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Tini a Tangaroa

New Zealand Billfish and Gamefish Tagging, 2016–17 to 2018–19

New Zealand Fisheries Assessment Report 2019/65

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Release and recapture data for 2016–17 to 2018–19 sport fishing years (July to June) are summarised in this report and compared with those from previous seasons. Recaptures that provide growth or movement information of significance or interest are described.

There were 5163 fish tagged and released in the New Zealand Gamefish Tagging Programme (NZGTP) over the three years of this project. A further 338 fish were tagged with NZGTP tags outside New Zealand fisheries waters, mostly striped marlin and blue marlin.

The seasonality and regional distribution of fish tagged is summarised for the main species from the tagging database and the number of gamefish landed by recreational fishers 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, southern bluefin tuna, mako and blue sharks. It is indicative of recreational catch, but less complete, for albacore and yellowfin tuna and other large shark species.

The number of striped marlin, yellowtail kingfish and mako sharks tagged and released over the last three years were below the 10 year annual average. Data from 370 small kingfish tagged, mainly by shallow water fly fishers with a single barb tag, are now incorporated into the NZGTP.

Yellowtail kingfish make up 69% of all recaptures, mostly from New Zealand waters. Marlin, tuna and sharks have been recaptured around the Southwest Pacific Ocean by various fleets, mainly surface longliners.

1. INTRODUCTION

1.1 Overview

This gamefish tagging programme is a cooperative project between Fisheries New Zealand, 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 Ministry for Primary Industries project TAG2016/01, 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 2016/17, 2017/18 and 2018/19 fishing years.

3. To compile annual summaries of the results of the tag recapture programme for 2016/17, 2017/18 and 2018/19 fishing years.

4. To develop graphical descriptions of linear displacements for each species tagged, released and recaptured by the programme; review displacements in terms of time-at-liberty, fish size, season and area.

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 broadbill 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, blue marlin and more recently southern bluefin tuna (*Thunnus maccoyii*).

Game fishing has developed on the west coast of the North Island over the last 25 years with, at times, a very productive marlin and tuna fishery accessed from the west coast harbours and beaches as far south as Taranaki. 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. 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*), broadbill 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 (Holdsworth & Saul 2017).

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, 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 Fisheries New Zealand and the words "Please measure – 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 (Holdsworth & Saul 2017).

The New Zealand Sport Fishing Council (NZSFC) compiles annual sport fish tallies for the main species from 54 gamefishing clubs around New Zealand. These records are used to provide an estimate of the national landed recreational catch of billfish, tuna and shark species in New Zealand waters. These are used to estimate the proportion of catch landed and tagged and released by species.

Catch records for individual fish including fish weight, vessel and capture date is 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

Striped marlin are the main billfish species caught and tagged in this fishery. The number tagged peaked at 1658 in 2015–16 but has been below the ten year average for the last three years (Table 1). The number of blue marlin tagged has been above the average of 42 per year for the last two years, while swordfish numbers were lower in 2018–19. The number of shortbill spearfish tagged has been variable over the last 10 years with a high of 32 in 2018–19. Striped marlin recaptures are often variable over the short term and were highest in number (7) in 2015–16. Over the last ten years there have been 26 striped marlin, 5 swordfish and 1 blue marlin recapture reported (Table 1).

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

	Year										Average
Species	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2010 to 2019
Striped marlin	858	733	663	858	520	1 088	1658	517	711	579	789
Blue marlin	32	78	50	18	9	37	35	35	72	58	42
Shortbill spearfish	15	21	5	0	6	12	26	12	24	32	15
Swordfish	18	37	51	47	38	34	29	31	51	12	35
Black marlin	3	1	3	3	4	7	5	4	5	3	4
Billfish recaptures	2	1	1	4	4	2	8	3	4	3	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 since 2009–10 and now exceeds the number tagged for this species. Blue marlin numbers have been variable over the last 10 years with an average of 103 landed per year. Shortbill spearfish numbers are also variable with between 11 and 91 landed per year (Helen Pastor, New Zealand Sport Fishing Council, pers. comm.).

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

	Year										Average
Species	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19*	2010 to 2019
Striped marlin	607	607	635	744	620	696	900	516	618	433	660
Blue marlin	100	179	78	54	64	102	99	96	159	148	103
Shortbill spearfish	46	74	19	11	25	58	69	46	91	90	49
Swordfish	9	29	34	55	80	87	85	87	72	58	60
Black marlin	4	2	9	2	4	5	4	7	5	5	5

* Provisional numbers for 2018–19

Some billfish were also tagged outside the New Zealand EEZ by NZGTP participants. For the three years 2016–17 to 2018–19, there were 60 blue marlin, 2 black marlin, 29 sailfish, 5 shortbill spearfish, and 240 striped marlin tagged with New Zealand tags outside the EEZ (Appendix A, Table A3). Most of the striped marlin were caught at the Wanganella Banks, 200 nautical miles northwest of New Zealand.

The New Zealand striped marlin season usually extends from January to May. Occasionally striped marlin are caught in early December but fishing effort is low until January. 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).

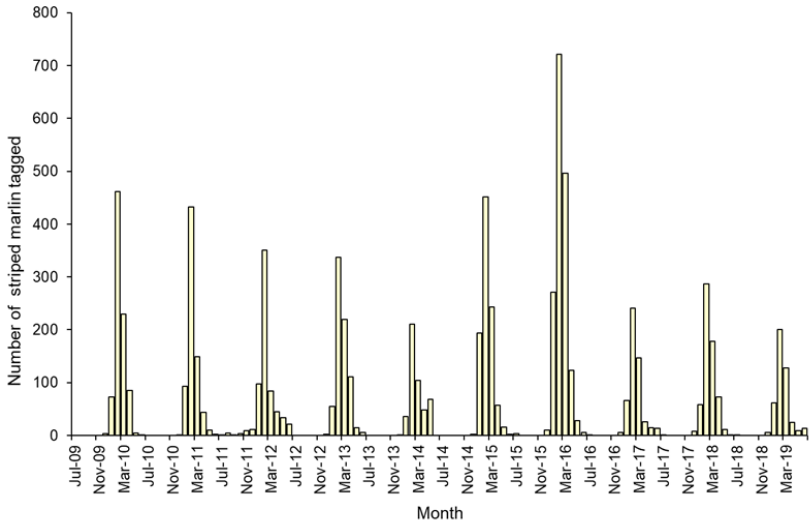


Figure 2: The number of striped marlin tagged by month in New Zealand waters since 2009–10.

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. The number of blue marlin tagged has increased in the last two fishing years.

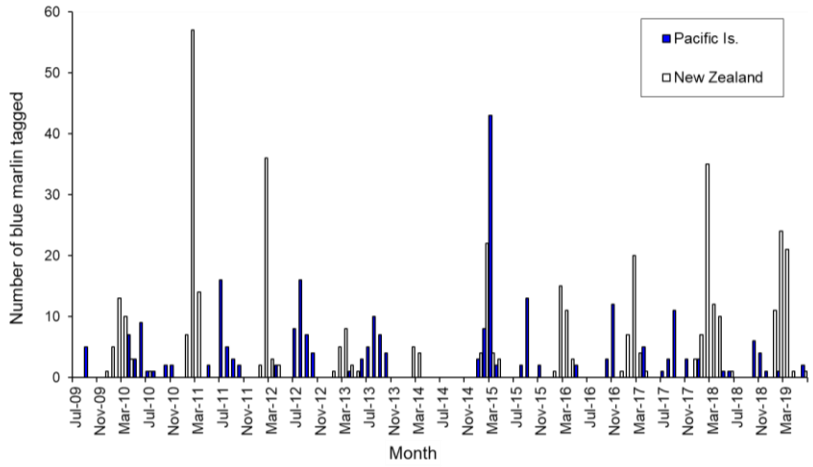


Figure 3: The number of blue marlin tagged by month in New Zealand and the Pacific Islands since 2009–10.

More striped marlin were tagged on 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 Three Kings area has been a productive area for marlin fishers in most years since 1990 but the number of striped marlin tagged in this area has been low over the last three years (Figure 4).

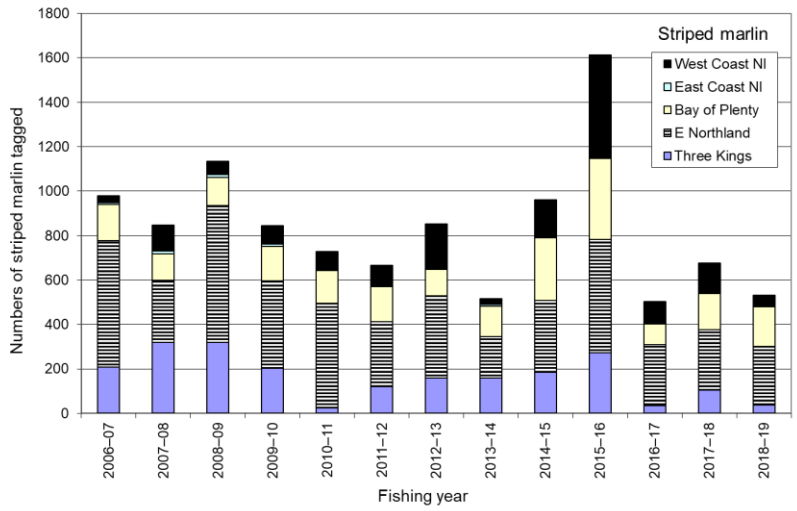


Figure 4: The number of striped marlin tagged by region and fishing year, 2009–10 to 2018–19.

In 2016–17 the mode of the estimated weights was at 90 kg with a slight skew to the left (Figure 5). In 2017–18, the mode was at the 80 kg weight bin and some larger fish were tagged, with 19% of tagged fish estimated at 120 kg or more (Figure 5).

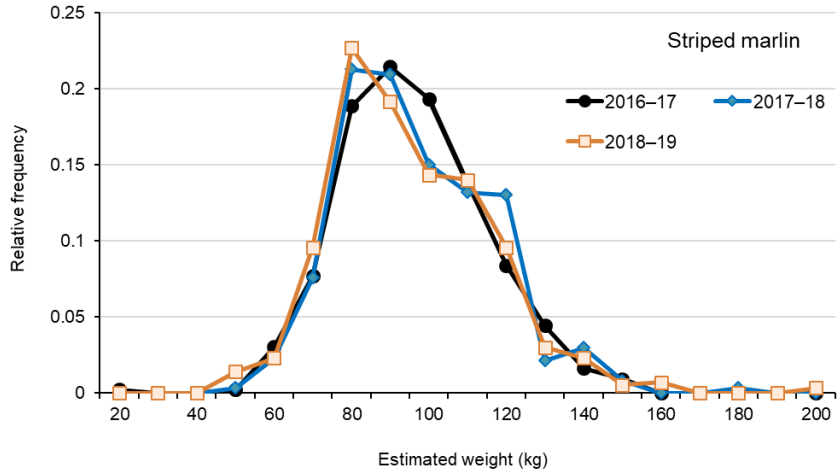


Figure 5: Comparison of the proportion by estimated weight of striped marlin tagged and released 2016–17 to 2018–19.

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 caught were caught from 2016–17 to 2018–19 (Figure 6).

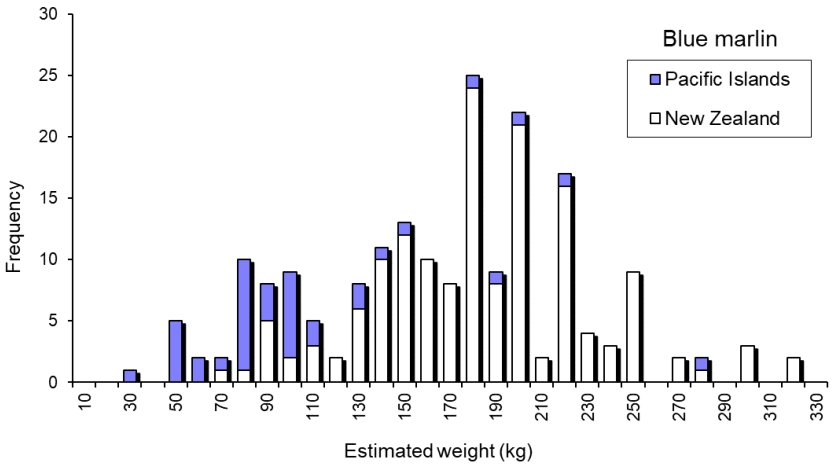


Figure 6: Weight frequency distribution of blue marlin from estimated weight on release 2016–17 to 2018–19.

Billfish recaptures

There were seven striped marlin and two swordfish with release and recapture details over the last three years as follows:

- A new record time at liberty for striped marlin in the NZGTP was set when a broken tag was retrieved from a fish on 3 March 2017, it had been at liberty for 4 years (1451 days) and was recaptured about 5 nautical miles (nmiles) from where it was tagged. This fish was estimated at 80 kg on release and weighed 113 kg on recapture.
- Another striped marlin recapture in March 2017 was a fish tagged at North Cape on 21 February 2017. This 95 kg fish was recaught 29 days later 75 nmiles away in the Bay of Islands.
- A striped marlin tagged off New Plymouth in March 2016 was recaptured on 6 March 2018 off Raglan. This fish, estimated at 110 kg, had a steel anchored tag and was recaught 55 nmiles north of the release area and weighed 122 kg on recapture.
- A striped marlin tagged on 30 March 2018 at the Wanganella Banks was recaptured 150 nmiles west of New Caledonia on 20 June 2018 by a local longline boat. This fish was estimated at 50 kg on release and had travelled 700 nautical miles NNW in 82 days.
- A striped marlin tagged on 8 April 2018 off Ocean Beach Whangarei was recaptured in the Coral Sea by a longliner from New Caledonia on 18 November 2018. This fish was estimated to be 120 kg on release and had travelled 1290 nmiles NW in 224 days.
- A striped marlin tagged off the Alderman Islands, Bay of Plenty in mid-January 2019 was caught and retagged off Wekarua, Whangaroa on 22 February 2019. This 100 kg fish was tagged 34 days earlier and had travelled 165 nmiles NW.
- A striped marlin tagged off Raglan on 12 February 2019 was recaptured 15 days later off Manukau Harbour. This fish weighed 90 kg and was 36 nmiles from the release area.
- A swordfish tagged on 12 April 2009 at Middlesex Bank was recaptured on 26 May 2017 by a New Zealand tuna longliner west of Port Waikato. It had been at liberty for 8 years 3 months and was recaught 225 nmiles south from the release area. This fish was estimated at 140 kg on both occasions. Male swordfish don't get much larger than this.
- A swordfish tagged in April 2016 in the Bay of Plenty was recaptured on 31January 2018 by a tuna longliner in the outer Bay of Plenty. The steel anchored tag had stayed in place for 1 year 10 months. This 100 kg fish was within 30 nmiles from the release location, although typically mature swordfish migrate into subtropical waters in spring.

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, Ducharme-Barth et al. 2019). 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. While no striped marlin tagged in the south Pacific have so far been recaptured beyond the south Pacific 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). Most striped marlin are tagged in New Zealand during the first and second quarter (January to June). Some striped marlin have left New Zealand and been recaptured in subtropical waters during the second quarter and many of the other recaptures in the subtropics are in the third and fourth quarter (Figure 7).

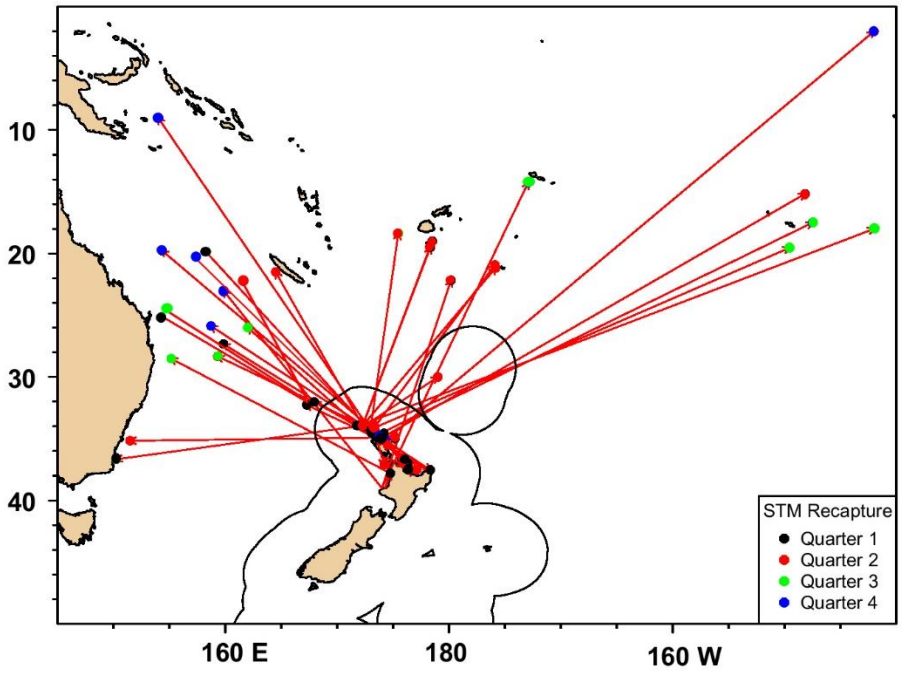


Figure 7: Long distance movements of striped marlin in the gamefish tagging programme for all years with recapture location colour coded by quarter (Quarter 1 = Jan-Mar).

Most striped marlin recaptures from New Zealand waters are reported by sport fishers within a few months of release (Figure 8). There have also been some fish moving into the subtropics, about 1000 nmiles away within 60 days, at an average displacement rate of 20 –30 mniles per day. There are 28 records of recaptures of striped marlin outside New Zealand waters with all but one from observers or crew on commercial vessels.

Blue marlin have a wide spread of displacement rates and better tag retention rates even though the sample size is small (Figure 8). Only one of these recaptures was for a fish tagged in New Zealand waters, which was recaptured 700 nmiles north after 158 days at liberty (Figure 9).

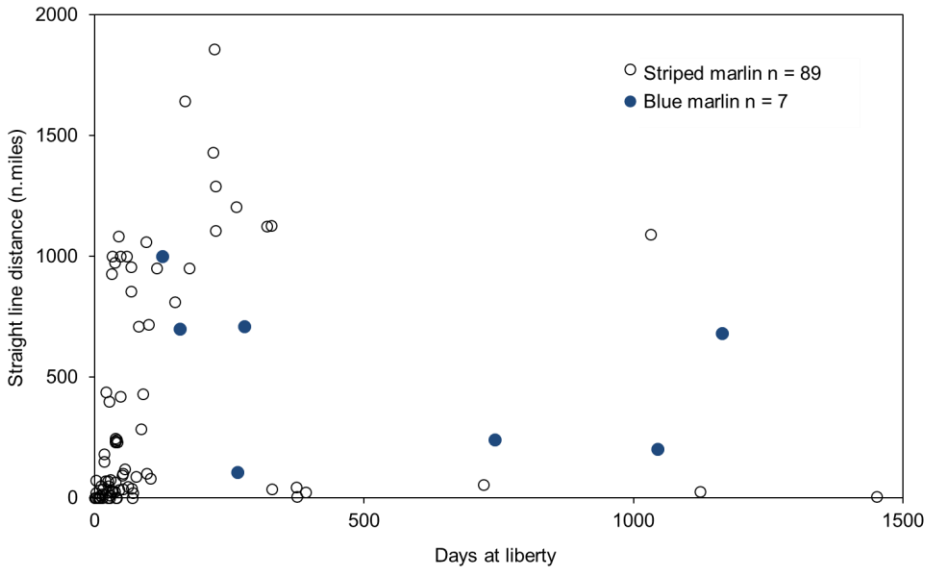


Figure 8: Marlin displacement distance by days at liberty, all years.

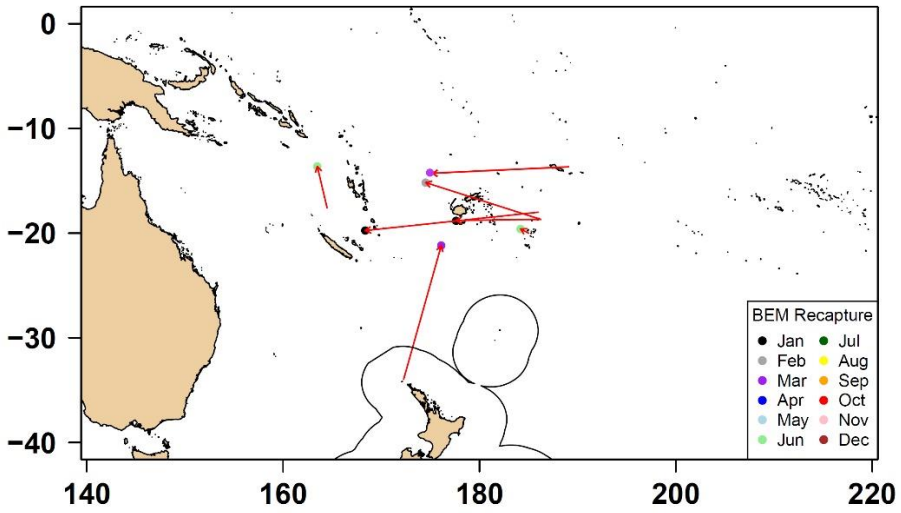


Figure 9: Long distance movements of blue marlin in the gamefish tagging programme for all years with recapture location colour coded by month.

Landed Catch

New Zealand Sport Fishing Council (NZSFC) 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 club weigh stations 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 2016–17 to 2018–19. Unaccounted catch is likely to be higher in seasons with high catch rates and when fishing is good off the west coast of the North Island, away from the main fishing ports.

There are also tagged billfish that are reported direct to Fisheries New Zealand 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. The NZSFC annual totals of tagged and landed striped marlin are shown in Figure 10.

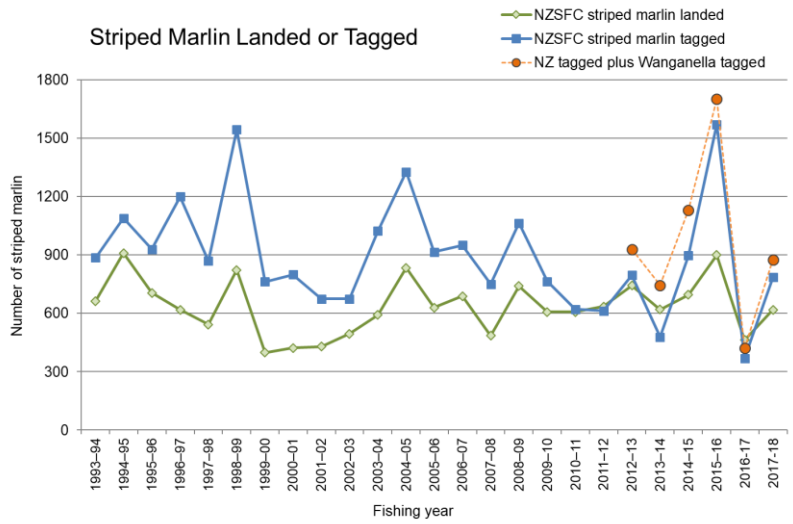


Figure 10: The number of striped marlin landed compared to the number tagged as recorded by NZSFC clubs by fishing year. Striped marlin tagged at the Wanganella Banks are outside the New Zealand EEZ but are added to the number tagged in New Zealand waters.

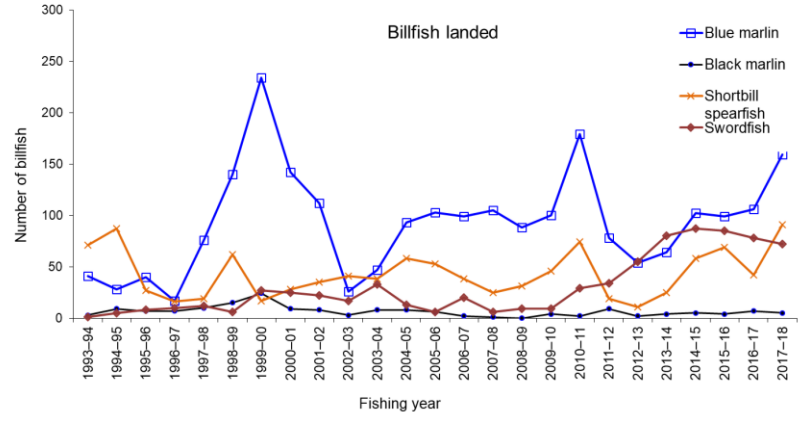


Figure 11: The number of billfish landed (excluding striped marlin) by year since 1993–94 from NZSFC records.

Of the landed billfish, other than striped marlin, in NZSFC club records blue marlin has dominated the landed catch but numbers of shortbill spearfish have increased while swordfish has started to decline in recent years (Figure 11).

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 69 % of all recaptures.

The number of kingfish tagged and released has declined in the last three years but remains over 500 per year (Table 3). The retirement of some leading charter skippers who have long supported kingfish tagging

has reduced releases and recaptures. A kingfish ageing study in 2010 encouraged fishers to measure all kingfish catch at sea and boosted the number of fish tagged. The use of smaller dart tags has been an initiative by fly fishers targeting smaller kingfish in harbours and on sand flats. They have deployed a useful number of tags (370) with an overall recapture rate of 7.8%.

Table 3: The number of yellowtail kingfish tagged and the number recaptured by tag type over the last ten years.

	Year										
	2008–09	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	Annual Average
Gamefish tag releases	661	1 381	1123	613	761	649	723	607	598	546	509	679
Gamefish tag recaptures	43	46	54	44	38	31	30	28	31	23	32	36
Dart tag releases								12	231	66	62	93
Dart tag recaptures									3	14	12	10

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 prominent since 2015 (Figure 12).

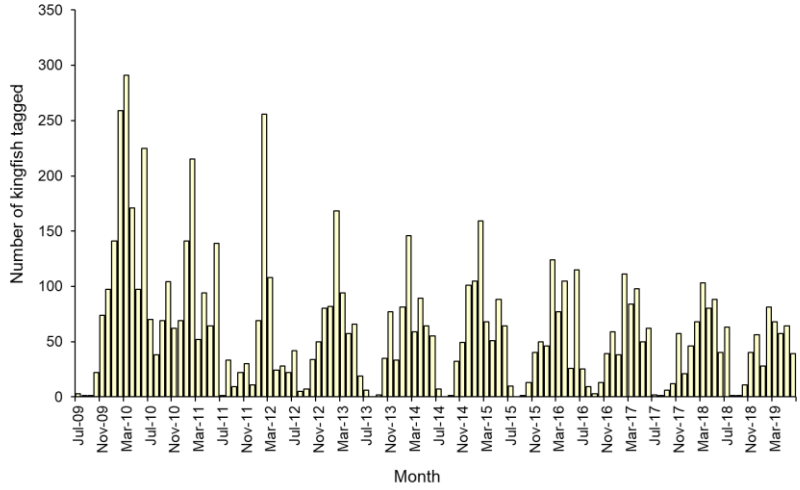


Figure 12: The number of yellowtail kingfish released with gamefish tags by month since 2006–07.

Trends in the proportion of annual kingfish releases by region over the last 13 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 2016–17 (391) was the second highest for the period shown (Figure 13).

The majority of tagged kingfish have been measured (fork length), before release. The length frequency distribution of tagged kingfish has been bi modal for the last three years (Figure 14). The modes at 75 and 80 cm size classes are mainly from inshore fisheries while the larger mode is mainly from fish tagged in offshore locations. Many of the kingfish tagged with the small Hallprint PDAT tags have also been measured on release (Figure 14). In the past fishers have been asked not to tag kingfish smaller than the minimum legal size for recreational fishers (75 cm) with the larger gamefish tags.

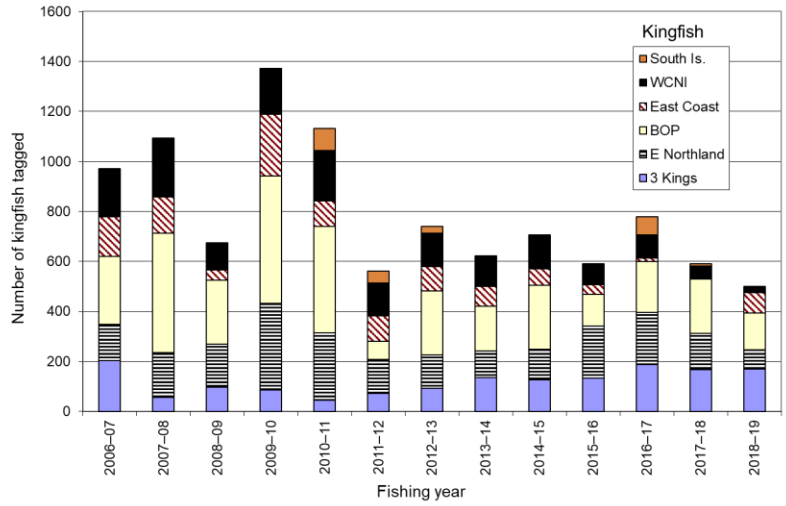


Figure 13: The number of yellowtail kingfish tagged by region and fishing year, 2006–07 to 2018–19.

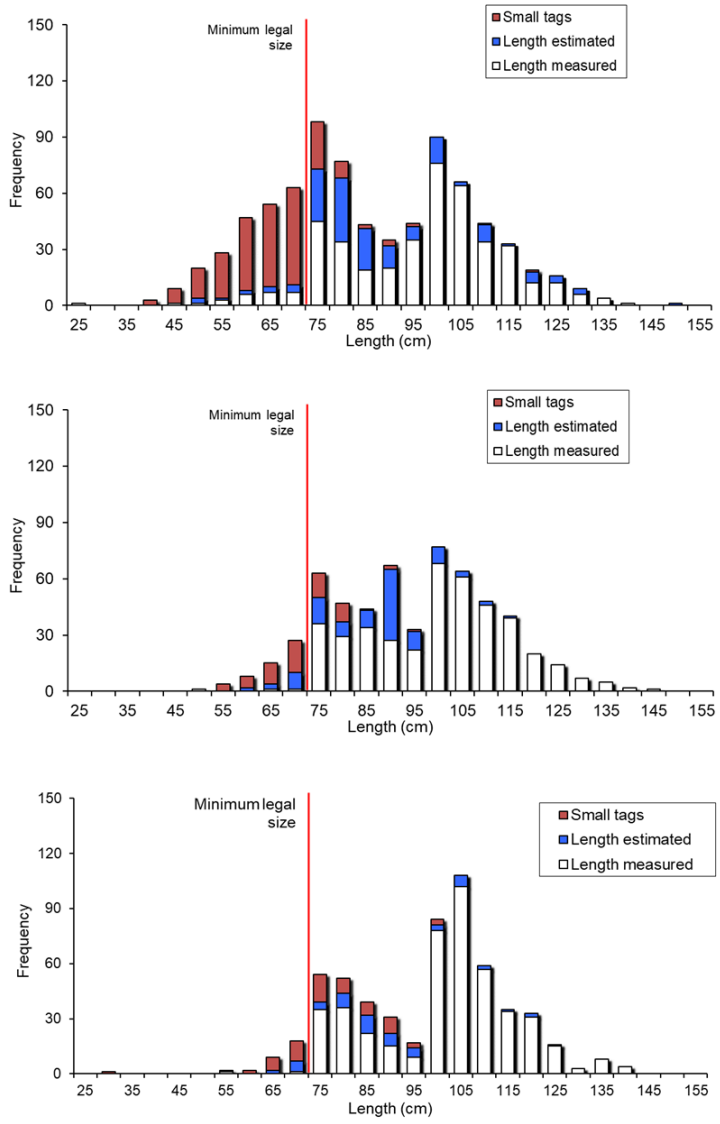


Figure 14: Yellowtail kingfish length frequency for released fish, fish measured (white bars) and those with estimated lengths (blue bars) 2013–14 to 2015–16.

Movement

Most kingfish are recaught close to their release location even after many years. Ninety four percent of recaptures at liberty for 30 days or more were within 100 nautical miles of the release point. Recapture locations of kingfish released by General Statistical Area in the main Northland and North Island west coast fishing locations show a small proportion of recaptures scattered across other regions (Figure 15).

Yellowtail kingfish are also capable of long distance movement 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.

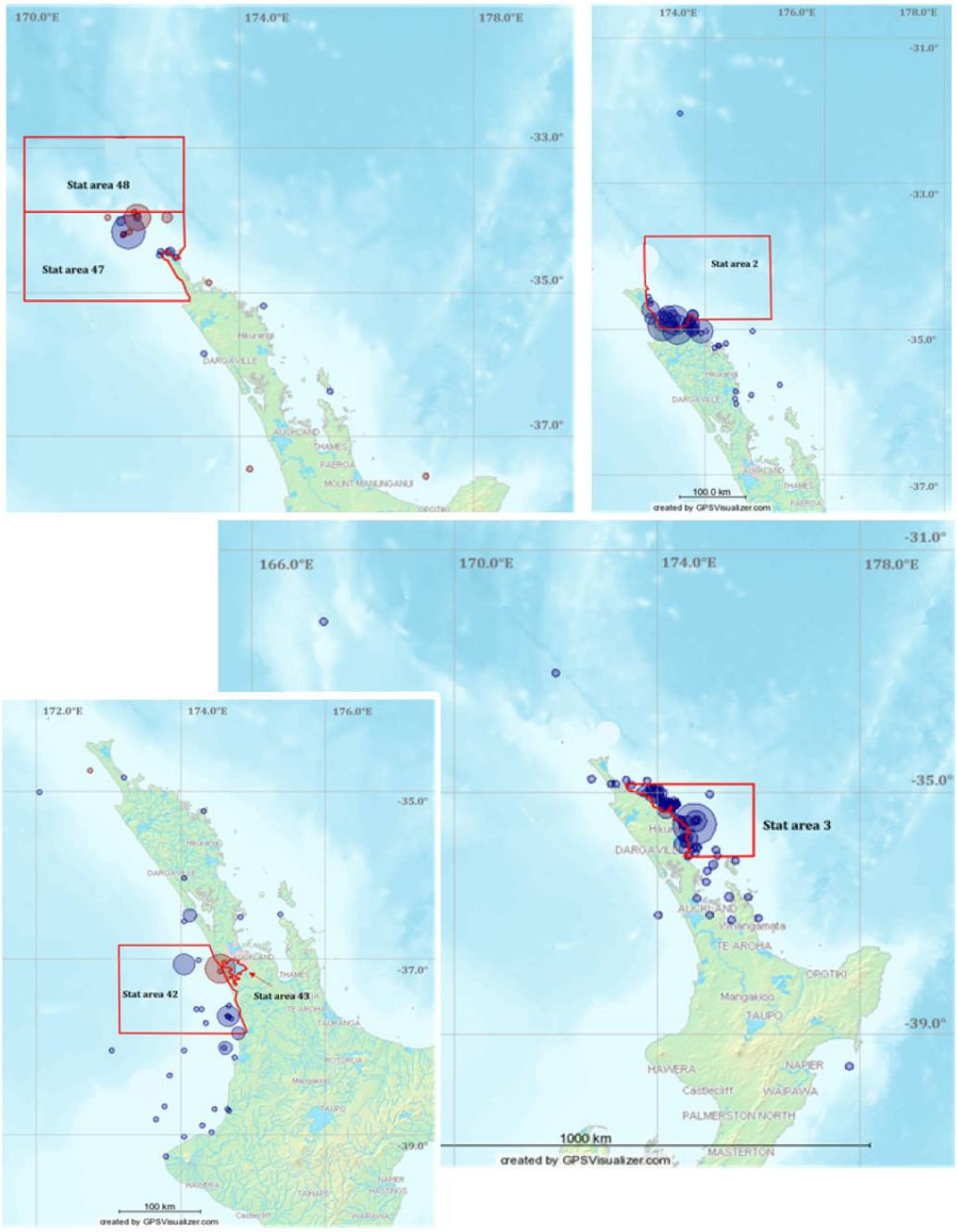


Figure 15: Distribution of recaptures recorded for kingfish released by General Statistical Area (red outline) in Northland and the North Island west coast.

Recapture locations for kingfish tagged in the Hauraki Gulf and eastern Coromandel (General Statistical Areas 005 to 008) tend to be in the same area that they were tagged (Figure 16). There have been 1464 kingfish tagged in Statistical Area 009, and 102 recaptures after 30 days or more. In Statistical Area 010 there have been 5828 kingfish tagged with 539 recaptures after 30 days or more. Most recaptures from these areas have been in the Bay of Plenty (Figure 16). Note however, that recaptures of tagged fish are fishery dependant so there will tend to be more recaptures in areas with more kingfish fishing effort.

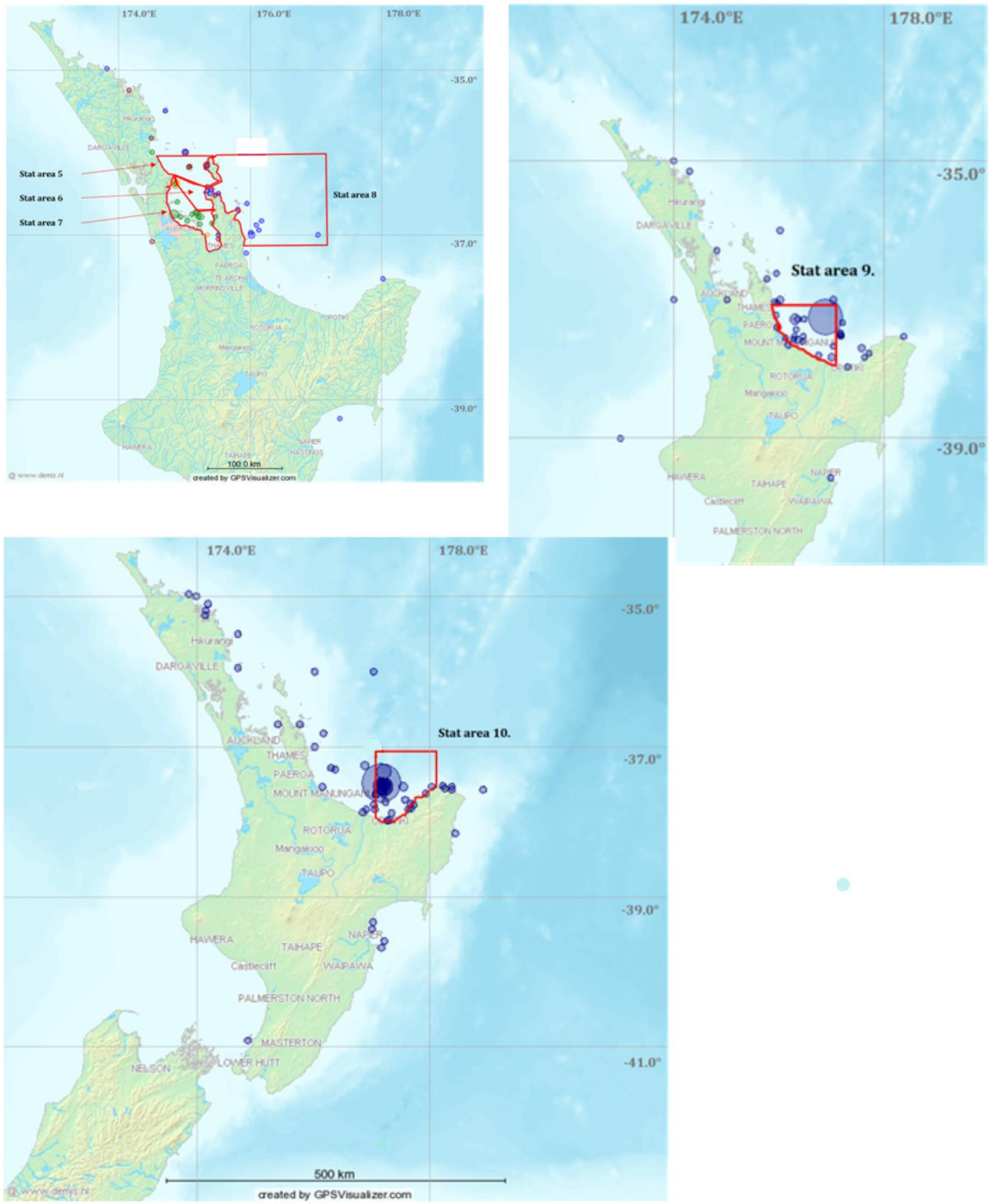
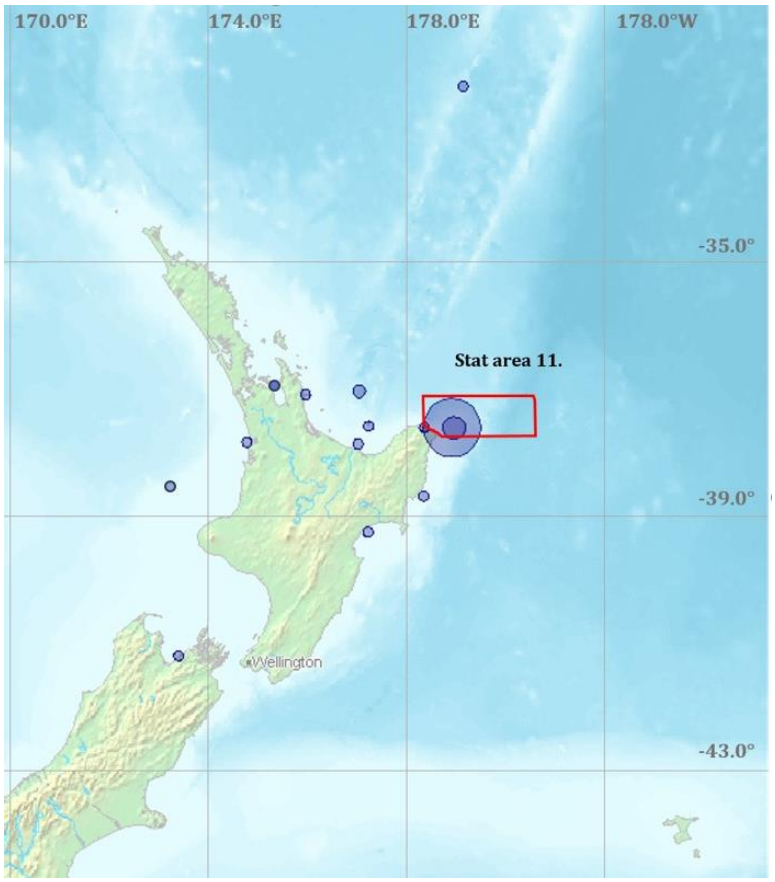


Figure 16: Distribution of recaptures recorded for kingfish released by General Statistical Area (red outline) in the Hauraki Gulf and Bay of Plenty.

Recapture locations from statistical areas along the East Coast of the central North Island also show a small proportion of fish moving long distances north and south and from the east to the west coast but there is a tendency for more recaptures to the north of the release location (Figure 17).



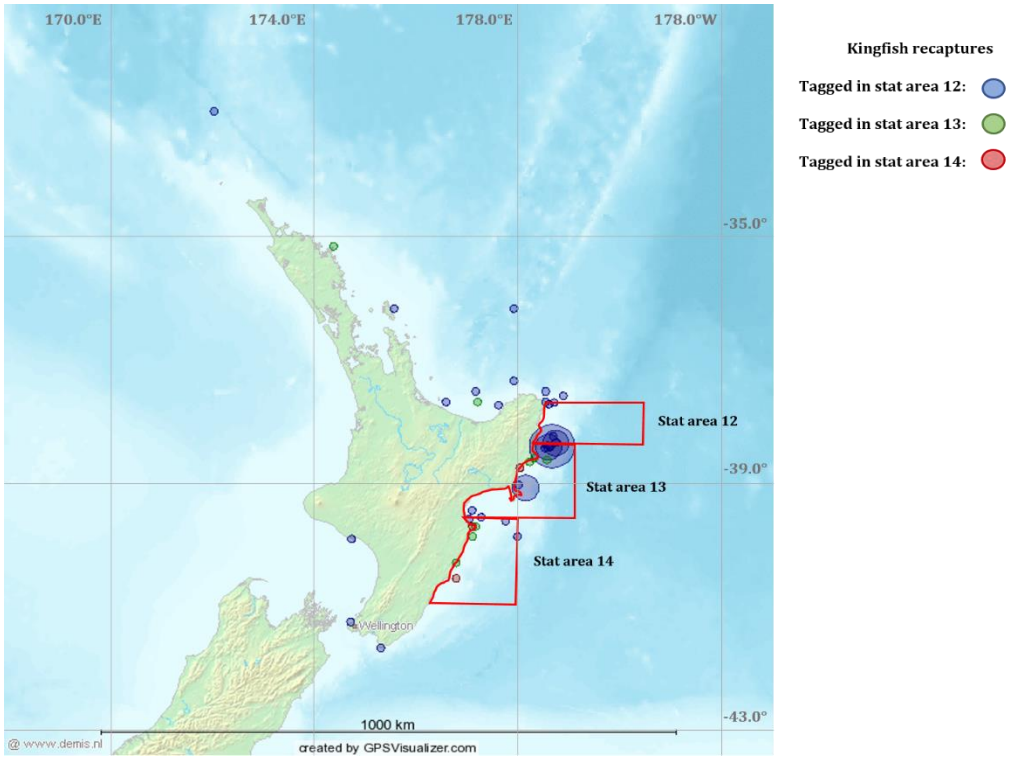


Figure 17: Distribution of recaptures recorded for kingfish released in General Statistical Areas 011, 012, 013 and 014 (red outline).

3.3 Mako and blue shark

The number of mako sharks tagged and released inside New Zealand fisheries waters decreased from 583 in 2015–16 to 205 in 2018–19 (Table 4). The number of blue sharks tagged has dropped below the 10 year average to the lowest recorded for the period (22) in 2018–19. This is largely due to the reduction of targeted fishing effort for blue sharks off Otago.

There were no mako or blue sharks tagged for this programme outside New Zealand fisheries waters between 2016–17 and 2018–19. The overall recapture rate is 2.4 % for mako sharks and 1.8% for blue sharks tagged in New Zealand waters (Appendix, Table A4).

Table 4: The number of mako and blue sharks tagged in New Zealand fisheries waters and the number recaptured by fishing year.

	Year										Average
Species	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2010 to 2019
Mako tagged	494	609	488	524	367	439	583	331	282	205	432
Blue shark tag	73	128	142	150	124	110	170	54	58	22	103
Mako recaptures	7	7	8	11	6	0	2	3	4	0	5
Blue shark recaptures	3	3	4	3	3	0	0	1	1	0	2

The number of mako and blue sharks tagged peaked during the mid-1990s then declined to a low level in the mid 2000s and has increased and decreased over the last 12 years (Figure 18). Generally, mako sharks are caught as a bycatch of other sport fisheries, particularly off the North Island.

Most mako sharks were tagged between January and April with a strong mode in February (Figure 19). This peak is associated with the New Zealand Sport Fishing Council Nationals Tournament which encourages the tag and release of various species. The strong mode in the number of blue sharks tagged in February is also during the Nationals Tournament, though numbers have declined in the last three years (Figure 20).

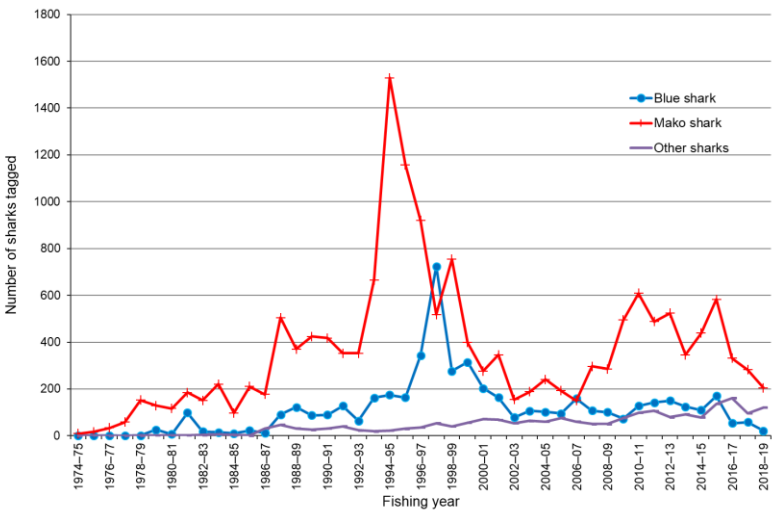


Figure 18: The number of mako and blue sharks tagged 1974–75 to 2015–16.

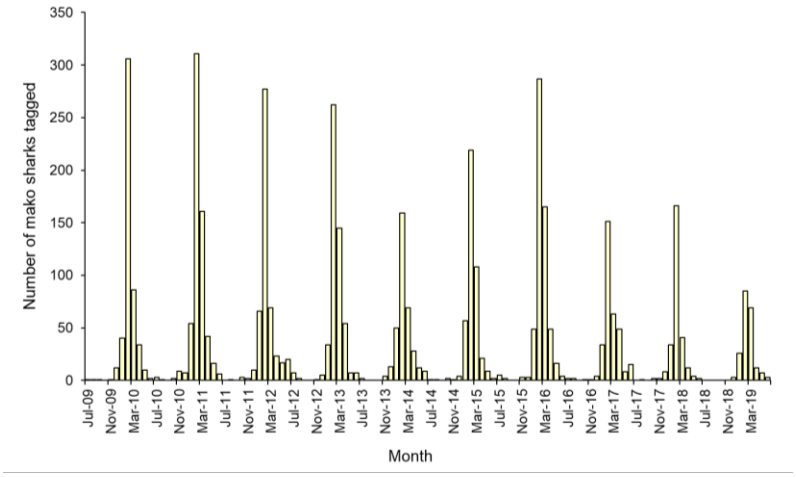


Figure 19: Number of mako sharks tagged by month since 2009–10.

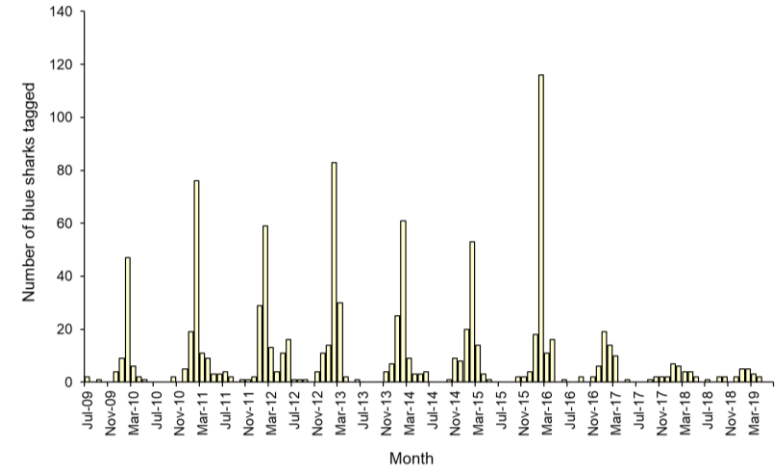


Figure 20: Number of blue sharks tagged by month since 2009–10.

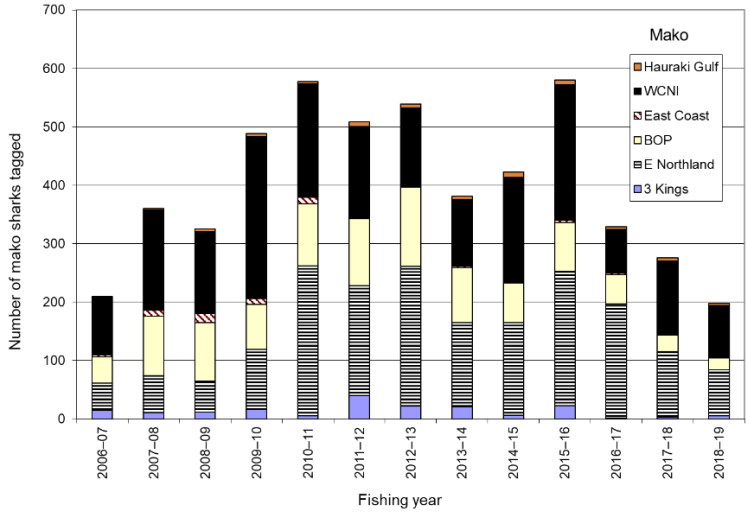


Figure 21: The number of mako sharks tagged by region and fishing year, 2006–07 to 2018–19.

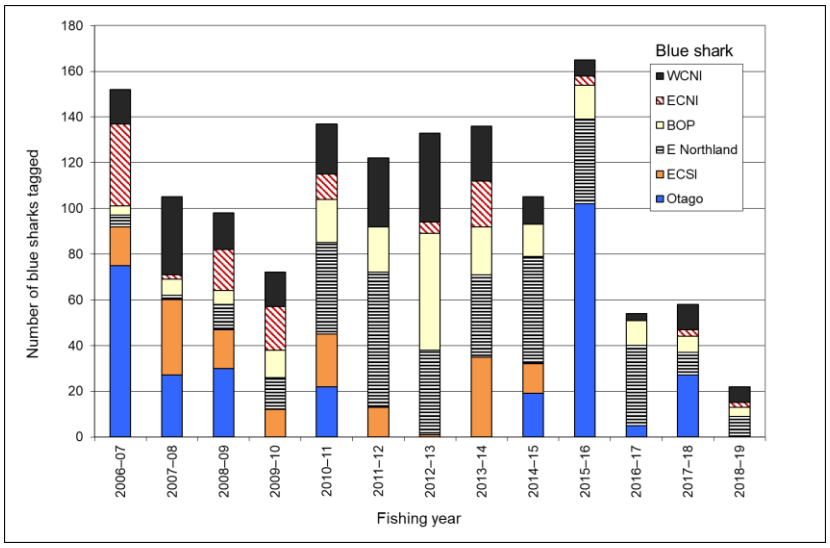


Figure 22: The number of blue sharks tagged by region and fishing year, 2006–07 to 2018–19.

The number of mako sharks tagged from 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 21).

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. Most blue sharks have been tagged in target fisheries off Otago and Canterbury or as incidental catch in East Northland and Bay of Plenty (Figure 22).

Mako and blue shark recaptures

There were seven mako and two blue sharks with release and recapture details over the 2016–17 to 2018–19 fishing years as follows:

- A 50 kg mako tagged of Waihau Bay on 23 February 2016 was recaptured in October 2016 by a surface longliner between Fiji and Samoa. This fish had travelled 1335 nmiles in 131 days.
- Another mako recapture in October 2016 was a 40 kg fish tagged at Cavalli Islands on 14 August 2016. This fish was recaught off Fiji 68 days later, on 21 October and travelled 1050 nmiles.
- A 75 kg mako tagged off New Plymouth on 31 January 2013 was recaptured 360 nmiles north of New Zealand by a surface longliner on 17 November 2016. This fish was reported by a New Zealand observer as a female 195 cm long and was 640 nmiles from the release area in 1386 days.
- A 50 kg mako tagged off Kawhia on 9 February 2017 was recaptured in August 2017 by a longliner from Noumea. This fish had travelled 1055 nmiles in 200 days and was released alive with the tag intact.
- A 35 kg mako tagged off Whangarei Heads on 8 January 2017 was recaptured south of Tongan waters in October 2017 after 272 days at liberty.
- A 15 kg mako free tagged (without being hooked) off Tangimoana on 19 March 2017 was caught by a recreational fisher in Bass Strait on 28 December 2017 after 284 days at liberty. This fish travelled 1380 nmiles and was retagged and released.
- A 60 kg mako tagged off New Plymouth on 17 February 2018 was recaptured by a trawler off Foxton Beach 51 days later, on 9 April 2018. This fish was about 100 nmiles from the release location.
- A 25 kg blue shark tagged off Muriwai Beach on 21 February 2013 was recaptured 430 nmiles north of New Zealand by a surface longliner on 8 December 2016. This fish was reported by a New Zealand observer as a male, 230 cm long and was 587 nmiles from the release area in 1386 days. This is the longest time at liberty for a recaptured blue shark in the NZGTP.
- A 40 kg blue shark tagged off Raglan on 23 February 2018 was recaptured 83 nmiles northwest by a surface longliner after 17 days at liberty.

There were no mako or blue shark recaptures in 2018–19.

Movement

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. However, mako sharks have tended to be recaptured in Fiji and New South Wales more often than striped marlin (Figure 23).

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.

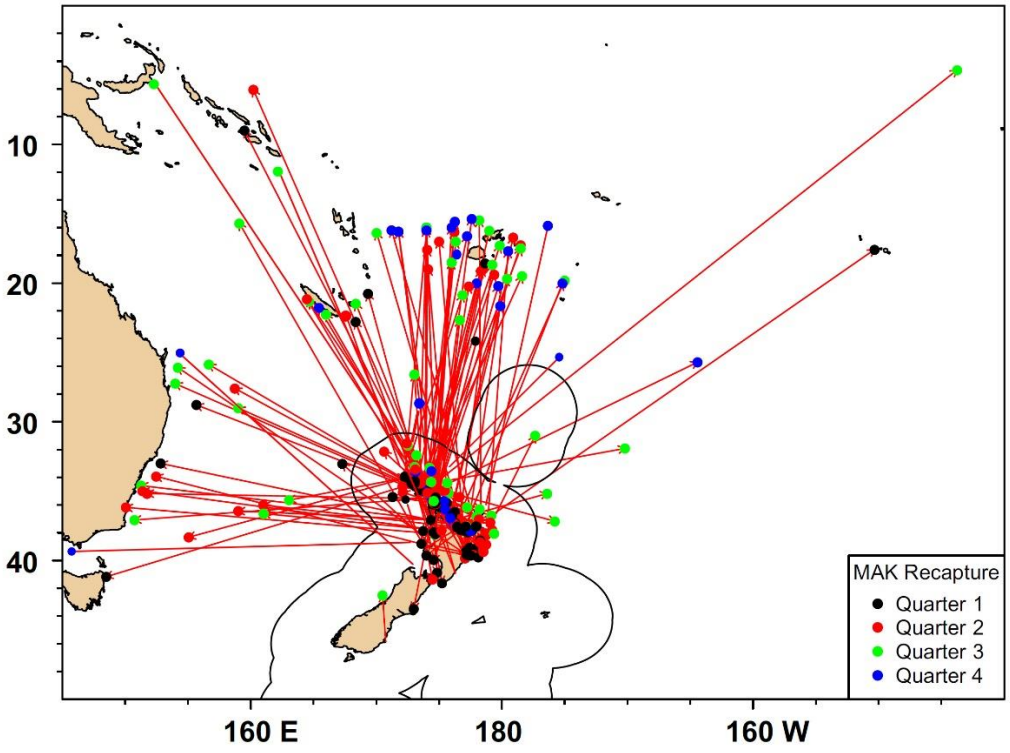


Figure 23: All release and recapture locations of mako sharks in the gamefish tagging programme, with recapture location colour coded by quarter (Quarter 1 = Jan-Mar).

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 24). 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.

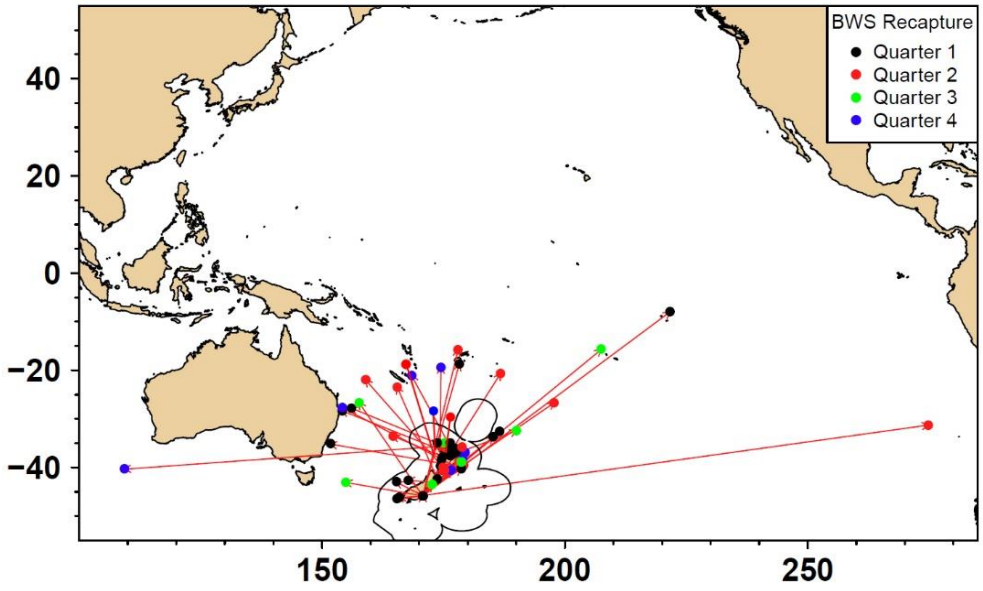


Figure 24: All release and recapture locations of blue sharks in the gamefish tagging programme, with recapture location colour coded by quarter (Quarter 1 = Jan-Mar).

The gamefish tags hold well on mako 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 (Figure 24).

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 (Figure 25). 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 9 months. A blue shark tagged off Tutukaka was recaptured after 53 days off Queensland, a minimum travel distance by sea of 1060 nmiles giving a displacement rate to date of 20 nautical miles per day, the maximum recorded for a blue shark in the NZGTP.

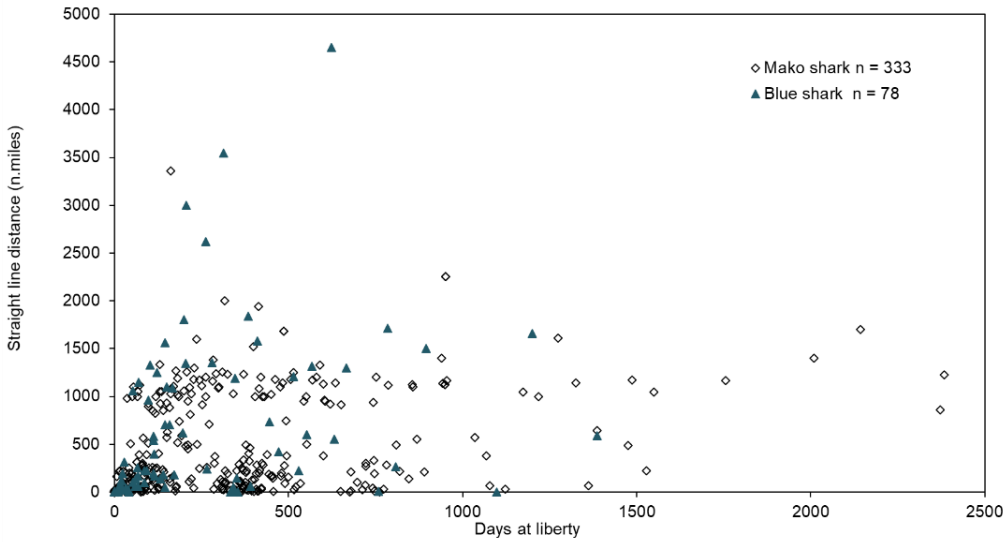


Figure 25: Mako and blue shark displacement distance by days at liberty, all years.

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 smooth hammerhead sharks *Sphyrna zygaena* and bronze whaler *Carcharhinus brachyurus*. The species composition of tagged sharks over the past 10 years is provided in Table 5. Most bronze whaler, hammerhead and thresher sharks are tagged over summer, January to April, by recreational fishers (Holdsworth et al. 2016).

Table 5: The number of sharks other than mako and blue shark tagged in New Zealand waters by fishing year.

Species	Year										Average
	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2010 to 2019
Bronze whaler	43	37	34	40	43	44	63	106	56	85	55
Hammerhead	16	43	38	19	27	17	51	34	26	23	29
Porbeagle	1	1		1			1		1		0.5
School shark	7	4	14	5	3	1	1	3	3	4	5
Sevengill	1	6					1		1	1	1
Shark unidentified	1	3	4	4	1	7	3	4	3	2	3
Thresher	5	8	16	16	11	9	17	13	5	6	11
White shark		1						1	1		0.3
Total	74	103	106	85	85	78	137	161	96	121	105

The number of bronze whalers tagged in New Zealand waters has increased over the last 10 years, primarily in the Bay of Plenty (Figure 26) where a research project has been undertaken by Melissa Kellett.

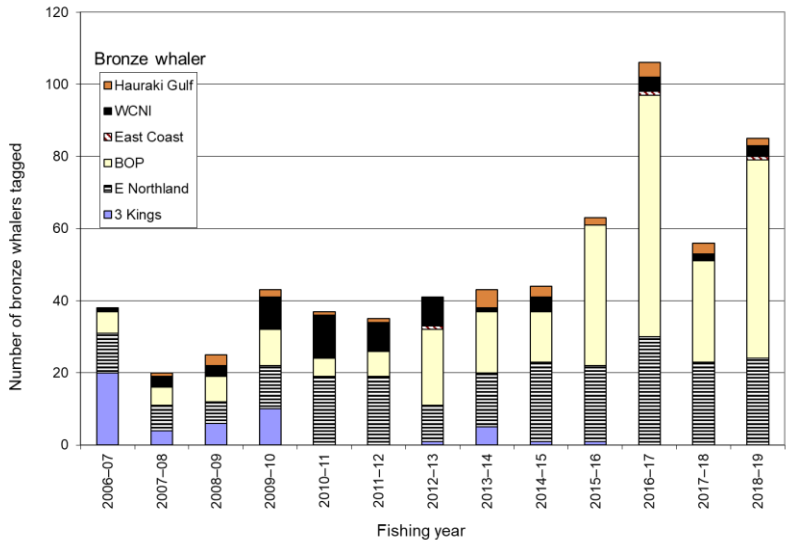


Figure 26: The number of bronze whalers tagged by region and fishing year, 2006–07 to 2018–19.

Recaptures

There were five bronze whaler and two school sharks with release and recapture details over the last three years. Four of the bronze whalers were caught close to where they were released, one caught from shore at Pauanui Beach and one in Tauranga harbour after nearly 1 and 2 years at liberty respectively (Figure 27). A bronze whaler was tagged and recaptured in the Kaipara Harbour after 67 days. Another bronze whaler tagged north of the Bay of Islands was recaptured at the King Bank, a distance of 110 nmiles north in 457 days.

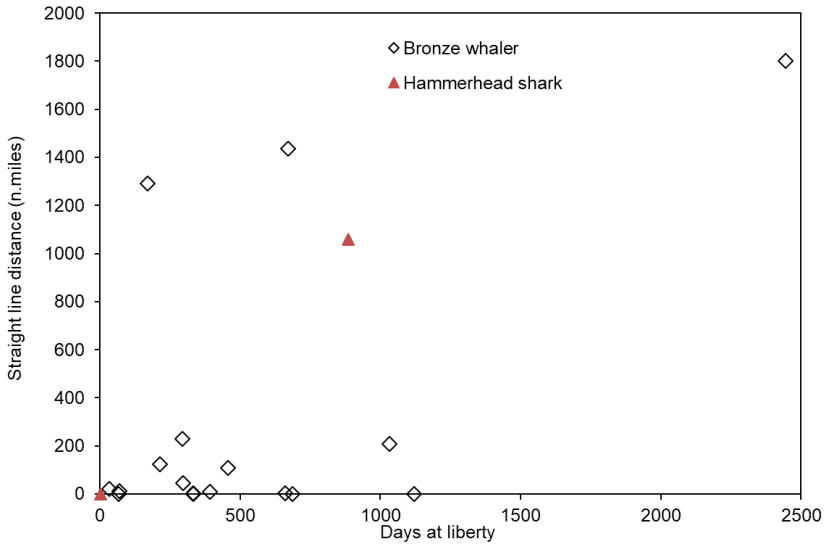


Figure 27: Bronze whaler and hammerhead shark displacement distance by days at liberty, all years.

Landed sharks

In the 1990s mako, blue shark and to a lesser extent hammerhead sharks were regularly caught and landed in New Zealand fishing competitions. The number landed declined for all species in the early 2000s (Figure 28). A similar trend is seen in the number tagged (Figure 18).

The NZSFC introduced minimum weights for sharks to qualify to be weighed. Over the last 10 years many clubs have removed prizes for landed sharks altogether, as attitudes toward sharks have changed.

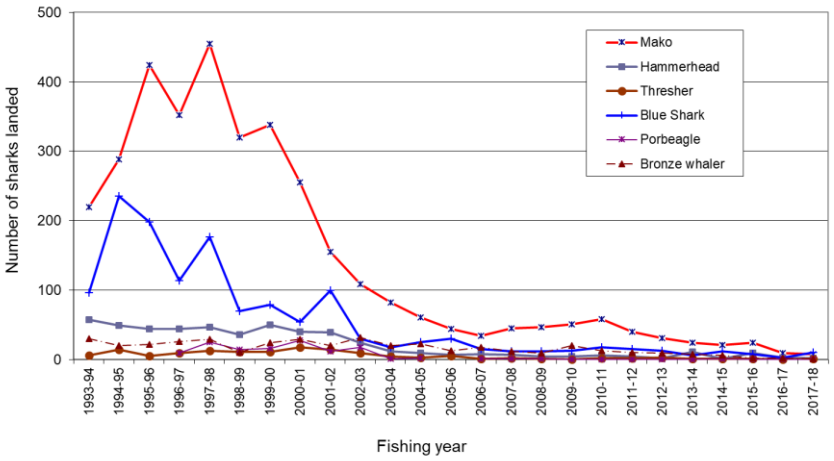


Figure 28: Number of sharks landed and recorded by New Zealand Sport Fishing Council clubs by species since 1993–94.

3.5 Tuna

For several years no yellowfin tuna were tagged and released in the NZGTP. In 2015–16 there were 63 yellowfin tagged with estimated release weights between 10kg and 65 kg (mean = 32 kg). Since then few yellowfin have been tagged and most yellowfin are caught by fishers targeting marlin (Table 6).

The number of Pacific bluefin tuna caught in the winter target recreational fishery off the West Coast has declined significantly since 2012 (Table 6). While many of the tuna in this fishery were released not many were tagged. A satellite tagging programme sponsored by Stanford University, University of Auckland, MPI and the New Zealand Marine Research Foundation deployed 46 PSAT tags on Pacific bluefin tuna between 2006 and 2008. These fish survived capture and release well but achieving deployments longer than 6 months was problematic due to attachment failures.

A few southern bluefin tuna have been tagged over the last 10 years (Table 6). Some of these have been small fish released by commercial fishers from surface longline vessels.

Table 6: The number of tuna tagged in New Zealand waters by fishing year.

	Year										Average
Tuna species	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18	2018–19	2010 to 2019
Pacific bluefin	15	15	16	5	4	0	0	0	0	0	6
Yellowfin	30	0	0	0	1	14	63	2	7	6	12
Southern bluefin	6	7	15	1	2	7	4	5	10	1	6

Landed Tuna

The total landed catch of yellowfin from NZSFC clubs and NZGTP records shows the decline in recreational catch since the mid-1990s (Figure 29). The large target fishery in the Bay of Plenty no longer operates and Whakatane Sport Fishing Club tournaments target marlin and other gamefish. The number of Albacore landed and weighed by clubs shows no obvious trend (Figure 29). Most of the albacore catch is reported from clubs from the Bay of Plenty south on east and west coasts.

A small recreational fishery for southern bluefin tuna developed on the west coast of the South Island in the 1970s. The Fiordland Game Fishing Club was formed and was a member of the New Zealand Sport Fishing Council until the late 1980s. Most of the southern bluefin tuna were caught in February and weighed less than 30 kg (Marquand 1978). A North Island recreational fishery for southern bluefin tuna rapidly emerged in June and July 2017. Good catch rates and favourable weather attracted hundreds of anglers to the eastern Bay of Plenty at short notice. Most fishers towed trailer boats and launched at Waihau Bay. Fish were caught by trolling lures using the same tackle as the summer billfish fishery. A high proportion of catch in 2017 and 2018 was weighed by fishers and recorded by clubs. The NZSFC fishing year ends on 30 June, in the middle of the North Island southern bluefin tuna season. The numbers plotted in Figure 29 include catch from June, July and August in the same year. In 2017 266 southern bluefin tuna were recorded in NZSFC club records.

A recreational fishery for Pacific bluefin tuna developed in 2005 off the west coast of the South Island with charter boats fishing from Greymouth and Hokitika but these fish are not captured in club records and the fishery has declined in recent years. A few bigeye tuna have been caught and weighed at fishing clubs.

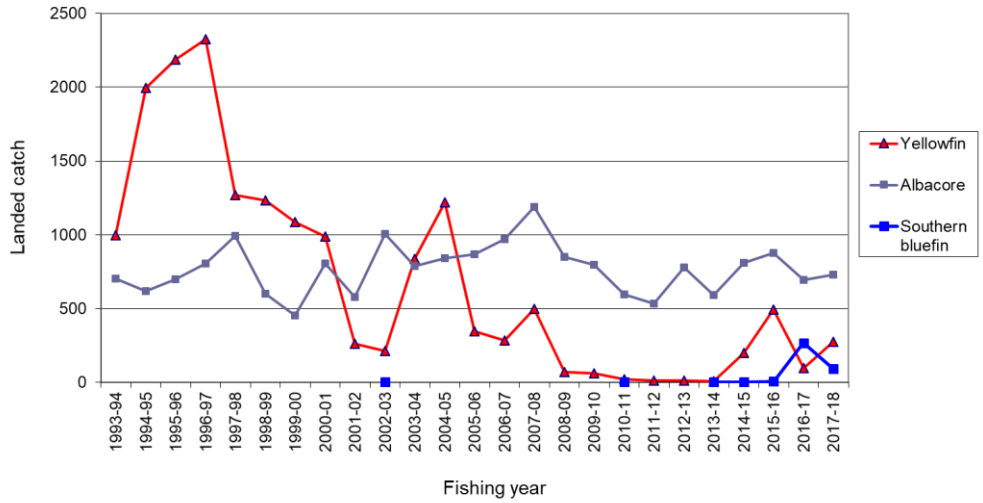


Figure 29: The number of landed tuna recorded by NZSFC clubs since 1993–94.

4. DISCUSSION

Cooperative tagging programmes are opportunistic but a cost 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 79 000 gamefish tagged in New Zealand waters and outside the EEZ with NZGTP tags. Recapture and reporting of tagged 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 that 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 Fisheries New Zealand ensure that the information is used. They fund data management, recapture rewards, analysis and inclusion of this information in New Zealand Working Group Reports, reports to the Western and Central Pacific Fisheries Commission and Fisheries Assessment Reports such as this.

The summer of 2015–16 was atypically warm and 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 19 years. Since then there has been a decline in the numbers tagged and landed for these species.

There is a notable increase in the number of blue marlin and shortbilled spearfish tagged and landed over the last three years.

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 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 by Pacific Island nations, where fishing by international tourists is increasing, may increase our knowledge of spawning aggregations and post spawning migrations which are important for determining stock structure and mixing.

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 info@fish.govt.nz Release or recapture information can be entered on the website fishtagnz.co.nz or posted to:

Gamefish Tagging
Fisheries New Zealand
PO Box 53030
Auckland 2150

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 Helen Pastor, from the NZSFC, for compiling catch information and keeping track of clubs and tags and Sandra Gaskell of Blue Water Marine Research for managing the data and processing recaptures. This project was reviewed by the Highly Migratory Species Working Group chaired by Dr John Annala from Fisheries New Zealand. The Ministry for Primary Industries provided funding for this project TAG2016/01, "Management of data from the gamefish tag recapture programme".

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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	859	18	15	30	9	3 014
2010–11	78	1	128	1 145	609	103	21	733	37	15		14	2 884
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	2 456
2013–14	9	4	124	649	347	85	6	520	38	4	1		1 787
2014–15	37	7	110	723	439	78	12	1 088	34		14		2 542
2015–16	35	5	170	607	583	137	26	1 658	29		63	10	3 323
2016–17	35	4	54	598	331	161	12	517	31		2	7	1 752
2017–18	72	5	58	546	282	96	24	711	51		7	11	1 863
2018–19	58	3	22	509	205	121	32	579	12		6	1	1 548
Total	687	66	5 076	23 684	16 150	2 003	293	25 570	525	142	1 331	741	76 286

Table A2: Fisheries New Zealand species codes used in these tables.

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 sharks	SWO	broadbill swordfish	OSP	all other species
SAI	sailfish						

Table A3: 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
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	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	23	18				1	2	2	134			1	181
2016–17	20	2					8		52				82
2017–18	23						10	5	91				129
2018–19	17						11		97			2	127
Total	838	68	0	3	7	4	191	33	1 546	5	53	47	2 795

Table A4: Number of fish recaptured by species and season by species.

Season	BEM	BKM	BWS	KIN	MAK	SHA	SSF	STM	SWO	TOR	YFN	0SP	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	3				1			70
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				28	2	4		7	1				42
2016–17			1	31	3	2		2	1				40
2017–18			1	23	4	2		3	1				34
2018–19				32		4		2					38
Total	8	1	89	1 608	377	75	1	106	7	4	15	25	2 278
Recapture rate (%)	0.5	0.7	1.8	6.8	2.3	3.7	0.3	0.4	1.3	2.8	1.1	3.2	