NSW DPI GAME FISH TAGGING PROGRAM

REPORT 2018-2019

Recreational Fishing Trusts

NSW GOVERNMENT Primary Industries

Pepperell Research
Marine Science & Recreational Fisheries

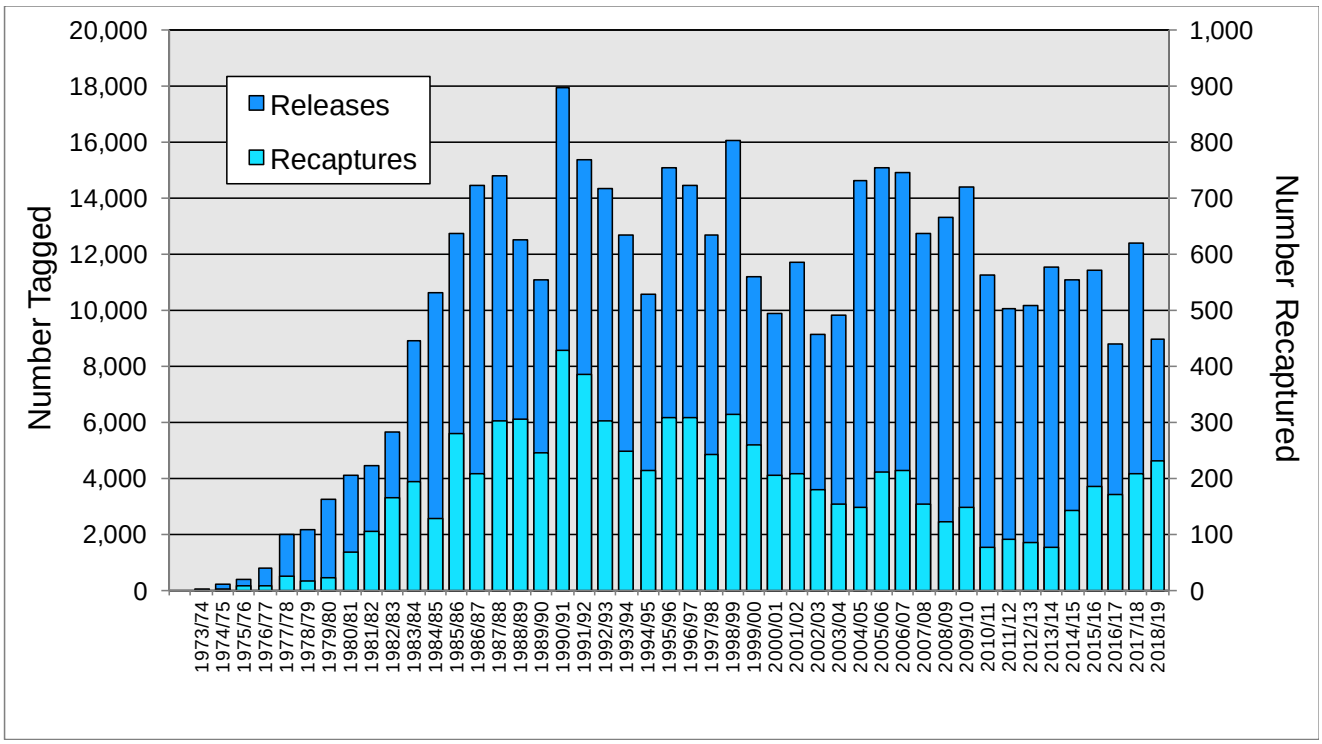
INTRODUCTION

During 2018/19 a total of 8,972 fish were tagged under the program – a marked decrease on the previous year's total of 12,386. On the other hand, the number of recaptures reported in 2018/19 was 229 – the highest total since 1999/2000. This was mainly due to large numbers of recaptures of yellowtail kingfish in both South Australia and New South Wales.

Figure 1 shows the number of fish tagged and recaptured each year since the origin of the program to July 2019. Following a rapid increase in tagging during the 1970s and early 1980s, numbers of fish tagged annually have fluctuated around an average of about 12,500, made up of varying proportions of species of fish tagged in different years. The total numbers of fish tagged each year vary for many reasons, not least the availability of certain species of highly mobile pelagic fish at different times and locations. For example, the program's two peak tagging years of 1990/91 and 1997/98 coincided with strong La Nina conditions on the east coast of Australia (as did the 2017/18 season), resulting in higher than usual numbers of some pelagic species becoming available to anglers.

The 2018/19 game fishing season was generally poor, especially off New South Wales. Far fewer marlin of all three species (black, blue and striped) were tagged in that region than in the previous year. Numbers of tagged southern bluefin tuna were also down, in fact, the lowest for 12 years.

FIGURE 1. NUMBER OF FISH TAGGED AND RECAPTURED BY YEAR SINCE THE ORIGIN OF THE PROGRAM



Cover photo: Shortfin mako shark released off Eaglehawk Neck, Tasmania, showing ideal tag position. Photo: Jonah Yick

THE PROGRAM TO DATE

As at the end of June 2019, the grand totals of fish tagged and recaptured on the program stood at 479,933 and 8,437 respectively (Table 1), continuing the program's status as the largest of its kind in the world. The table summarises releases and recaptures of the main species or species groups tagged, with the remainder combined as 'all other species'.

The single species tagged in the highest numbers continues to be black marlin with just over 72,600 tagged (15.1% of all releases). Yellowtail kingfish now exceed yellowfin tuna as the second most tagged species followed by sailfish, striped marlin, southern bluefin tuna and dolphinfish. Other prominent key species are albacore, whaler sharks (as a group – *Carcharhinus* spp.), blue marlin, Spanish mackerel (narrow-barred) and shortfin mako sharks. Striped tuna, mackerel tuna and bonito are also prominent, although the majority of those totals were contributed in the earlier years of the tagging program and are now discouraged as tagging species.

TABLE 1. TOTAL NUMBERS OF FISH TAGGED AND RECAPTURED 1974-2019

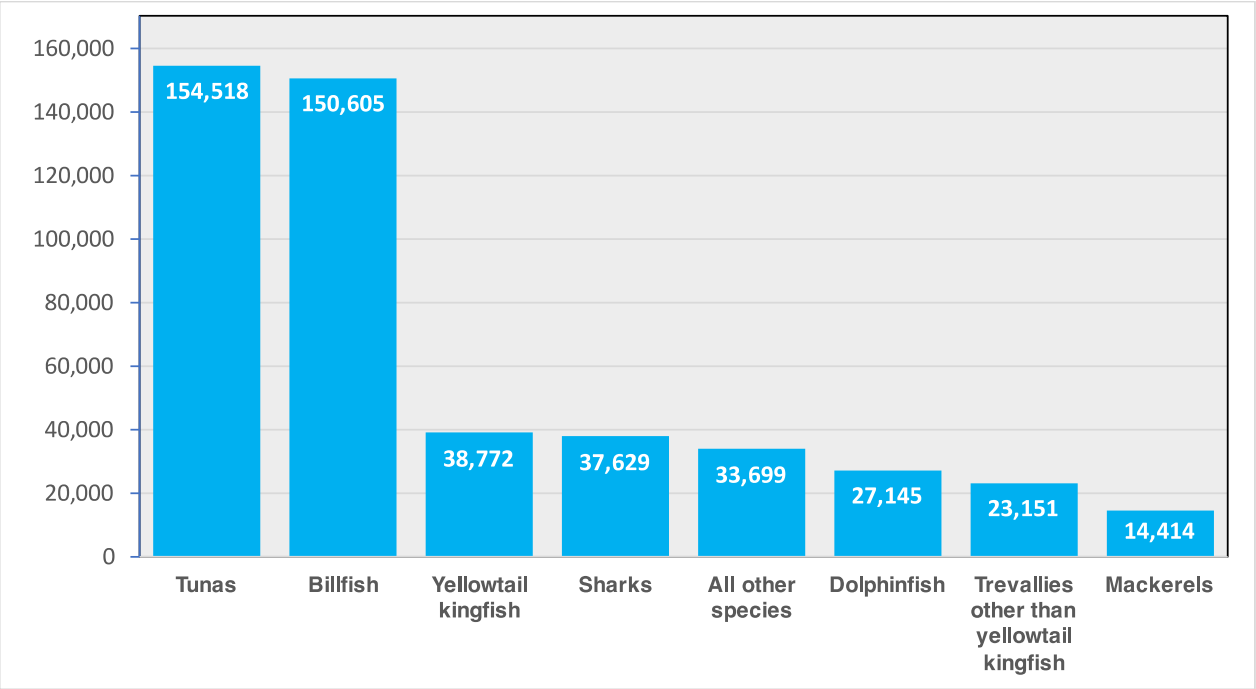
Species	Total Tagged	Total Recaptured	% Recapt
BLACK MARLIN	72,630	569	0.78
YELLOWTAIL KINGFISH	38,772	2,677	6.90
YELLOWFIN TUNA	38,310	709	1.85
SAILFISH	34,323	346	1.01
STRIPED MARLIN	30,427	262	0.86
SOUTHERN BLUEFIN TUNA	27,298	226	0.83
DOLPHINFISH	27,145	251	0.92
ALBACORE	22,382	171	0.76
STRIPED TUNA	21,584	68	0.32
MACKEREL TUNA	20,876	62	0.30
WHALER SHARKS*	14,365	294	2.05
BONITO	13,251	219	1.65
BLUE MARLIN	12,410	40	0.32
AUSTRALIAN SALMON**	10,440	634	6.07
SPANISH MACKEREL	9,599	97	1.01
MAKO SHARK	8,630	194	2.25
SILVER TREVALLY**	7,170	200	2.79
HAMMERHEAD SHARKS	5,849	62	1.06
BLUE SHARK	5,228	79	1.51
LONGTAIL TUNA	5,151	60	1.16
TAILOR**	4,032	122	3.03
QUEENFISH	3,542	10	0.28
TREVALLY	3,417	31	0.91
BARRACUDA	3,406	6	0.18
SAMSON FISH	3,108	121	3.89
GIANT TREVALLY	2,772	37	1.33
OTHER SPECIES COMBINED	33,816	890	2.63
TOTAL	**479,933**	**8,437**	**1.76**

*Whaler sharks' include the following tag card entries: Whaler, bronze whaler, bull shark, black tip whaler, white tip shark, oceanic white tip shark and Galapagos shark.

**Some species, such as tailor, silver trevally and Australian salmon, were tagged in large numbers in the past, but have since been removed from the list of desirable species to tag.

Combining the main species or species groups together over the history of the program, Figure 2 shows that tunas combined remain the group tagged in the largest numbers – 154,518 tagged, or 32.2% of the total, followed by billfish – 150,605 – 31.4% of all fish tagged. A single species, yellowtail kingfish, with 38,772 tagged, accounts for 8.1% of all releases while the total numbers of sharks combined (37,629) constitute 7.8% of the total number of fish tagged on the program.

FIGURE 2. TOTAL NUMBERS OF FISH TAGGED AS SPECIES GROUPINGS, 1974-2019



SUMMARY OF TAGGING ACTIVITY FOR 2018/19

Table 2 shows the numbers of all fish tagged and recaptured during 2018/19. As has been the case for some time, the seven species tagged in highest numbers continue to be black marlin, yellowtail kingfish, southern bluefin tuna, striped marlin, sailfish, blue marlin, and dolphinfish, although their positions on the 'leaderboard' may change from year to year depending on their relative abundance.

The previous year had registered an all-time record total number of billfish tagged – 7,491. Not surprisingly, the total number of billfish tagged in 2018/19, at 4,566 was considerably lower but nevertheless, an impressive tally.

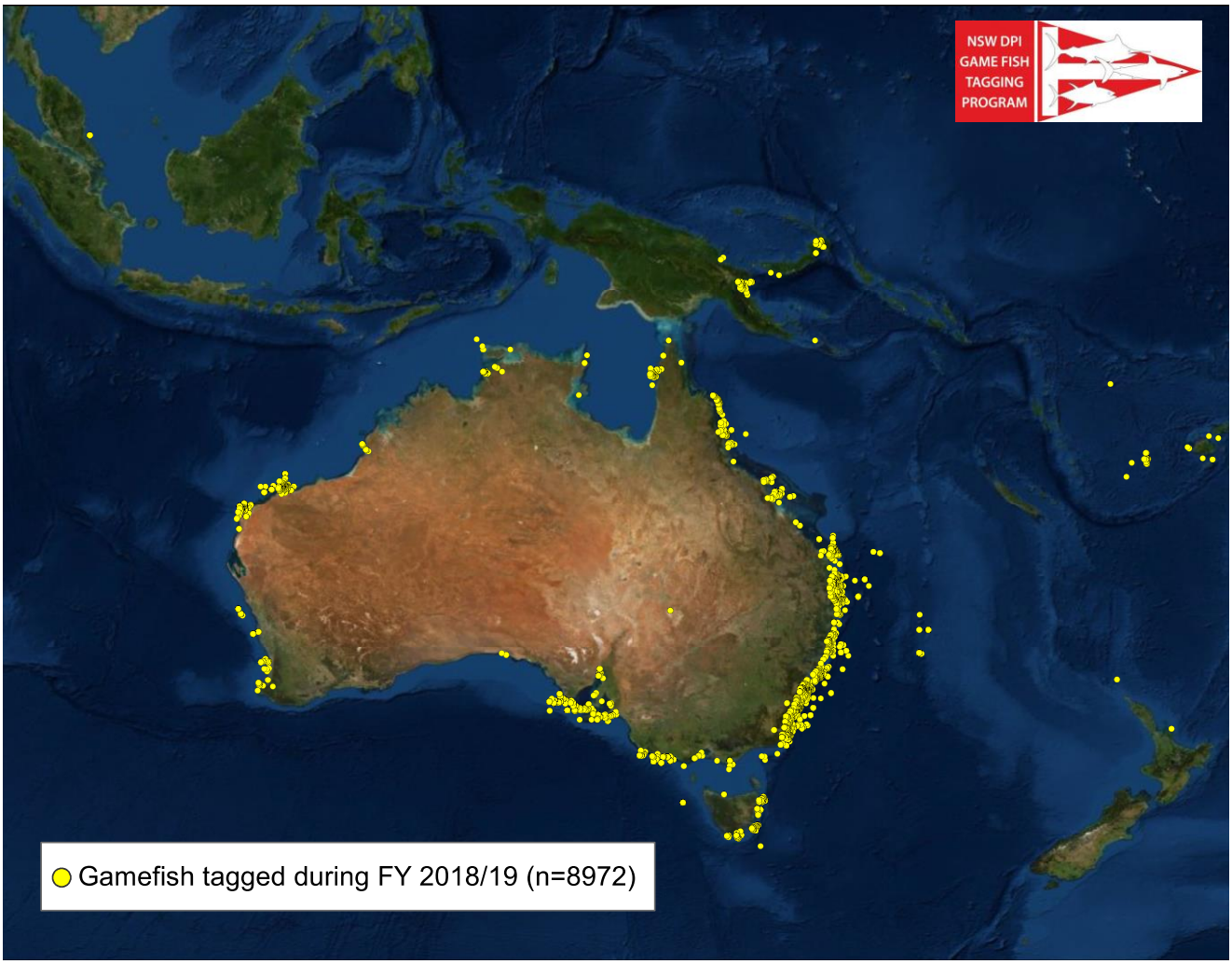
TABLE 2. NUMBERS OF ALL SPECIES / SPECIES GROUPS TAGGED AND RECAPTURED DURING 2018/19

Species	Total Tagged	Total Recaptures
BLACK MARLIN	2104	14
YELLOWTAIL KINGFISH	1061	136
SOUTHERN BLUEFIN TUNA	988	18
STRIPED MARLIN	944	4
SAILFISH	834	5
BLUE MARLIN	640	1
DOLPHINFISH	372	5
WHALER SHARKS	279	4
MAKO SHARK	186	3
SAMSON FISH	178	13
SPANISH MACKEREL	140	4
SPOTTED MACKEREL	122	2
BRONZE WHALER	94	5
STRIPED TUNA	81	
LONGTAIL TUNA	74	1
TIGER SHARK	71	1
QUEENFISH	70	
HAMMERHEAD SHARKS	67	1
BULL SHARK	65	5
BLUE SHARK	58	1
ALBACORE	49	
YELLOWFIN TUNA	47	1
COBIA	39	
GOLDEN TREVALLY	36	
SHORTBILL SPEARFISH	28	
BROAD BARRED MACKEREL	26	
GIANT TREVALLY	26	
GALAPAGOS SHARK	25	
EAGLE RAY	17	
WAHOO	17	
BROADBILL SWORDFISH	16	
GUMMY SHARK	15	3
SCHOOL SHARK	11	1
AMBERJACK	9	
BIGEYE TUNA	4	
OTHER SPECIES	179	1
TOTAL	**8,972**	**229**

DISTRIBUTION OF TAGGING EFFORT IN 2018/19

The map below (Figure 3) shows locations of all 8,972 fish tagged in 2018/19. Note that each point may represent many releases at the same coordinates. While the program is primarily conducted around the Australian coast, it has historically also extended to neighbouring regions where anglers wish to tag their catch, with obvious benefits to accruing knowledge of the pelagic fishes of our general region. The map for 2018/19 shows similar distribution of tagging activity to recent years, with clustering of releases around known 'hot spots' – for example Exmouth and Dampier in WA, but also a broad spread of activity right along the Australian east coast, especially from southern Queensland to Victoria. Positions of releases for each of the main species tagged are shown in the relevant sections below.

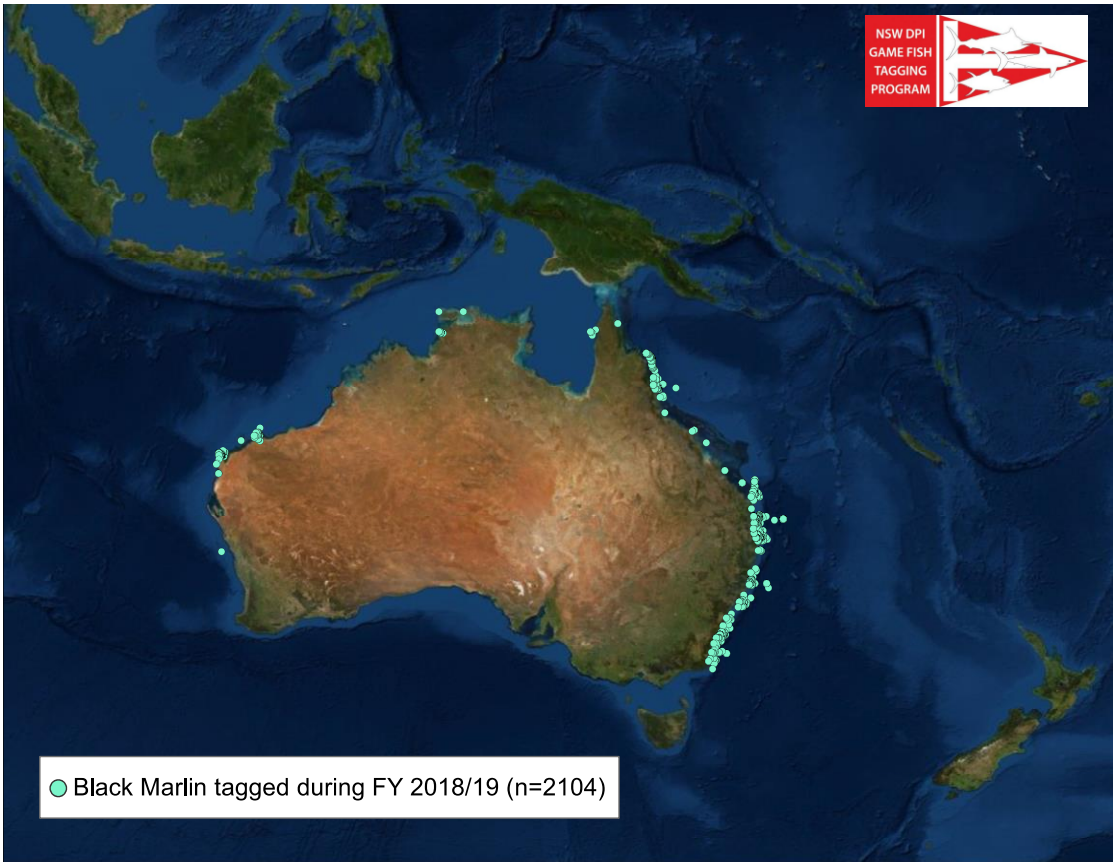
FIGURE 3. POSITIONS OF RELEASES OF ALL TAGGED GAMEFISH DURING 2018/19



BLACK MARLIN

Locations of all black marlin tagged during the past season are shown in Figure 4. Note that each point may represent many releases at the same given position.

FIGURE 4. POSITIONS OF RELEASES OF TAGGED BLACK MARLIN DURING 2018/19



For the third year in succession, black marlin topped the list of species tagged. The total of 2,104 black marlin releases was down somewhat on the previous near-record year of over 3,400 tagged, but very close to the average annual number tagged for the past 10 years (2,237).

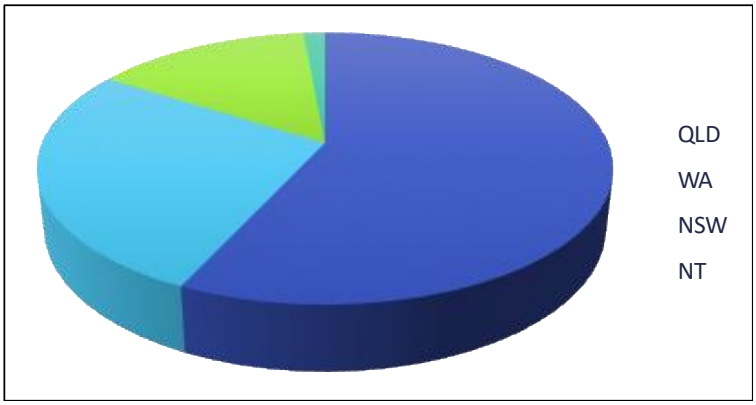
As is usually the case, overall numbers of black marlin tagged for any given year are strongly influenced by the appearance or non-appearance on the east coast of juvenile fish in their first year of life. The previous year saw a strong recruitment of small to very small fish (5 to 10 kg), initially off northern Queensland, then extending to Hervey Bay, off the Sunshine Coast and the Gold Coast, QLD and into New South Wales, especially off Seal Rocks and Port Stephens. In 2018/19, small black marlin averaging around 10 kg appeared inside the Great Barrier Reef, mainly near Fitzroy Island, northern QLD and later in the year, a relatively strong 'pulse' of smaller fish, less than 10 kg, were encountered in Hervey Bay, southern QLD. The Sunshine and Gold coasts then enjoyed good seasons tagging fish in the 20 to 50 kg size range (likely two year old fish), which did extend into northern NSW and as far as Port Stephens, but in relatively low numbers.

In Western Australia, 506 black marlin, ranging from 15 to 40 kg, were tagged off Exmouth, continuing an increasing trend (410 were tagged the year before). On the other hand, numbers tagged off Dampier were relatively low, with 54 tagged, averaging about 30 kg, compared with 144 the previous year. And for the fourth year running, no black marlin were tagged off Broome. This is

thought to be mainly due to the decision of the Broome Fishing Club four years ago to discontinue tagging of billfish (see also below under 'Sailfish').

Other areas where black marlin were tagged were the Northern Territory, mainly off Darwin (30) and off Weipa, western Cape York (6). There were no recorded tag-and-releases of black marlin outside Australian waters (Figure 5).

FIGURE 5. PROPORTIONS OF BLACK MARLIN TAGGED BY STATE, 2018/19

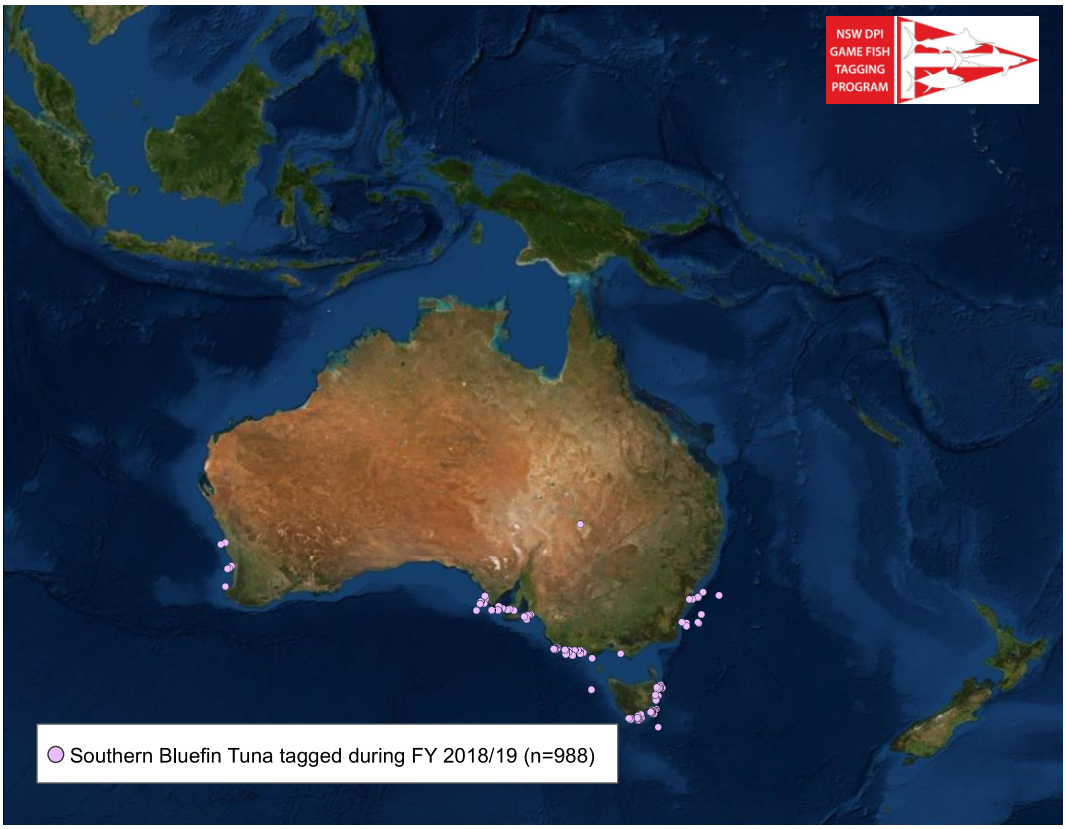


The number of black marlin reported tagged during the heavy tackle season off Cairns/Lizard Island (137), was slightly up on the numbers in the previous two years (106 and 92), but still far fewer than were traditionally tagged in this fishery in the past. As indicated in previous reports, this is not because fewer fish are being caught and released during the season, but because there has been a marked shift towards free release of fish (ie, without tagging) by many of the charter captains operating in the fishery. In a fishery such as this, with a high rate of release, tag cards can be used as a surrogate for total catch through time, so in this case, and also for the sailfish fishery off Broome, WA (see below), the use of release cards is strongly recommended in order to continue the long-term recording of total released catch, with or without a tag. A release card would contain the same information as a tag card, minus a tag number, and data would be entered in a separate field of the Game Fish Tagging database.

SOUTHERN BLUEFIN TUNA

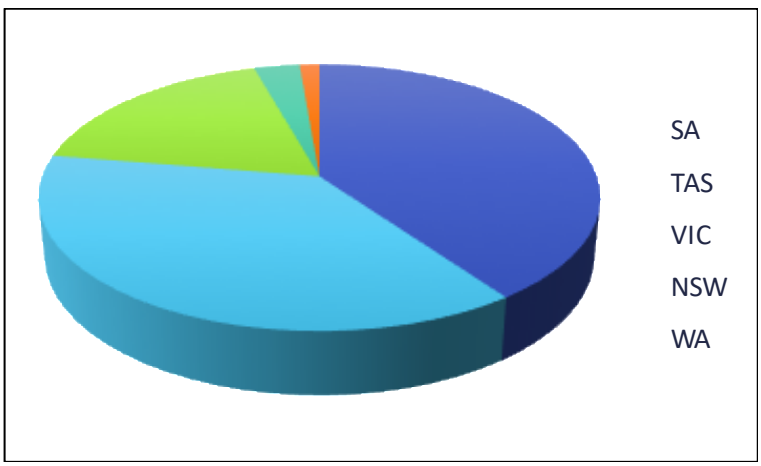
Locations of all southern bluefin tuna (SBT) tagged during the past season are shown in Figure 6. Note that each point may represent many releases at the same position.

FIGURE 6. POSITIONS OF RELEASES OF TAGGED SOUTHERN BLUEFIN TUNA DURING 2018/19



A total of 988 southern bluefin tuna (SBT) were tagged in 2017/18, a decrease from the previous year (1,359) and about half of the average number tagged for the past 10 years (1,932). Figure 7, shows that nearly 40% of SBT tagged this year were released in South Australia, followed by Tasmania (37.6%) and Victoria (18%). As is usually the case, the numbers of SBT tagged in New South Wales and Western Australia were very small (30 and 13 respectively).

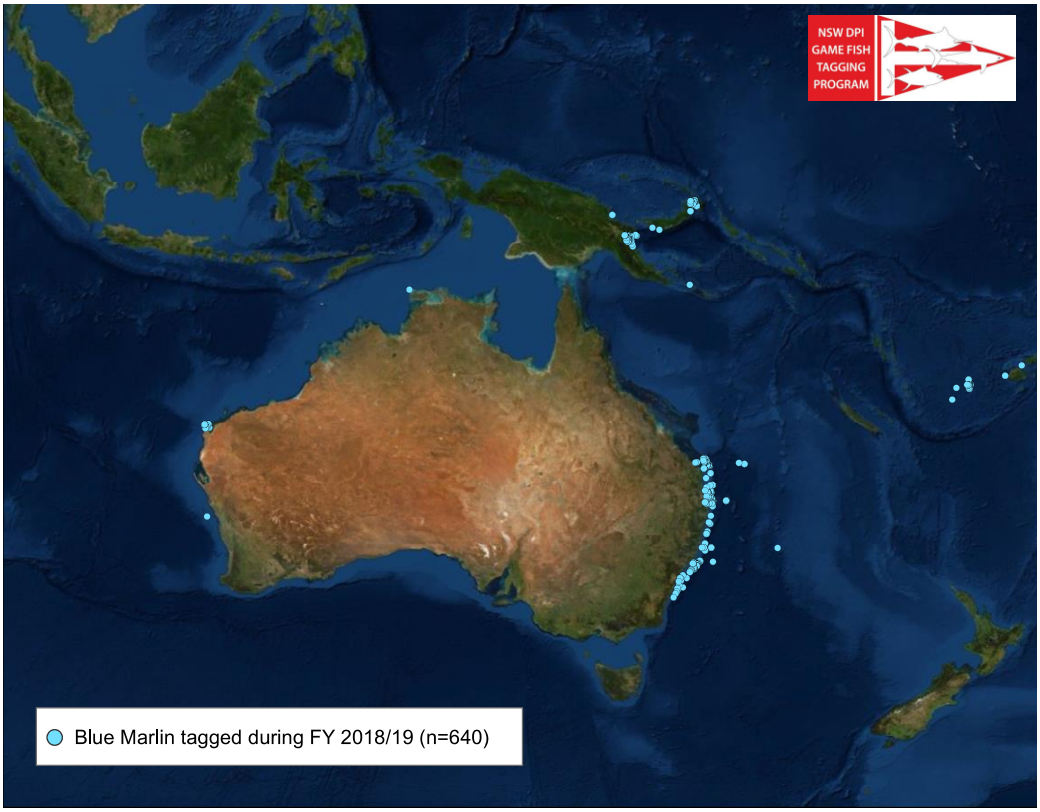
FIGURE 7. PROPORTIONS OF SOUTHERN BLUEFIN TUNA TAGGED BY STATE, 2018/19



BLUE MARLIN

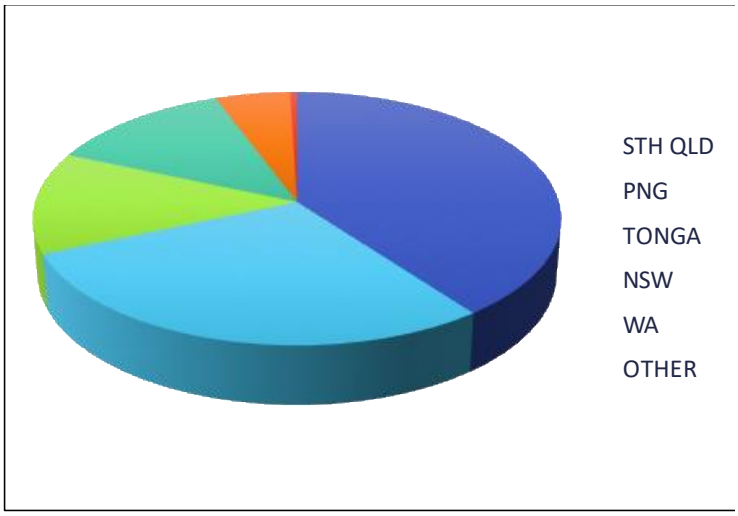
Locations of all blue marlin tagged during the past season are shown in Figure 8. Note that each point may represent many releases at the same position.

FIGURE 8. POSITIONS OF RELEASES OF TAGGED BLUE MARLIN DURING 2018/19



A total of 640 blue marlin were tagged during 2018/19, which was less than the record 1,109 tagged the previous year but right on the average number tagged over the past 10 years (642). Figures 8 and 9 show tagging effort was spread mainly between southern Queensland (251 tagged), Papua New Guinea (182) and Tonga (82). Numbers of blue marlin tagged off New South Wales (81) were well down on the previous year (320), as were numbers tagged off Exmouth, Western Australia (33 compared with 107).

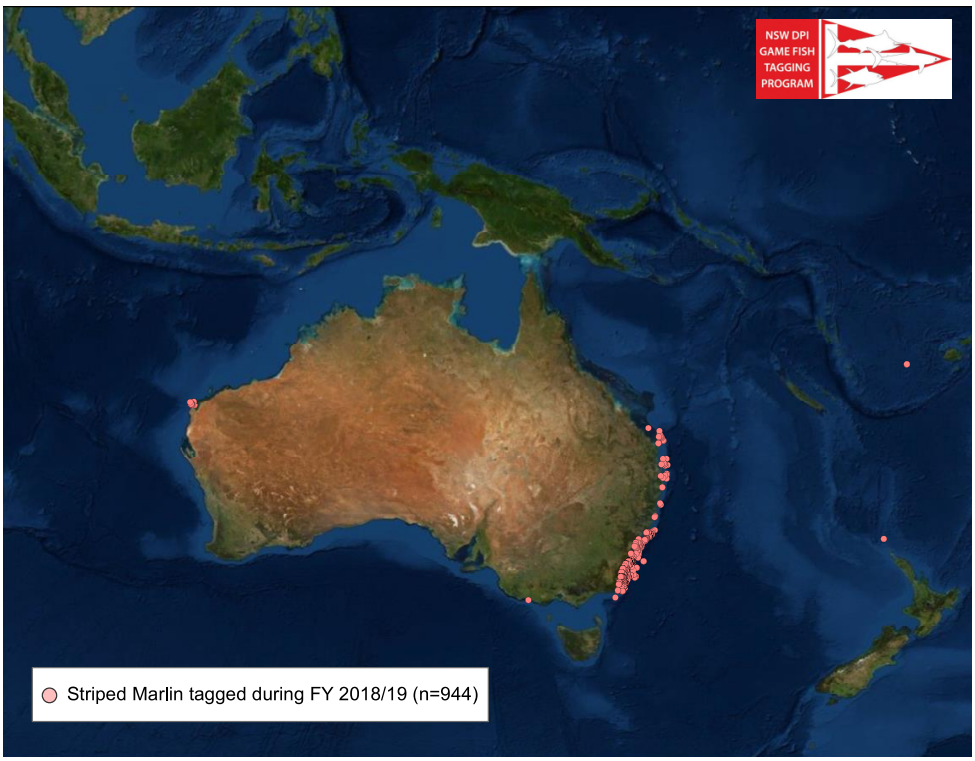
FIGURE 9. PROPORTIONS OF BLUE MARLIN TAGGED BY REGION, 2018/19



STRIPED MARLIN

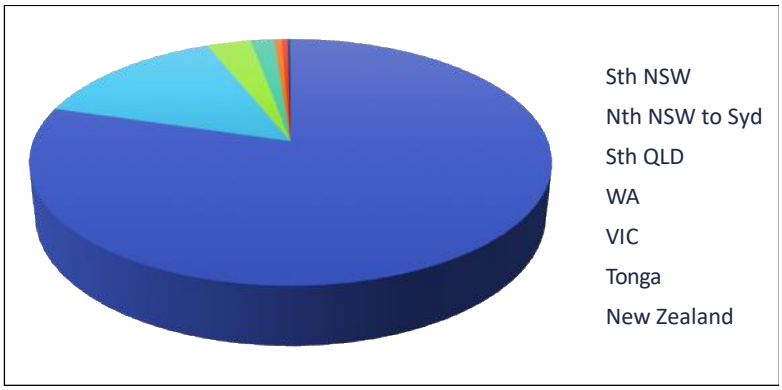
Locations of all striped marlin tagged during the past season are shown in Figure 10. Note that each point may represent many releases at the same position.

FIGURE 10. POSITIONS OF RELEASES OF TAGGED STRIPED MARLIN DURING 2018/19



A total of 944 striped marlin were tagged in 2018/19. This was only about half the number tagged in the record previous year (1,809), but only a little down on the average for the past 10 years (1,133). This difference was primarily due to a relatively poor 'show' of striped marlin off Port Stephens NSW, especially at the site known as the 'car park', an offshore canyon head where aggregations of the species often appear, feeding on large schools of baitfish. In contrast, the far south coast of New South Wales enjoyed an excellent season on striped marlin, recording 740 releases (Figure 11).

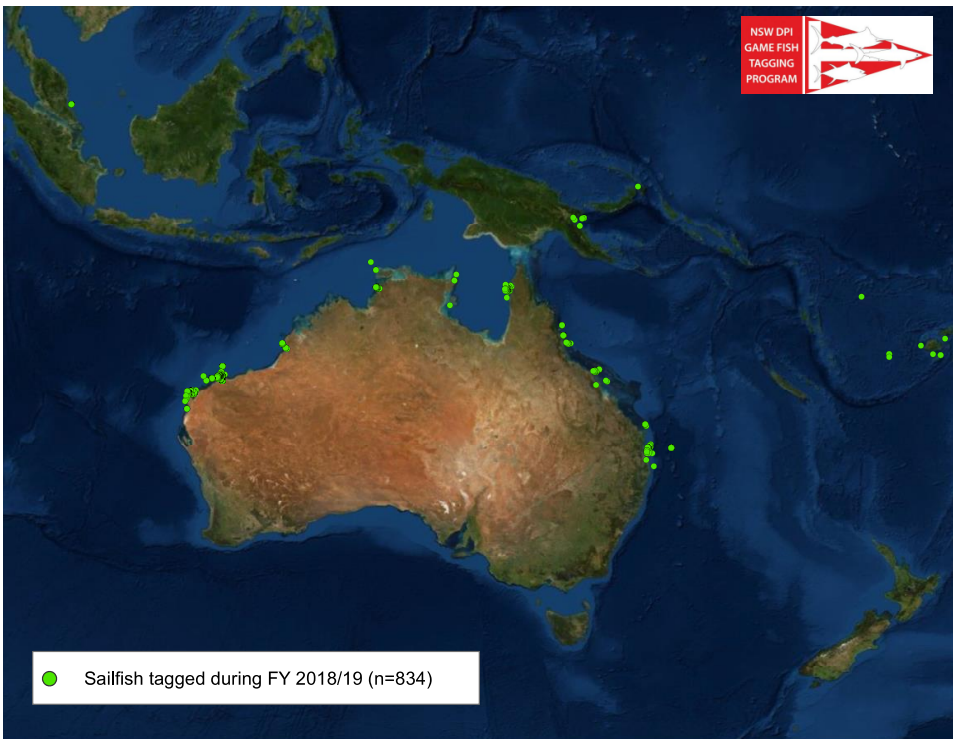
FIGURE 11. PROPORTIONS OF STRIPED MARLIN TAGGED BY REGION, 2018/19



SAILFISH

Locations of all sailfish tagged during the past season are shown in Figure 12. Note that each point may represent many releases at the same position.

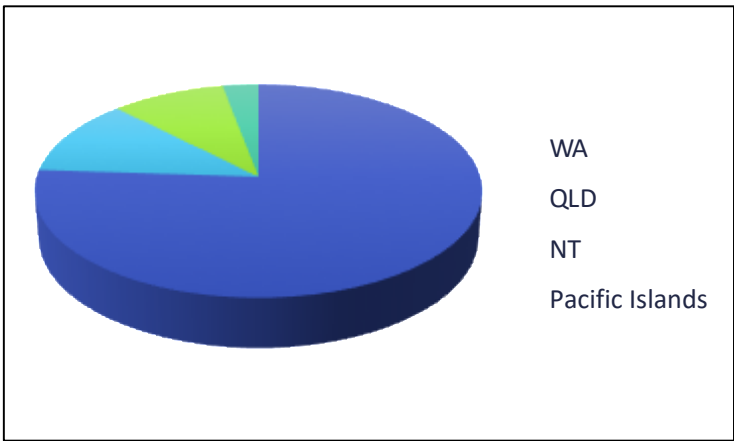
FIGURE 12. POSITIONS OF RELEASES OF TAGGED SAILFISH DURING 2018/19



The number of sailfish tagged in 2018/19 (834) was down on the previous year (1,114), primarily due to a large decrease in numbers tagged in Queensland waters, most notably, off Weipa. In the past, tagging of hundreds of sailfish each year off Broome WA contributed significantly to the program's annual total. However, since 2017, a decision by the Broome Fishing Club to allow free release rather than tagging for points resulted in a sharp decline in sailfish tagging in that region. As a case in point, during the 2018 Broome Billfish Tournament, a total of 347 sailfish were free released, which, if tagged, would have substantially increased the tally for the season.

As can be seen in Figure 13, the lack of tagging of sailfish off Broome was offset in Western Australia by the tagging of over 500 sailfish off Dampier and Exmouth WA combined. In contrast, only 83 sailfish were tagged in Queensland and 21 in Pacific island locations (Papua New Guinea, Fiji and Tonga).

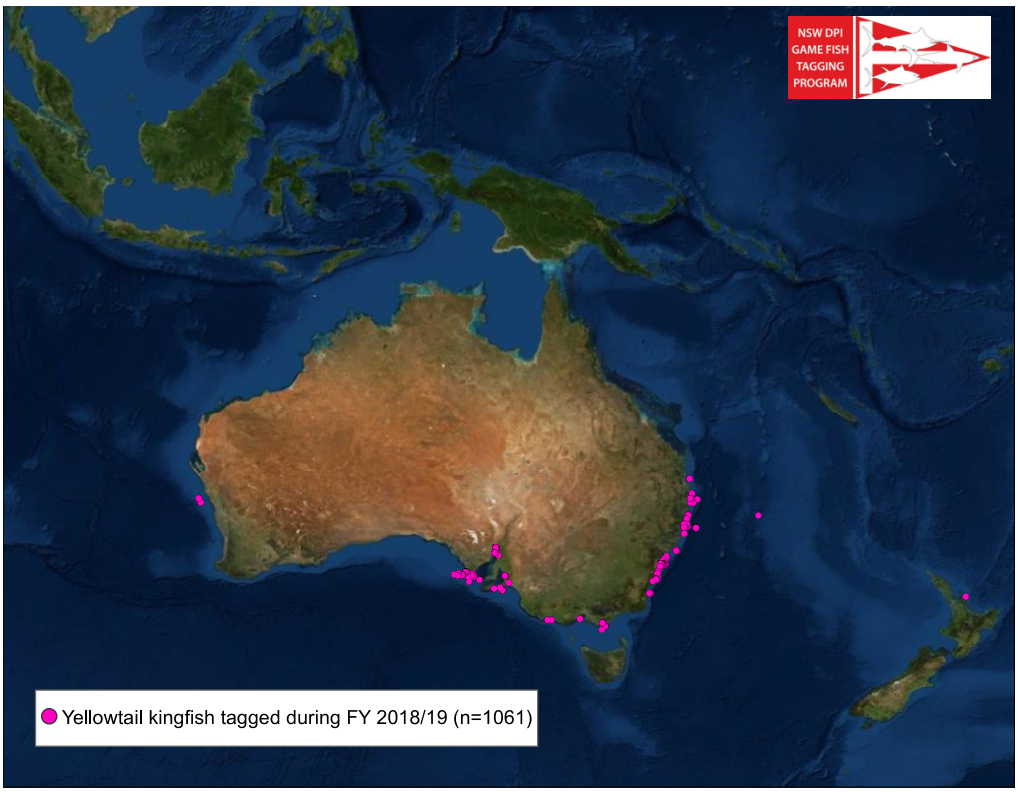
FIGURE 13. PROPORTIONS OF SAILFISH TAGGED BY REGION, 2018/19



YELLOWTAIL KINGFISH

Locations of all yellowtail kingfish tagged during the past season are shown in Figure 14. Note that each point may represent many releases at the same position.

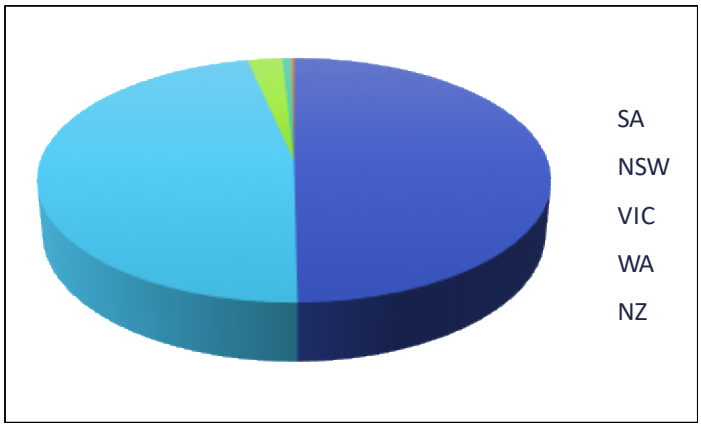
FIGURE 14. POSITIONS OF RELEASES OF TAGGED YELLOWTAIL KINGFISH DURING 2018/19



A total of 1,056 yellowtail kingfish was tagged during 2018/19, the highest in 12 years and continuing an increasing trend over the past three to four years. Figures 14 and 15 show that just under half of these were tagged off South Australia, 46.8% were released off New South Wales while small

numbers were tagged off Victoria, Western Australia and New Zealand. A high proportion of kingfish tagged in South Australia were relatively large, with many in the 10-20kg, or even 20-30kg range. In contrast, the great majority of kingfish tagged off New South Wales were estimated at less than 5kg in weight.

FIGURE 15. PROPORTIONS OF YELLOWTAIL KINGFISH TAGGED BY REGION, 2018/19



TAGGING TRENDS OVER TIME

Considering the numbers of different species of gamefish tagged over this long running program, it is clear that these can and do fluctuate widely over time, sometimes showing trends, and sometimes marked shifts from one year to the next. Such changes may be reflecting the abundance of particular species over these periods, or they may simply be reflecting changes in availability of those species to recreational fisheries around Australia. For example, the number of black marlin tagged each year is strongly influenced by the appearance or non-appearance of a 'pulse' of juvenile fish in their first year of life on the Australian east or west coasts, or both.

To inspect this in more detail in recent years, the numbers of gamefish tagged over the past 5 years are plotted on a single graph (Figure 16), while individual plots for ten of the key species tagged for the past 12 years are shown in Figure 17. One point to note when examining these graphs is that Figure 16 shows the same scale for numbers tagged of all species, while in Figure 17, the numbers tagged – shown on the vertical axes – are not to the same scales, but more readily show relative fluctuations for each species through time and covering double the time frame of Figure 16.

FIGURE 16. NUMBERS OF THE MAIN SPECIES AND SPECIES GROUPS TAGGED IN 2018/2019 AND THE PREVIOUS FOUR YEARS

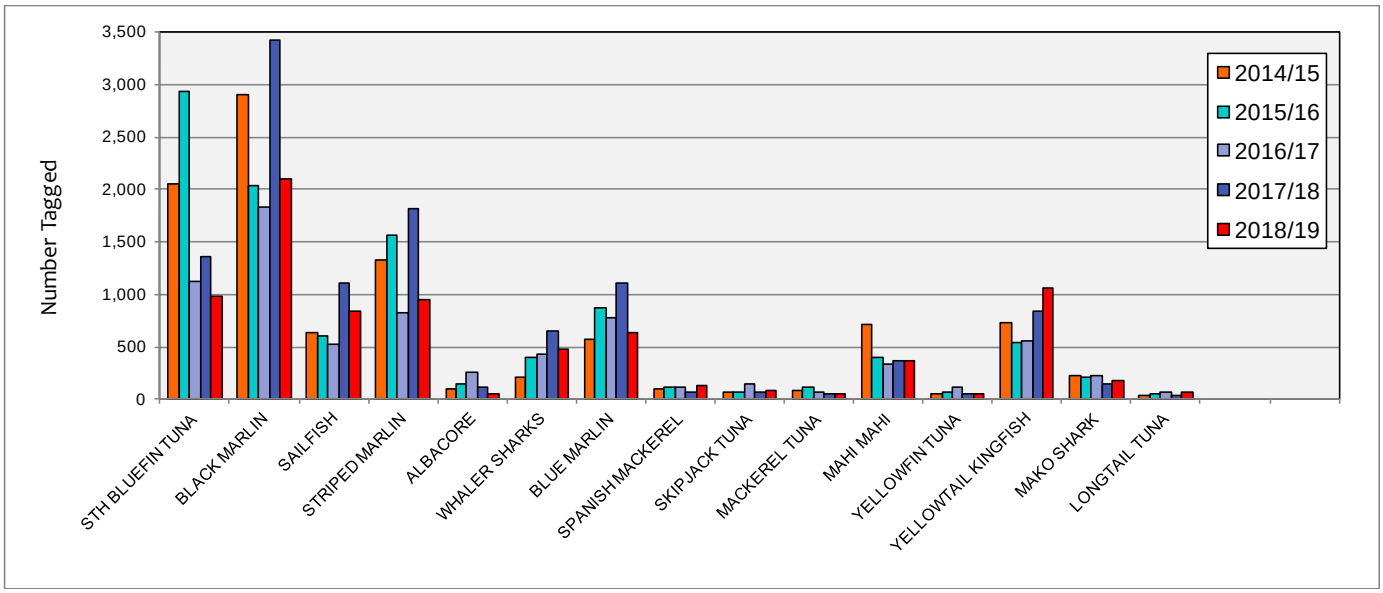
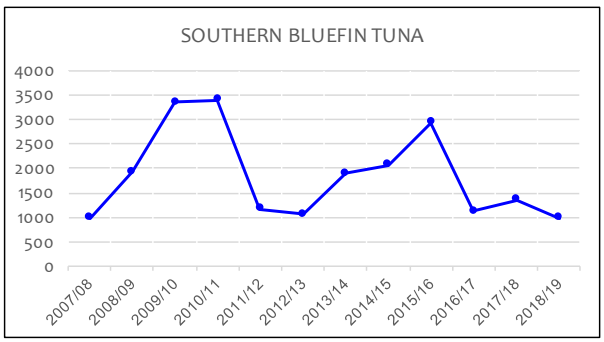
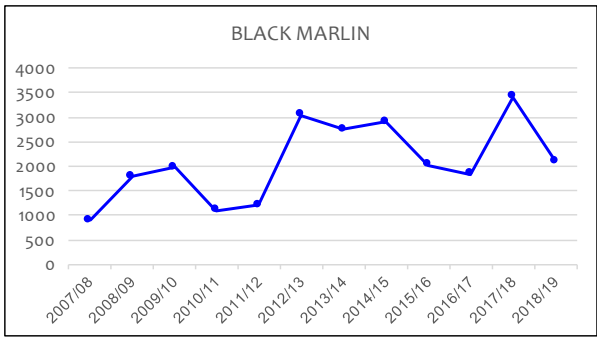
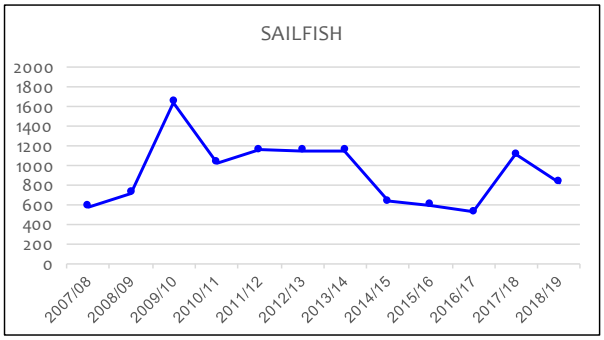
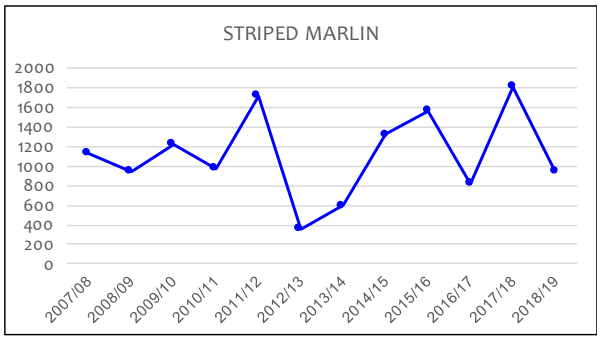


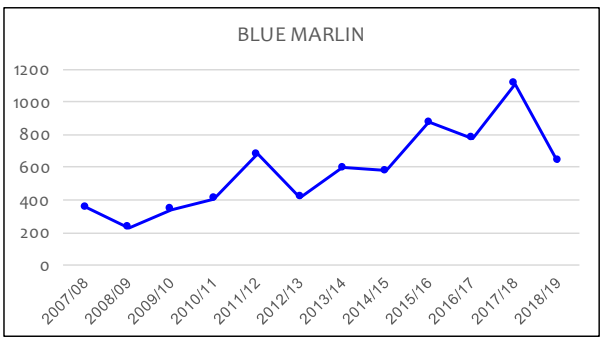
FIGURE 17. INDIVIDUAL PLOTS OF NUMBERS OF KEY GAMEFISH SPECIES TAGGED OVER THE PAST 12 YEARS

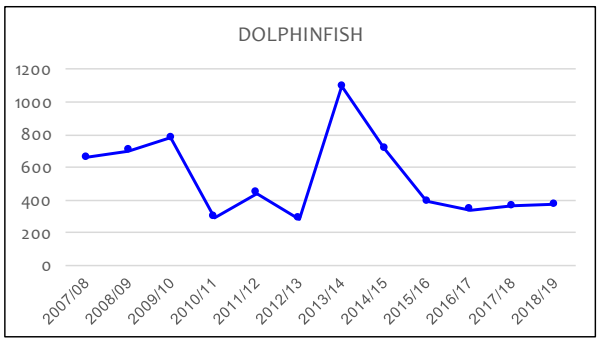


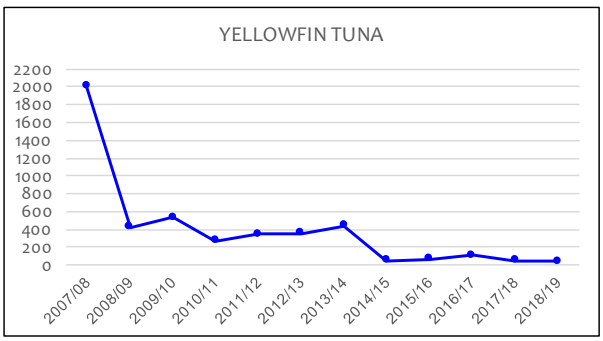


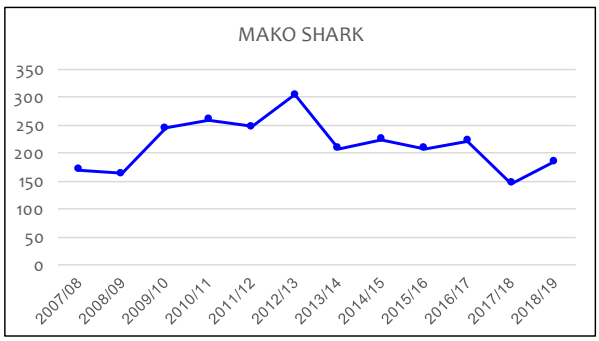


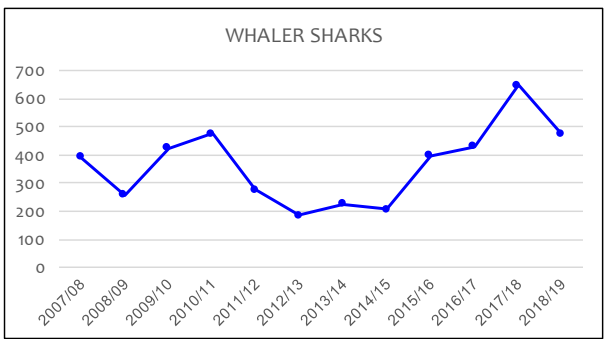


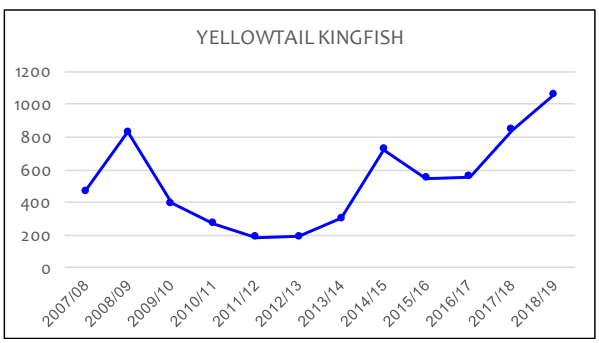












Focusing in turn on particular species shown in Figure 17, we see quite large fluctuations in numbers of southern bluefin tuna tagged over the given timeframe, from lows of around 1,000 in several years to highs of over 3,000 in others. After a steady build up from a low in 2012/13 to a peak of 2,900 tagged in 2015/16 and then a drop again to around 1,000 fish tagged, numbers kicked up again in 2017/18 to over 1,400 but dropped again in 2018/19 to a little over 1,000.

After reaching near record numbers of black marlin tagged in 2017/18, numbers tagged this year fell to a little over 2,000, but with no indication of a downward long term trend. Numbers of sailfish tagged dipped a little from the relatively high mark of the previous year; striped marlin releases were also down on the previous year, but show no obvious trend through time. With increased targeting by offshore anglers, blue marlin tagging had shown a steady increase over the past decade, but the number tagged in 2018/19 was the lowest for four years. Numbers of dolphinfish tagged from year to year are highly variable, reflecting recruitment events of this very short-lived species. Yellowfin tuna have shown the most dramatic shift, with numbers tagged declining sharply in 2008/09 followed by a stable period and then another sharp and sustained drop in numbers since 2014/15. This year, just 47 were tagged. The number of mako sharks tagged has been relatively steady over the past decade while numbers of whaler sharks (combined species), from a low base 3 to 5 years ago, showed a steady increase to a record high in 2017/18, followed by a drop in the past year. Lastly, following a dip in numbers tagged in the early 2010s, yellowtail kingfish releases climbed steadily to match in 2017/18 the number tagged ten years earlier and exceed that number in the past year.

Combining the species tagged into species or species groups, Figure 18 shows that billfish as a group dominated overall taggings in 2018/19, comprising 50.9% of all fish tagged. This was down on the previous year (60.5%) but similar to the year before (51.5%). This result also extends a trend of much higher proportions of billfish tagged than for earlier 'average' years when billfish were averaging between 30 and 35% of the total tagged. The proportion of tunas tagged represented 14.5% of the total in 2018/19, similar to 2017/18 (13.7%) but down from 20.5% the previous year and 30% the year before. These differences are largely due to fluctuations in numbers of southern bluefin tuna tagged each year. Sharks represented 9.9% the total tagged, up slightly on 2017/18 (8.9%), still maintaining a somewhat higher proportion than the average of about 7% over the last decade or so.

FIGURE 18. SPECIES GROUPS TAGGED IN 2018/2019

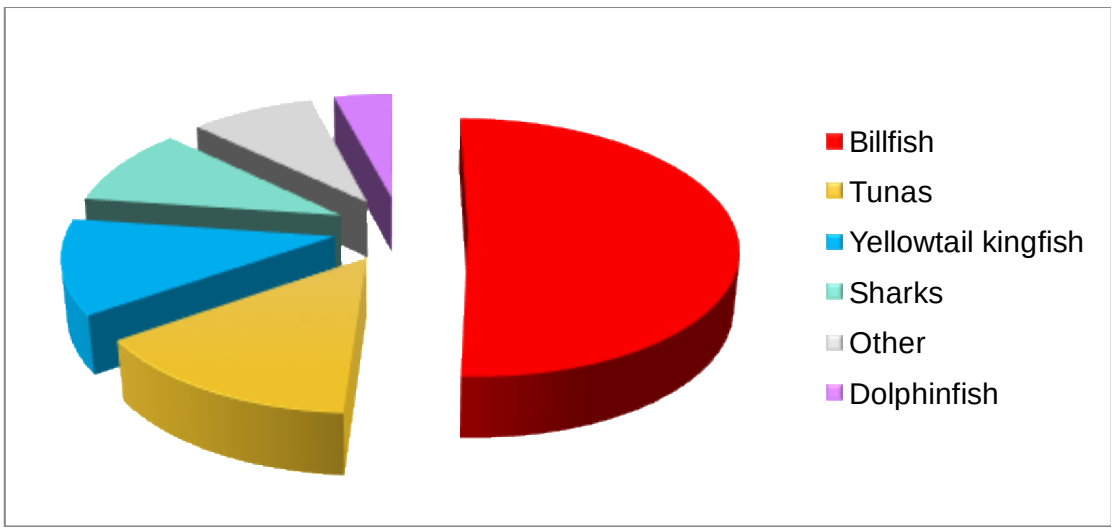
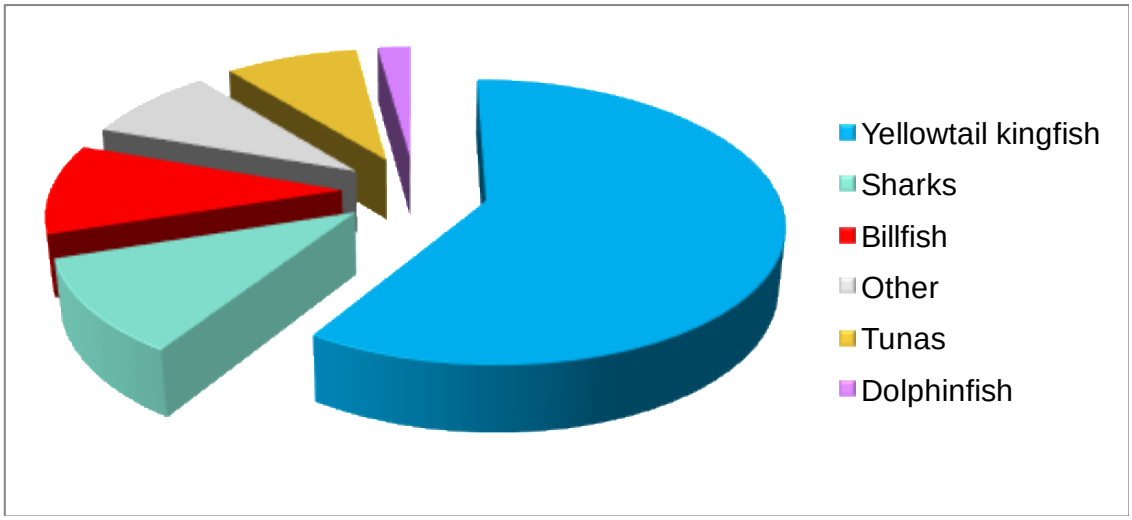


Figure 19 shows the proportions of the major species groups recaptured in 2018/19, and as is usually the case, indicates quite different proportions to those tagged. Yellowtail kingfish again dominated, with 59.1% of all recaptures (52.9% last year and 45.3% the year before) while sharks and billfish represented the next highest proportions of recaptures at 10.9% and 10.4% respectively. This represented a marked drop in recaptures of billfish, most probably in part due to the non appearance of juvenile black marlin along the eastern seaboard during the 2019 season.

FIGURE 19. SPECIES GROUPS RECAPTURED IN 2018/2019



RECAPTURE HIGHLIGHTS IN 2018/19

The full list of completed recaptures that were reported in 2018/19 is shown in Appendix I. Some of the highlights of these recaptures are detailed below. Because of the interest among anglers, we tend to emphasise some of the longer times at liberty or longer distances moved by tagged fish, however, these may often be exceptions to the rule. In contrast, many fish are also recaptured relatively close to their points of release, often, but not always within relatively short times. Therefore, it is stressed that information gained from these less 'spectacular' recaptures is just as important to our understanding of the movements and growth of game fish as are longer term, longer distance recaptures.

BLACK MARLIN

Fourteen black marlin recaptures were reported during 2018/19. Times at liberty ranged from 6 to 1,492 days (4 years 24 days) and minimum distances travelled from 2 to 2,663 nautical miles. Nine of the recaptured black marlin had been tagged in Queensland waters, 4 off New South Wales and one off Western Australia.

Four of the recaptured black marlin had travelled considerable distances from their points of release into the southwestern Pacific Ocean (Figure 13). An estimated 15 kg fish, tagged inside Hervey Bay QLD was recaptured 345 days later by an Indonesian longliner near Woodlark (Muyua) Island, Papua New Guinea. Its weight was reported as 55 kg. Another small black marlin estimated at 25 kg was tagged off the Gold Coast QLD and recaptured in the Solomon Islands by a native canoe fisherman. It had been at liberty for 265 days and weighed 55 kg at recapture. A fish tagged on the Barwon Banks off Noosa was recaptured 293 days later to the south of Kadavu, Fiji by a local domestic longliner. When released it was estimated at 35 kg and at recapture, 40 kg.

The longest distance recorded by a black marlin in 2018/19 was by a fish tagged off Broughton Island NSW in February 2018. It was recaptured 437 days later by a US purse seine vessel northeast of the island of Tokelau, a minimum swim of 2,663 nautical miles. This fish had been estimated at 70 kg on release, and weighed 110 kg on recapture.

In contrast to these long-distance movements, a black marlin, tagged at Browns Mountain off Sydney, was recaptured four years later only 76 nautical miles away at the famous 'Tubes', Jervis Bay. That recapture was also especially noteworthy since it was the first land-based recapture of a tagged black marlin.

Over the years there have been numerous incidences of juvenile black marlin tagged in northern Queensland which make their way southwards along the eastern Australian coast. Such recaptures not only inform us of seasonal movements of black marlin in their first year of life, but also can be very useful in determining early growth rates of this species in different years. This year, with only a weak recruitment of small black marlin in northern Queensland, there was just one such recapture. That fish was tagged near Fitzroy Island QLD in August 2018, when it was estimated at 20 kg. Just over five months later it was recaptured off the Gold Coast by a recreational angler who estimated it at 30 kg, fitting nicely with expected growth rates derived from previous recaptures and ageing of small black marlin by counting daily increments on their otoliths (ear bones).

Another interesting recapture was that of a black marlin originally tagged off the Sunshine Coast QLD, estimated at 25 kg, in April 2017. It was recaptured nine months later (January 2018) off the Gold Coast where it was estimated to weigh 50 kg before being re-released.

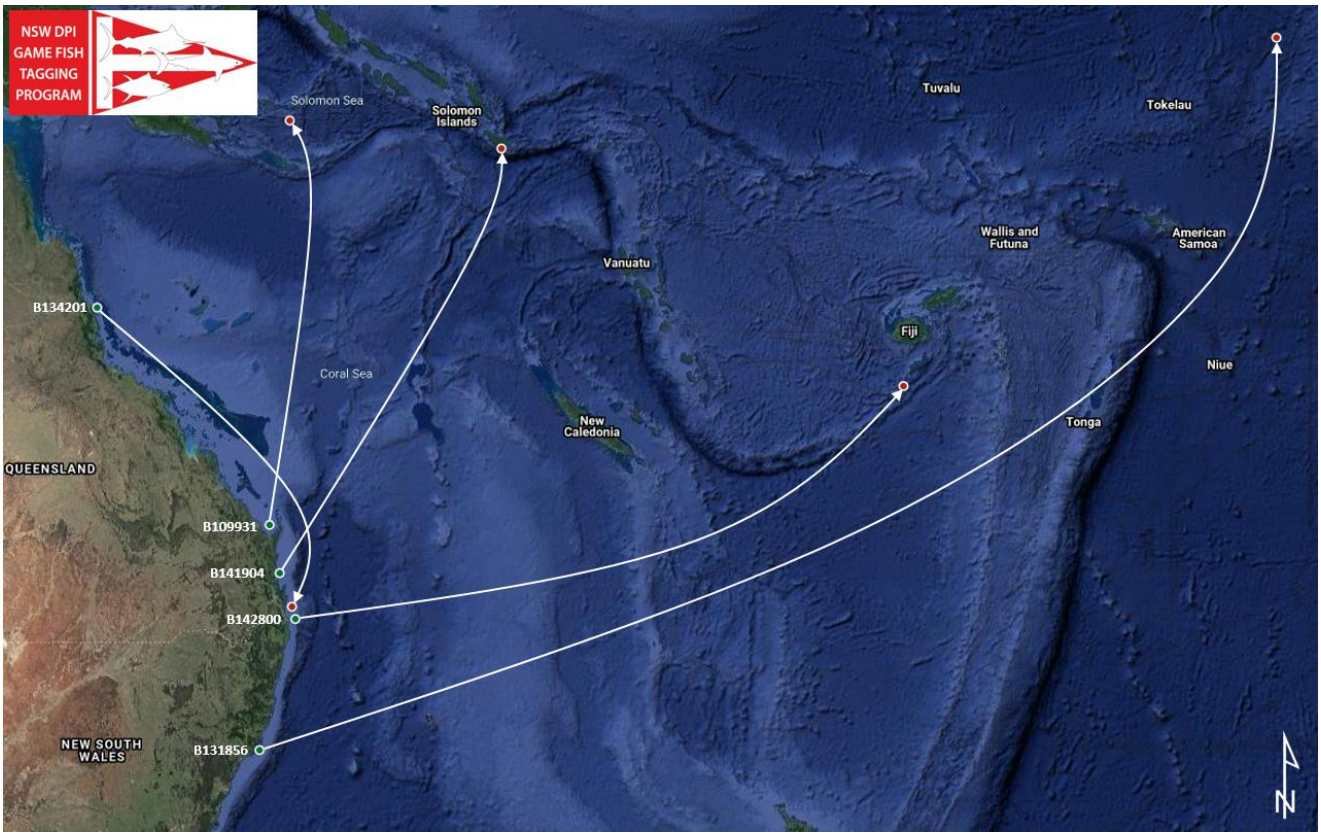
Ayden Wass recaptured and then re-released this well-conditioned black marlin off the Gold Coast in January 2018. It had been tagged by small fry angler Ben Massurit off the Sunshine Coast nine months earlier when it was estimated at 25 kg – the photo showing just how rapidly black marlin are capable of growing.

Two other recaptures of black marlin were noteworthy primarily because of their small size at release. They were tagged within a day of each other in late May at Sandy Cape, Fraser Island, QLD with estimated weights of just 4 and 5 kg and were recaptured after 19 and 22 days respectively within a couple of miles of their release points and re-released. These indicate that fish of that size do survive release after being removed from the water, and also that these very small juveniles, estimated at around 4 months old, spend at least several weeks in the sheltered waters of Hervey Bay, having presumably travelled down the coast from northern spawning grounds.

A single black marlin recapture was recorded in Western Australia. Tagged off Exmouth in late June, the estimated 20 kg fish was recaptured nearly two months later, 14 nautical miles north of its release point. At recapture and re-release it was estimated to weigh 30 kg.

Occasionally, the program receives information about recaptures from many years prior. Last year we received information on four past tag recoveries from the Oceanic Fisheries program of the Secretariat of the Pacific Community, Noumea, one of which was a black marlin. This fish was originally released in October 2013 off Hicks Reef in Northern Queensland, at an estimated weight of 110 kg. It was subsequently recaptured in December 2014 (421 days at liberty) south of Port Moresby, Papua New Guinea by a commercial longline vessel when it was estimated at 150 kg. Apart from the scientific value this recapture, it is an important reminder that an unknown number of tagged fish are no doubt recaptured but not reported for many reasons.

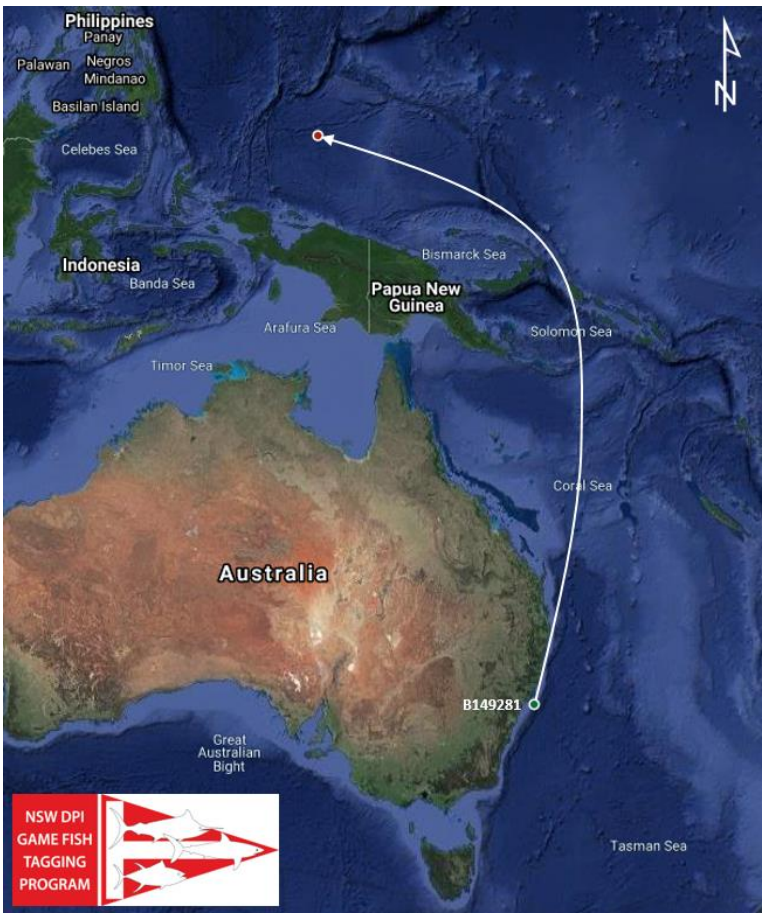
FIGURE 20. LONG DISTANCE MOVEMENTS BY RECAPTURED BLACK MARLIN RECORDED IN 2018/19.



BLUE MARLIN

Just one blue marlin recapture was reported in 2018/19. That fish, estimated at 95 kg, was tagged wide of the shelf off Port Stephens NSW in November 2018. Exactly six months later it was recaptured by a commercial longline vessel in an area known as the West Caroline Trough, about 350 nautical miles north of Irian Jaya (New Guinea) and 300 nautical miles southwest of Palau. At recapture, the fish weighed 100 kg. The straight line point-to-point displacement was 2,373 nautical miles, however, taking into account land masses, the shortest possible distance travelled by the fish would have been closer to 2,600 nautical miles, and in all likelihood, probably considerably further during its long journey. Since the program's inception in 1973 there have been only 40 blue marlin recaptures reported to NSW DPI. This is the second furthest distance travelled by a blue marlin for the program. The record distance for a blue marlin tagged under the program stands at 4,514 nautical miles (8,350km). That fish was originally tagged off Norah Head canyon NSW in 1993 and went on to be recaptured by a Japanese longline vessel fishing a remote seamount south of Sri Lanka in the Indian Ocean.

FIGURE 21. LONG DISTANCE MOVEMENT BY RECAPTURED BLUE MARLIN RECORDED IN 2018/19



SAILFISH

Five sailfish recaptures were reported in 2018/19, the same number as reported the previous year. Two had been tagged in Exmouth Gulf WA, two off Mooloolaba QLD and one off Weipa in the Gulf of Carpentaria. As is fairly typical of sailfish recaptures, none showed very much apparent movement from their release points (zero to 30 nautical miles). Times at liberty ranged from 2 to 610 days (20 months), the latter fish being recaptured just 3 nautical miles from its point of release off Weipa QLD.

Over the course of the tagging program, 346 sailfish have now been recaptured, and while a small number of these have moved minimum distances as far 500, or in just one case, 1,000 nautical miles, the overwhelming majority have been recaptured close to their release points. This is true for sailfish tagged on both the west and east coasts and more lately, in the Gulf of Carpentaria, both off Weipa and Groote Eylandt. As noted in previous annual reports, many sailfish have been recaptured very close to their release locations after times at liberty of nearly exactly one, two, three, four or in one case off Broome WA, seven years. It is generally believed in these locations that sailfish are not present year round, so these results strongly suggest annual homing, or 'philopatry' — meaning the tendency to return to one's home. The general lack of recaptures of sailfish away from tagging sites remains difficult to explain, but may simply be due to lack of fishing effort targeting sailfish in other areas and at other times of the year.

Mark Beutel releasing a sailfish off Mooloolaba QLD. The fish was recaptured not far away 16 days later. Fishing the same grounds a month later, he recaptured another tagged sailfish after it has spent 106 days at liberty.

At 94 years of age, American angler Ed Martin recaptured this tagged sailfish while fishing off the Sunshine Coast with Captain Rob Smith.

STRIPED MARLIN

Four striped marlin were recaptured in 2018/19 with times between release and recapture ranged from 22 to 73 days and apparent distances moved between 26 and 864 nautical miles. All four had been tagged off New South Wales, three off the south coast and one off the central coast. The latter fish was tagged wide of Woy Woy and recaptured 70 days later in the Coral Sea by a New Caledonian longline vessel (see Figure 15). Of the other three recaptured striped marlin, two were caught and reported by Australian longline vessels.

Chloe Lawrence releasing one of four striped marlin she and husband Tom caught on 24 March 2019 off Ulladulla NSW. The pictured fish was recaptured by a domestic longline vessel 22 days later about 45 nautical miles northwest.

FIGURE 22. LONG DISTANCE MOVEMENTS BY RECAPTURED STRIPED MARLIN RECORDED IN 2018/19.

These recaptures reinforced some findings from previous years which have shown striped marlin to be far less migratory than black or blue marlin, and that their times-at-liberty are nearly always short, rarely exceeding 12 months.

Over the long course of the program, the dearth of long term recaptures of striped marlin has been a continuing mystery. There have now been 258 recaptures recorded on the program but only 2.9% of these have been recaptured more than one year after release. This contrasts with two other billfishes, black marlin and sailfish, for which 11.2% and 10.6% of recaptures have occurred more than a year after release respectively. The most likely explanation for this discrepancy is that striped marlin have a natural tendency to reject tags at a higher rate than other species, although this has yet to be proven. A recent paper published in xx has now added weight to that hypothesis.

The paper described the results of a study in which striped marlin were surgically implanted with data-recording 'archival' tags. The researchers, had been frustrated with the perennial problem of pop-up satellite tags, jabbed into the shoulder of billfish, coming off the fish way too early – 49 days on average for striped marlin. They therefore decided to implant essentially similar tags into the body cavity so that they could not possibly be released or rejected and would therefore potentially record data for years. The only problem with this method was that the fish would need to be recaptured, killed and cleaned in order for the tag to be found and the data downloaded. This meant a lot of fish would need to be implanted if even one or two tags might be expected to be returned. They therefore implanted the expensive tags into 99 striped marlin caught by rod and reel off Magdalena Bay, Mexico between 2008 and 2010.

The results were quite remarkable. Of the 99 fish tagged, 10 were recaptured and the internal tags found and returned. This translates into a known recapture rate of 10.1% – an order of magnitude higher than for conventional tagging with dart tags. Equally interesting was the fact that times between release and recapture of the implanted fish ranged from 1.1 years to 7.6 years, greatly exceeding the vast majority of times at liberty for conventionally tagged striped marlin. In addition, when the archival tags were implanted, a specially designed external conventional tag was also

placed in the shoulder of each fish with a message offering a large reward to retrieve the implanted tag and return it. However, not one of the recaptured fish had retained its external tag, clearly indicating a high tag loss rate, at least from fish at liberty for more than a year.

Surgically implanting a piece of hardware into a live striped marlin is a very different procedure than simply jabbing a small tag into the shoulder of a fish while it is still in the water. Each fish had to be laid on the deck with a deck-hose in its mouth while the tag was implanted and the incision sutured, possibly leading to at least some post-release mortality. As well, with the external tag missing, it is highly likely that other implanted fish were also recaptured but the tag not noticed at all. In fact, two of the implanted tags were not found until the fish were being processed at commercial facilities. In other words, the actual recapture rate of tagged fish is likely to have been higher than the 10.1% figure, adding further weight to our knowledge that billfish actually have high post-release survival rates, and that striped marlin in particular do indeed reject standard plastic tags at a relatively high rate.

SHARKS

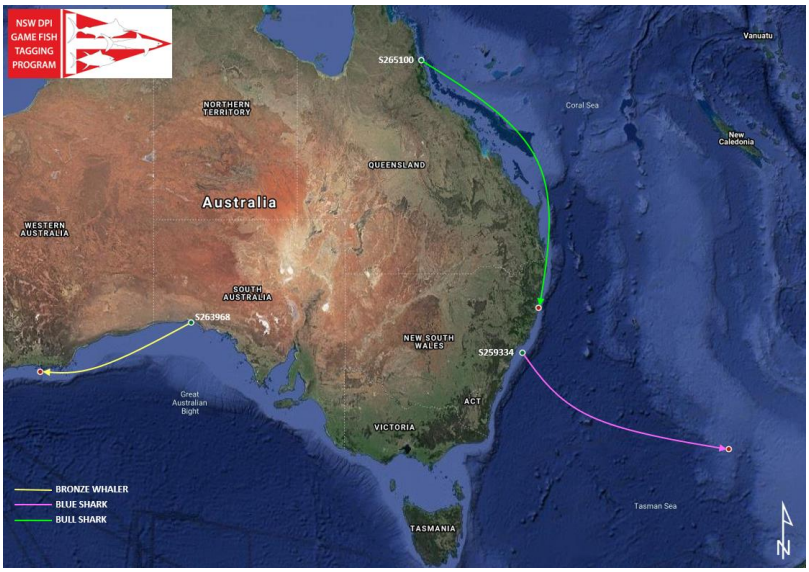
A number of interesting recaptures of sharks were reported in 2018/19 including three long distance movements (see Figure 16). A bull shark tagged at Ellis Beach, northern Queensland was recaptured 903 nautical miles south, at the mouth of the Macleay River NSW, 955 days (2 years 7 months) after its release. It was estimated at 70 kg on release and weighed 105 kg at recapture.
An estimated 45 kg blue shark tagged off Catherine Hill Bay NSW was recaptured about half way between Australia and New Zealand (658 nautical miles from its release point) by a Spanish longline vessel 113 days after release. And a bronze whaler, tagged off Yalata SA was recaptured by a commercial gillnetter off Esperance WA, a displacement of 493 nautical miles in its 207 days of liberty.

The longest time-at-liberty for a shark in 2018/19 was achieved by a mako, tagged off Bemagui NSW and recaptured just under four years later off Jervis Bay, only 90 nautical miles from its release point. When tagged it was estimated at 60 kg, and at recapture, was weighed at 174 kg – a growth rate that compares well with known estimates based on counting rings on vertebrae.

A small bronze whaler, estimated at just 6 kg, tagged off Kangaroo Island SA was recaptured after 3 years 18 days only 4 miles from where it was released. Interestingly, its estimated size at recapture was 10 kg, indicating a very slow growth rate for this particular shark. Two whaler sharks, most likely Galapagos sharks, tagged and recaptured at Elizabeth Reef, north of Lord Howe Island, were particularly notable. Both were tagged and recaptured by the same game fishing vessel, 'Tantrum' which had travelled from Sydney Game Fishing Club on two separate trips a year apart. Remarkably, both sharks were recaptured on the same day, the first, just short of two years after its release, the second just under one year after release. This result adds weight to a 2008 genetic study of Galapagos sharks sampled at Lord Howe Island, Middleton and Elizabeth reefs which showed that the Elizabeth/Middleton reef population was distinct from that of Lord Howe Island.

Other noteworthy recaptures of sharks this year included a gummy shark, tagged off Port MacDonnell SA and recaptured 18 months later off Victor Harbour, SA; a 2.7 metre bull shark tagged in Sydney Harbour by NSW DPI staff and recaptured by a recreational angler in the same area 1 year and 4 days later and a tiger shark, estimated at 80 kg when it was released off Dampier WA recaptured exactly one year later in the same general area and estimated at 90 kg.

FIGURE 23. LONG DISTANCE MOVEMENTS BY RECAPTURED SHARKS RECORDED IN 2018/19.



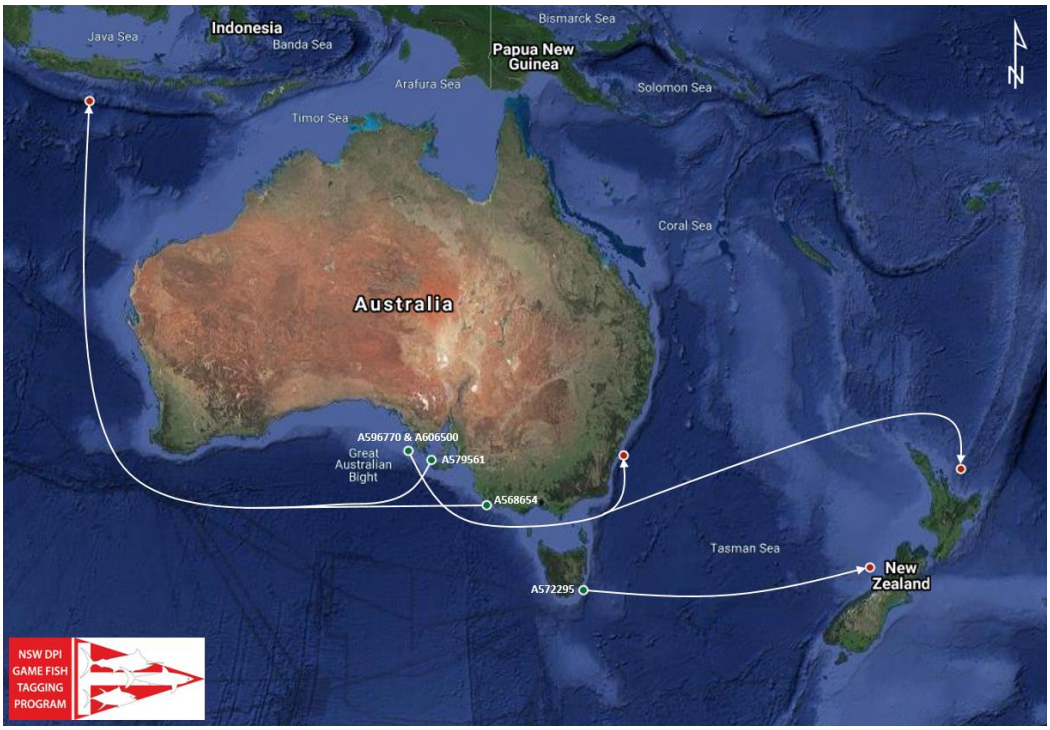
SOUTHERN BLUEFIN TUNA

During 2018/19, eighteen recaptures of southern bluefin tuna (SBT) were reported. Fourteen of these were recaptured in Australian waters – thirteen by Australian purse seine vessels associated with the South Australian tuna ranching aquaculture industry and one by an Australian east coast longline vessel.
The other four recaptures are of particular interest since they were caught at considerable distances from their points of release, all by commercial longline vessels (see Figure 17).

Two of these fish had crossed the Tasman to be recaptured in New Zealand waters after being at liberty for considerable periods. The first was tagged off Rocky Island South Australia and recaptured 877 days (2 years 4 months) later about 90 miles north of the Bay of Plenty. During that time, it had grown from an estimated 15 kg to 24 kg. The second fish had been tagged off Tasman Island Tasmania and had been at liberty for 1,137 days (3 years one month) before taking a longline hook off southwestern New Zealand. When released, it was estimated at 18 kg and on recapture, weighed a hefty 55 kg.

The other two long distance travellers were landmark recaptures, both having been tagged off South Australia and recaptured in the Java Trench by Indonesian longline vessels, again after long periods at liberty. The Java Trench is the only know spawning ground for SBT, but it is rare for fish tagged around southern Australia to be recaptured in that region (or at least, to receive reports of recaptures). Both of these fish had been tagged off South Australia, one near the mouth of Spencer Gulf, the other off Port MacDonnell. They were recaptured within six days of each other, although their release dates were eight months apart. During its 1,363 days (3 years 9 months) at liberty, the Spencer Gulf tuna had grown from an estimated 17 kg to a weight of 40 kg, while the Port MacDonnell fish, which had been at liberty for 1,622 days (4 years 5 months) had increased in size from 12 to 90 kg. These recaptures are great examples of the valuable scientific information that continues to accrue from this long term gamefish tagging program.

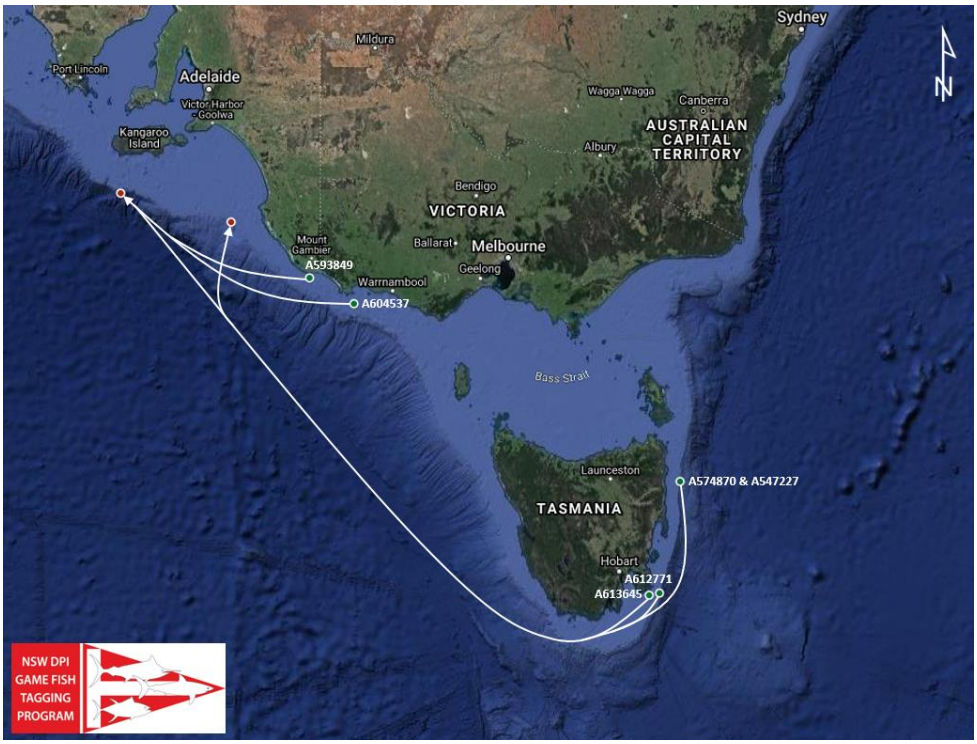
FIGURE 24. LONG DISTANCE MOVEMENTS BY RECAPTURED SOUTHERN BLUEFIN TUNA IN 2018/19



As noted, another 13 SBT recaptures were reported in 2018/19 by commercial vessels associated with the tuna aquaculture industry operating out of Port Lincoln South Australia. Figure 18 shows that four of those had been tagged off Tasmania and six others tagged off either western Victoria or Port MacDonnell SA. The remaining three had been tagged in an area known as the 'Cabbage Patch' SA, relatively close to where they were recaptured at later dates by commercial purse seine vessels.

When examining these recaptures in Appendix I of this report, care should be taken in interpreting both rates of movement and growth rates since the fish are held alive in pens for months after capture, and fed liberally with pilchards to increase their weight and quality for the market. This means that the tags may not be recovered until the fish are harvested and processed.

FIGURE 25. 2018/19 RECAPTURES OF SOUTHERN BLUEFIN TUNA BY SOUTH AUSTRLAIAN TUNA FARM COMMERCIAL VESSELS.



Keen Tasmanian angler Jonah Yick with a nice southern bluefin tuna about to be released. Note the correct placement of the tag at the base of the second dorsal fin.

YELLOWTAIL KINGFISH

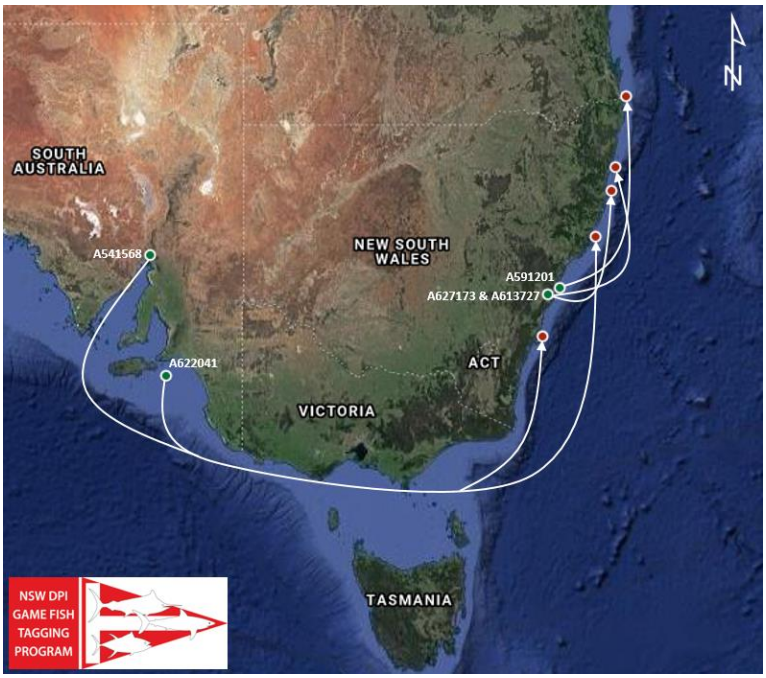
Recapture rates of tagged yellowtail kingfish have always been relatively high, currently showing an overall rate of 6.9% over the life of the tagging program to date. In fact, this species accounts for 31.7% of all recaptures, even though it represents 8% of fish tagged. As a result of this relatively high recapture rate, every year, many reports of tagged kingfish are received, always adding incrementally to our knowledge of the species, but also providing surprises as well.
This year, 136 recaptures of kingfish were reported, by far the largest number for the past 12 years. Times at liberty ranged from zero days (six fish were recaptured the day of their release) to 1,864 days (5 years and 1 month). Interestingly, the latter fish was recaptured at the same location as its

release off Port Augusta SA. Two other fish were also recaptured after 5 or more years at liberty. Both had also been tagged off Port Augusta, one recaptured 41 nautical miles away off Whyalla SA exactly five years later, the other recaptured 170 miles away, off Coffin Bay SA, after 5 years 3 weeks.

The longest distance recorded for a tagged kingfish in 2018/19 was by a fish tagged off Kangaroo Island SA and recaptured 384 days later off Forster NSW (see Figure 19). The calculated minimum displacement for this and all other fish recaptured on the program is a straight line between the release and recapture points. In this case, that distance is 745 nautical miles, however, when land masses are taken into account, the minimum swim by this fish around the coast, passing through Bass Strait, would have been about 1,000 nautical miles. Another kingfish made a similar journey this year – from Port Augusta SA to Currarong NSW, having been at liberty for 422 days. Movements of kingfish from South Australian to NSW waters have been recorded for several years now, strongly suggesting that fish from both areas form a single stock. This is further supported by the fact that the fish making these long journeys are larger, presumably adult fish in the 12 to 25 kg size range.

In contrast, of the 136 recaptured kingfish, 89 were recaptured within 2 nautical miles of their release locations and a further 24 were recaptured within 50 miles of where they were tagged. Twenty-one fish had moved more than 100 nautical miles, all but one of which were measured or estimated to be in excess of a metre in length and 11 kg in weight.

FIGURE 26. LONGER DISTANCES MOVED BY RECAPTURED YELLOWTAIL KINGFISH DURING 2018/19



Gianni Lo Giudice releasing a kingfish inside Sydney Harbour that was recaptured 220 days later 360 nautical miles to the north off Tweed Heads NSW.

SAMSON FISH

Related to yellowtail kingfish, but entirely native to Australian waters, nearly 3,000 samsonfish have been tagged over the course of the program off both Western Australia and South Australia. A total of 108 samsonfish were tagged in 2018/19 and while 13 recaptures were recorded during the year, six of those had been released in previous years. Twelve of the recaptured fish had been tagged off South Australia, around islands in the vicinity of Coffin Bay/Port Lincoln, while the other was tagged off Shellharbour NSW. Most of the South Australian tagged fish were recaptured within 15 miles of their release points, with the main exception being a fish recaptured at Marion Bay SA, 116 nautical miles east of where it was tagged, albeit 5 years and 25 days later. Other recaptures of South Australian tagged fish also occurred after lengthy periods of 1,552, 1,069, 1,058, 977 and 394 days, all showed very little apparent displacement in the interim. Ironically, the furthest distance moved by a samsonfish this year was by the single fish tagged in NSW waters. It had moved from Shellharbour to Coffs Harbour, a distance of 310 nautical miles during its 126 days-at-liberty.

This South Australian samsonfish was first released in June 2014 then recaptured and re-released by Luke Donhardt (pictured) 1,852 days later having travelled at least 116 nautical miles from where it was released.

DOLPHIN FISH

Five dolphinfish were recaptured this year, one at a wave rider buoy, the other four off Fish Aggregating Devices (FADs) deployed by NSW DPI. The longest time at liberty and furthest distance moved were achieved by the same fish, initially tagged at the Tweed Heads FAD in October 2018 and subsequently recaptured at the Port Hacking FAD 88 days later. During its three months between release and recapture, the fish had doubled its size, from an estimated 3 kg to 6 kg, again demonstrating the rapid growth rate of this high energy species. `

RECAPTURES WITH MISSING TAG CARDS

Each year, we receives notification of recaptures of some fish for which no tag card has been received. In many cases, the missing card is eventually sent, or is located by contacting club recorders or boat owners who have returned tag cards from the same batch of tags as the missing ones. In some cases though, these efforts fail to locate the missing cards, which disappointedly means potentially valuable information is lost. This year, we received information on 29 recaptures for which no matching tag card had been received at the time of writing this report. These are shown in Table 3 below in the hope that the cards might be located, and to encourage the return of any completed tag cards, regardless of when the fish were released.

We ask you to take a careful look at the Table, and if you have tagged any of the species listed at any time, please check to make sure there are no completed tag cards sitting in a drawer of a boat or at home.

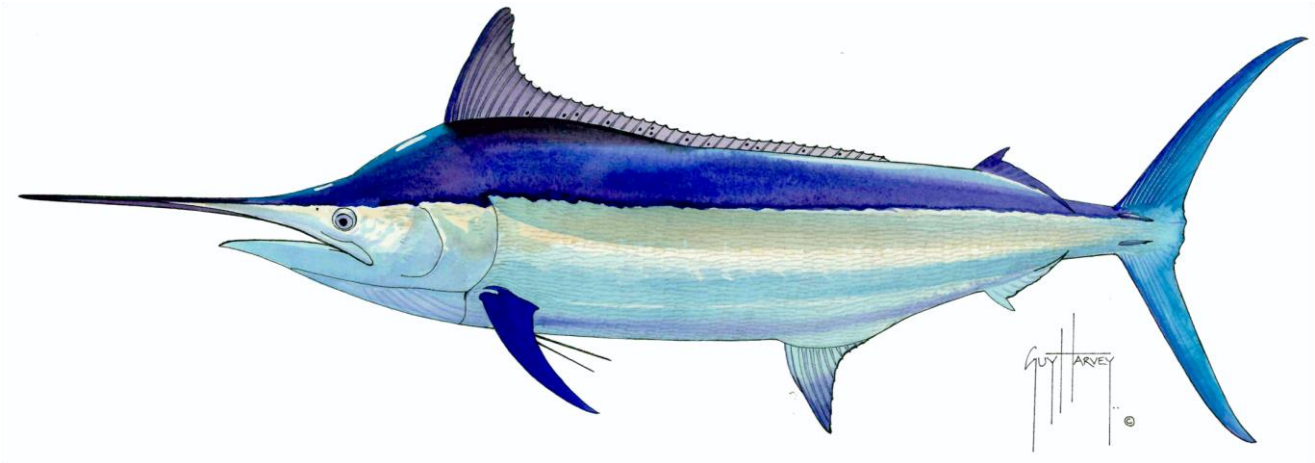
TABLE 3 DETAILS OF FISH RECAPTURED IN 2018/19 FOR WHICH NO TAG CARD HAS BEEN RECEIVED.

Tag No	Species	Where recaptured	Date recaptured	Recapt Lngth (cm)	Recapt Wt (kg)
B142424	BLACK MARLIN	FITZROY ISLAND QLD	18/8/18	130	15
S265734	BLUE SHARK	BROWNS MOUNTAIN NSW	4/8/18		80
A588102	DOLPHINFISH	SYDNEY NORTH FAD NSW	9/4/19	67	
A606641	DOLPHINFISH	TERRIGAL FAD NSW	19/5/19	82	4.5
A610476	MULLOWAY	NEWCASTLE HARBOUR NSW	29/12/18	100	10.2
B085976	SAILFISH	DAMPIER WA	25/9/18	180	20
B110901	SAILFISH	LINDEN BANK QLD	27/11/18	180	45
D018979	SILVER TREVALLY	SANDERS BANK SA	28/1/19	57	2.9
A567153	SOUTHERN BLUEFIN TUNA	KANGAROO IS. (52 NM SW) SA	16/2/19	105	25.5
A545549	SOUTHERN BLUEFIN TUNA	KANGAROO IS. (52 NM SW) SA	24/12/18	108	27.4
A607769	SOUTHERN BLUEFIN TUNA	KANGAROO IS. (52 NM SW) SA	13/1/19	102	26
B144214	STRIPED MARLIN	TURA BEACH NSW	2/3/19		60
S256218	TIGER SHARK	FRASER ISLAND QLD	24/10/18	360	380
A626707	YELLOWTAIL KINGFISH	GREENLY ISLAND SA	14/3/19	135	26
A616597	YELLOWTAIL KINGFISH	GYMEA BAY NSW	5/1/19	65	2
A616599	YELLOWTAIL KINGFISH	GYMEA BAY NSW	15/12/18	56	
A628493	YELLOWTAIL KINGFISH	LONG REEF NSW	18/2/19	95	
A639855	YELLOWTAIL KINGFISH	NEWPORT NSW	10/12/18	75	
A587248	YELLOWTAIL KINGFISH	PORT AUGUSTA SA	15/2/19	75	
A580239	YELLOWTAIL KINGFISH	PORT AUGUSTA SA	30/11/18	140	
A578214	YELLOWTAIL KINGFISH	PORT AUGUSTA SA	21/10/18	137	23
A508110	YELLOWTAIL KINGFISH	PORT AUGUSTA SA	10/11/18	137	23
A530202	YELLOWTAIL KINGFISH	PORT AUGUSTA SA	19/11/18	140	26
A609356	YELLOWTAIL KINGFISH	PORT AUGUSTA SA	27/10/18	113	13
A612372	YELLOWTAIL KINGFISH	PORT AUGUSTA SA	29/10/18	145	24
A590694	YELLOWTAIL KINGFISH	PORT HACKING NSW	7/1/19	88	6.3
A628823	YELLOWTAIL KINGFISH	PORT KEMBLA NSW	19/12/18	77	
A623589	YELLOWTAIL KINGFISH	SOUTH HEAD, SYDNEY NSW	14/4/19	94	
A625174	YELLOWTAIL KINGFISH	SYDNEY HARBOUR NSW	12/12/18	82	4

SCIENTIFIC VALUE OF THE GAME FISH TAGGING PROGRAM

It may not be widely realized that data accumulated on the Game Fish Tagging program is often sought for a wide variety of studies of aspects of the biology and fisheries of pelagic fishes. **Appendix III** shows the impressive list of reports, University theses and peer-reviewed scientific papers that have utilized data from the program in some way. And it is not just information derived from recaptures of tagged fish that make the Game Fish Tagging program so valuable. Understanding changes through time in availability of fish or fishing activities of the recreational sector would not be possible in the absence of the tagging program. Thus, the tagging database is widely recognised as a vital source of information on long term trends in the relative abundance of pelagic fish, and is used wherever possible for studies on changes in catches in relation to historic environmental variables such as temperature, chlorophyll, sea height and El Nino/La Nina cycles. Such studies' reports and publications are also included in Appendix III.

FOCUS ON BLACK MARLIN (*ISTIOMPAX INDICA*)



Each year, the tagging report takes a look at the biology of key species tagged on the program. The following summary of the biology of the black marlin has been adapted from the book, 'Fishes of the Open Ocean' by Julian Pepperell (UNSW Press, U. Chicago Press). Black marlin illustration courtesy Guy Harvey.

The black marlin is the least common of the world's four species of marlin and as such, is one of the least understood of the billfishes. This is one of the largest of the teleost (bony) fishes in the world, growing to over 4 metres in length and to at least 709kg in weight.

IDENTIFICATION

The main feature that sets the black marlin apart from all other billfishes is its rigid pectoral fins. In adults, these fins cannot be folded against the body, even with reasonable force. It should be noted, however, that very small fish have flexible pectoral fins, the calcification of the pectoral joint which causes this rigidity not occurring until a size of about 10 to 15 kg. Another diagnostic feature is the position of the second dorsal and anal fins. The black marlin is the only istiophorid in which the second dorsal fin is anterior to the second anal fin – a feature that holds for all sizes. Lastly, the dorsal fin of the black marlin is the lowest of all of the istiophorids, measuring no more than half the maximum body depth in adults.

GEOGRAPHIC RANGE

Although black marlin are distributed throughout the Indo-Pacific between about latitudes 40°N and 40°S, closer examination of historic Japanese catch rates clearly shows that the density of the species is very sparse in open ocean areas, but much more 'clumped' near large land masses and continents. In fact the black marlin is the most land-associated of the billfishes, preferring waters on or near continental shelves during most stages of its life cycle.

Areas where black marlin aggregate include the northern part of the Great Barrier Reef, the east coast and the northwest shelf of Australia, extending to the southern islands of Indonesia, the South China Sea off Vietnam, Malaysia and Thailand, in the eastern Pacific off Peru and central America (Panama and Ecuador) and off Kenya and Mauritius in the Indian ocean.

Black marlin do not occur in the Atlantic ocean, however, Japanese research longliners historically recorded stray black marlin from time to time in the Atlantic as far north as the coast of Brazil and even in the Caribbean. The likely route for these infrequent 'invasions' would be around the Cape of Good Hope, and most world distribution maps of black marlin show dotted arrows following this route. Even so, such occurrences are considered very rare.

MOVEMENTS

The first black marlin was tagged off Cairns, Australia in 1968. Since then, more over 72,500 have been tagged, the great majority in Australian waters.

The large movements shown by recaptures of some tagged fish may give the impression of regular mass long distance dispersal of black marlin. However, this picture does not necessarily mean that many or most fish take these routes in all or most years. It does, however, clearly indicate that the species is capable of very extensive movements throughout its range. Even so, recent studies of the genetics of black marlin in the Indo-Pacific has shown distinct partitioning of populations between the Indian and Pacific oceans, as well as between the southwestern and northern Pacific.

Another question is whether the movements of black marlin are random, or part of some purpose-driven migratory cycle. Tagging results have clearly shown that, after a period of several months, the average distance moved by tagged black marlin increases rapidly with time at liberty, at least for the first nine months or so after release. This rapid dispersal takes fish away from the tagging grounds off eastern Australia throughout the western Pacific and beyond at an average rate of about 20 nautical miles per day. However, recapture data also show that there is a very marked 'cluster' of recaptures near the point(s) of release after about one year (330 to 400 days) followed by another period of apparent rapid dispersal in the ensuing months. Clustering of recaptures near release points is then also apparent after two years, and also after three, four and five years (with decreasing numbers of recaptures as time increases). This fascinating finding suggests two possibilities: either some fish never leave the areas in which they were tagged, or annual homing occurs, at least for a proportion of the population. Careful examination of historic Japanese catch records off the Great Barrier Reef (GBR) over long periods have clearly shown that, by early summer each year, catch rates of black marlin suddenly declined dramatically, indicating a sudden *en masse* departure of fish from that area over a very short time. Long term charter boat captains in the area also attest to the fact that black marlin virtually disappear completely at this time.

Therefore, the conclusion based on recaptures of tagged fish near their release sites after yearly or multi-yearly intervals is that at least some fish must be returning to the same general region off the GBR on an annual basis.

Growth and size

By carefully analyzing the size 'pulses' of small black marlin which appear every so often along the east coast of Australia, it is estimated that they reach a size of about 25kg at one year of age, and that a 100kg fish would be 3 to 4 years old. Several very small black marlin have been aged by counting presumed daily rings on their otoliths. Previous work on tuna indicates that these rings are laid down every day during the early life of fish, and assuming that this is also the case for marlin, two black marlin weighing just under 4 kg were estimated to have been only about 130 days (4 months) old. A rare, even smaller specimen of a black marlin, only 45cm in length, was also aged in this way and estimated to be about 80 days old.

After several years of age, the growth rates of black marlin become more difficult to assess, but all evidence so far points to continued rapid growth. It is very likely that male black marlin grow more slowly than females and die at an earlier age, explaining why all fish over about 170kg are females.

The maximum size to which black marlin grow is of the order of 700 kg, the all tackle world record for the species being 709 kg for a fish caught off Peru in 1953 while another weighing 691kg was caught in the same area in 1954. Nearly 600 fish weighing more than 450 kg have been captured since then, nearly all off the Great Barrier Reef to the north of Cairns, but none has exceeded these two long-standing records. There are persistent anecdotes of much larger black marlin being caught by longline vessels, but none of these has ever been substantiated.

Reproduction

Examining the gonads of black marlin caught by both recreational anglers and Japanese longliners, together with some records of occurrence of black marlin larvae, has revealed that spawning takes place in the Coral Sea in late spring/early summer each year. Egg counts from ovaries taken from adult females weighing between 400kg and 600 kg ranged from 65 million to 250 million eggs.

The fully ripe eggs of the black marlin, about 1.3mm in diameter, are fertilized externally, after which they float at the surface for several days before hatching into tiny larvae. The larvae are themselves miniature predators of the planktonic world — all eyes and mouth, with one purpose — to eat and therefore, to grow. The mortality rate during these critical early stages must be enormous, as a whole suite of slightly larger predators take their relentless toll. Although mortality rates are obviously extremely high, it is still difficult to understand why very small black marlin, less than about 10kg, are extremely rare in recreational and commercial catches. It is possible that, during this phase of their life cycle, very small fish remain offshore in the mid water zone, and are therefore not available to most fishing gears, although this explanation obviously needs to be tested.

Behaviour

The diving behaviour of black marlin has been revealed by tracking using electronic tags, both acoustic and data-storing satellite tags. In most cases, tagged black marlin tend to swim closer to the surface during the night compared with the day. There is also a tendency for fish to dive to deeper depths after dawn, and to make more ascents to the surface after about noon.

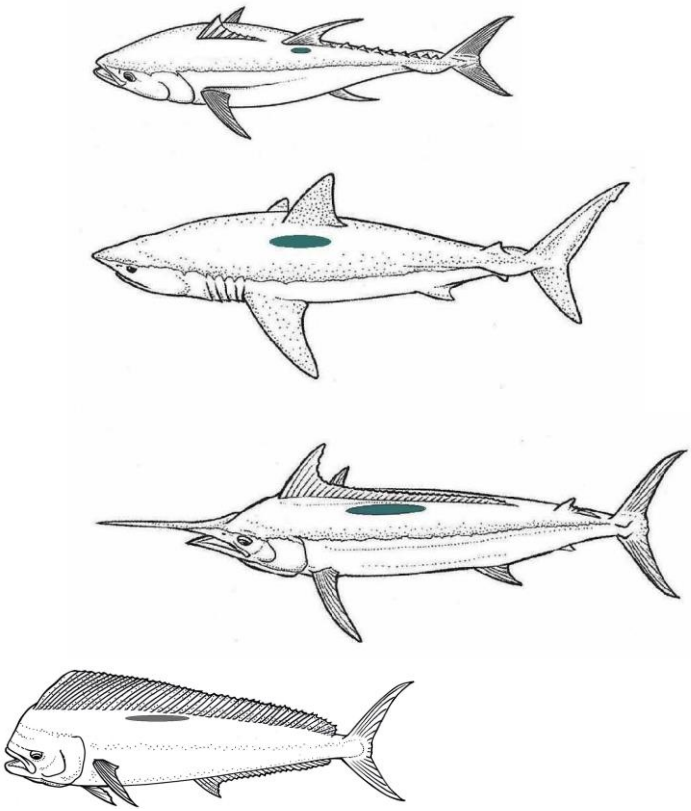
Tracked fish have rarely penetrated the thermocline, and then only briefly, remaining at temperatures no more than 8°C below that of the surface waters. The deepest dives so far recorded have only been to about 180 metres. During tracking, fish tended to initially move offshore from the edge of reefs before heading parallel to the shore. The average mean swimming speeds over the ground for tracks lasting up to 28 hours ranged from about 1.5 to 4 knots.

FISHERIES

Although black marlin are not now targeted by most commercial fisheries in the Pacific, the numbers taken each year as bycatch are probably quite large. It has been estimated that in the western and central Pacific, at least 40,000 black marlin are taken annually. Beginning in the early 1950s, Japanese longliners consistently fished off northern Queensland Australia and during the peak years of the 1960s, up to 14,000 fish were taken annually by that fishery. A long-standing charter fishery for black marlin off the Great Barrier Reef, Australia has operated successfully for more than 40 years. During that time, strike rates have fluctuated considerably, but the fishery has proven itself to be sustainable over this entire period.

TAGGING TIPS

RECOMMENDED TAGGING AREAS



HOW TO TAG LARGE GAME FISH

- Once the angler brings the fish within range, the fish should be traced and led alongside the boat so that it presents a broad tagging target. It is usually best to keep the boat moving slowly forwards to enable better control of the fish.
- Once the fish is in position for tagging, the person handling the tag pole should take position behind the person tracing the fish to allow for a clear tag shot.
- An attempt to apply the tag should only be made if the fish is calm or subdued. The tag should be placed towards the middle of the fish, well above the lateral line towards the dorsal fin.
- For billfish and most sportfish, the fish should be tagged with a firm, well-aimed stroke—simply place the tag against the fish's flank and push. Do not stab. Sharks will require a firm jab in order to penetrate their tough skin.
- Once the tag has been placed, remove the hook if possible (a de-hooker can facilitate this) or cut the trace close to the fish's mouth.
- Revive any fish that appear to be exhausted or are struggling to remain upright in the water. A commonly used approach for billfish is to hold the fish firmly by its submerged bill whilst the boat moves forwards at 2 to 3 knots. This ensures a good flow of water over the fish's gills.

- The fish should only be released when it shows strong signs of life and displays improved skin colour, which may take several minutes or more. Exercise caution, especially in rough weather. Alternatively, use a snooter. This is a safe and effective tool for reviving billfish.
- Fill out the tag card immediately and return to NSW DPI (or your fishing club recorder) as soon as possible, otherwise tagging is of no value.

HOW TO TAG SMALL GAME/SPORT FISH

Smaller pelagic species may be removed from the water before tagging. This enables improved accuracy of tagging and may simplify hook removal. Often holding the fish on its back will lessen its 'flapping'. Try to prevent the fish damaging itself on hard, hot, or dry surfaces. A wet foam mat or similar is ideal (or a wet towel will suffice) for on-boat tagging.

Pelagic tags should be inserted using a hand tagger or short pole since they are designed to lock behind the bony structures of the dorsal fin or second dorsal fin in order to stay in position. Carefully insert the tag into the fish's back, close to the base of the fin and angled in so that it passes through the bony structures at the base of the fin. Try to insert the tag at an angle of at least 45° to reduce water friction and then twist the tag pole before removing it. In effect, you should be trying to hook the barb of the tag around one of these spines, which then locks the tag in place.

TAGGING AND IMPROVED SURVIVAL TIPS

Elect one crew member as the person in charge of the tagging equipment, to ensure that:

- the number of the tag in position on the tag pole matches that on the tag card
- details of the tagging are promptly recorded on the card
- the card is handed to the fishing club recorder or mailed to NSW DPI as soon as possible.
- Use non-offset circle hooks whenever possible when using live or dead baits. These hooks minimise deep hooking, foul hooking and bleeding and promote the survival of tagged fish.
- Keep your tag cards in an orderly bundle. This will help to ensure that tags do not become loose and fall out of their corresponding tag card.
- Load your tagging pole with a tag before you hook a fish to ensure that it is attached properly and is readily available whenever you wish to tag a fish.
- Check the length of your billfish tag applicator 75mm is the optimal length for most billfish — this ensures that the tag is placed at the correct depth and reduces the risk of the tag being shed by the fish.
- Do not attempt to tag very active fish, especially if the fish is jumping at the side of the boat. Poor tag placement can injure fish or result in the tag being shed. The recommended tagging areas are shown below. It is better to release the fish without tagging, if accurate tag placement is not possible.

ESTIMATING THE SIZE OF TAGGED FISH

This may be done by estimating the weight of the fish or by measuring the fish when it is in, or alongside the boat. If the fish is less than a metre in length it may be carefully brought on board and measured using a standard measuring tape. However, larger fish should remain in the water.

If you estimate the size of the fish (especially fish weight), get a consensus from all the crew immediately after release, and record immediately (first impressions are always best!).

For measuring length of fish in the water, it is best to rig up a simple tape measure. It helps if it is flexible, and at least 4 metres long. Attach a tennis ball to the zero end and when a fish is alongside, or being held at the back of the boat, float the tennis ball to the tail fork and get a measurement to the fish's snout, or to the tip of the lower jaw for billfish. For billfish, it is important that the recorded measurement should state where the fish was measured from and to (i.e. lower jaw to tail fork length or total length - tip of bill to end of tail).

REPORTING A PREVIOUSLY TAGGED FISH

If an earlier tag is noticed on a fish, should the tag be retrieved and the fish re-tagged, or should the fish be kept for scientific examination? Unfortunately, there is no clearcut answer, but generally speaking, if the tag looks very fresh (ie, bright yellow or orange with no growth) then it is probably a very recent tag and the fish can be returned after first either recording the tag number, or better, cutting off the tag and putting another into the fish.

If the fish is small enough to measure, then this should be done, ideally from the tip of the snout to the fork in the tail (or if a billfish, from the tip of the lower jaw to the tail fork). Alternatively, if the tag is fairly obviously an old one, usually identified by being faded and covered with at least some marine growth, then the best advice is to keep the fish, if possible, for later scientific examination. It should be wrapped in plastic and frozen, and a call made to NSW DPI Nowra, or your local Fisheries Department, for advice. Very useful information can be gathered from inspection of recaptured fish, including more accurate growth rates, condition of released fish and effectiveness of different types of tags and tagging sites.

One other point regarding reporting recaptures of tagged fish should be kept in mind. In these days of nearly 100% release of billfish, previously tagged fish are quite often caught and re-released without being able to retrieve the earlier tag. If you do hook and release a fish which has a previous tag in place, you should definitely record the details of the event (even though the tag number is unknown) and report the incident to NSW DPI (Fisheries) at Nowra as a genuine recapture. In this way, better statistics on actual recapture rates of billfish will be able to be maintained.

CONTACT THE PROGRAM

If you would like to contact the game fish tagging program either to obtain further information on the program, tags, or to report a recapture directly, call
+61 (02) 6691 9602 or email gamefish.tagging@dpi.nsw.gov.au.

ACKNOWLEDGEMENTS

The Game Fish Tagging Program, operated by NSW DPI, is generously supported by the NSW Recreational Fishing Trust through funds raised from the Recreational Fishing Licence in that State. We also acknowledge the thousands of anglers, club officials, captains and crew who participate in the program. Without this continued effort, our knowledge of the biology of pelagic fish would be much the poorer. This report was prepared with the assistance of Clay Hilbert, Phil Bolton and Emma Simpson of NSW DPI.

One of 988 southern bluefin tuna tagged during 2018/19. Photo: Matty Harris.

APPENDIX I: ALL RECAPTURES OF TAGGED FISH REPORTED IN 2018/2019

Species	Date tagged	Release location	Days at liberty	Dist moved (nmi)	Direction
BLACK MARLIN	30-Jun-18	EXMOUTH (TANTABIDDY) WA	56	14	NNE
BLACK MARLIN	16-Aug-18	FITZROY ISLAND QLD	161	785	SSE
BLACK MARLIN	02-Jan-19	ULLADULLA NSW	48	94	S
BLACK MARLIN	08-Jan-19	JERVIS BAY SHELF NSW	44	86	SSW
BLACK MARLIN	07-Feb-15	SYDNEY (BROWNS MOUNTAIN) NSW	1492	76	SSW
BLACK MARLIN	19-Feb-18	BROUGHTON ISLAND NSW	437	2663	ENE
BLACK MARLIN	12-Nov-17	HERVEY BAY QLD	345	968	N
BLACK MARLIN	20-Oct-18	FRASER ISLAND (BREAKSEA SPIT NTH) QLD	149	114	SE
BLACK MARLIN	25-May-19	FRASER ISLAND (SANDY CAPE) QLD	22	2	SSW
BLACK MARLIN	26-May-19	FRASER ISLAND (SANDY CAPE 2NM E) QLD	19	4	WNW
BLACK MARLIN	17-Mar-19	BARWON BANKS QLD	6	10	NE
BLACK MARLIN	16-Dec-17	GOLD COAST QLD	265	1166	NE
BLACK MARLIN	18-Mar-18	BARWON BANKS QLD	293	1298	NE
BLACK MARLIN	20-Apr-18	BARWON BANKS QLD	275	84	S
BLUE MARLIN	24-Nov-18	PORT STEPHENS SHELF (SE) NSW	182	2373	NNW
BLUE SHARK	02-Feb-19	CATHERINE HILL BAY (EAST) NSW	113	658	SE
BRONZE WHALER	07-Dec-18	EAGLE BAY (WA)	70	7	SE
BRONZE WHALER	02-Jun-18	CHEYNES BEACH WA	318	181	ENE
BRONZE WHALER	01-Jan-18	YALATA (BOBS KITCHEN) SA	207	493	WSW
BRONZE WHALER	02-Jan-16	KANGAROO IS (AMERICAN RIVER) SA	1114	4	WSW
BRONZE WHALER	04-Apr-19	PORT STEPHENS (CAR PARK) NSW	0	0	NW
BULL SHARK	16-Jun-16	ELLIS BEACH QLD	955	903	SSE
BULL SHARK	30-Jan-19	CLARKE ISLAND (SYDNEY HARBOUR) NSW	6	2	WNW
BULL SHARK	27-Feb-18	SOW & PIGS (SYDNEY HARBOUR) NSW	369	3	WSW
BULL SHARK	18-Nov-18	LOGAN RIVER QLD	28	0	NW
BULL SHARK	07-Dec-18	GOLD COAST QLD	54	9	NNW
DOLPHINFISH	29-Mar-19	PORT HACKING FAD NSW	10	0	NW
DOLPHINFISH	07-Jan-19	HAT HEAD NSW	3	9	SSW
DOLPHINFISH	10-Jan-19	HAT HEAD NSW	7	164	SSW
DOLPHINFISH	17-Apr-19	BALLINA FAD NSW	9	2	N
DOLPHINFISH	27-Oct-18	TWEED HEADS FAD NSW	88	366	SSW
GUMMY SHARK	09-May-17	PORT MACDONNELL SA	544	162	NW
GUMMY SHARK	02-Jun-18	PORT FAIRY VIC	182	77	SE
GUMMY SHARK	14-Jul-18	TORQUAY VIC	155	11	WSW
HAMMERHEAD SHARK	30-Dec-18	BROKEN BAY NSW	28	0	NW
LONGTAIL TUNA	13-Mar-19	CAMDEN HEAD NSW	13	64	SSW
MAKO SHARK	17-Jan-19	TORQUAY VIC	25	12	E
MAKO SHARK	03-May-15	BUNGA CANYONS NSW	1434	93	NNE
MAKO SHARK	04-Aug-18	BROWNS MOUNTAIN (SYDNEY) NSW	0	4	ENE
SAILFISH	26-Mar-19	EXMOUTH (TANTABIDDI) WA	2	30	SW
SAILFISH	16-Oct-18	EXMOUTH GULF WA	15	0	NW
SAILFISH	21-Dec-16	WEIPA QLD	610	3	NNE
SAILFISH	16-Mar-19	MOOLOOLABA (18 MILE) QLD	86	0	NW
SAILFISH	05-May-19	MOOLOOLABA (18 MILE) QLD	16	3	WNW

APPENDIX I: RECAPTURES OF TAGGED FISH REPORTED IN 2018/2019 (CONTD)

Species	Date tagged	Release location	Days at liberty	Dist moved (nmi)	Direction
SAMSON FISH	15-Mar-18	ROCKY ISLAND SA	346	10	NE
SAMSON FISH	29-Mar-14	GREENLY ISLAND SA	1852	116	ESE
SAMSON FISH	07-Mar-15	GREENLY ISLAND SA	1551	0	NW
SAMSON FISH	26-Jan-19	GREENLY ISLAND SA	0	0	
SAMSON FISH	26-Jan-19	GREENLY ISLAND SA	0	0	
SAMSON FISH	24-Mar-18	GREENLY ISLAND SA	310	1	SSW
SAMSON FISH	26-Mar-16	HUMMOCKS SA	1058	15	WNW
SAMSON FISH	26-Jan-18	COFFIN BAY NORTH SA	394	3	NNW
SAMSON FISH	09-Mar-18	HUMMOCKS SA	348	69	W
SAMSON FISH	02-Jul-16	HOPKINS ISLAND SA	1069	0	NW
SAMSON FISH	20-May-16	HOPKINS ISLAND SA	977	66	NW
SAMSON FISH	06-May-18	WEDGE ISLAND SA	81	2	N
SAMSON FISH	20-May-18	SHELLHARBOUR NSW	126	310	NNE
SCHOOL SHARK	12-Aug-18	VIVONNE BAY (KANGAROO ISLAND) SA	1	0	NW
SHOVEL NOSE SHARK	25-Nov-17	NAMBUCCA HEADS NSW	468	10	SSE
SOUTHERN BLUEFIN TUNA	13-Feb-16	ROCKY ISLAND SA	892	854	SE
SOUTHERN BLUEFIN TUNA	28-Feb-16	ROCKY ISLAND SA	877	2073	SE
SOUTHERN BLUEFIN TUNA	09-Apr-18	CABBAGE PATCH SA	286	87	SE
SOUTHERN BLUEFIN TUNA	16-Mar-18	CABBAGE PATCH SA	297	84	SE
SOUTHERN BLUEFIN TUNA	17-Mar-19	CABBAGE PATCH SA	18	0	NW
SOUTHERN BLUEFIN TUNA	16-Jan-15	ALTHORPE ISLANDS SA	1363	1920	WNW
SOUTHERN BLUEFIN TUNA	01-Apr-18	PORT MACDONNELL	329	87	NW
SOUTHERN BLUEFIN TUNA	13-May-17	PORT MACDONNELL SA	617	244	WNW
SOUTHERN BLUEFIN TUNA	09-May-14	PORT MACDONNELL SA	1622	2271	WNW
SOUTHERN BLUEFIN TUNA	12-May-17	PORT MACDONNELL SA	654	90	WNW
SOUTHERN BLUEFIN TUNA	02-Jun-18	PORTLAND VIC	205	289	WNW
SOUTHERN BLUEFIN TUNA	02-Jun-18	PORT FAIRY VIC	268	157	WNW
SOUTHERN BLUEFIN TUNA	13-Apr-18	PORT FAIRY VIC	313	236	WNW
SOUTHERN BLUEFIN TUNA	12-Jul-17	CAPE PILLAR TAS	557	678	WNW
SOUTHERN BLUEFIN TUNA	26-May-18	TASMAN ISLAND TAS	212	678	WNW
SOUTHERN BLUEFIN TUNA	07-May-16	TASMAN ISLAND TAS	1137	957	E
SOUTHERN BLUEFIN TUNA	14-Jul-18	ST HELENS PLATEAU TAS	163	644	WNW
SOUTHERN BLUEFIN TUNA	14-Jul-18	ST HELENS (EAST) TAS	233	510	WNW
SPANISH MACKEREL	28-May-16	FIN REEF QLD	792	37	WNW
SPANISH MACKEREL	12-Apr-19	NAMBUCCA HEADS (ALBANY REEF) NSW	20	0	NW
SPANISH MACKEREL	02-Mar-19	CAPE MORETON QLD	55	27	NNW
SPANISH MACKEREL	12-Jan-19	CAPE MORETON (11 NM NE) QLD	19	32	WNW
SPOTTED MACKEREL	12-Apr-19	NAMBUCCA HEADS (ALBANY REEF) NSW	35	7	S
SPOTTED MACKEREL	14-Apr-19	NAMBUCCA HEADS (ALBANY REEF) NSW	23	0	NW

APPENDIX I: RECAPTURES OF TAGGED FISH REPORTED IN 2018/2019 (CONTD)

Species	Date tagged	Release location	Days at liberty	Dist moved (nmi)	Direction
STRIPED MARLIN	28-Jan-19	EDEN NE NSW	23	9	SW
STRIPED MARLIN	09-Mar-19	TUROSS (SHELF) NSW	73	705	NE
STRIPED MARLIN	24-Mar-19	ULLADULLA WIDE NSW	22	26	NW
STRIPED MARLIN	13-Apr-19	WOY WOY (SHELF) NSW	70	864	NNE
TIGER SHARK	19-Aug-17	DAMPIER WA	364	11	NE
WHALER SHARK	29-Mar-19	EXMOUTH (TANTABIDDI NORTH) WA	0	0	
WHALER SHARK	28-Mar-19	EXMOUTH (TANTABIDDY) WA	0	0	NW
WHALER SHARK	03-Jan-17	ELIZABETH REEF AUST	724	3	SW
WHALER SHARK	06-Jan-18	ELIZABETH REEF AUST	356	4	SW
YELLOWFIN TUNA	20-Jan-18	BATEMANS BAY NSW	242	145	NNE
YELLOWFIN TUNA	20-Jan-18	BATEMANS BAY NSW	242	147	NNE
YELLOWTAIL KINGFISH	10-Nov-18	ROCKY ISLAND SA	106	0	NW
YELLOWTAIL KINGFISH	01-Mar-17	GREENLY ISLAND SA	627	199	NE
YELLOWTAIL KINGFISH	21-Feb-19	GREENLY ISLAND SA	15	0	NW
YELLOWTAIL KINGFISH	17-Feb-19	GREENLY ISLAND SA	19	0	NW
YELLOWTAIL KINGFISH	17-Feb-19	GREENLY ISLAND SA	25	0	NW
YELLOWTAIL KINGFISH	02-Mar-17	GREENLY ISLAND SA	736	0	NW
YELLOWTAIL KINGFISH	08-Apr-18	GREENLY ISLAND SA	341	1	SSW
YELLOWTAIL KINGFISH	11-Jan-19	HUMMOCKS SA	22	0	NW
YELLOWTAIL KINGFISH	24-Oct-17	COFFIN BAY SA	368	170	NE
YELLOWTAIL KINGFISH	07-Oct-15	COFFIN BAY SA	1081	0	NW
YELLOWTAIL KINGFISH	10-Nov-18	COFFIN BAY SA	0	0	
YELLOWTAIL KINGFISH	15-Sep-15	COFFIN BAY SA	1131	170	NE
YELLOWTAIL KINGFISH	31-Oct-17	COFFIN BAY SA	354	170	NE
YELLOWTAIL KINGFISH	20-Nov-16	COFFIN BAY SA	720	170	NE
YELLOWTAIL KINGFISH	31-Oct-17	COFFIN BAY SA	377	159	NE
YELLOWTAIL KINGFISH	20-May-16	HOPKINS ISLAND SA	875	169	NNE
YELLOWTAIL KINGFISH	25-May-18	HOPPIES SA	352	0	NW
YELLOWTAIL KINGFISH	04-Nov-16	PORT AUGUSTA (OUTLET CHANNEL) SA	736	170	SW
YELLOWTAIL KINGFISH	10-Nov-17	PORT AUGUSTA (OUTLET CHANNEL) SA	350	170	SW
YELLOWTAIL KINGFISH	03-Sep-14	PORT AUGUSTA (OUTLET CHANNEL) SA	1478	0	NW
YELLOWTAIL KINGFISH	26-Oct-15	PORT AUGUSTA (OUTLET CHANNEL) SA	1110	0	NW
YELLOWTAIL KINGFISH	09-Oct-18	PORT AUGUSTA (OUTLET CHANNEL) SA	52	0	NW
YELLOWTAIL KINGFISH	29-Sep-18	PORT AUGUSTA (OUTLET CHANNEL) SA	58	0	NW
YELLOWTAIL KINGFISH	14-Oct-16	PORT AUGUSTA (OUTLET CHANNEL) SA	749	41	SW
YELLOWTAIL KINGFISH	26-Nov-13	PORT AUGUSTA (OUTLET CHANNEL) SA	1827	41	SW
YELLOWTAIL KINGFISH	02-Dec-15	PORT AUGUSTA (OUTLET CHANNEL) SA	1059	0	NW
YELLOWTAIL KINGFISH	07-Nov-18	PORT AUGUSTA (OUTLET CHANNEL) SA	45	191	SW
YELLOWTAIL KINGFISH	02-Sep-18	PORT AUGUSTA (OUTLET CHANNEL) SA	122	167	SSW
YELLOWTAIL KINGFISH	07-Nov-14	PORT AUGUSTA (OUTLET CHANNEL) SA	1518	167	SSW
YELLOWTAIL KINGFISH	07-Oct-18	PORT AUGUSTA (OUTLET CHANNEL) SA	40	0	NW

APPENDIX I: RECAPTURES OF TAGGED FISH REPORTED IN 2018/2019 (CONTD)

Species	Date tagged	Release location	Days at liberty	Dist moved (nmi)	Direction
YELLOWTAIL KINGFISH	04-Nov-18	PORT AUGUSTA (OUTLET CHANNEL) SA	0	0	null
YELLOWTAIL KINGFISH	29-Sep-18	PORT AUGUSTA (OUTLET CHANNEL) SA	50	41	SW
YELLOWTAIL KINGFISH	21-Sep-18	PORT AUGUSTA (OUTLET CHANNEL) SA	67	28	S
YELLOWTAIL KINGFISH	19-Nov-16	PORT AUGUSTA (OUTLET CHANNEL) SA	735	0	NW
YELLOWTAIL KINGFISH	10-Oct-17	PORT AUGUSTA (OUTLET CHANNEL) SA	375	0	NW
YELLOWTAIL KINGFISH	19-Sep-18	PORT AUGUSTA (OUTLET CHANNEL) SA	0	0	
YELLOWTAIL KINGFISH	25-Nov-17	PORT AUGUSTA (OUTLET CHANNEL) SA	358	11	NW
YELLOWTAIL KINGFISH	02-Oct-18	PORT AUGUSTA (OUTLET CHANNEL) SA	32	0	NW
YELLOWTAIL KINGFISH	05-Oct-18	PORT AUGUSTA (OUTLET CHANNEL) SA	0	0	
YELLOWTAIL KINGFISH	03-Dec-15	PORT AUGUSTA (OUTLET CHANNEL) SA	1070	0	NW
YELLOWTAIL KINGFISH	19-Oct-13	PORT AUGUSTA (OUTLET CHANNEL) SA	1848	170	SW
YELLOWTAIL KINGFISH	12-Dec-17	PORT AUGUSTA (OUTLET CHANNEL) SA	321	0	NW
YELLOWTAIL KINGFISH	10-Oct-15	PORT AUGUSTA (OUTLET CHANNEL) SA	1107	0	NW
YELLOWTAIL KINGFISH	12-Sep-18	PORT AUGUSTA (OUTLET CHANNEL) SA	39	0	NW
YELLOWTAIL KINGFISH	26-Sep-17	PORT AUGUSTA (OUTLET CHANNEL) SA	394	104	SE
YELLOWTAIL KINGFISH	15-Oct-17	PORT AUGUSTA (OUTLET CHANNEL) SA	362	22	WNW
YELLOWTAIL KINGFISH	24-Nov-17	PORT AUGUSTA (OUTLET CHANNEL) SA	322	14	SSE
YELLOWTAIL KINGFISH	21-Oct-17	PORT AUGUSTA (OUTLET CHANNEL) SA	402	0	NW
YELLOWTAIL KINGFISH	30-Aug-15	PORT AUGUSTA (OUTLET CHANNEL) SA	1173	0	NW
YELLOWTAIL KINGFISH	24-Nov-17	PORT AUGUSTA (OUTLET CHANNEL) SA	290	0	NW
YELLOWTAIL KINGFISH	20-Sep-18	PORT AUGUSTA (OUTLET CHANNEL) SA	103	167	SSW
YELLOWTAIL KINGFISH	24-Oct-17	PORT AUGUSTA SA	422	675	SE
YELLOWTAIL KINGFISH	08-Oct-13	PORT AUGUSTA SA	1864	0	NW
YELLOWTAIL KINGFISH	28-Oct-17	PORT AUGUSTA SA	363	0	NW
YELLOWTAIL KINGFISH	27-Aug-18	PORT AUGUSTA SA	47	11	NW
YELLOWTAIL KINGFISH	07-Apr-18	PORT AUGUSTA SA	384	745	NE
YELLOWTAIL KINGFISH	14-Jan-19	LADY JULIA PERCY IS (PORT FAIRY) VIC	20	0	NW
YELLOWTAIL KINGFISH	26-Jan-19	JERVIS BAY NSW	53	0	NW
YELLOWTAIL KINGFISH	25-May-18	JERVIS BAY NSW	57	11	NE
YELLOWTAIL KINGFISH	21-Apr-19	CURRARONG NSW	22	0	NW
YELLOWTAIL KINGFISH	13-Apr-18	POINT PERPENDICULAR NSW	109	78	NNE
YELLOWTAIL KINGFISH	28-Mar-19	CURRARONG NSW	8	5	NNW
YELLOWTAIL KINGFISH	08-Sep-18	PARRAMATTA RIVER NSW	42	2	E
YELLOWTAIL KINGFISH	13-Oct-18	PARRAMATTA RIVER NSW	52	1	N
YELLOWTAIL KINGFISH	08-Sep-18	PARRAMATTA RIVER NSW	94	1	S
YELLOWTAIL KINGFISH	08-Sep-18	PARRAMATTA RIVER NSW	39	2	E
YELLOWTAIL KINGFISH	05-Sep-18	PARRAMATTA RIVER NSW	40	0	NW
YELLOWTAIL KINGFISH	03-Sep-18	PARRAMATTA RIVER NSW	39	2	E
YELLOWTAIL KINGFISH	08-Jan-18	PARRAMATTA RIVER NSW	284	2	E
YELLOWTAIL KINGFISH	02-Nov-18	PARRAMATTA RIVER NSW	20	2	E

APPENDIX I: RECAPTURES OF TAGGED FISH REPORTED IN 2018/2019 (CONTD

Species	Date tagged	Release location	Days at liberty	Dist moved (nmi)	Direction
YELLOWTAIL KINGFISH	03-Sep-18	PARRAMATTA RIVER NSW	64	2	E
YELLOWTAIL KINGFISH	19-Feb-19	JIBBON BEACH NSW	12	1	NW
YELLOWTAIL KINGFISH	21-Nov-18	GOAT ISLAND (SYDNEY) NSW	219	8	NE
YELLOWTAIL KINGFISH	11-Jun-18	GOAT ISLAND (SYDNEY) NSW	322	4	NE
YELLOWTAIL KINGFISH	30-Nov-18	GOAT ISLAND (SYDNEY) NSW	106	5	ESE
YELLOWTAIL KINGFISH	17-Dec-18	GOAT ISLAND (SYDNEY) NSW	30	4	ENE
YELLOWTAIL KINGFISH	31-Oct-18	GOAT ISLAND (SYDNEY) NSW	110	9	NE
YELLOWTAIL KINGFISH	13-Nov-17	GOAT ISLAND (SYDNEY) NSW	458	39	NNE
YELLOWTAIL KINGFISH	03-Dec-18	GOAT ISLAND (SYDNEY) NSW	31	0	NW
YELLOWTAIL KINGFISH	20-Oct-18	GOAT ISLAND (SYDNEY) NSW	44	0	NW
YELLOWTAIL KINGFISH	20-Oct-18	GOAT ISLAND (SYDNEY) NSW	15	0	NW
YELLOWTAIL KINGFISH	12-Dec-18	GOAT ISLAND (SYDNEY) NSW	31	2	E
YELLOWTAIL KINGFISH	03-Dec-18	GOAT ISLAND (SYDNEY) NSW	9	0	NW
YELLOWTAIL KINGFISH	11-Jun-18	GOAT ISLAND (SYDNEY) NSW	117	204	NNE
YELLOWTAIL KINGFISH	09-Feb-19	SYDNEY HARBOUR NSW	3	0	NW
YELLOWTAIL KINGFISH	12-Feb-19	SYDNEY HARBOUR NSW	52	2	ESE
YELLOWTAIL KINGFISH	12-Feb-19	SYDNEY HARBOUR NSW	52	2	ESE
YELLOWTAIL KINGFISH	24-Jun-18	SYDNEY HARBOUR NSW	161	0	NW
YELLOWTAIL KINGFISH	02-May-18	PORT JACKSON NSW	76	3	ENE
YELLOWTAIL KINGFISH	05-Apr-19	CLARKE ISLAND (SYD HARBOUR) NSW	43	0	NW
YELLOWTAIL KINGFISH	19-May-18	SYDNEY HARBOUR (TAYLORS BAY) NSW	161	61	S
YELLOWTAIL KINGFISH	12-May-19	MIDDLE HARBOUR NSW	7	0	NW
YELLOWTAIL KINGFISH	08-May-18	MIDDLE HARBOUR NSW	359	6	NNE
YELLOWTAIL KINGFISH	03-Sep-18	MIDDLE HARBOUR NSW	128	0	NW
YELLOWTAIL KINGFISH	11-Mar-19	OLD MANS HAT NSW	19	5	WSW
YELLOWTAIL KINGFISH	08-Mar-19	OLD MANS HAT NSW	13	2	ENE
YELLOWTAIL KINGFISH	11-May-19	SOUTH HEAD NSW	21	0	NW
YELLOWTAIL KINGFISH	03-Dec-18	PITTWATER NSW	8	0	NW
YELLOWTAIL KINGFISH	20-Nov-14	SYDNEY (NORTH HEAD) NSW	1389	358	NNE
YELLOWTAIL KINGFISH	17-Feb-17	SYDNEY (NORTH HEAD) NSW	529	12	ESE
YELLOWTAIL KINGFISH	20-Jan-19	LONG REEF NSW	43	6	SSW
YELLOWTAIL KINGFISH	02-Mar-19	LONG REEF NSW	25	0	NW
YELLOWTAIL KINGFISH	19-Oct-18	LONG REEF NSW	69	0	NW
YELLOWTAIL KINGFISH	01-Dec-18	LONG REEF NSW	10	0	NW
YELLOWTAIL KINGFISH	10-Jun-18	MIDDLE HARBOUR NSW	34	266	NNE
YELLOWTAIL KINGFISH	02-Aug-18	12 MILE REEF NSW	272	10	NW
YELLOWTAIL KINGFISH	28-Jul-18	12 MILE REEF NSW	59	4	ENE
YELLOWTAIL KINGFISH	31-Jul-18	12 MILE REEF NSW	249	0	NW
YELLOWTAIL KINGFISH	09-Aug-18	12 MILE REEF NSW	36	0	NW
YELLOWTAIL KINGFISH	14-Sep-18	12 MILE REEF NSW	5	0	NW
YELLOWTAIL KINGFISH	06-Aug-18	12 MILE REEF NSW	132	0	NW

APPENDIX I: RECAPTURES OF TAGGED FISH REPORTED IN 2018/2019 (CONTD

Species	Date tagged	Release location	Days at liberty	Dist moved (nmi)	Direction
YELLOWTAIL KINGFISH	26-Jun-18	12 MILE REEF NSW	173	0	NW
YELLOWTAIL KINGFISH	28-Jul-18	12 MILE REEF NSW	51	0	NW
YELLOWTAIL KINGFISH	09-Aug-18	12 MILE REEF NSW	94	0	NW
YELLOWTAIL KINGFISH	09-Aug-18	12 MILE REEF NSW	94	0	NW
YELLOWTAIL KINGFISH	28-Jul-18	12 MILE REEF NSW	0	0	
YELLOWTAIL KINGFISH	14-Sep-18	12 MILE REEF NSW	13	0	NW
YELLOWTAIL KINGFISH	01-Aug-18	12 MILE REEF NSW	59	0	NW
YELLOWTAIL KINGFISH	02-Aug-18	12 MILE REEF NSW	54	0	NW
YELLOWTAIL KINGFISH	25-Sep-18	12 MILE REEF NSW	68	0	NW
YELLOWTAIL KINGFISH	09-Aug-18	12 MILE REEF NSW	42	10	WSW
YELLOWTAIL KINGFISH	02-Aug-18	12 MILE REEF NSW	50	0	NW
YELLOWTAIL KINGFISH	14-Sep-18	12 MILE REEF NSW	5	0	NW
YELLOWTAIL KINGFISH	25-Jun-18	12 MILE REEF NSW	53	0	NW
YELLOWTAIL KINGFISH	22-Jun-18	12 MILE REEF NSW	56	0	NW
YELLOWTAIL KINGFISH	22-Jun-18	12 MILE REEF NSW	56	0	NW
YELLOWTAIL KINGFISH	24-Jul-18	12 MILE REEF NSW	35	0	NW
YELLOWTAIL KINGFISH	06-Aug-18	12 MILE REEF NSW	11	0	NW
YELLOWTAIL KINGFISH	31-Jul-18	12 MILE REEF NSW	249	0	NW
YELLOWTAIL KINGFISH	20-Dec-19	12 MILE REEF NSW	0	0	
YELLOWTAIL KINGFISH	11-Jul-18	SOUTH WEST ROCKS NSW	35	0	NW
YELLOWTAIL KINGFISH	10-Jun-18	SOUTH WEST ROCKS (FISH ROCK) NSW	58	0	NW
YELLOWTAIL KINGFISH	24-Dec-18	SOUTH SOLITARY ISLAND NSW	69	139	SW
YELLOWTAIL KINGFISH	03-May-19	TWEED HEADS (30 FATHOMS) NSW	26	0	NW
YELLOWTAIL KINGFISH	17-May-19	FISH ROCK (SOUTH WEST ROCKS) NSW	19	0	NW
YELLOWTAIL KINGFISH	07-Jan-19	FISH ROCK (SOUTH WEST ROCKS) NSW	72	0	NW

APPENDIX II: TOP TAGGING BOATS AND ANGLERS FOR 2018/2019

NSW DPI would like to recognise the boats and anglers that have provided exceptional contributions to the program over the past season. These boats and anglers are shown in the table below with the numbers of fish that they tagged over the 2018/2019 season. We will continue to develop these end of season summaries and acknowledge the strong supporters of the tagging program in future years. The 2018/2019 game fishing season ended on June 30, 2018 and resulted in over 8,900 fish tagged. The top ten species tagged are shown in the table below.

KEY SPECIES TAGGED 2018/2019

Species	Number tagged
BLACK MARLIN	2104
YELLOWTAIL KINGFISH	1061
SOUTHERN BLUEFIN TUNA	988
STRIPED MARLIN	944
SAILFISH	834
BLUE MARLIN	640
DOLPHINFISH	372
WHALER SHARK	279
MAKO SHARK	186
SAMSON FISH	178

TOP TAGGING BOATS AND ANGLERS 2018/19

Species	Top boat	Runner up boat
Billfish combined	**128 - *The Wench* (WA) King Bay GFC**	**115 - *Pole Dancer* (QLD) Sunshine Coast GFC**
Black Marlin	**94 - *Pole Dancer* (QLD) Sunshine Coast GFC**	**57 – *Mistress* (QLD) Gold Coast GFC**
Blue Marlin (International)	**62 - *Blue Marlin Magic* (Tonga) Vava'u SFC**	**33 – *Black Label* (PNG) Lae GFC**
Blue Marlin (Australia)	**45 - *Mistress* (QLD) Gold Coast GFC**	**19 - *Pole Dancer* (QLD) Sunshine Coast GFC**
Striped Marlin	**67 – *Relentless Pursuit* (NSW) Canberra GFC**	**65 – *Tomahawk* (NSW) Ulladulla GFC**

Species	Top boat	Runner up boat
Sailfish	**74 - *The Wench* (WA) King Bay GFC**	**50 - *Big Daddy* (WA) King Bay GFC**
Shortbill Spearfish	**3 - *Engagement* (NSW) Lake Macquarie GFC, *Tantrum* (NSW) Sydney GFC**	**2 - *Outa The Blue* (NSW) Lake Macquarie GFC, *Reel Smart* (NSW) Sydney GFC**
Swordfish	**7 - *Tagged by Commercial Vessel* (NSW)**	**3 - *Terminator* (NSW) GFC of Northern Tasmania**
Shark combined	**83 – *Tantrum* (NSW) Sydney GFC**	**26 - *Undertaker* (NSW) Port Hacking GFC**
Mako Shark	**15 - *Undertaker* (NSW) Port Hacking GFC**	**6 - *Makajax II* (TAS) GFC of Northern Tasmania**
Blue Shark	**8 - *Undertaker* (NSW) Port Hacking GFC**	**5 - *Tantrum* (NSW) Sydney GFC**
Tiger Shark	**6 - *Blue Stuff* (WA) Nickol Bay SFC**	**5 - *Triple H* (WA) Perth GFC**
Whaler Shark	**75 - *Tantrum* (NSW) Sydney GFC**	**25 - *Wet Puss* (WA) Perth GFC**
Hammerhead Shark	**6 - *Phillet* (NSW) Port Macquarie GFC**	**4 - *Frantic* (NSW) Shellharbour GFC**

Species	Top boat	Runner up boat
Thresher Shark	**2 - *Gaurdian* (NSW) Bermagi BG & LAC**	**1 - Choona Chasa (TAS) Tuna Club of Tasmania**
Tuna combined	**113 - *Meerkat* (VIC) Warrnambool Offshore & Light GFC**	**96 - *Spartacus* (SA) GFC of SA**
Yellowfin Tuna	**5 - *Hardline* (QLD) Mackay GFC**	**4 - *Another Screema* (NSW) Canberra GFC**
Southern Bluefin Tuna	**113 - *Meerkat* (VIC) Warrnambool Offshore & Light GFC**	**96 - *Spartacus* (SA) GFC of SA**
Bigeye Tuna	**4 - *Tagged by Commercial Vessel* (NSW)**	
Albacore Tuna	**8 - *Boys Toys* (TAS) Tuna Club of Tasmania, *Sharkn Hell* (TAS) St Helens GFC**	**7 - *Bugger Work* (TAS) St Helens GFC**
Longtail Tuna	**9 - *Black Rat* (NSW)**	**6 - *Tag Team* (QLD) Weipa Billfish Club**
Dogtooth Tuna		
Spanish Mackerel	**31 - *Mates Rates* (QLD) Mackay GFC**	**14 – *Mandalay* (WA) Perth GFC**
Mahi Mahi	**34 – *Hooked Up* (NSW)**	**23 - *Nevahome* (NSW) Eden S & GFC**
Yellowtail Kingfish	**127 - *Ocean Hunter* (NSW) Ocean Hunter Sports Fishing Charters**	**113 - *Reel Therapy* (SA) Absolute**

Species	Top boat	Runner up boat
		Fishing Charters

Species	Top individual	Runner up individual
Billfish	**72 - Dale Penhall (QLD) Sunshine Coast GFC**	**58 - Chloe Laurence (NSW) Ulladulla GFC**
Shark	**51 - Mia Wright (NSW) Sydney GFC**	**25 - Chloe Hornhardt (WA) King Bay GFC**
Tuna	**62 - Jan Oosthuizen (VIC) Warrnambool Offshore & Light GFC**	**38 - Anne-Marie Oosthuizen (VIC) Warrnambool Offshore & Light GFC**
Seriola	**162 - Vic Levett (NSW)**	**59 - Seamus McCleave (NSW)**

APPENDIX III

SCIENTIFIC PUBLICATIONS THAT HAVE UTILIZED OR CITED DATA FROM THE TAGGING PROGRAM

(LISTED CHRONOLOGICALLY FROM MOST RECENT)

Corrigan, S., A.D. Lowther, L.B. Beheregaray, B.D Bruce, G. Cliff, C.A. Duffy, A. Foulis, M.P. Francis, S.D. Goldsworthy, J.R. Hyde, R. Jabado, D. Kacev, L. Marshall, G.R. Mucientes, G.J.P. Naylor, J.G. Pepperell, N. Queiroz, W.T. White, S.P. Wintner, P.J. Rogers (2018). Population connectivity of the highly migratory shortfin mako (*Isurus oxyrinchus* Rafinesque 1810) and implications for management in the Southern Hemisphere. Frontiers in Ecology and Evolution, section Conservation, 6:187, doi: 10.3389/fevo.2018.00187.

Williams, S.M., J.G. Pepperell, M.B. Bennett, B.J. Holmes and J.R. Ovenden (2018). Global genetic population structure of black marlin (*Istiompax indica*) and its relevance to fishery management. In Review.

Brodie S., L. Litherland, J. Stewart, H.T. Schilling, J.G. Pepperell and I.M. Suthers (2018). Citizen science records describe the distribution and migratory behaviour of a piscivorous predator, *Pomatomus saltatrix*. ICES Journal of Marine Science, doi:10.1093/icesjms/fsy057

Tracey, S. and J. Pepperell (2018). Understanding the movement, behaviour and post-capture survival of recreationally caught swordfish from southeast Australia – a pilot study. FRDC Project No 2015/022, 87pp.

Champion, C., A. J. Hobday, Z. Xuebin, G.T. Pecl and S.R. Tracey (2018). Changing windows of opportunity: past and future climate-driven shifts in temporal persistence of kingfish (*Seriola lalandi*) oceanographic habitat within south-eastern Australian bioregions. Marine and Freshwater Research, doi.org/10.1071/MF17387.

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Hillary, R., A. Preece, D. Kolody, K. Evans and C. Davies (2016). Development of an approach to harvest strategy management of internationally managed multi-species fisheries, CSIRO, Hobart, Tasmania, Australia. FRDC Project No 2013/203

Zischke, Mitchell T., Litherland, Lenore, Tilyard, Benjamin R., Stratford, Nicholas J., Jones, Ebony L. and Wang, You-Gan (2016). Otolith morphology of four mackerel species (*Scomberomorus* spp.) in Australia: species differentiation and prediction for fisheries monitoring and assessment. Fisheries Research 176, 39-47.

Romanov, E. (2016). A preliminary summary of billfish tagging in the Indian Ocean. Indian Ocean Tuna Commission (IOTC) Working Party on Billfish (WPB) Victoria, Seychelles. IOTC–2016–WPB14–INF01

Hill, N.J., A.J. Tobin, A.E. Reside, J.G. Pepperell and T.C.L. Bridge (2015). Dynamic habitat suitability modelling reveals rapid poleward distribution shift in a mobile apex predator. Global Change Biology, doi: 10.1111/gcb.13129.

Brodie, S., A.J. Hobday, J.A. Smith, J.D. Everett, M.D. Taylor, C.A. Gray and I.M. Suthers. (2015). Modelling the oceanic habitats of two pelagic species using recreational fisheries data. Fisheries Oceanography, 24 (5), 463-477.

Bridge, T., A. Tobin, A. Reside, J. Pepperell and N. Hill (2015). Anglers have helped detect a shift in the habitat of black marlin. The Conversation, December 2, 2015.

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Holmes, B., J. Pepperell, S Griffiths, F. Jaine, I. Tibbetts and M Bennett (2014). Tiger shark (*Galeocerdo cuvier*) movement patterns and habitat use determined by satellite tagging in eastern Australian waters. Marine Biology, DOI 10.1007/s00227-014-2536-1.

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Bruce, B. and 24 co-authors (2014). Shark futures: A synthesis of available data on mako and porbeagle sharks in Australasian waters. Current status and future directions – August 2014. FRDC 2011/045 Tactical Research Fund, 137pp.

Pepperell, J., P. Bolton, A. Welfare and S. Boyd (2013). Forty years of conventional billfish tagging. Successes, failures and lessons learned. Paper presented at the Fifth International Billfish Symposium, Taipei, Taiwan, November 2013.

Domeier, M.L. and P. Speare. (2012). Dispersal of adult black marlin (*Istiompax indica*) from a Great Barrier Reef spawning aggregation. PLoS ONE 7, e31629.

Zischke, M.T., Griffiths, S.P. and Tibbetts, I.R. (2012). Catch and effort from a specialized recreational pelagic sport fishery off eastern Australia. Fisheries Research 127-128: 61-72.

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Pepperell, J. (2010). Fishes of the Open Ocean: A Natural History and Illustrated Guide, UNSW Press.

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Babcock, E. (2008). Recreational fishing for pelagic sharks worldwide. In: Sharks of the Open Ocean: Biology, Fisheries and Conservation, Edited by M. D. Camhi, E. K. Pikitch and E. A. Babcock © 2008 Blackwell Publishing Ltd. ISBN: 978-0632-05995-9

McLoughlin, K. and G. Eliason (2008). Review of information on cryptic mortality and the survival of sharks and rays released by recreational fishers. Bureau of Rural Sciences, Canberra. SEDAR21-RD-22, 22 pp.

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UNIVERSITY THESES

The following theses have all been successfully completed, most of them relying heavily on data from the NSW DPI Game Fish Tagging program:

Cameron Baber, James Cook University. Examining the impacts of environmental factors on the distribution of the shortfin mako shark, *Isurus oxyrinchus*, from eastern Australia. M.Sc., 2018.

Samuel Williams, University of Queensland. The global biology, ecology and phylogenetic status of black marlin (*Istiompax indica*) Ph.D. 2018.

Shane Ovington, University of Queensland. The distribution and size structure of blue marlin (*Makaira nigricans*) along the East Coast of Australia, modelled from recreational capture and tagging data. B.Sc. Honours 2017.

Stephanie Brodie, University of New South Wales. The ecology and distribution of two pelagic fish: yellowtail kingfish Seriola lalandi and dolphinfish *Coryphaena hippurus*. Ph.D. 2016.

Bonnie Holmes, University of Queensland. The biology and ecology of the tiger shark (*Galeocerdo cuvier*) on the east coast of Australia. Ph.D 2015.

Nicholas Hill. James Cook University. Variability in the distribution and movement of black marlin (Istiompax indica) determined via environmental conditions along the East Coast of Australia using recreational tag data. B.Sc. Honours, 2014.

Samuel Williams, University of Queensland Genetic population structure of black marlin (*Istiompax indica*) within the central Indo-Pacific: Breeding populations defined despite mitonuclear discordance. B.Sc. Honours, 2014.

Ronan Lynch, University of Queensland, Variability in the spatial and temporal occurrence, and size composition of sailfish (*Istiophorus platypterus*) in eastern Australian waters, and the influence of environmental conditions. B.Sc. Honours, 2012.

Richard Keller Kopf, Charles Sturt University. Age, growth and reproductive dynamics of striped marlin, *Kajikia audax*, in the southwest Pacific ocean. Ph.D., 2010.

Tom Bridge, University of Sydney. Effects of environmental variables on the recruitment and distribution of juvenile black marlin, *Makaira indica*, off the east coast of Australia. B.Sc. Honours, 2007.

John Hoolihan, University of New South Wales, Biology and stock structure of sailfish in the Persian Gulf. Ph.D., 2005.

Danielle Williams, University of New South Wales. Variations in the size composition and occurrence of yellowfin tuna (*Thunnus albacares*) in eastern Australian waters through time, inferred from a unique recreational-based dataset. B.Sc. Honours, 2003.

Ricky Chan, University of New South Wales. Biology of pelagic sharks off New South Wales. Ph.D., 2001.

Joanne Bennett, University of New South Wales. Ecology of dolphin fish (*Coryphaena hippurus*) and other large pelagic species: Environmental influences on their distribution. B.Sc. Honours, 2000.

CURRENT PROJECTS USING DATA

Two studies are currently under way that are utilizing data from the Game Fish Tagging program. They are:

“Where have all the yellowfin tuna gone? Investigating the disjunct between commercial and recreational catches off NSW”. Led by Pepperell Research and CSIRO co-investigating.

“Investigate oceanographic and environmental factors impacting on the Eastern Tuna and Billfish Fishery (ETBF)”. Led by CSIRO with input from AFMA, BoM, ABARES and the University of the Sunshine Coast.

MAGAZINES, EMAIL LISTS

Many articles on the tagging program have appeared in recreational fishing magazines, especially in ‘Bluewater Boats & Sportfishing’, which is targeted at a game fishing audience.

Regular updates on the tagging program, provided by NSW DPI staff, are published in ‘Bluewater Boats & Sportfishing’.

Tag Times e-zine is distributed to a large email list on a regular basis.

Annual Reports of the Game Fish Tagging program

Lastly, detailed Annual Reports on the program have been regularly published throughout its history, originally in hard copy, and digitally over the past decade. These are all available at NSW Game Fish Tagging Reports