

Monitoring and Research on Landed Fish at Game Fishing Tournaments in NSW

2006/2007



Report to

The NSW Recreational Fishing Trusts Expenditure Committee

by

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Project background

The gamefish fishery which operates off the New South Wales coast is among the largest of its kind in the world, generating vital economic activity in regional towns and centres along the entire coast. The fishery is well organized and self-regulated, with member clubs affiliated to the parent body, the NSW Game Fishing Association, operating from most of the major ports along the coast. The annual game fishing season runs from October through May, although most activity and organized events occur from January through April. A wide range of gamefish species are caught in the fishery, including black, blue and striped marlin, shortbill spearfish, sailfish, yellowfin, bigeye, longtail, skipjack and mackerel tuna, albacore, dolphin fish (mahi mahi), wahoo and cobia and a range of offshore shark species including mako, blue, tiger, hammerhead and various whaler sharks.

A high percentage of most of these species is now tagged and released. However, the remainder of the catch, representing potentially valuable scientific specimens, are captured and brought back to weigh-stations during tournaments and club activities. In the absence of scientific examination, such specimens are usually eaten for food, but their scientific value is lost. Biological and scientific monitoring of catches is an important part of studying any fishery. Tournaments and organized events provide excellent opportunities to undertake such biological monitoring and research on the landed catch, and in the past, these opportunities have been taken advantage of to varying degrees.

Before the current project was conceived, biological data was collected at NSW Game Fishing Tournaments by Pepperell Research on an ad hoc basis, especially during the largest game fishing event, the annual Interclub tournament at Port Stephens, which has been sampled continuously for over 25 years. During this period, many research projects being undertaken by a wide range of research organizations have been assisted through cooperation with game fishing tournaments in New South Wales. The annual Interclub tournament at Port Stephens in particular has attracted many researchers from around Australia and overseas, especially during the past decade or so. Table 1 lists some of the projects which have been undertaken, illustrating the potential benefits to research and to acquiring knowledge on the biology of game fish which can derive from such cooperation with the fishery.

Table 1. Previous and current scientific studies facilitated through NSW game fishing tournaments.

Project	Organization(s)
Global genetics of striped marlin	Virginia Institute of Marine Science (VIMS)
Global genetics of mako sharks	VIMS
Global genetics of black marlin	Pepperell Research/VIMS
Ageing of black marlin*	Pepperell Research & SPC
Biological studies of pelagic sharks	University of NSW/Pepperell Research
Digenic trematode parasites of marlin & sharks*	University of Queensland
Antifouling properties of skin of sharks	Macquarie University
Pit organs in sharks	Sydney University
Biology of slimy mackerel & yellowtail*	NSW Fisheries
Distribution & abundance of dolphin fish	University of NSW/Pepperell Research
Age and growth of dolphin fish*	Sydney University
Distribution & abundance of yellowfin tuna	University of NSW/Pepperell Research
Competition of parasites on marlin skin	Australian Museum/Oxford University
Vision of billfish*	University of Queensland
Vision of sharks*	University of Queensland
Brain structure and function in sharks*	University of Queensland
Attachment mechanisms of external parasites*	Oxford University
Distribution & abundance of black marlin	Sydney University/Pepperell Research
Ongoing monitoring of pelagic sharks*	NSW DPI Fisheries
Ongoing size monitoring and sexing of marlin*	Pepperell Research
Positioning of Satellite tags on blue shark fins*	CSIRO
Parasites in stomachs of marlin and mahi mahi*	University of Queensland
Mercury levels in striped, blue & black marlin*	AMC Tasmania/Pepperell Research
Global genetics of remoras*	VIMS
Global genetics of striped marlin (new study)*	University of Southern California
Studies of nematode parasites in pelagic fishes*	University of Melbourne, Vet Dept.
Testing PSAT tag anchor heads on tiger sharks*	Pepperell Research & NSW DPI
Age, growth & reproduction of striped marlin*	Charles Sturt University
Trematode parasites of pelagic fishes*	University of Adelaide/Museum of SA
Ultrasound testing on large sharks*	NSW DPI
Global genetics of mako sharks (new study)*	National Marine Fisheries Service (US)
Testing PAT tag attachment to tiger sharks*	Pepperell Research & NSW DPI

* Studies assisted through current Recreational Trust project

Between 1998 and 2002, many sharks weighed at NSW tournaments were measured and sampled by Dr R Chan of UNSW for his Ph.D (co-supervised by the author). With the successful completion of that work, and the need for ongoing sampling of all fish, it was proposed to the Recreational Fishing Trust that data collection at major tournaments should now continue on a regular basis. It was proposed that all fish brought to the weigh station of major tournaments would be measured, weighed, and sexed, and biological samples, such as tissue for DNA analysis and hard parts for ageing would be collected, labelled and either supplied for current research projects, or archived for future possible use. It was further proposed to encourage and facilitate research projects on gamefish conducted by other research organizations.

Some initial funding from the small grants program of the Recreational Fishing Trust was obtained in 2001 to coordinate the scientific program for the 2002 Interclub Game Fishing Tournament at Port Stephens. This demonstrated the benefits which can flow from coordinated cooperation between game fishing tournaments and research and monitoring projects and as a result, a more comprehensive program was proposed to cover a broader range of tournaments geographically and through the game fishing season.

In 2002, the Recreational Fishing Trust approved a further proposal to establish a monitoring and sampling program for captured fish at game fishing tournaments during the 2002/2003 season. The establishment of such a program, with its many benefits, was seen by the fishery and the public as an important undertaking. Apart from the cooperation with other research organizations, a rewarding side benefit is the linking with Universities in providing training and research projects for students. With the successful conducting of the project in 2002/2003, to 2005/2006 (see final reports), application was made for continuation of the program for the 2005/2006 game fishing season. The application was successful and this report summarises the activities of the program the 2006/2007 game fishing season.

Aims

The continuing objectives of this project are to organize, coordinate and report on biological research and sampling at major game fishing tournaments in New South Wales. To establish a baseline monitoring program for recording biological data of weighed fish, and to archive biological samples taken from weighed fish

Methods

A range of selected Australian and overseas research institutions were contacted to establish interest in undertaking research during the 2006/2007 game fishing season. Responding scientists supplied information on their prospective research operations and their requirements to conduct their work during tournaments. Necessary arrangements were made regarding equipment delivery, accommodation and other special requirements of researchers. Coordination of all research operations was arranged in consultation with the tournament committees of each tournament.

Marine science students were recruited as tournament sampling staff. They **were Antony Gould (Sydney University), Hayley Gorsuch (Sydney University) and Daniel Johnston (Sydney University). New samplers were given face to face** field training in techniques for measuring, tissue sampling and sexing the various species of gamefish and in identification of marlin, sharks, tuna and other gamefish.

Peter Davies, Keller Kopf, xxx

Prior to commencement of the project, standardized sets of equipment for measuring and sampling at tournaments were again distributed to samplers. A set of equipment includes a surveyor's tape measuring in centimetres to at least 6 metres, a long stout-bladed knife, knife sharpener, zip-lock plastic bags of various sizes, waterproof labels, field data sheets, clipboard and pencils, fish

identification information and a large cooler. Other specialized equipment included phials filled with preserving fluid such as DMSO or 95% ethanol, dissecting tools etc.

Whenever possible, sampling staff attended the briefing on the evening before each tournament and outlined what work was to be carried out at the weighstation. This ensured that competitors and officials were aware of requests for assistance in allowing access to their fish, and ensured cooperation in the logistic operation at the weighstations.

As far as practicably possible, all gamefish landed at tournaments which were attended by a field sampler were examined. In many cases, fish examined included some specimens which would not have appeared in official records of an event. These would include disqualified fish, undersized fish and those not weighed for various reasons. Weights, measurements, sex (by observation in the case of sharks or dissection in the case of all other species) and any other secondary observations such as dietary items, parasites and injuries were recorded. Biological samples were obtained for specific research programs as well as for routine archiving, and preserved or frozen as necessary. Researchers from other organizations were facilitated in obtaining their data and samples. This often required coordinated cooperation with weighstation officials.

Where facilities allowed, the activities of scientists conducting research at the tournament were explained and conveyed to the general public during the weigh-ins, who often viewed proceedings in large numbers. Information was also relayed to a wider audience via interested print, radio and television media. A magazine article on the scientific activities at tournaments, was prepared and published in *Bluewater Boats & Sportfishing* magazine during the year (Appendix I).

Scientific personnel at Nelson Bay weighstation during 2007 Interclub Tournament. Front row, left to right, Dr Nick Otway (NSWDPI), Dr Megan Storrie (NSWDPI), Jason Griffith (NSWDPI). Back row, left to right, Stacey Kopf (Charles Sturt University), Keller Kopf (Charles Sturt University), Dr Julian Pepperell. (Missing: Antony Gould (UNSW))



Results

Tournaments sampled during the season were selected on the basis of their location, timing, likely number of competing vessels and therefore, fishing days, and their history. On this basis, eight tournaments were selected, covering the main game fishing centres between Port Macquarie and Bermagui. A brief summary of each tournament covered follows, and full results of fish sampled and tagged at all tournaments are presented in Appendix II.

Golden Lure Tournament, Port Macquarie (6-12 January 2007).

This tournament is always held during the second week of January, and is normally the first major tournament of the calendar. Fishing takes place on the second weekend of January plus the following Friday and Saturday, and a midweek Ladies' and Juniors' day is held as a separate event.

The number of boats which registered to fish this tournament was well down on previous years, with only 25 boats participating (normally 40 to 50 boats take part). A student sampler and Professor Davie were able to cover the full tournament, which spans two weekends, with one fishing day for juniors and ladies midweek. Even though fishing effort was down, relatively good catches were recorded.

While in previous years, the catch at this tournament has been numerically dominated by dolphin fish (mahi mahi), this year only six of this species was tagged and none weighed. Interestingly, the species caught in the largest numbers was blue marlin, with eight tagged and nine captured, the largest weighing 244kg. Unfortunately for the age and growth study of the species, only one striped marlin was weighed (four were tagged). One feature of the tournament was the appearance of adult yellowfin tuna, relatively uncommon in recent years. Nine were weighed ranging between 38 and 53kg. Other notable species were wahoo (two landed and four tagged) and two cobia, the first of this species recorded at any tournament over the history of this project. Lastly, no sharks were landed, but six whaler sharks and two hammerhead sharks were tagged.

Bill Heyward Memorial Tournament, Botany Bay (26-27 January 2007)

This tournament has been an annual event on the game fishing calendar for over 15 years and traditionally attracts a strong fleet of boats from the metropolitan clubs. The tournament was attended by Antony Gould. This year, the tournament attracted 53 boats, five less than last year. Fishing conditions were fair on the first day of the event, but the second day was cancelled due to bad weather. Eight fish were weighed compared with nine last year – three tiger sharks, two makos, a black marlin, a mahi mahi and a whaler shark. The latter was positively identified as a spinner shark, *Carcharhinus brevipinna*.



A tiger shark caught during the Australia Day weekend tournament at Botany Bay. The opportunity was taken to test attachment of popup satellite tags (PATs) to tiger sharks by trialling several designs of tag anchors and applicators on this landed shark. This was invaluable for designing the final models for use of PATs on tiger sharks later in the year

Blue Water Classic, Bermagui (26-28 January 2007)

This tournament is always held to coincide with the Australia Day long weekend and as such, clashes with the Botany Bay tournament discussed above. This year, it was possible to attend the tournament, the first in the calendar year held on the NSW south coast. The tournament was well supported with 59 registered boats, of which 56 fished the first day. The second day was cancelled due to weather, but 49 boats were able to fish the third day. These numbers were significantly higher than 2006. This year, only four fish were landed (three striped marlin and one mako shark), but 46 fish were tagged, including 18 yellowfin tuna, six striped marlin and three black marlin. The numbers of striped marlin caught during this tournament usually indicate how the season will fare for the species, so the result of nine caught overall was considered an indication of a poor striped marlin season.



This striped marlin is the smallest yet sampled for the age and growth study being conducted through Charles Sturt University. It was caught at Bermagui by an angler who was not fishing in the tournament, but was able to be sampled by project personnel who were present. It was not weighed but was estimated at about 20kg.

Big Fish Bonanza, Lake Macquarie (3-4 February 2007)

This regular tournament is always held at the same time of year – the first weekend of February. The host club, Lake Macquarie Game Fishing Club, tends to specialize on fishing for sharks, so the results of this tournament may give some indication of the availability and sizes of pelagic sharks in the area each year. This is always a two day tournament, but this year only the first day was able to be sampled. At the time of writing, it had not been possible to obtain the tag results for this tournament, but capture results showed that only six marlin were weighed – one blue marlin and five striped.

Riviera 44th NSW Interclub Tournament, Port Stephens (24 Feb – 4 March 2007)

This is the largest game fishing tournament in the southern hemisphere, always held over the last weekend of February and the first weekend of March. It is by far the most important event of the NSW game fishing calendar, being the annual competition among all NSW game fishing clubs, always attracting in excess of 200 competing boats. This year, the number of entries was down slightly on the previous year, with 213 boats registered (221 last year and 205 the year before). The main tournament is held over two weekends, while during the week, a Ladies' Day and a separate one day tournament are held. All fishing days were covered by the Project personnel. As has been the case in previous years of the project, the Interclub tournament was well attended by scientists and students from various organizations. This year, the list of visiting personnel included Keller and Stacy Kopf, both Ph.D students from Charles Sturt University and Dr Nick Otway and Dr Megan Storrie, both from NSW DPI. Project coordinator Dr Julian Pepperell also attended throughout the tournament.



Above: An angler is photographed with a 'tag-and-release' board recording the details of tagging a striped marlin during the 2007 Interclub tournament. Well over 90% of most species of gamefish are tagged and released in organized game fishing activities.

Right: Removing dorsal spines from a landed striped marlin. The spines are sectioned as part of a major study on the age and growth of this important species – the only marlin permitted to be taken by commercial fishing. Also visible on the left of the marlin are the gonads (ovaries) which are measured and weighed to assess reproductive activity of the species.



Left: A tiny flying fish brought to the weigh station by the crew of a competing boat for examination by scientists. Anglers take advantage of the attendance of scientists at tournaments to report unusual catches and observations.

Fortunately, no days were lost due to bad weather this year, although the fourth day was fished under marginal conditions and many boats returned to port early that day. Even though fishing effort was relatively high, far fewer fish were caught during the tournament than last year. A total of 24 fish were weighed and 266 tagged compared with totals of 55 fish weighed and 502 tagged last year. This year, only seven billfish and 13 sharks were weighed compared with 28 billfish and 20 sharks last year. Total numbers of billfish caught (captured plus tagged) were: 113 black marlin (150 last year and 563 the year before); 51 striped marlin (a poor year compared with 170 last year and 149 the year before) and just 10 blue marlin (26 last year and 13 the year before).

A total of seven tiger sharks were caught this year compared with 17 last year and 10 the year before. Sizes of captured tiger sharks ranged from 91 to 591kg, the largest tiger shark landed during this tournament. As was the case last year, seven mako sharks were weighed this year (101 to 260kg) and two adult spinner sharks were landed, an interesting observation since one was also weighed in late January during the Botany Bay tournament. Although not landed as part of the tournament, an interesting midweek capture of a 15kg broadbill swordfish was brought to our attention. This was caught in daylight hours by an angler fishing on the bottom, and as such, was a most unusual catch. Samples were permitted by the angler to be taken from the fish.



An unusual baitfish brought to the weighstation for identification. This is a redbait, *Emmelichthys nitidus nitidus*, which is relatively common off Tasmania but not often encountered where this specimen was caught, off Port Stephens, NSW. This is another example of information being brought to the attention of researchers by anglers during tournaments.

Broken Bay Invitational Tournament, Broken Bay (17-18 March 2007)

This annual tournament, hosted by the Broken Bay Game Fishing Club in late March, is fished over two weekend days. This year, yellowfin tuna dominated the catch with 69 tagged (but none weighed). Captures included five striped marlin, three blue marlin a black marlin and a tiger shark. A total of 21 marlin were either captured or tagged this year compared with eight the year before and 17 the year before that. Again suggesting a relatively poor show of tiger sharks this year, just two were weighed compared with nine last year (but only one the year before). This tournament again demonstrated a poor showing of mahi mahi along the coast this season. Only three were tagged this year compared with 59 last year and 74 the year before.

Canberra Yellowfin Tuna Tournament, Bermagui (25-27 May 2007)

This tournament was not sampled last year since it was decided to monitor another yellowfin tuna tournament at Batemans Bay in early May. That tournament did not attract a large fleet, so we again returned to Bermagui this year for the long-standing annual Canberra Game Fishing Club's yellowfin tuna tournament. There had been a good run of medium sized yellowfin tuna (30kg plus) in the area leading up to the tournament, a fact which no doubt helped to swell the number of competing boats this year to 93. Good weather was enjoyed for the three days fishing, although it was only possible to sample on the first two days of the tournament.

Results were excellent, with 166 yellowfin caught altogether (125 tagged and 41 weighed). The weighed tuna ranged between 16.4 and 70kg. This meant that for the third year in a row a good 'run' of yellowfin tuna had appeared on the south coast of NSW in May.

While yellowfin tuna were obviously the main target of the fleet, other fish landed included three mako sharks, two blue sharks and a blue marlin. And as well as yellowfin tuna being tagged, a total of 21 albacore, three blue sharks, two striped marlin and a mako shark were also tagged and released.

Data Summary

Full details of all fish weighed and tagged during tournaments attended by project staff can be found in Appendix II. As many weighed fish were measured and sexed as possible (not all landed fish are available for examination by sampling staff). Anal spines (for ageing) and muscle samples (archived for a variety of potential future projects) have been taken from all billfish weighed. All sharks were identified to species and those examined by Dr Otway have been dissected for various studies, including identification of shark species from fins, age and growth, reproductive and dietary studies.

Other activities associated with project

An article was requested and prepared for boat company Riviera for use in their corporate magazine. Riviera sponsored the Interclub tournament for the first time this year, and executives were very impressed with the sampling research carried out on the weigh station. The article outlined the program and duly acknowledged the Recreational Fishing Trusts in the article. Throughout the season, a number of radio interviews were conducted with the author in which the benefits of the scientific program at tournaments were emphasised. As well, constant liaison with game fishing clubs maintains an excellent working relationship with the fishery.

Scientific Program

A number of scientific projects, both local and international, were able to be facilitated or assisted through the project in 2005/2006. These are summarised as follows:

Global genetics of mako sharks

Requesting / partner organization(s): US National Marine Fisheries Service (NMFS), La Jolla, California. Shortfin mako sharks (*Isurus oxyrinchus*) occur throughout the tropics and sub tropics of the three major world oceans. An earlier study of their global genetics indicated some population structure, but to refine these results, NMFS is conducting a new study. The Gamefish Tournament Monitoring Program continued to cooperate with this study by collecting muscle samples from all landed mako sharks at tournaments. This year, a further 15 samples were obtained for this important study.

Age, growth and reproduction of striped marlin

As was the case last year, Keller Kopf, a Ph.D student with Charles Sturt University, attended as many tournaments as possible as part of this important study (Dr Pepperell is his external co-supervisor). Preliminary stock assessments of striped marlin have indicated that the western/central Pacific stock may be fully fished, but this work has been severely hampered by lack of knowledge of the true growth rates of this animal. As well, information on the striped marlin reproductive cycle dates back to a single Japanese study in the 1970s. Samples from striped marlin for this study are vital to the stock assessment work, for which a major workshop will be held in Noumea in early 2009. Last year, 16 striped marlin were sampled for ageing and reproduction work and this year, a further 17 samples were obtained. One of these was from a particularly small fish (about 20kg) caught at Bermagui, which is a critical and rare size of fish necessary for estimating the full growth curve for the species.



A student from Charles Sturt University wearing a T-shirt indicating the research program being undertaken on striped marlin. Age and growth and reproduction of the species are being studied in this important undertaking which will have implications for large scale stock assessment.

Biological Studies on Pelagic Sharks: NSW DPI scientist Dr Nick Otway again attended the Interclub and other tournaments and point score days throughout the season. This year, Dr Otway was able to examine more than 30 sharks and add to his archive of detailed data and biological samples from these species. He has developed a method for measuring large sharks by taking digital images of them with known reference scales while the sharks are being weighed, and later calculating various length measurements. These are particularly useful in situations where it is not possible to measure the sharks in a natural horizontal position.

Dr Nick Otway holds a mako shark for photographing to later determine its body dimensions. The white rod marked with red stripes suspended from the dorsal fin is used for that purpose and provides very accurate digital measurements which are archived with all previously collected data.



Ongoing Monitoring and Sampling of Billfish: As in previous years, Principal Investigator, Dr Julian Pepperell of Pepperell Research & Consulting organized and coordinated all of the above research and continued his own ongoing research into billfish biology and determining long term patterns of distribution and abundance of marlin. All marlin brought to the weigh station were weighed, measured, sexed and sampled. Archived tissue samples are regularly requested by overseas researchers for a number of projects, such as those listed above. These samples are taken from not just billfish, but also sharks, tuna and other gamefish. During all weigh-ins attended, information on the scientific work being carried out at the weigh station, including past results of projects, was frequently conveyed to the general public via the tournament public address systems.

Composition of the Monitored Catch

The following sections summarise the species composition of the total catches (weighed and tagged) for all tournaments covered by the project in 2006/2007.

Table 2 Numbers of each species captured and tagged during the tournaments attended for the project.

Species	Pt Macq Cpts	Pt Macq Tags	Bot Bay Cpts	Bot Bay Tags	Berm Cpts	Berm Tags	Lake Macq Cpts	Lake Macq Tags	Pt Steph Capt	Pt Steph Tagged
Albacore						15				
Bigeye Tuna		1								
Black Marlin		5	1	1		3		8	2	111
Blue Marlin	9	8		2			1	1	2	8
Blue Shark									1	1
Cobia	1	1								
Hammerhead		2		1						1
Mahi Mahi		6	1	1				1		2
Mako Shark			2		1	1			7	3
Sh'bill spearfish										1
Skipjack tuna		3		4		3				6
Striped Marlin	1	4		4	3	6	5	55	3	48
Tiger Shark			3					1	5	2
Whaler shark		6	1						2	5
Wahoo	2	4		1					1	13
Yellowfin Tuna	9	4				18			1	65
Y'tail Kingfish				2				1		
Totals	22	44	8	16	4	46	6	67	24	266

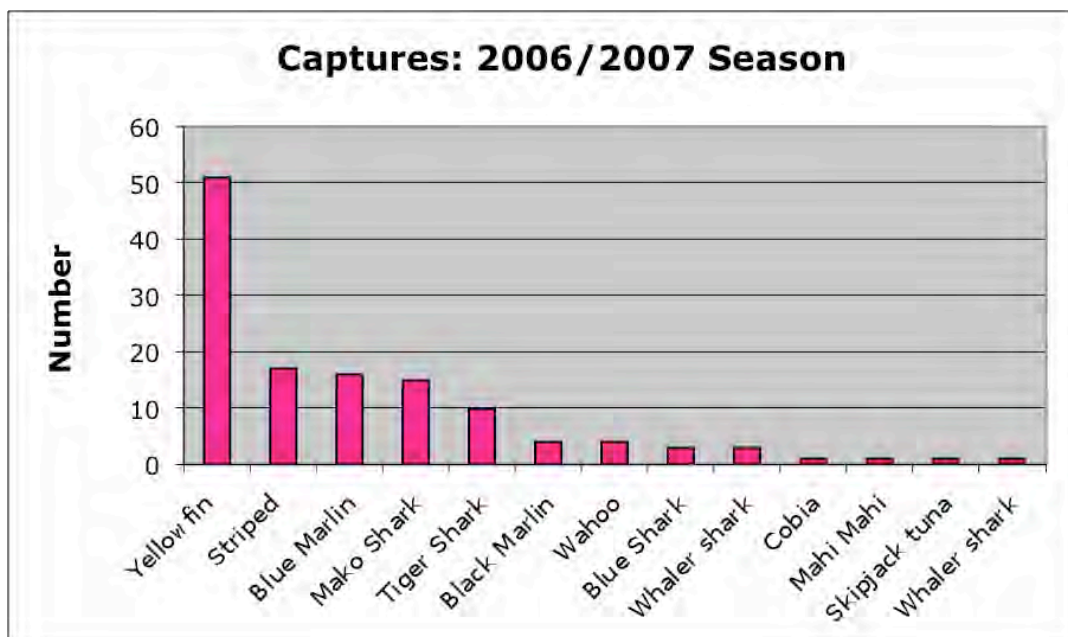
Table 2 (Contd.) Numbers of each species captured and tagged during the tournaments attended for the project.

Species	Br Bay Capt	Br Bay Tagged	Canb Yfin Capt	Canb Yfin Tagged	Total Capt	Total Tagged	Total Catch
Albacore				21	0	36	36
Bigeye Tuna					0	1	1
Black Marlin	1	3			4	131	135
Blue Marlin	3	2	1		16	21	37
Blue Shark			2	3	3	4	7
Cobia					1	1	2
Hammerhead					0	4	4
Mahi Mahi		3			1	13	14
Mako Shark	2	1	3	1	15	6	21
Spearfish					0	1	1
Skipjack tuna		2			0	18	18
Str Marlin	5	7		2	17	126	143
Tiger Shark	2	2			10	5	15
Whaler shark		1			3	12	15
Wahoo	1	2			4	20	24
Y'fin Tuna		69	41	125	51	281	332
Y'tail Kingfish					0	3	3
Totals	14	92	47	152	125	683	808

Considering the combined species composition of all fish caught at all tournaments attended, Figures 1 and 2 indicate that quite different proportions of the main species are tagged and weighed.

The main species weighed in 2006/2007, by number, was yellowfin tuna, followed by striped marlin and blue marlin (Fig 1). Last year, these figures were quite different, with the main species captured being tiger sharks, followed by mako sharks and blue marlin. Few tiger sharks were weighed this year compared with previous years, indicating a relatively poor season for that species. Few black marlin were again weighed compared with numbers tagged.

Figure 1. Numbers of all species caught and weighed during the major game fishing tournaments covered by the project in 2006/2007.

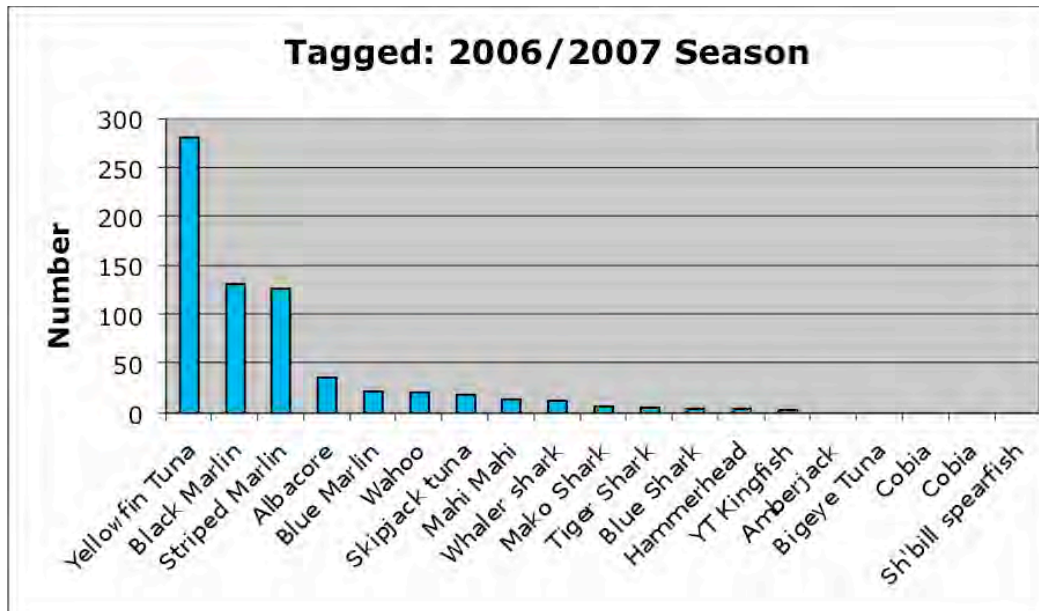


Regarding species tagged, Figure 2 indicates that the main species tagged was yellowfin tuna, with 281 released during the attended tournaments. This contrasted markedly with last year when the dominant tagged species was mahi mahi, with 347 tagged. This year, only 13 mahi mahi were tagged, also indicating a very poor season for this species; in fact, the worst since monitoring began.

Regarding marlin, striped marlin topped the list again with 126 tagged (204 last year) followed by black marlin with 131 (186 last year) and blue marlin with 21 tagged (29 last year). As for last year, this continues a trend, begun in the early 1990s, of striped marlin becoming the dominant marlin species in the New South Wales gamefish fishery in all years except those when a strong year class of juvenile black marlin appears (as happened in 2004/2005). For at least three decades prior to the early 1990s, striped marlin were relatively rare in the game fishing catch of marlin, which had been completely dominated by black marlin. The shift to striped marlin has been a phenomenon which is due partly to improved targeting techniques, but also, almost certainly to increased regional abundance of the species. There are continuing signs that the peak in striped

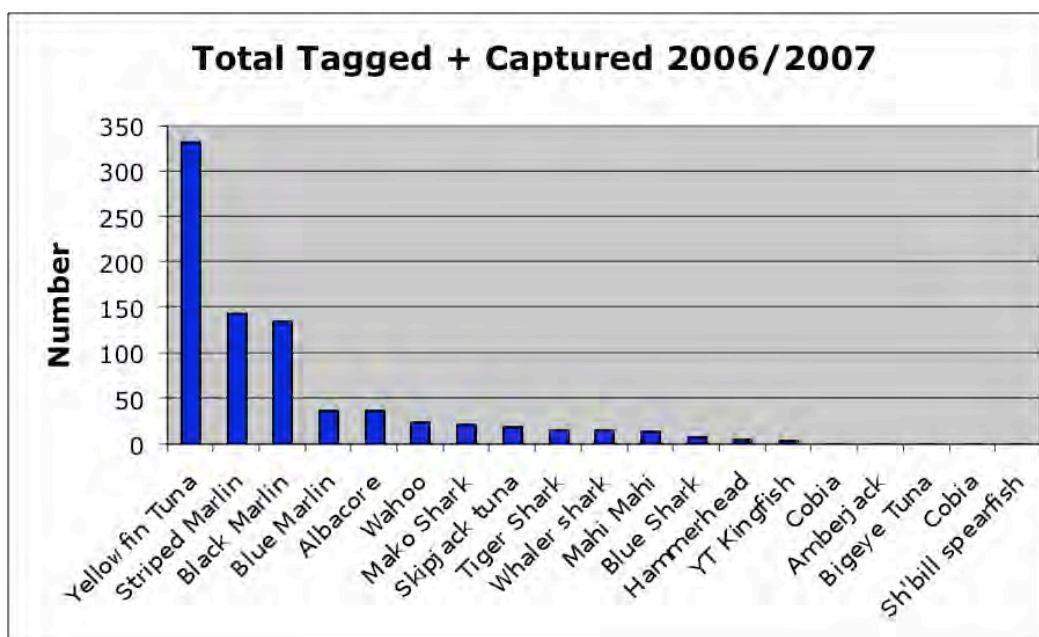
marlin availability may have been passed, indicated by lower numbers this year than in the previous three years. More research is required to consider long term cycles of striped marlin abundance.

Figure 2. Numbers of all species tagged and released during the major game fishing tournaments covered by the project in 2006/2007.



Combining tagged and captured fish, Figure 3 shows the species composition of the total catch for all tournaments combined.

Figure 3. Numbers of each species caught (captured plus tagged and released) during all tournaments attended in 2006/2007



The foregoing figure largely reflects the numbers of fish tagged, although in some cases, such as tiger sharks and mako sharks, the ratio of tagged to captured numbers is relatively low (see Figure 8). This figure indicates that yellowfin tuna represented the highest overall catch this year, with 332 tagged and captured (combined). This is a large improvement on the last two years (47 and 100 respectively) and may indicate a reasonable recruitment of yellowfin tuna to the region this year.

Continuing a trend, overall shark captures and taggings were quite low, with only 58 in total for the year (the lowest on record). Again, the main shark caught was mako, but only 21 of these were either tagged or captured, compared with 75, 20 and 38 for the previous three years (last year was unusual in that results for a special mako shark tournament were included). Tiger shark numbers were low this year, with 15 caught altogether, compared with 32, 27 and 31 in three previous years. In fact, tiger sharks made a late appearance off Sydney in 2006/2007 with good fishing being recorded in May 2007, outside tournaments.

Comparing absolute and relative catches with those recorded in the first year of this project with the previous four years. Figures 4a and 4b indicate that the species composition has varied considerably over the four seasons. In 2002/2003, mahi mahi and yellowfin tuna were the most numerous species caught while black, blue and striped marlin were proportionally less abundant than in 2003/2004, in relative terms. In 2004/2005, black marlin became the most numerous species, entirely due to an influx of one year old fish travelling down the coast – a phenomenon which occurs perhaps twice per decade. In the 2005/2006 season, mahi mahi again dominated numerically, while black marlin catches subsided, but were still higher than the first two years. In 2006/2007, yellowfin tuna became the most numerous component of the catch for the first time, but catches of other species were generally down on recent years. Catches of tiger sharks and hammerheads were down compared with the past four seasons, while catches of wahoo and albacore were well up on previous years.

Figure 4a. Numbers of the main species caught (captured plus tagged and released) during all tournaments attended 2002/2003 through 2006/2007

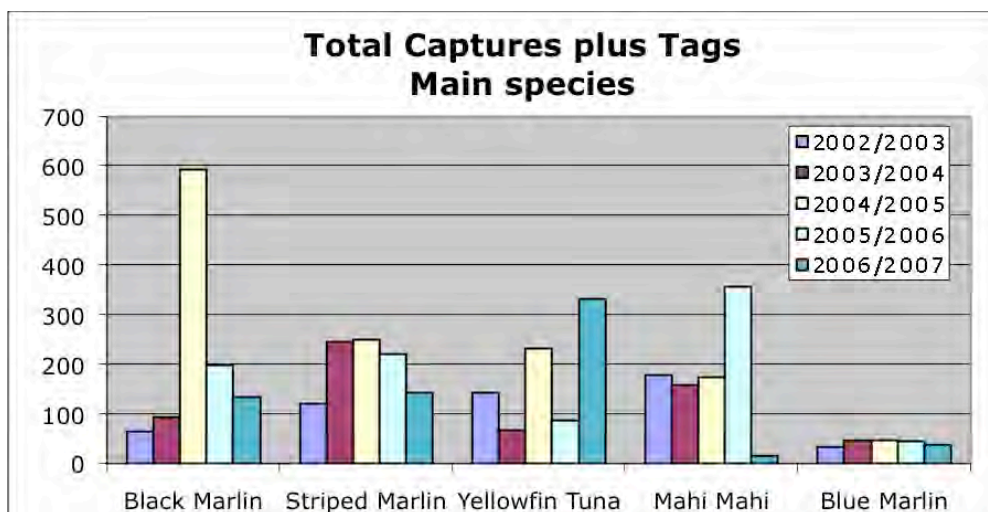
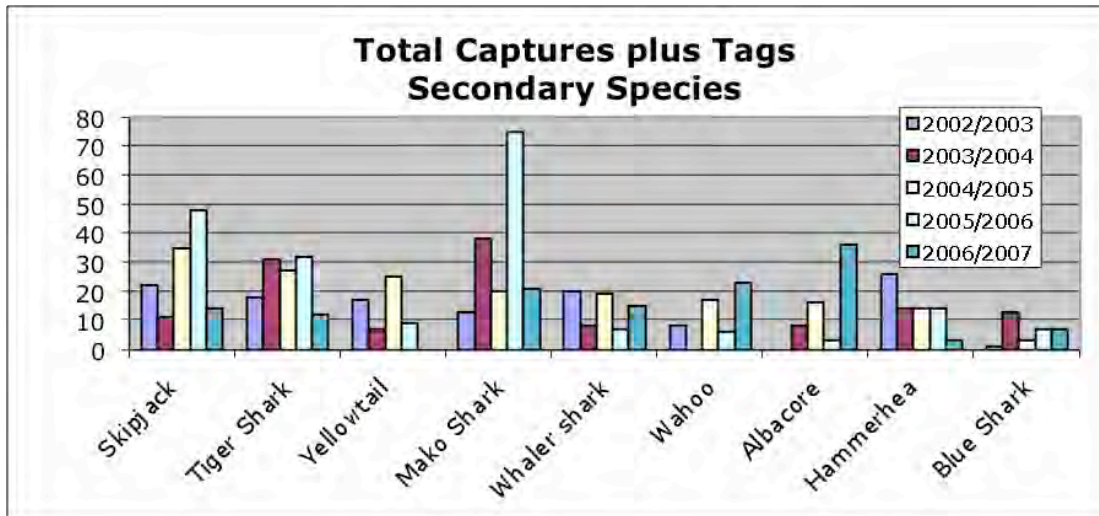
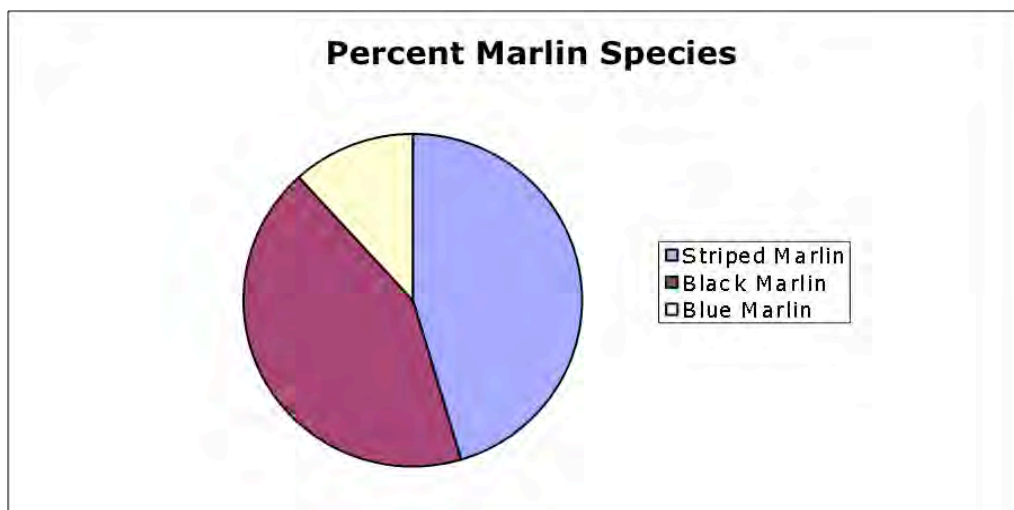


Figure 4b. Numbers of secondary species caught (captured plus tagged and released) during all tournaments attended 2002/2003 through 2006/2007



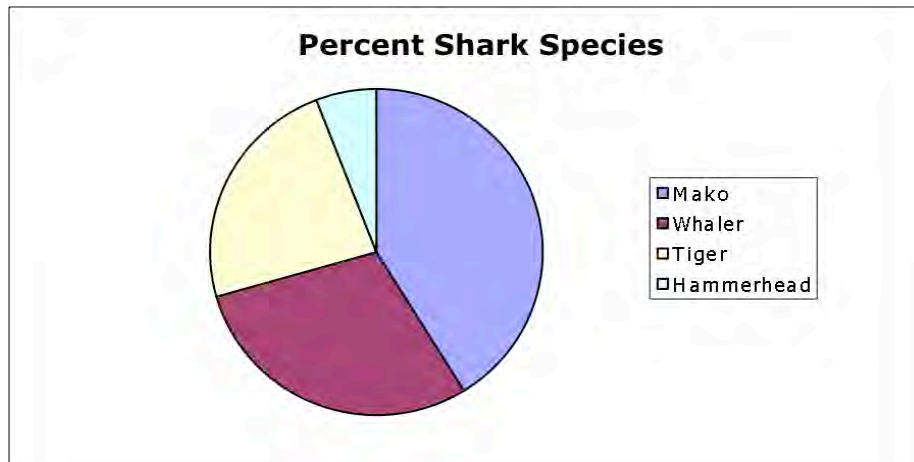
Considering now the ratio of marlin species recorded during the season, Figure 5 shows that striped marlin constituted 45.4% of the total (47.4% last year) followed by black marlin (42.8%, virtually identical to last year) and blue marlin with 11.7% (9.7% last year). These ratios appear to be relatively consistent through years, except in those years when small black marlin dominate the fishery

Figure 5. Catch composition of all marlin caught (weighed and tagged) during monitored tournaments in 2006/2007.



Turning to shark captures, Figure 6 shows the species composition of all sharks caught during monitored tournaments.

Figure 6. Catch composition of all sharks caught (weighed and tagged) during monitored tournaments.

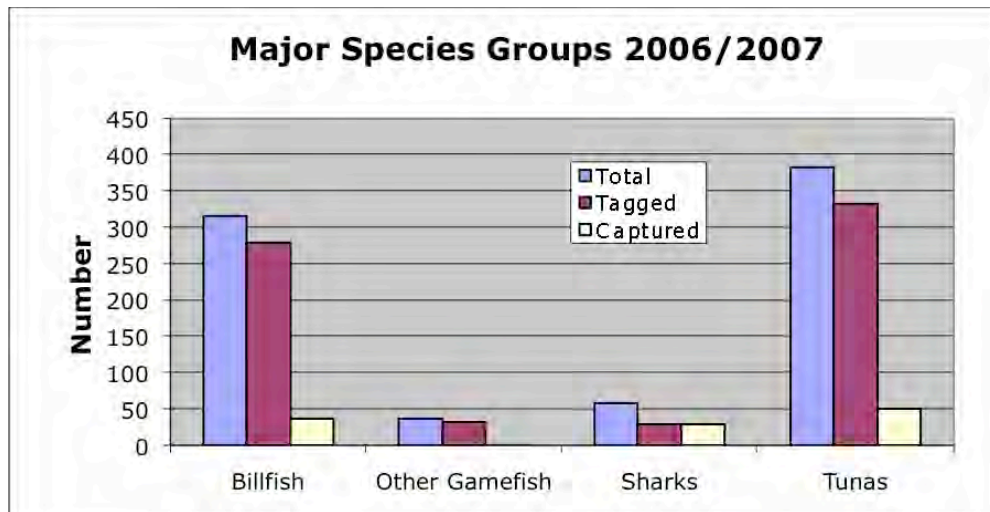


This shows that this year, mako sharks represented 41% of sharks caught (55% last year, but again, due to sampling a winter tournament), while whaler sharks as a group were next with 29.4% of the total shark catch. Tiger sharks constituted 23.5% of the catch, compare with 24% last year. As for previous years, hammerhead and blue sharks made up the remaining catch.

Most hammerhead and whaler sharks are caught while trolling baits intended for marlin, while tiger and mako sharks are mostly caught while drifting with dead baits intended for sharks. Because many more boats troll for marlin than drift for sharks, this means that higher numbers of hammerhead and whaler sharks in the catch almost certainly indicate a higher absolute abundance of these in the area at that time (which occurred in 2002/2003). Without a measure of targeted effort for tiger sharks, it is difficult to interpret fluctuating numbers of this species in the catch. Monitoring the catch through this program is an excellent way of keeping track of such changes in availability and possibly abundance of this and other species.

Another way to consider species composition of the catch is to combine species groups and compare proportional representation. In contrast to the last two years, Figure 7 shows that combined tuna catch (consisting this year primarily of yellowfin tuna and albacore) represented the majority species group caught by gamefish anglers during the season. Billfish catches as a group were slightly down in terms of absolute numbers, compared with the last two years, but with over 300 marlin (striped, black and blue) either tagged or captured in total, the season was relatively successful for this prize target group of fishes.

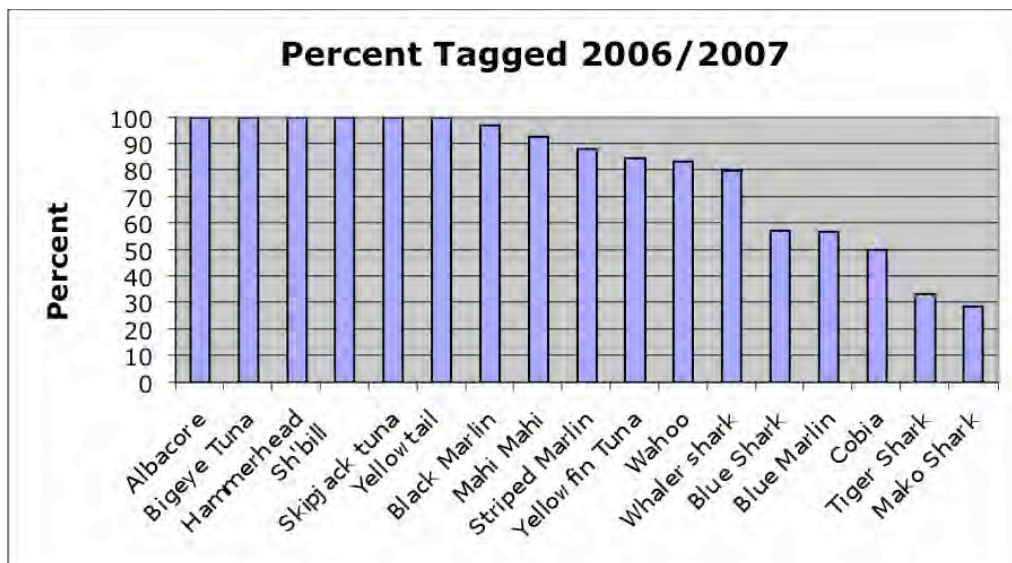
Figure 7. Numbers of fish caught at all tournaments, combined as species groups.



As is always the case, Figure 7 indicates that only relatively small proportions of billfish, tunas and other gamefish were captured and weighed, with the majority being tagged and released. Figure 8 shows this proportion tagged and released broken down by species.

This again indicates that at least 80% of most species were tagged and released in 2006/2007. As usual, the main exceptions were blue marlin (56.8% tagged) and three shark species – blue sharks (57.1% tagged), tiger shark (33.3% tagged), and mako sharks (28.6% tagged). While for all three shark cases, percent tagged increased last year over previous years, percentages dropped again, but not to historic lows. It is thought that the low figure of percentage of mako sharks tagged is due to the lack of small makos in the region during the season. Species which continue to be tagged in high proportions include yellowfin tuna black and striped marlin. Percentages of marlin released, with the last two year's figures in brackets, were: black marlin, 97% (93.5%, 98.8%), and striped marlin, 88.1% (92.7%, 92.8%). The percentage of blue marlin tagged continues to be lower than the other two species. Again this is primarily due to the fact that blue marlin found off NSW tend to be much larger than either blacks or stripes, and therefore, there is some incentive to bring larger fish to the scales in some tournaments. Nevertheless, the proportion of *large* blue marlin tagged is still high.

Figure 8. Proportion of each species tagged during attended tournaments.



Discussion

Some biological sampling has been undertaken at game fishing tournaments in New South Wales to varying degrees for over 25 years. The author first collected data on juvenile black marlin landed at the Port Stephens Interclub tournament in 1977 (Pepperell 1990) and CSIRO scientists regularly monitored catches of sharks from central NSW game fishing events in the late 1970s and early 1980s (Stevens 1984). As noted, many Australian and overseas research projects have benefited over the years through cooperation from game fishing tournaments (see Table 1) and routine monitoring of catches at tournaments is often a core research function in overseas organizations (see, for example, Stillwell and Kohler 1982).

Regular monitoring of catch and effort of game fishing tournaments in New South Wales did not commence until 1993 (Pepperell and Henry 1997) but since then, very detailed catch/effort data has been carefully collected every year (Murphy et al 2002). More recently, a study on the biology of large sharks, in particular, mako and tiger sharks, could not have been undertaken without the provision of free access to specimens brought to weigh stations during game fishing tournaments over a four year period (Chan 2001). Despite this history, biological research and monitoring at game fishing events in New South Wales had not been methodically undertaken in a planned fashion until the commencement of this project. Until then, research was undertaken when and where possible, and no long term data sets on weighed fish were officially maintained (although these kinds of data on marlin have been archived for many years by the author).

Now that the project has been underway for five years, some indicators of consistency, or variability in catches can be examined. Apart from the vagaries of the availability of fish in the region of a given port when a tournament is held, weather plays a role in the number of days able to be fished in that event. In previous years, days lost due to bad weather have been quite significant. In 2003 for example, one entire weekend of the Port Stephens Interclub

tournament was cancelled due to weather, while in 2004, one of the three fishing days of that event was also cancelled. In 2005, the Port Stephens Interclub tournament was fished on all four days, but other tournaments were badly affected by weather. The 2006/2007 season also saw a number of fishing days cancelled, notably, at Botany Bay and again, at Broken Bay.

In order to gain a feel for variability of fish availability at the same time and place over four years, Table 3 compares the numbers of fish captured and tagged during the 2003, 2004, 2005, 2006 and 2007 Interclub tournaments at Port Stephens.

Table 3. Numbers of fish by species captured and tagged during the NSW Interclub Tournaments of 2003, 2004, 2005, 2006 and 2007. Note that in 2003, two full fishing days were cancelled and in 2004, one full day was cancelled.

Species	2003	2003	2003	2004	2004	2004	2005	2005	2005	2006	2006	2006	2007	2007	2007
	Capt	Tag	Total	Capt	Tag	Total	Capt	Tag	Total	Capt	Tag	Total	Capt	Tag	Total
Black Marlin	3	23	26	7	58	65	6	557	563	9	141	150	2	111	113
Blue Marlin	2	4	6	5	17	22	1	12	13	6	20	26	2	8	10
Blue Shark	0	0	0	0	1	1	1	0	1	1	2	3	1	1	2
Hammerhead	3	8	11	1	2	3	1	9	10	1	7	8	0	1	1
Mahi mahi	1	31	32	3	27	30	6	15	21	1	206	207	0	2	2
Mako	0	1	1	7	5	12	6	1	7	7	4	11	7	3	10
Sailfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S'bill Spearfish	0	2	2	0	3	3	0	0	0	1	4	5	0	1	1
Skipjack Tuna	0	6	6	0	0	0	0	6	6	1	20	21	0	6	6
Striped Marlin	3	27	30	9	140	149	10	139	149	11	159	170	3	48	51
Tiger Shark	2	1	3	1	1	2	9	1	10	12	5	17	5	2	7
Wahoo	2	9	11	0	0	0	0	10	10	0	0	0	1	13	14
Whaler Shark	0	3	3	2	5	7	0	18	18	0	2	2	2	5	7
White Shark	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Yellowfin Tuna	2	47	49	5	10	15	1	21	22	5	31	36	1	65	66
Y'tail Kingfish	0	2	2	0	2	2	0	0	0	0	0	0	0	0	0
Total	18	164	182	40	272	312	41	789	830	55	601	656	24	266	290

Considering some key species, these data indicate that the availability of gamefish, at least to the coastal game fishing fleet, fluctuates quite markedly from year to year. For example, striped marlin were scarce in 2003, relatively abundant in the next three years but became less abundant last year. Blue marlin had been caught in record numbers in 2002 (before this project commenced), were scarce in 2003, and have been a low background catch since then. Black marlin provide an even larger contrast. Numbers of this species were quite low for 2003 and 2004, but in 2005, the tournament was dominated by a large influx of juvenile fish, a phenomenon occurs perhaps twice per decade. In 2006, this year class was again present, but in much lower numbers than 2005 and in 2007, virtually no young of the year fish were present, resulting in lower, but still good catches.

Another species of importance is the tiger shark. This species was caught in much lower numbers during the first two years of this series compared with longer term averages (Chan 2001). The numbers caught in 2005 and 2006 increased to more 'average' levels, especially when all tournaments are taken

into account but in 2007, catches were relatively poor. It is important to realize, as noted in last year's report, that there has been a likely decline in fishing effort aimed at tiger sharks, but catch trends of this icon species warrant a more in depth examination of all potential factors than is possible to undertake in this report. It is again highly recommended that the NSW DPI catch/effort monitoring program be analysed with respect to catch rates of all species of sharks during the past 10 years. Lastly, in the report of this project for 2005/2006, some concern was directed towards yellowfin tuna numbers in the catch. In 2006, numbers caught at other tournaments, including the Interclub, where over 220 boats fishing for four days, were very low. However, this year, numbers were the best for five years, even though only one weighable fish was caught. The appearance of at least one year class of yellowfin tuna at the Interclub this year, and a good show of two year old fish (30kg+) on the south coast later in the season, augers well for successful fishing for this species in the coming season.

Conclusions

This project has now completed its fifth full year of operation and has again clearly shown the many benefits which can be derived from a funded and organized monitoring and sampling operation at game fishing tournaments. Such benefits have been summarized in previous reports, and they are again worth outlining below:

- Scientific utilization of fish brought to the weigh station by facilitating the collection of valuable biological data on otherwise difficult to access species. This has included the whole range of pelagic species, viz, billfish, sharks, tuna and other gamefish such as mahi mahi and wahoo.
- The provision of such data for the use in management of various species. Some, such as blue and black marlin, are recreational-only species while others (eg striped marlin) are subject to allocation between the recreational and commercial sectors.
- Provision of a hands-on training ground for students interested in possible research careers in fisheries science, providing them with not only practical experience but also suitable payment for their work. This has been a particularly pleasing aspect of the project and continues to attract keen students.
- The familiar presence of scientific staff at tournaments provides a vehicle for anglers to report interesting specimens, observations and information, such as tag recaptures, unusual specimens or parasites, longline hooks found in fish, plastic bands around sharks and other wildlife and so on. Direct feedback to the fishery has obvious benefits, especially with respect to continued cooperation from the fishery.
- Flow-on benefits include providing access to otherwise unobtainable research material to researchers from other institutions, education of the general public who attend the tournament weigh-ins in large numbers, both directly and through the print and electronic media, who take great interest in the scientific aspects of such events, and demonstration of cooperation of the NSW Game Fishing Association with ongoing scientific research.

It is important to record that the Recreational Fishing Trust always receives due acknowledgement through all of the above activities and as such, the Recreational Fishing Licence is demonstrated to be of direct benefit, not just to the game fishing sector, but to the wider community who are interested in the marine world in general.

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