NSW DPI Game Fish Tagging Program

Report 2013-2014

Recreational Fishing Trusts

NSW GOVERNMENT Primary Industries

Pepperell Research
Marine Science & Recreational Fisheries

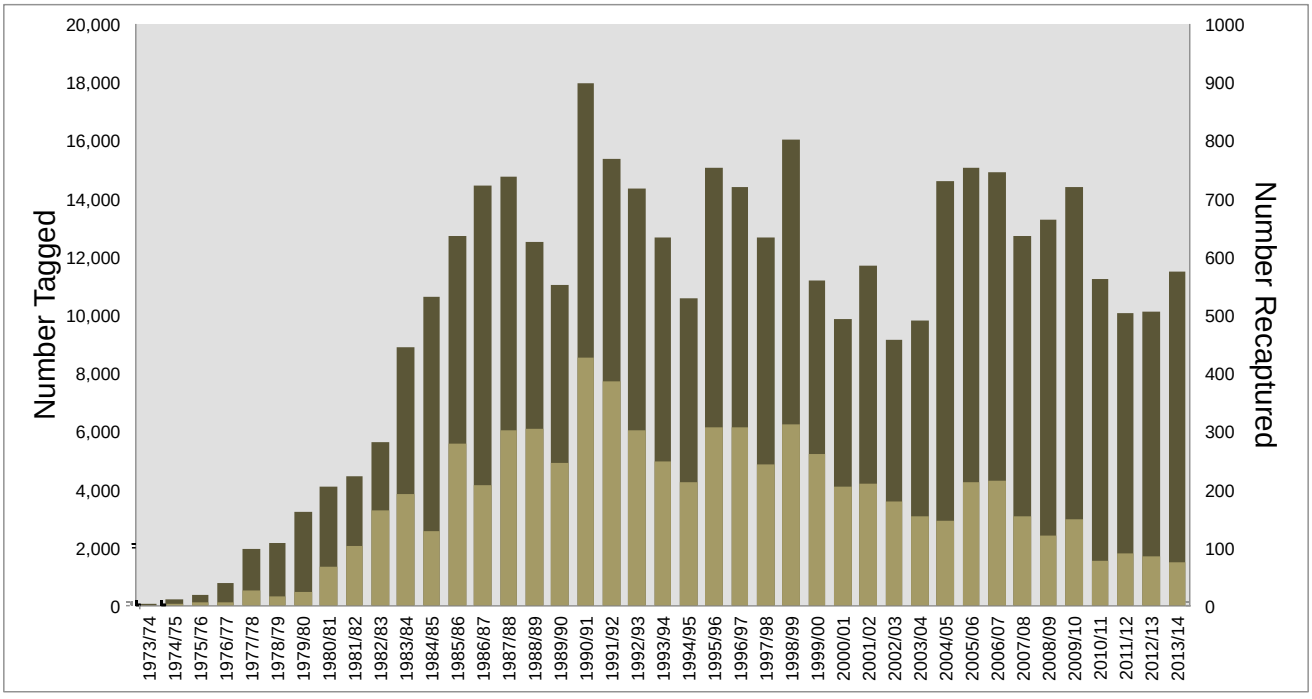
NSW DPI Game Fish Tagging Program

2013/2014

Gamefish anglers around most of Australia enjoyed a good fishing season during 2013/2014. Reversing a downward trend, the number of fish tagged during the year was higher than the previous three years. A total of 11,501 fish were tagged for the year and 73 completed recaptures were recorded. Figure 1 shows the number of fish tagged (and recaptured) in the program throughout its history. The number of fish tagged each year has fluctuated through time. There was a steady increase in annual numbers of taggings to the mid 1980s as the program gained acceptance and tag-and-release became an integral part of game fishing in Australia. In nearly every year since then, the total number of fish tagged has exceeded 10,000 (Figure 1).

Total numbers of fish tagged each year vary for many reasons, especially the availability of different 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, resulting in stronger than usual influxes of some species in the warmer currents. This year, as outlined further in the report, for the second year in succession, juvenile (less than one year old) black marlin appeared in numbers from northern Queensland to central NSW, and off northwestern Australia, resulting in high numbers of that species being tagged. Another contributor to increased taggings this year was a strong appearance of dolphinfish (mahi mahi) off the NSW coast in summer resulting in nearly four times as many of that species tagged compared with last year.

Figure 1. Numbers of fish tagged and recaptured by year, to 2013/2014



The Program overall

Over the history of the program, the grand total of fish tagged and recaptured, as at the end of June 2014, stood at 419,791 and 7,098 respectively, continuing the program's status as one of the largest of its kind in the world (Table 1). This table summarises taggings and recaptures of the main species (or species groups) tagged, with all others combined as 'all other species'.

The species tagged in the greatest numbers continues to be black marlin (just under 59,000 tagged, and representing 14.0% of all releases) followed by yellowfin tuna, yellowtail kingfish, sailfish, mahi mahi (dolphinfish), striped marlin and albacore.

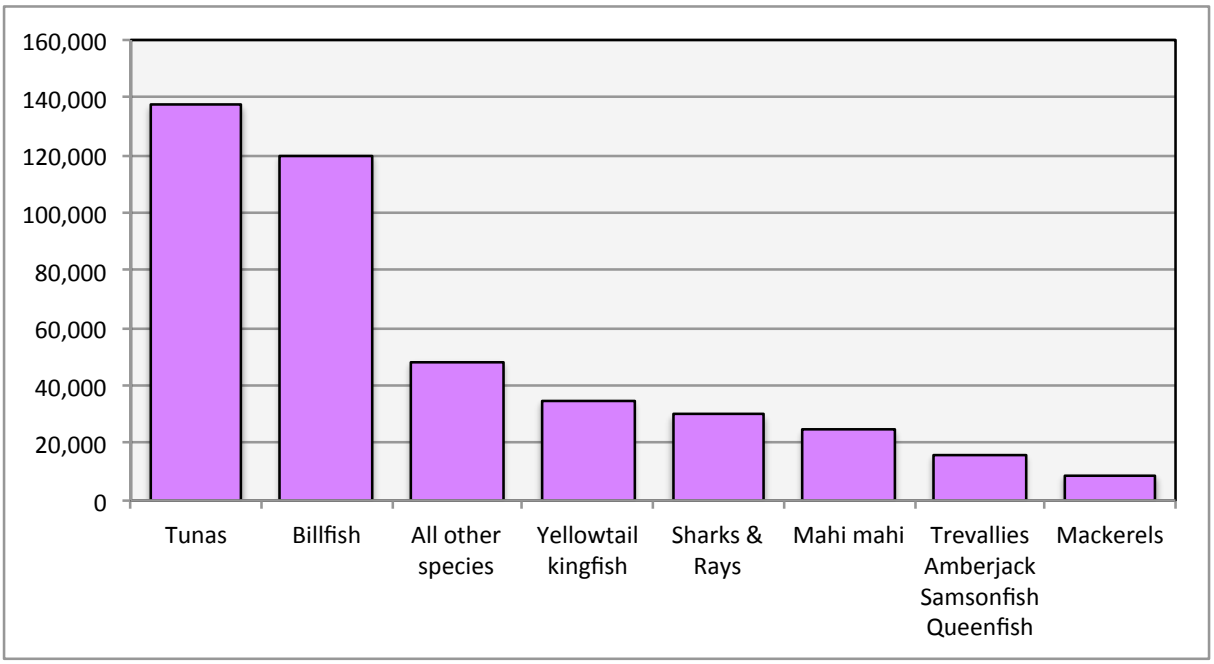
Table 1. Total numbers of fish tagged and recaptured: 1974-2014

Species	Total Tagged	Recaptures	%Recapt
BLACK MARLIN	58,960	450	0.76
YELLOWFIN TUNA	37,860	687	1.81
YELLOWTAIL KINGFISH	34,640	2,198	6.35
SAILFISH	29,707	308	1.04
DOLPHINFISH	24,709	219	0.89
STRIPED MARLIN	23,308	218	0.93
ALBACORE	21,632	163	0.75
STRIPED TUNA	21,038	68	0.32
MACKEREL TUNA	20,443	62	0.3
SOUTHERN BLUEFIN TUNA	18,134	127	0.7
WHALER SHARKS	12,406	253	2.04
BONITO	13,241	219	1.65
AUSTRALIAN SALMON*	9,742	611	6.27
SPANISH MACKEREL	8,961	83	0.93
BLUE MARLIN	7,920	22	0.29
MAKO SHARK	7,546	174	2.31
SILVER TREVALLY*	6,931	197	2.84
HAMMERHEAD SHARKS	5,332	55	1.03
LONGTAIL TUNA	4,857	59	1.21
BLUE SHARK	4,675	76	1.63
TAILOR*	4,030	122	3.03
TREVALLY	3,376	31	0.92
BARRACUDA	3,311	6	0.18
QUEENFISH	3,234	10	0.31
GIANT TREVALLY	2,571	34	1.32
ALL OTHER SPECIES	31,227	646	2.07
TOTAL	**419,791**	**7,098**	**1.69**

*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 for the history of the program, Figure 2 shows that tunas remain the group tagged in the largest numbers (137,205 tagged, or 32.7% of the total) followed by billfish (119,895 or 28.6% of all fish tagged). A single species, yellowtail kingfish, with 34,640 tagged, represent 8.3% of all taggings while the total number of sharks and rays (29,959) represents just 7.1% of the total number of fish tagged.

Figure 2. Total numbers of fish tagged as species groupings, 1974-2014



Summary for 2013/2014

Table 2. Numbers of fish tagged and recaptured in 2013/2014

Species	Number	Recaptured
BLACK MARLIN	2,757	16
SOUTHERN BLUEFIN TUNA	1,896	4
SAILFISH	1,157	10
DOLPHINFISH	1,094	5
BLUE MARLIN	596	
STRIPED MARLIN	567	2
STRIPED TUNA	475	
YELLOWFIN TUNA	442	
ALBACORE	331	2
YELLOWTAIL KINGFISH	303	13
SAMSON FISH	229	2
MAKO SHARK	208	4
SPANISH MACKEREL	208	1
WHALER SHARK	142	3
BLUE SHARK	122	
AUSTRALIAN SALMON	121	1
BARRACUDA	84	
BRONZE WHALER	78	
QUEENFISH	70	
MACKEREL TUNA	67	
SPOTTED MACKEREL	60	
SNAPPER	50	3
HAMMERHEAD SHARK	46	
LARGE SCALE TUNA	44	
TIGER SHARK	37	2
EAGLE RAY	32	
LONGTAIL TUNA	32	
WAHOO	30	
SHORTBILL SPEARFISH	29	
TREVALLY	27	
GUMMY SHARK	25	2
SCHOOL SHARK	19	2
BROAD BARRED MACKEREL	17	
BROADBILL	15	
COBIA	15	1
GIANT TREVALLY	14	
RAINBOW RUNNER	13	
BIGEYE TUNA	9	
AMBERJACK	8	
SCHOOL MACKEREL	8	
BLACKTIP SHARK	6	
GOLD SPOTTED TREVALLY	4	
GOLDEN TREVALLY	4	
MULLOWAY	3	
SILVER TREVALLY	2	
BARRAMUNDI	1	
BONITO	1	
DOGTOOTH TUNA	1	
THRESHER SHARK	1	
WHITETIP SHARK	1	
TOTAL	**11,501**	**73**

Regarding the 2013/2014 tagging year, Table 2 shows that black marlin was the species tagged in the greatest numbers (2,757) – following the previous year's near record total of just over 3,000. This total was strongly contributed to by an excellent season on juvenile fish (35-45kg) off both Dampier and Exmouth in Western Australia, and on even smaller fish (10-20kg) off northern and southern Queensland. There were also significant numbers of two year old fish (40-60kg) tagged off central NSW, presumably the flow-on from the previous year's strong showing of one year olds.

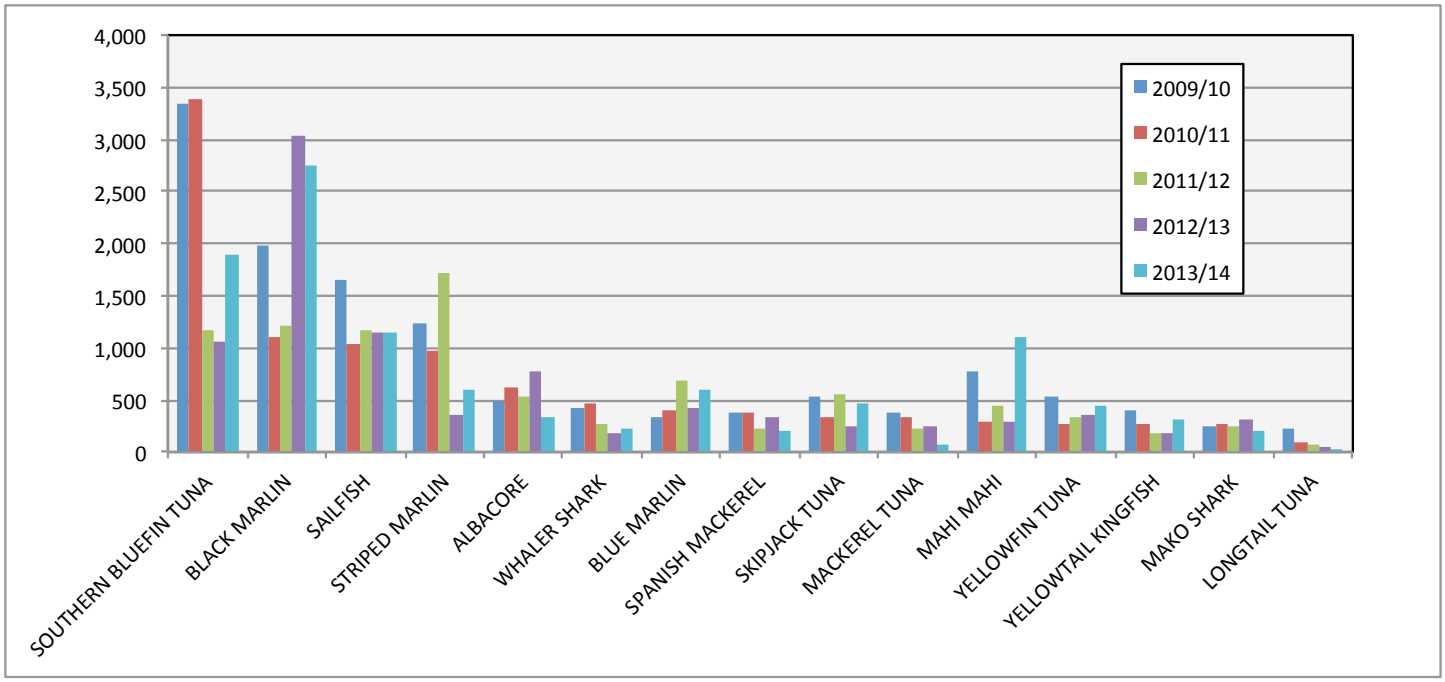
The number of blue marlin tagged (596) was near the record high set in 2011/2012, contributed from good seasons off the Gold Coast and central NSW, as well as Exmouth WA. Significant numbers of blue marlin were also tagged off Papua New Guinea, Tonga and Vanuatu.

Tag-and-releases of southern bluefin tuna (SBT) were close to double the number of releases last year. The great majority of fish tagged were 'school' fish, ranging between 3 kg and 20 kg. Tagging activity on SBT was concentrated largely off Kangaroo Island and Port MacDonnell in South Australia, Portland and Warrnambool in Victoria and off eastern Tasmania. A few very small fish were tagged in Western Australia and small numbers of larger fish (50-55 kg) were tagged off the NSW south coast.

Reiterating points made in previous reports, the real-time detection and quantification of changes in either fishing activities of the recreational sector, or availability of fish, would be all but impossible in the absence of the tagging program.

Figure 3 (below) shows a comparison of species or species groups tagged over the past five years. This illustrates the variability in availability of different species across a number of seasons. For example, it shows the marked fluctuations in black marlin and southern bluefin tuna taggings already mentioned. Other points of interest are the very similar numbers of sailfish tagged over the past three years, steady annual increases in the number of yellowfin tuna tagged, high inter-annual variability in numbers of mahi mahi tagged and relatively consistent numbers of blue marlin tagged.

Figure 3. Numbers of main species and species groups tagged in 2013/2014 and the previous four years.



Combining the species tagged into groups, Figure 4a shows that billfish dominated overall taggings in 2013/2014, constituting 44.5% of all fish tagged – a little lower than the previous year but considerably higher than has been the case in average years when billfish have averaged about 30 to 35% of all fish tagged in a given year. The proportion of tunas tagged represented 28.7% of the total while sharks and rays combined represented 6.2% of the total, down a little on the average of about 7% over the last decade or so.

Figure 4a. Species groups tagged in 2013/2014

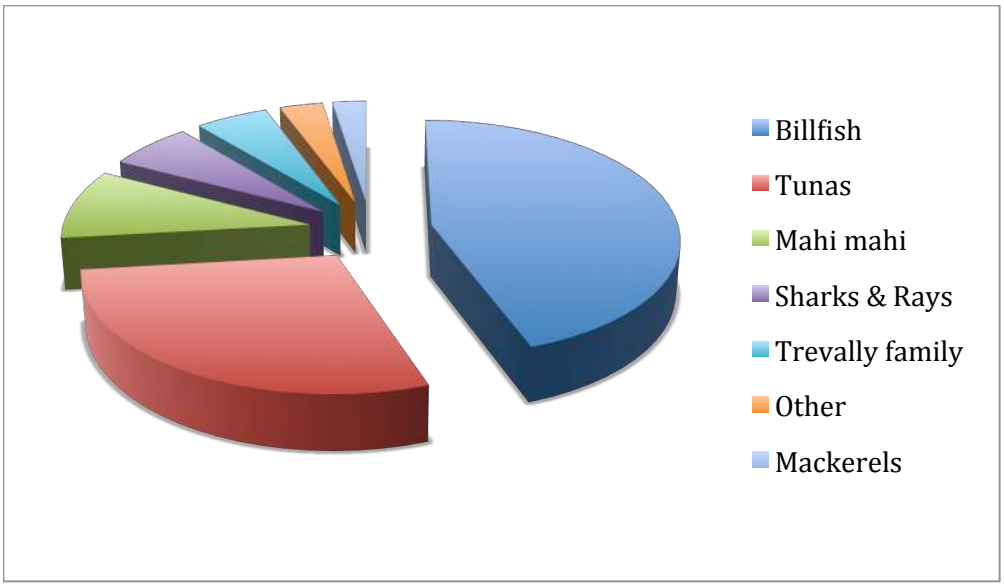
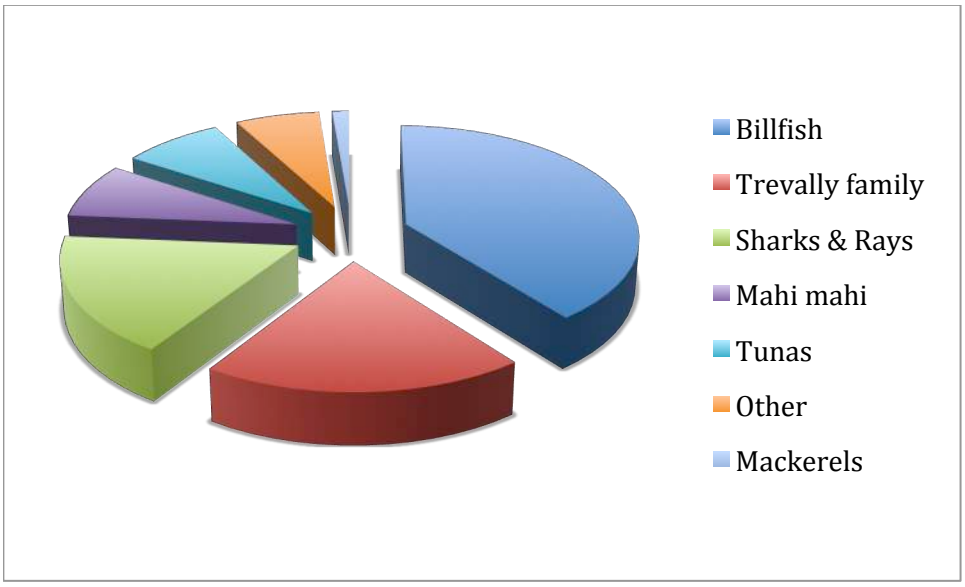


Figure 4b shows the proportions of the major species groups recaptured in 2013/2014, as usual indicating quite different proportions to those tagged. While billfish still dominate recaptures (39.5%), the trevally family, due mainly to yellowtail kingfish, represent the next highest proportion of recaptures (19.7%) and as usual, sharks show a higher recapture rate, constituting about 17% of all recaptures. This year, tuna recaptures consisted of just four southern bluefin and two albacore, nevertheless, an increase on last year when only one tuna recapture (a mackerel tuna) was recorded.

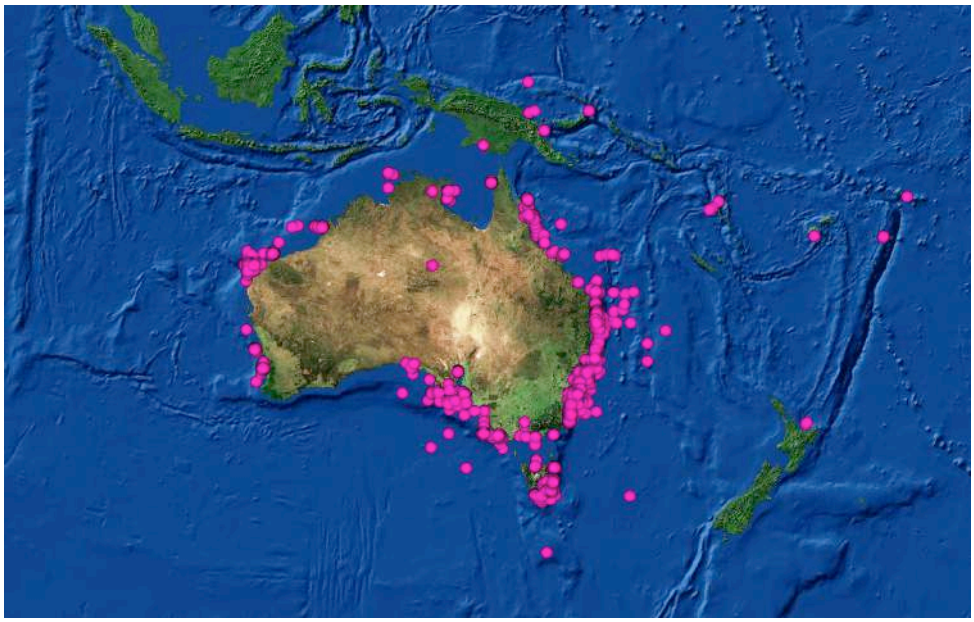
Figure 4b. Species groups recaptured in 2013/2014



Highlights

The map below shows locations of fish tagged in 2013/2014. The program is a truly national one, and extends to neighbouring regions. Note that New Zealand operates its own similar tagging program.

Figure 5. Positions of releases of tagged gamefish during 2013/2014.



Recaptures 2013/2014

All of the completed recaptures recorded in 2013/2014 are listed in Appendix I. Following are just some of the highlights of these recaptures. These tend to emphasise some of the longer times at liberty, or longer distances moved by tagged fish, and as such, are often exceptions to the rule. In contrast, many fish are recaptured relatively close to their points of release, often within relatively short times and it is important to realise that the information gained from these recaptures is just as important to our understanding of the movements and growth of game fish as longer term, longer distance recaptures.

Black marlin

For the second year running, black marlin topped the recapture list. This year, 16 recaptures were recorded with days at liberty ranging from 13 to 391 days. All but two of these fish had been tagged in Queensland waters between Oyster Reef in the north and Mooloolaba in the south. The other two had been released off Port Stephens NSW. Noteworthy recaptures included one of the Port Stephens fish which moved a minimum distance of 1,650 nautical miles north in its seven months of liberty, to be recaptured by a traditional fisherman off Buka Island, Bougainville. Another was also recaptured by a native fisherman off Buka Island, having been tagged off Oyster Reef, Cairns 391 days earlier, while yet another black marlin, tagged off Townsville, travelled 1,358 nautical miles northeast to the Solomon Islands where it was also recaptured by a canoe fisherman almost exactly one year after tagging. These recaptures add to a growing list of juvenile black marlin that have been tagged off eastern Australia and recaptured by artisanal fishermen using dugout canoes through the Solomons, Bougainville and the Milne Bay province of eastern Papua New Guinea. Adding to this story was another recapture by a New Caledonian longliner of a small black marlin at Bellona Reefs, on an undersea ridge running between Lord Howe Island and the Solomon Islands. This suggests that the route for these fish after leaving the Australian coast is initially northeasterly until they locate one of the north-south ridges and then following those to the Solomons and PNG. Interestingly, a very small (8 kg) black marlin tagged off Innisfail, QLD headed even further north. It was recaptured by a Taiwanese longline vessel in the waters of Micronesia, some 1,559 nautical miles from its release point. This fish had originally been called a blue marlin at release, but confirmed as a black at recapture. It had been at liberty for 347 days at which time it was estimated to weigh 40 kg – confirming the very rapid growth rate of juvenile black marlin. A similar example of rapid growth was shown by the recapture of a black marlin estimated at just 13 kg on its release off Townsville. It was subsequently recaptured off Southwest Rocks NSW one year and five months later at an estimated size of 55 kg. These are good illustrations of a sometimes forgotten benefit of the tagging program – the provision of direct estimates of growth rates of gamefish.

Seven of the black marlin recaptured in 2013/2014 were tagged off Mooloolaba, southeastern Queensland. Five of those were recaptured within 20 miles of their points of release up to 84 days after tagging. On the other hand, one Mooloolaba tagged fish was recaptured off Port Stephens after 50 days, while the fastest mover was recaptured off ‘the Tubes’, Jervis Bay NSW after only 21 days, a distance of 525 nautical miles at an average of 25 nautical miles per day. This recapture was actually a first for the tagging program, being the first land-based recaptured marlin. It was caught by 13 year Gorkem Biyiksiz on his first attempt at marlin fishing from the rocks with his father Tijay.

Sailfish

Ten sailfish were recaptured during 2013/2014, five tagged off northwestern Australia and five off Mooloolaba, southeast Queensland. As is usually the case for sailfish, very little movement was evident for all except one fish, tagged off Mooloolaba and recaptured 130 miles to the north off Fraser Island 40 days after release. Two of the sailfish that were recaptured very near their release points were at liberty for long periods – one, tagged and recaptured off Mooloolaba, for nearly exactly a year and the other, tagged and recaptured off Exmouth, WA, for almost exactly three years. Both were recaptured within 7 nautical miles of their release points. Only a handful of the 308 sailfish recaptured over the history of the program have been caught more than 500 miles from their release points, while in contrast, many have been recaptured very near their release points after one, two, three or even four years. This mounting evidence points to regional populations of sailfish and it is hoped that recent advances in genetics will allow these to be discerned. Recreational anglers are being asked to help this work by collecting small fin-clips from released fish that can be used to extract DNA, similar to a highly successful 'citizen science' project on juvenile black marlin caught off both the east and west coasts of Australia.

Striped marlin

Two recaptures of striped marlin were reported in 2013/2014, however, at the time of writing, release details of one of these had not been received. The other was tagged off Bermagui NSW in early March 2014 and recaptured two months later by a domestic longline vessel wide of Fraser Island, QLD – a movement of 691 nautical miles.

Of the 218 reported recaptures of striped marlin on the Program so far, very few have been recaptured after more than one year. This is in contrast to much longer maximum times-at-liberty for black marlin, blue marlin and sailfish, and suggests one of two explanations. That post-release and/or natural mortality are higher for striped marlin than for other billfish, or that tag loss happens more quickly in striped marlin, perhaps due to a greater ability to reject the tag after relatively short periods. However, because popup satellite tagging indicates relatively low post-release mortality for striped marlin, the second theory of higher tag rejection rate recaptures is a more likely reason for lack of long term recaptures of this species.

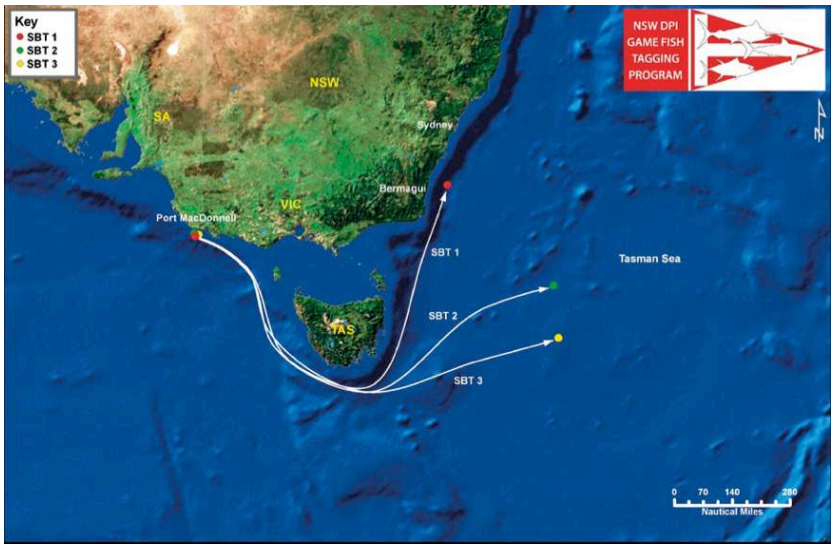
Southern bluefin tuna

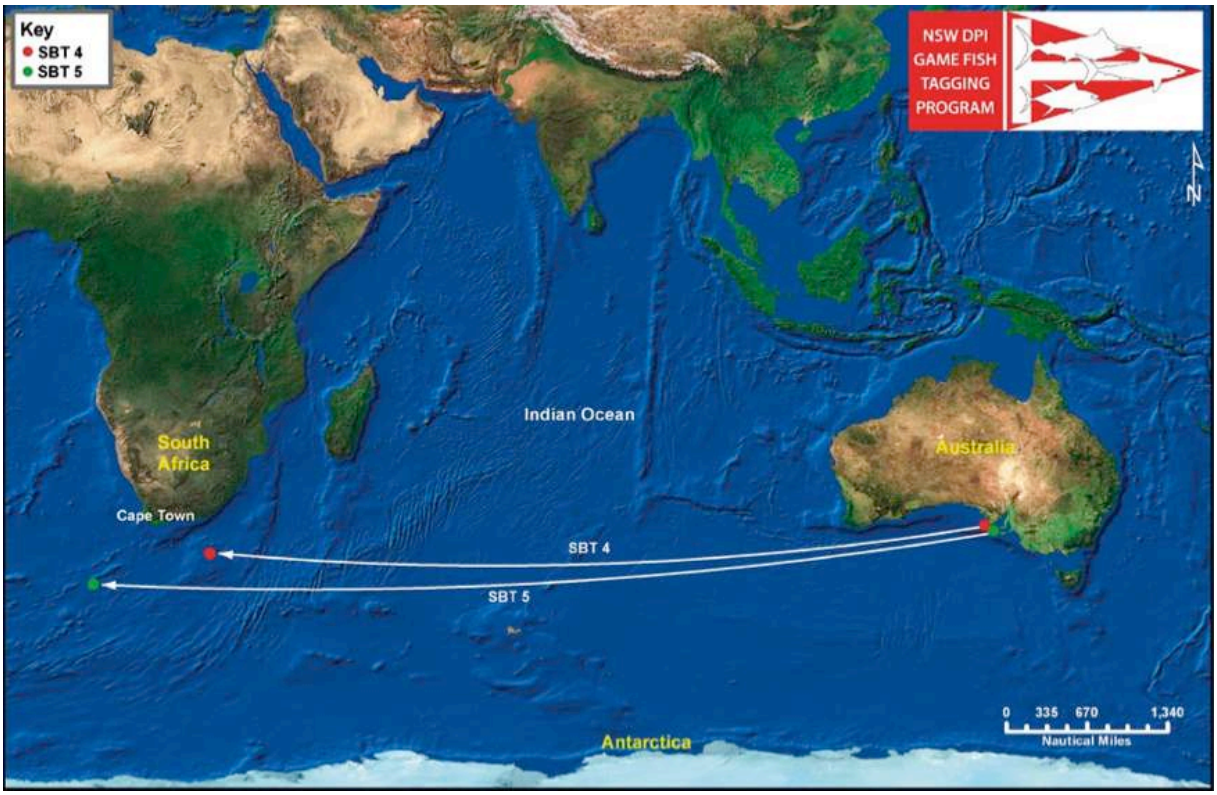
Last season, no recaptures of tagged southern bluefin tuna (SBT) were recorded despite more than 1,000 being tagged. Since the last report however, we were notified of several recaptured SBT by the National Research Institute of Far Seas Fisheries based in Shizuoka, Japan. All had been at liberty for considerable periods. One of these was the furthest west recapture for any SBT tagged on the Program. During the 2.5 years between release off Port MacDonnell and recapture, it traversed the entire Indian ocean, passing the Cape of Good Hope, South Africa and in to the southern Atlantic ocean. Another SBT tagged off South Australia in April 2008 also crossed the Indian ocean to be recaptured off southern South Africa. This fish was at liberty for 4 years 3 months and had grown from an estimated 15kg at release to 64kg at recapture.

To add to the above, during the 2013/14 tagging year, four SBT recaptures were recorded, all tagged off South Australia, three of which had been tagged in earlier seasons.

One of these fish set a new record for time-at-liberty for the species – 5 years and 3 months between tagging and recapture. This fish had been tagged off Port MacDonnell and recaptured by a commercial vessel wide of Montague Island NSW. Another, tagged off 'Cabbage Patch' SA was recaptured almost exactly two years later only 20 nmi from its release point but perhaps the most interesting recapture of a SBT was one that had been tagged off Victor Harbour SA in February 2013 and recaptured 307 days later by an Indonesian commercial longline vessel. Very few SBT have ever been recaptured in Indonesian waters despite tens of thousands having been tagged off southern Australian, both under this tagging program and by CSIRO. This is of particular interest since it is known that SBT spawn only in the waters off southern Java, Indonesia. There was just one problem with this recapture though. The location of where this fish was caught was not recorded, and because the vessel is a large ocean going freezer vessel, the fish could have been recaptured over a broad area in the Indian ocean so we can't be sure that it was caught in Indonesian waters.

Figure 6a (right). Easterly movements of tagged southern bluefin tuna (SBT). Figure 6b. (below). Trans-Indian ocean movements of two tagged SBT. See text for details.





Mako shark

Mako sharks continued to be tagged in good numbers around southeastern Australia, especially off eastern Tasmania, southern NSW and off Sydney. Four recaptures were recorded, all of which had been at liberty for quite lengthy periods. The longest time between tagging and recapture was 2 years 11 months for a shark tagged off Bermagui and recaptured just 88 nautical miles to the north while a second shark at liberty for 2 years 10 months, had moved from Kangaroo Island SA to Portland VIC, Another recaptured off Portland had been tagged off Eden NSW 11 months earlier while the fourth was released at Browns Mountain off Sydney and recaptured 463 nautical miles to the south off St Helens TAS one year and four months later – the longest recorded distance for a mako this year.

In recent years, mako sharks have been tagged with 'SPOT' satellite tags off South Australia by Dr Paul Rogers of SARDI. These tags are mounted on the dorsal fin and give accurate positions of the shark when it comes to the surface for 30 seconds or more. Several of these tagged makos have moved very long distances, either all the way to the Coral Sea or into the Indian ocean towards Java. In all such cases, though, the sharks have returned to the general area where they were tagged. On the other hand, other tagged sharks have tended to remain in southern Australian waters, from the Great Australian Bight to southeastern NSW, as also was the apparent case for the four conventionally tagged makos recaptured on the Program this year.

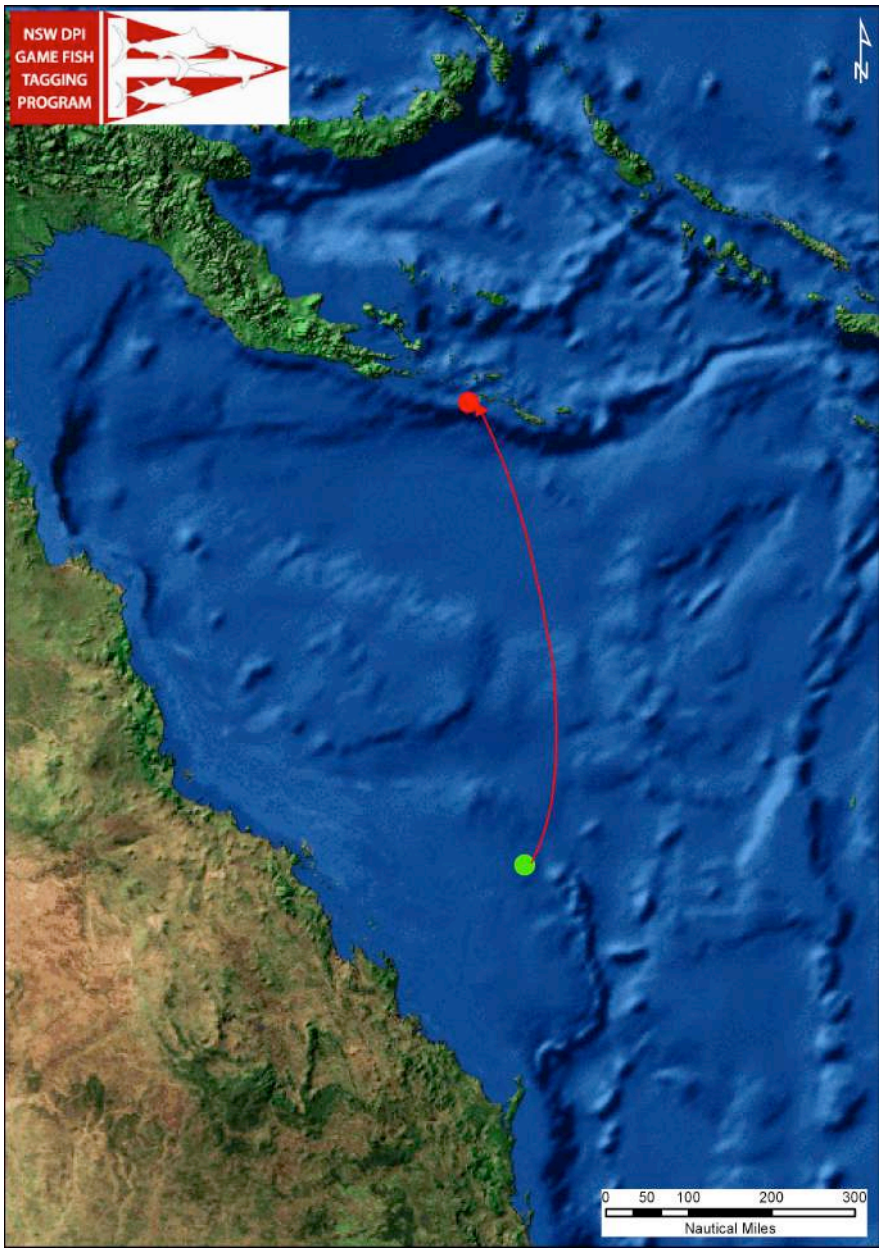
Tiger shark

The Game Fish Tagging Program is fortunate to have a number of commercial boats that participate in the program. These boats tag non commercial species of fish, recognising that the fishery would benefit by them surviving and continuing to be a part of the ecosystem. While recreational boats tend to focus tagging fairly close to shore, the commercial boats that have been supporting the program can help fill in a few extra pieces to the tagging puzzle by tagging fish well offshore.

One of these, an Australian longline vessel, *Straight Shooter*, skippered by keen recreational fisherman Dan Carter, has tagged a number of black marlin and swordfish along with an assortment of shark species. Interestingly, one of these, a tiger shark, was recaptured by a native fisherman in Papua New Guinea. The juvenile shark was originally tagged near Kenn Reef in the Coral Sea in November 2013 and was recaptured on a "shark line" at the end of March 2014, near the Duchateau Islands, PNG. On release the shark measured 1.27m and when recaptured, over 590 nautical miles from its release point, was estimated to be 1.5m in length. This is the furthest north any tiger shark tagged under the program has been recaptured and brings the total number of recaptured tiger sharks to 35 since the program began.

This recapture nicely illustrates the cooperation with the program by skippers of commercial boats in not only reporting recaptured fish but also participating in the tagging too. It also demonstrates the international nature of the program in recording movements of fish to often remote locations. Over the years, the program has received recapture information on tagged billfish, tuna and sharks from traditional fishers from many Pacific island nations as well from artisanal fishermen in countries as far flung as India, Sri Lanka and Costa Rica. Naturally, we don't hear about every tagged fish that is recaptured, but each one that is reported adds to the growing stock of knowledge about movements of game fish throughout the Indo-Pacific.

Figure 7. Minimum movement path of 1.2 metre tiger shark tagged by a commercial longline vessel and recapatured by a traditional PNG fisherman.



Yellowtail kingfish

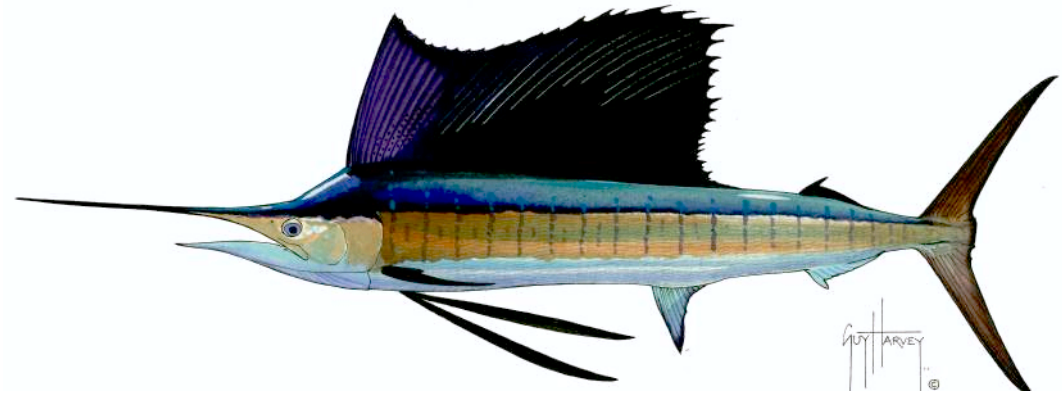
This year, 13 recaptured yellowtail kingfish were reported. Of particular note was one of these, a kingfish originally tagged in November 2013 at Kiama, NSW south coast and recaptured at the same location after having been at liberty for 168 days. Recaptures such as that are quite normal, with little apparent movements of most (but not all) fish even after months or even years. What was interesting about this particular fish, though was its remarkable growth rate.

The measured length of this kingfish at release was 73cm and when recaptured in May 2014, the fish had reached a total length of 97cm, an increase in length of 24 cm over a period of slightly less than 6 months.

This first prompted telephone calls to the release and recapture anglers to confirm the lengths of the fish and ensure that they had been accurately measured. The anglers confirmed that the fish had been measured on brag mats before being released and they were confident they were correct. But was this a record growth rate?

The game fish tagging database shows that to date, there have been 2,220 kingfish reported recaptured. Of those, 36 fish measuring between 50 cm and 80 cm in length at tagging have been at liberty for between 160 and 190 days. Of those fish, the greatest increase in length was a kingfish that had grown 23cm having been released off Ulladulla in March 1988 at a length of 56cm and recaptured at “The Banks” 176 days later at 79 cm. Thus, the recently recaptured kingfish does indeed break the growth rate record, but only just, with a number of other fish clocking up growth in the high teens after being at liberty for around six months. Again, the value of the tagging program is shown in not only helping to determine movements and stock structure of game fish, but also, directly measured growth rates as well.

Focus on: Sailfish (*Istiophorus platypterus*)



The following summary of the biology of the sailfish has been adapted from the book, 'Fishes of the Open Ocean' by Julian Pepperell (UNSW Press).

The sailfish is a member of the family Istiophoridae, which also includes the marlins and spearfishes. The istiophorid billfishes are characterized by possessing a pair of lateral keels on either side of the caudal peduncle or 'tail wrist', round bills in cross section and by their long-based dorsal fins. The sailfish is readily identified by its extraordinarily large first dorsal fin, by far the highest of the billfishes, leading to its name *Istiophorus platypterus*, which literally means 'flat-winged sail bearer'.

Geographic range

Worldwide distribution maps of sailfish convey the impression that the species is spread right throughout the three major oceans, and while this is true to some extent, sailfish are much more concentrated near land masses and islands than in the open ocean. One reason that their apparent distribution is pan-oceanic may be because the Japanese, who originally mapped pelagic fish catches by their longline fleet, traditionally lumped sailfish and spearfish catches together under one category. More recently, observers on longline vessels have recorded that, in the open ocean away from land, spearfish are far more numerous than sailfish. Therefore, sailfish distribution may prove to be far more 'patchy' than shown in the standard texts.

Sailfish often aggregate where nutrient-rich coastal water meets oceanic water to form fronts. These fronts are visible from satellites, and are known to be areas of concentration of plankton which in turn attracts planktivorous fish such as pilchards and anchovies. And where such baitfish congregate in numbers, so too do sailfish. Often, this nutrient-rich water flows into the sea from mangrove-lined rivers, bays and inlets, so it is seaward of such habitats where concentrations of sailfish might be expected.

Movements

Even though the billfishes as a group are sometimes called 'fish without a country', referring to their tendency to move large distances, even sometimes across entire oceans, cooperative tagging programs around the world have shown that sailfish differ from the marlins in not showing strong tendencies to travel over large distances. In the Gulf of Mexico and the southwestern Atlantic, where many thousands of sailfish have been tagged by recreational anglers, movements have been quite limited. As if to prove the rule, there have been a small number of long

distance travelers though, the record being set by a sailfish tagged off North Carolina and recaptured near the Guineas in the southern Caribbean, a distance of 3,000 km. Recaptures of sailfish tagged in Australia on both the east and west coasts also indicate that the great majority of tagged sailfish have moved very little, if at all, even after times at liberty as long as four years. Again, there are some exceptions, but of more than 300 recaptured fish, very few had moved more than 200 km. Finally, a study in the Persian Gulf, in which sailfish were tagged using both conventional and electronic tags found that the population there is entirely confined to that relatively small body of water.

Growth and size

For many years, sailfish were considered to be a particularly short-lived species, perhaps only living for four or five years. Growth rates based on size frequency analysis and lack of any tag returns after four years seemed to support that view. However, in 1984 a tagged female sailfish was recaptured in the Atlantic after being at liberty for 4,025 days (10 years 10 months). This recapture completely changed these earlier notions and we now realize that, even though this particular fish may have been a slow grower, some individual sailfish probably do live into their teens.

The most recent study of the growth rate of sailfish was conducted in Taiwan where scientists and students at the National Taiwan University have access to thousands of specimens of billfish at the central fish market in Shinkang. The dorsal fin spines from over 1,100 sailfish were sectioned and the visible growth rings counted to estimate age. This study indicated that sailfish, at least from near Taiwan, may have slower growth rates than other studies had suggested. Fish of about 20 kg were estimated on average to be four years old while a fish of 35 kg might be as much as eight years old, although there is a wide range of sizes for any given estimated age. Interestingly, this study showed that female fish reach a larger size than males, and confirmed the suspicion for all of the istiophorid billfishes that females also grow faster than males.

Sailfish grow to different maximum sizes in different oceans, and appear to reach different maximum sizes even on different sides of the same ocean. It has long been known that sailfish tend to be much larger in the eastern Pacific (off Ecuador and Mexico) than in the western Atlantic (off Florida and Brazil). In the 1980s, a study of Japanese longline data showed that sailfish in the western Atlantic off Africa were also relatively large. Checking the record charts of IGFA reveals that nearly all of the Atlantic records for sailfish were indeed caught off the west coast of Africa, mostly in the 1990s. The record for the Atlantic stands at 64 kg (140.8 lb) caught off Angola in 1994. In contrast, all line-class records for Pacific sailfish are greater than 60 kg, the current all tackle record being 100.2 kg caught off Ecuador way back in 1947. Most of the other line class records were caught in the eastern Pacific, although large sailfish over 90 kg have been caught in both the Philippines and Tonga. There are no current IGFA line class records for sailfish from the Indian Ocean, but the largest sailfish weighed from Western Australia was 77.9 kg. The variations in maximum and average sizes of sailfish in different areas may be due to differences in environmental conditions or to differences in genetics at a population level.

Reproduction

The ovaries of a mature sailfish of about 35 kg may contain as many as five million eggs. Spawning is thought to take place in relatively shallow water near land masses, or near islands. Spawning seasons vary, but may occur throughout the

year with a peak period during summer months. Fertilization is external and the eggs, about 1 mm in diameter, hatch into larvae within several days. The larvae bear little resemblance to adult sailfish, but are nevertheless ferocious little predators of the warm surface layers of the ocean. Quite a lot of sailfish larvae up to about 10 mm long have been collected during larval surveys, but they are rarely seen above this size. This is because the larger larvae and post-larvae are mobile enough to avoid towed plankton nets. The most effective way of catching these miniature sailfish is by dip net, usually at night under a bright light. Very small billfish are extremely valuable scientifically, so if one is caught or found in the stomach of another fish, every effort should be made to freeze or preserve it.

Size at first maturity seems to vary considerably with location, and size is not necessarily correlated with maturity. In a Taiwanese study, the smallest mature female fish measured 162 cm (lower jaw to caudal fork) which equates to about 20 kg in weight. The author’s observations have shown that female sailfish off northeast Australia are usually mature at weights of about 30 to 35 kg, while those off northwestern Australia are mature by about 23 kg. Again, these differences may be environmental, genetic or both.

Behaviour

Sailfish cooperate with each other when feeding on small, schooling baitfish such as anchovies, sardines, or surprisingly, pelagic pufferfish. The hunt appears to begin with one sailfish making a series of leaps and re-entry splashes, sometimes as many as twenty consecutive jumps at a time at a time, in a semi-circular route. The purpose of this behaviour, known as 'free jumping', is almost certainly to round up a school of baitfish in an area into a panicked, tight ball. Other sailfish, perhaps 20 or 30 at a time, will then move in, and may be seen swimming leisurely around and below the ball of baitfish. If the ball begins to disperse, one or two of the sailfish will immediately raise their sails like great, dark capes and flash their reflective blue and purple colors, immediately causing the baitfish to again pack tightly together. Then, one by one, the predators will casually move into the ball, striking with their bills, or simply plucking a single fish from the ball with a deft turn of the head.

Fisheries

Although sailfish are not a targeted commercial species by high seas longline fisheries, they are caught in increasing quantities by coastal gillnet fisheries in many developing countries including Kenya, the Maldives, India, Sri Lanka, Malaysia and Vietnam. That said, there is no doubt that sailfish are a significant by-catch of the world's tuna fisheries. This also applies to purse seine fisheries which set their nets around logs, incidentally catching any attendant sailfish.

In the Indian Ocean where sailfish are perhaps targeted more than in other major oceans, the minimum average annual catch by all countries was estimated for the period 2010 to 2013 to be around 30,000 tonnes, which, if fish averaged 20kg, would equate to 1.5 million fish.

By far the most significant fisheries for sailfish though, especially in terms of economic value, are sport and charter. Sailfish tournaments generate considerable income to local economies in a number of countries, and sailfish charter fisheries in developing or resource-poor countries such as the Maldives, Ecuador, Guatemala, Mexico, Costa Rica, Thailand and Fiji are proving to be viable alternatives to commercial exploitation

Tagging Tips

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

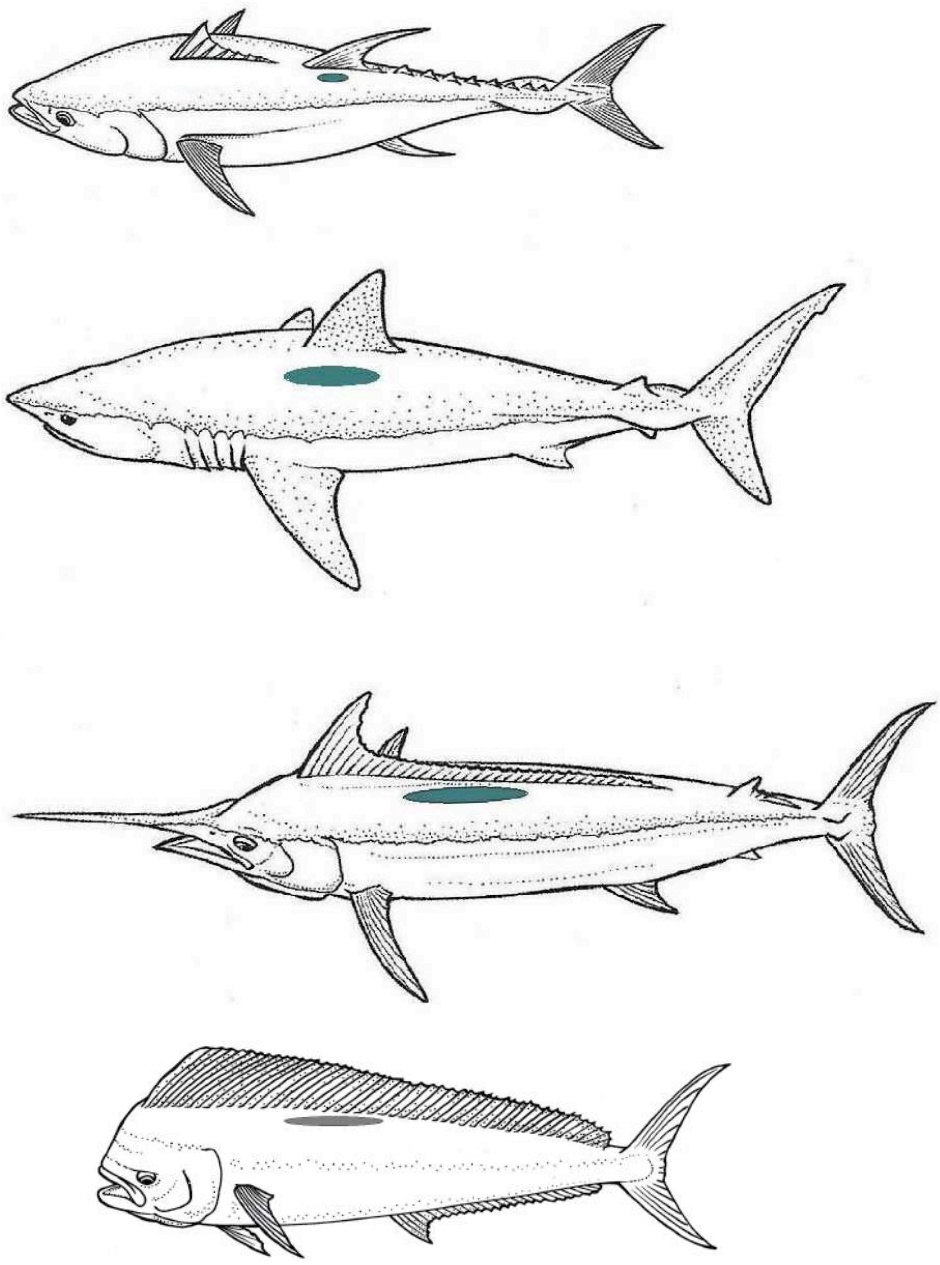
Smaller pelagic species may be removed from the water before tagging. This enables improved accuracy of tagging and may simplify hook removal. Often holding the fish on its back will lessen its 'flapping'. Try to prevent the fish damaging itself on hard, hot, or dry surfaces. A wet foam mat or similar is ideal (or a wet towel will suffice) for on-boat tagging. Where possible, try to place the tag at an angle of at least 45° to reduce water friction on the tag.

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 area is shown below. It is better to release the fish without tagging, if accurate tag placement is not possible.

Recommended tagging areas



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 (ie 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 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 (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) 4424 7411 or email gamefish.tagging@dpi.nsw.gov.au.

Acknowledgements

The Game Fish Tagging Program 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.

Appendix I: All Recaptures of Tagged Fish Reported in 2013/2014 for which tag cards had been received

Species	Release Date	Release Locality	Days at Liberty	Distance moved (nm)	Direction
Albacore	24/11/12	Jervis Bay Canyons	288	35	ENE
Albacore	19/05/12	Bermagui (Wide)	686	437	SW
Australian Salmon	19/04/14	Ardrossan (SA)	55	3	W
Black Marlin	14/07/12	Cape Cleveland	367	1358	NE
Black Marlin	25/08/12	Oyster Reef Cairns	391	861	NNE
Black Marlin	22/12/12	Hutchison Shoals (QLD)	303	432	NE
Black Marlin	22/03/13	Gibber Reef (Pt Stephens)	220	1650	N
Black Marlin	1/01/14	Mooloolaba	21	525	SW
Black Marlin	14/09/12	Townsville	512	769	SSE
Black Marlin	12/09/13	Cairns (General)	170	1058	SSE
Black Marlin	11/01/14	Mooloolaba	50	425	SW
Black Marlin	11/01/14	Mooloolaba (18 Mile)	84	2	SSW
Black Marlin	16/11/13	Fraser Island (Breaksea Spit Nth)	140	117	S
Black Marlin	23/03/14	Mooloolaba (8 NM E)	13	20	NE
Black Marlin	16/02/14	Port Stephens (Car Park)	54	152	SSW
Black Marlin	16/03/14	Mooloolaba (18 Mile)	33	3	SSE
Black Marlin	5/04/14	Mooloolaba (18 Mile)	53	1	N
Black Marlin	24/03/14	Mooloolaba	73	2	W
Black Marlin	29/09/12	Innisfail	347	1559	NE
Cobia	26/11/11	The Hards (QLD)	633	11	SSW
Dolphinfish	5/04/14	Botany Bay Wide FAD	-1	0	S
Dolphinfish	5/04/14	Sydney Harbour FAD	25	184	NNE
Dolphinfish	17/05/14	Sydney (Wide)	2	31	NNW
Dolphinfish	17/05/14	Sydney	2	31	NNW
Dolphinfish	5/04/14	Botany Bay Wide FAD	45	0	S
Gummy Shark	7/05/12	Cape Northumberland	520	2	SSE
Gummy Shark	16/11/13	Port Welshpool (VIC)	53	104	ENE
Mako Shark	1/10/10	Bermagui (Wide)	1059	88	NNE
Mako Shark	26/02/11	D'estrees Bay (Kangaroo Is) SA	1024	227	SE
Mako Shark	5/08/12	Sydney (Browns Mountain)	510	463	SSW
Mako Shark	27/04/13	Eden Shelf	335	427	SW
Sailfish	26/09/10	Mooloolaba (10 NM NE)	1098	7	ENE
Sailfish	19/10/12	Exmouth (WA)	361	7	SW
Sailfish	25/10/13	Exmouth Gulf	2	3	SW
Sailfish	26/10/13	Exmouth Gulf	10	0	S
Sailfish	6/10/13	Mooloolaba (8 NM NE)	40	132	NW
Sailfish	22/02/14	Dampier Archipelago	7	2	E
Sailfish	23/02/14	Dampier Archipelago	41	2	E
Sailfish	8/03/14	Mooloolaba (18 Mile)	60	1	W
Sailfish	6/04/14	Mooloolaba (18 Mile)	68	1	NE
Sailfish	6/04/14	Mooloolaba (18 Mile)	68	1	NE

Species	Release Date	Release Locality	Days at Liberty	Distance moved (nm)	Direction
Samson Fish	4/03/14	Greenly Island (SA)	19	12	SSW
Samson Fish	8/10/13	Rottnest Island	187	0	S
School Shark	15/09/13	Port Macdonnell (SA)	176		
School Shark	26/01/14	Wilsons Promontory (Sealers Cove) VIC	52	5	NE
Snapper	18/06/13	Thistle Island (SA)	32	2	W
Snapper	18/04/13	Abrolhos Islands	122	2	SSE
Snapper	28/01/08	Cape Jervis (SA)	2295	4	SW
Southern Bluefin Tuna	7/05/08	Port Macdonnell (SA)	1938	501	NE
Southern Bluefin Tuna	5/02/13	Victor Harbour (SW) SA	307	0	
Southern Bluefin Tuna	15/04/12	Cabbage Patch (SA)	627	21	ENE
Southern Bluefin Tuna	7/04/13	Port Macdonnell (SA)	431		
Spanish Mackerel	20/11/10	Sandy Cape QLD	1037	17	SSE
Striped Marlin	6/03/14	Bermagui (Wide)	65	691	NE
Tiger Shark	27/04/13	Port Stephens	70	188	NNE
Tiger Shark	20/11/13	Coral Sea (Kenn Reef)	129	597	NNW
Whaler Shark	23/03/13	The Banks (Jervis Bay)	327	1	E
Whaler Shark	14/01/14	Cronulla	49	23	SSW
Whaler Shark	16/02/14	The Banks (Jervis Bay)	34	1	NNW
Yellowtail Kingfish	29/06/13	Tweed Heads (9 Mile Reef)	14	8	E
Yellowtail Kingfish	13/12/12	Long Reef (Sydney)	254	9	SW
Yellowtail Kingfish	4/11/10	Point Lowly (SA)	1053	16	NW
Yellowtail Kingfish	20/09/13	Port Augusta (Outlet Channel)	14	7	N
Yellowtail Kingfish	16/11/13	Port Augusta (Outlet Channel)	3	0	
Yellowtail Kingfish	23/11/13	Port Augusta (Outlet Channel)	3	3	NW
Yellowtail Kingfish	11/10/12	Port Augusta (SA)	411	0	S
Yellowtail Kingfish	26/11/13	Manly (2 NM E)	73	0	
Yellowtail Kingfish	22/02/14	Yellow Rock (Malabar)	8	0	
Yellowtail Kingfish	11/09/13	Port Augusta (Outlet Channel)	188	201	SW
Yellowtail Kingfish	21/10/13	Coffin Bay (SA)	160	38	WSW
Yellowtail Kingfish	24/11/13	Rangoon Island (Kiama)	168	1	E
Yellowtail Kingfish	25/05/14	Block And Cheese (Jervis Bay)	29	7	WSW

Appendix II: NSW DPI Game Fish Tagging Program Top Taggers for 2013/2014

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 2013/2014 season. We will continue to develop these end of season summaries and acknowledge the strong supporters of the tagging program in future years.

Species	Top boat	Runner up boat
Billfish combined	109 – *The Wench* (WA) King Bay GFC	74 – *Reel Capture* (QLD) Sunshine Coast GFC
Blue Marlin (International)	31 – *Reel Addiction* (Tonga) Vava'u SFC / Reel Addiction Charter boat.	12 – *Stephanie* (PNG) New Britain GFC
Blue Marlin (Australia)	17 – *Gamefisher* (WA) Exmouth GFC	15 – *First Priority* (QLD) Gold Coast GFC
Black Marlin	62 – *The Wench* (WA)King Bay GFC	52 – *Reel Capture* (QLD) Sunshine Coast GFC
Striped Marlin	18 – *Blu Alibi* (NSW) Ulladulla GFC, *Dreamcatcher* (VIC) Greenvale S & GFC	17 – *Polaris* (NSW) Eden S & GFC
Sailfish	58 – *The Wench* (WA) King Bay GFC	52 – *Billistic* (WA) Broome FC
Shortbill Spearfish	3 – *Hoodlum* (NSW) Sydney GFC	2 – *Murphys Law* (QLD), *Rabbit* (NSW), *Jugs* (QLD)
Swordfish	1 – *Choona Chaser* (TAS) Tuna Club of Tasmania	*14 – (Tagged by Commercial Vessel, QLD)*
Shark combined	22 – *Top Shelf* (WA) Perth GFC and King Bay GFC	21 – *Sea Hog* (NSW) Eden S & GFC
Mako Shark	9 – *Dorado* (NSW) Batemans Bay GFC, *MC1* (NSW) Shellharbour GFC, *The Cure* (NSW) Sydney GFC	8- *Sea Hog* (NSW) Eden S & GFC, *Yeah Boy* (TAS) St Helens GFC
Blue Shark	12 – *Seahog* (NSW) Eden S & GFC	10 – *Tantrum* (NSW) Sydney GFC
Tiger Shark	3 – *Casey* (NSW) Sydney GFC, The Judge (WA) Nickol Bay SFC	2- *Svengali* (WA), *Top Shelf* (WA),*Greyhounder* (NSW), *Oh Bugga* (WA),*Sniper* (NSW)
Whaler Shark	15 – *Double Trigger* (NSW) Sydney GFC	*Top Shelf* (WA) King Bay GFC and Perth GFC
Hammerhead Shark	8 – *Top Shelf* (WA) King Bay GFC and Perth GFC	3 – *El bandito* (NSW) Kiama GFC
Thresher Shark	1 – C*ouranna Jae* (SA) Port MacDonnell OAC	
Tuna combined	175 – *Galaxy Star* (SA) GFC of SA	156 – *No Alibi (*SA) Port Macdonell Offshore Angling Club
Yellowfin Tuna	29 – *Fire Island* (WA) Geraldton & District Offshore Fishing Club, *Cranky* (QLD) Redcliffe Peninsula Sport & Game Fishing Club	18 – *Ambition* (NSW) Sydney GFC

Species	Top boat	Runner up boat
Southern Bluefin Tuna	175 – *Galaxy Star* (SA) GFC of South Australia	151 – *No Alibi* (SA) Port Macdonell Offshore Angling Club
Bigeye Tuna	1 – *Aquaholic II* (NSW) Canberra GFC, *Svengali* (WA) King Bay GFC	*4 – (Tagged by commercial vessel, QLD)*
Albacore Tuna	20 – Couranna Jae (SA) Port MacDonnell OAC	*18 – Whitewash II (SA) Port MacDonnell OAC*
Longtail Tuna	6 – No Name (WA) King Bay GFC	*3 – Top Shelf (WA) King Bay GFC, Rugrats (NT) Groote Eylandt GFC, Shinboner (WA) King Bay GFC*
Dogtooth Tuna	1 - Nauti-Buoy (PNG) Lae GFC	
Spanish Mackerel	41 – Mandalay (WA) Geraldton & District OFC and Perth GFC	*34 – Allure (WA)Geraldton & District OFC*
Mahi Mahi	32 – Jig-a-Sauras (NSW) South Sydney Amateur Fishing Association	*28 – Avalon (NSW) Port Hacking GFC*
Yellowtail Kingfish	42 – Sea Jay (SA) Adelaide GFC	*32 – Likeaboss (SA) Adelaide GFC*
Species	Top individual	*Runner up individual*
Billfish	55 – Channon Arbuthnot (QLD) Sunshine Coast GFC	*46 – Darren Lee (QLD) Sunshine Coast GFC*
Shark	16 – Krystal Wietecki (NSW) Shoalhaven GFC	*15 – Mirko Seserko (NSW) Batemans Bay GFC*
Tuna	69 – Tony Bell (SA) Port Macdonell Offshore Angling Club	*62 – Rolf Czabayski (SA) GFC of SA*