stainless steel tag. Of the 319 swordfish tagged in the last 10 years 70% have been tagged with nylon anchored tags, either as a single tag or as one of a double tag release. The performance of nylon anchored tags on swordfish will be highlighted to sport fishers and their use promoted.

Release information collected on tag cards on where and how fish are caught and released can be a useful component of tagging programme data. Anglers are encouraged to complete all the details on the card including approximate latitude and longitude.

There are a number of other cooperative tagging programmes operating in the southwest Pacific, run from Australia, Tonga, and the USA. In addition, a number of projects have used electronic tags on fish caught on recreational vessels, providing more detail of survival and behaviour after release (Domeier et al. 2003; Francis et al. 2015a; Francis et al. 2015b; Holdsworth et al. 2009; Sippel et al. 2011). Researchers can also draw on current and historical data collected by remote sensing satellites. The full value of the time series of gamefish release and recapture information may be yet to be realised. In future a wider spread of tagging locations for billfish, in Pacific Island nations where tourist fisheries are becoming important, may increase our knowledge of spawning and post spawning migrations which are important for determining stock structure in the Pacific Ocean.

Your feedback on the NZGTP and this report is encouraged. The programme aims to continue providing good value for all those involved: fishers, New Zealand Sport Fishing Council, scientists and government. You can email John@bluewatermarine.co.nz or Science.Officer@mpi.govt.nz or post release or recapture details to:

Ministry for Primary Industries
PO Box 19747
Avondale
Auckland 1746
New Zealand

5. ACKNOWLEDGMENTS

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6. REFERENCES

- Davies, N.; Hoyle, S.; Hampton, J. (2012). Stock assessment of striped marlin (*Kajikia audax*) in the southwest Pacific Ocean. Report to the Western and Central Pacific Fisheries Commission Scientific Committee. WCPFC-SC8-2012/SA-WP-05. 84pp. (www.wcpfc.int).
- Domeier, M.L.; Dewar, H.; Nasby-Lucas, N. (2003). Mortality rate of striped marlin (*Tetrapturus audax*) caught with recreational tackle. *Marine and Freshwater Research* 54: 425–434.
- Francis, M.P.; Duffy, C.; Lyon, W. (2015a). Spatial and temporal habitat use by white sharks (*Carcharodon carcharias*) at an aggregation site in southern New Zealand. *Marine and Freshwater Research* 66: 900–918.
- Francis, M.P.; Holdsworth, J.C.; Block, B.A. (2015b). Life in the open ocean: seasonal migration and diel diving behaviour of Southern Hemisphere porbeagle sharks (*Lamna nasus*). *Marine biology* 162: 2305–2323.
- Holdsworth, J.; Saul, P. (2003). New Zealand billfish and gamefish tagging, 2001–02. *New Zealand Fisheries Assessment Report 2003/15*. 39 p.
- Holdsworth, J.C.; Saul, P.J. (2014). New Zealand billfish and gamefish tagging, 2012–13. *New Zealand Fisheries Assessment Report 2014/11*. 26 p.
- Holdsworth, J.C.; Saul, P.J.; Boyle, T.; Sippel, T. (2016). Synthesis of New Zealand gamefish tagging data, 1975 to 2014. *New Zealand Fisheries Assessment Report 2016/24*. 63 p.
- Holdsworth, J.C.; Sippel, T.J.; Block, B.A. (2009). Near real time satellite tracking of striped marlin (*Kajikia audax*) movements in the Pacific Ocean. *Marine Biology* 156: 505–514.
- Kopf, R.K.; Davie, P.S.; Bromhead, D.B.; Young, J.W. (2012). Reproductive biology and spatiotemporal patterns of spawning in striped marlin *Kajikia audax*. *Journal of Fish Biology* 81(6): 1834–1858.
- Ortiz, M.; Prince, E.; Serafy, J.; Holts, D.; Davy, K.; Pepperell, J.; Lowery, M.; Holdsworth, J. (2003). A global overview of the major constituent-based billfish tagging programs and their results since 1954. *Marine and Freshwater Research* 54: 489–508.
- 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.
- Sippel, T.; Holdsworth, J.; Dennis, T.; Montgomery, J. (2011). Investigating Behaviour and Population Dynamics of Striped Marlin (*Kajikia audax*) from the Southwest Pacific Ocean with Satellite Tags. *PLoS ONE* 6(6): e21087. doi: 10.1371/journal.pone.0021087.

APPENDIX TABLES

Table A1: Number of fish tagged and released by species and season, and the mean number of releases for the 10 seasons previous to 2011–12, for fish tagged by recreational and commercial fishers 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	159	977	150	61	14	965	16	14	8	6	2 398
2007–08	29		108	1 120	297	51	8	806	25	31	21	7	2 503
2008–09	24	2	101	661	285	50	5	1 058	24	35		9	2 254
2009–10	32	3	73	1 390	494	76	15	858	18	15	30	9	3 013
2010–11	78	1	128	1 145	609	103	21	731	37	15		14	2 878
2011–12	50	3	142	575	488	106	5	663	51	16			2 099
2012–13	18	3	150	761	524	86		858	47	5		4	2 450
2013–14	9	4	124	649	347	85	6	519	38	4	1		1 794
2014–15	37	7	110	723	439	78	12	1 086	34		14		2 522
2015–16	30	3	169	602	554	130	22	1 530	29		62	10	3 140
Total	575	55	4 963	22 535	15 508	1 718	253	24 208	443	142	1 321	741	72 462

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
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	40				110
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	24						7	2					33
2010–11	9						3	10	1				23
2011–12	28							2	2		1		33
2012–13	36							5		133	1		175
2013–14	26							2	2	267		2	299
2014–15	56	1			2			4	1	233			297
2015–16	19	18				1	1	2	131				172
Total	774	66		3	7	4	161	28	1 303	5	53	44	2 448

BEM	blue marlin	KIN	kingfish	SAI	sailfish	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 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	3	2	1	3			1		68
2008-09			4	43	8	2		3		2		2	64
2009-10			3	46	7	2		2				2	62
2010-11	1		4	54	7	2				1			69
2011-12			4	44	9				1	1			59
2012-13			3	40	12	2		4					61
2013-14			3	34	6	2		3	1			1	50
2014-15				30				2					32
2015-16				26	2	3		7	1				39
Total	8	1	87	1 520	370	65	1	99	5	4	15	25	2 200
Releases				22	15			25					
All areas	1 349	121	4 963	538	515	1 722	281	511	448	142	1 374	785	74 910
Recapture rate (%)	0.6	0.8	1.8	6.7	2.4	3.8	0.4	0.4	1.1	2.8	1.1	3.2	

Table A4: Billfish recapture details 2013–14 to 2015–16.

Tag no.	Species	Release date	Area tagged	Weight estimate (kg)	Vessel (t)	Recapture date	Area recaptured	Weight (kg)	Type
G 138152	STM	02-May-13	Wanganella Bank	90	Bwana 2	27-Jul-13	Fraser Is. AUS		
G 98593	STM	21-Feb-11	Stephenson Is.	125	Kai Time	21-Mar-14	Rocky Point BOI	139.4	Weigh
G 130447	STM	08-Mar-14	Red Mercury Is.	120	Acciano	03-May-14	Whangaruru	99.3	Weigh
G 123720	STM	25-Feb-15	Piha	100	Mindoro	25-Feb-15	King Bank	80	Est
G 144495	STM	23-May-14	Wanganella Bank	130	Bwana 2	01-Apr-15	Coffs Harbour		
G 141395	STM	16-Jan-15	Whangamata	80		12-Feb-16	Aldermen Is.	90.4	Weigh
G 126871	STM	16-Jan-16	Aldermen Is.	80	Crows Nest	13-Feb-16	Mercury Bay	79	Weigh
G 136031	STM	06-Feb-16	Poor Knights Rise	80	Cruenza 2	26-Feb-16	Cone Rock	70	Est
G 118706	STM	10-Jan-16	Cape Brett	110	Kotare	27-Mar-16	Ocean Beach Whangarei	89	Weigh
G 132968	STM	05-Mar-16	Great Barrier Is.	90	Pelagic	12-Apr-16	Aldermen Is.	90	Est
	STM					09-Apr-16	Ocean Beach Whangarei	105.2	Weigh
G 149797	STM	27-Feb-16	Cape Brett	120	Yonkers	06-May-16	Wekarua	148.6	Weigh
N 127578	SWO	21-Apr-11	Middlesex Bank	150	Primetime	14-Sep-13	South of Tuvalu	150	Est
N 127908	SWO	23-Feb-12	Garden Patch	100	Primetime	07-Apr-16	New Plymouth	100	Est