Enhancement of Citizen Science in the Recreational Fishery for Southern Bluefin Tuna in Victoria

Report to

Victorian Fisheries Authority

Recreational Fishing Grants

Pepperell Research & Consulting Pty Ltd

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Introduction

Biological and scientific monitoring of catches is an important part of studying any fishery. The relative abundance of southern bluefin tuna (SBT) off the Victorian coast has increased considerably over the past decade, establishing a reliable seasonal appearance of SBT within easy reach of recreational trailerboats. Portland in particular has become a major centre of the recreational fishery, with a 90% of the estimated 240 tonne Victorian recreational catch of SBT in 2011 being taken from this port (Anon. 2012).

The principal investigator for this project, Dr Julian Pepperell, was invited by VFA to visit Portland in 2017 during the Hooked on Tuna Festival and present a talk on SBT biology. During the visit, it was noted that, even though many hundreds of SBT are landed during the season, very few are tagged and released by the Portland-based fishery. This contrasts with the situation at Port MacDonnell in South Australia where usually, many hundreds are tagged annually. Furthermore, it was clear that the landing and cleaning of so many fish at one point was an ideal opportunity for biological sampling to be undertaken and that such activity would likely help to ameliorate the impression by some of this being solely a 'meat' fishery.

Sampling and archiving biological material from pelagic fish has proven to be of considerable value to the Australian and international scientific community. A monitoring and sampling program at NSW game fishing tournaments has been in progress every year since 2003 and tissue samples from that program have been subsequently used in numerous studies including global genetics, stable isotopes and oceanic pollution (Pepperell 2019). A similar project was conducted at game fishing events in Western Australia for three years (Pepperell 2018), archiving tissue samples from more than 400 fish for future research.

This form of cooperation with scientific research by the sport and game fishing sector is a genuine example of citizen science in action. Although there is no obligation to do so, anglers, charter operators and club officials will generally allow access by scientists to freshly caught specimens often difficult-to-access pelagic fish, especially if they are made aware of the aims of the research and its value to our understanding of the biology of their target species. In so doing, such cooperation demonstrates to the general public and the wider recreational fishing community the level of cooperation and commitment towards research and knowledge from the game fishing and charter sectors.

It was considered that greater participation in the Australia-wide Game Fish Tagging Program (operated by NSW DPI) would also demonstrate involvement of the Portland-based SBT fishery in ongoing research, and provide a value-added outcome of releasing SBT – which is already occurring either because of bag limits, or because anglers and charter clients prefer to do so. Data generated by tagging released fish increases knowledge of the movements of fish (via reported recaptures) and also of the effects of environmental variables on relative and seasonal abundance via analysis of release data. As well as the benefits from cooperation with other research organizations, a further benefit of this approach in other States has been in providing hands-on training and experience for students in fisheries-related field work.

Cover photo: A local angler looks on as student samplers Stephanie Chessum, Darren Wong and Bailey Thomas begin the process of extracting the tiny otoliths (earbones) from a large southern bluefin tuna

Routine sampling and archiving of biological material from recreationally-caught fish is of great value in itself, however, a study being conducted on SBT by CSIRO investigating the size and age of fish at first maturity would clearly benefit from samples of gonads and otoliths taken from fish caught by the recreational sector.

The project also nests well with a concurrent FRDC funded SBT community engagement project. That project focuses on angling practices for SBT, fish welfare (for released as well as boated fish) and best practices for processing fish if destined for the table. The two projects were seen to have clear synergies.

Aims

The aims of the project were:

- To undertake a biological sampling program on SBT, primarily at Portland
- To train student samplers to collect samples from fish landed by recreational anglers during the Portland Hooked on Tuna event throughout April 2019. Samples to include otoliths from the full size range of landed fish, and ovaries from large (>110cm) female fish. Both of these activities to feed directly into an existing CSIRO project monitoring the age structure of the population and also monitoring the age at maturity of SBT.
- To promote and increase the level of tag-and-release of SBT by the Portland-based recreational and charter fleets.

Methods

Three Fisheries/Marine Science students were recruited from Deakin University, Queenscliff, through recommendations from Dr Justin Rizzari, Lecturer in Fisheries Science.

Information regarding requirements for the CSIRO study was received from Dr Jessica Farley, CSIRO as follows: To collect otoliths from the full size range of fish landed, from both sexes and to collect ovary samples from female fish over 110 cm fork length, and preferably in the range 110 cm to 135 cm fork length. Protocols for sampling ovaries and extracting otoliths were also provided by Dr Farley (see Appendix II).

Prior to the commencement of fieldwork, equipment was purchased including histopots pre-filled with 10% formalin (for gonad samples), screw-top phials for storing otoliths, dissecting instruments, flexible measuring tapes, stout-bladed knives, knife sharpeners, zip-lock plastic bags of various sizes, waterproof labels, waterproof field data sheets, clipboards and pencils, head lamps, plastic buckets and portable coolers. Two reticulating saws and

blades for sampling otoliths were also purchased, one for smaller 'school' fish, and a heavy duty model for the very large fish being caught at the time of the field work.

Following a request to NSW Department of Primary Industries by the Principal Investigator, 1,000 standard conventional plastic dart tags, in packs of 10,together with 50 stainless applicator needles were sent to event organizers in Portland. The organizers included a tagging section and had a special trophy made to award to the boat tagging the most tuna. A $500 voucher was also donated as a tagging prize by Portland Bait & Tackle. Tags were distributed to anglers wishing to enter that section prior to fishing on each of the four weekends.

In order to train students, the Principal Investigator met in Portland with Dr Rizzari and the three students two days prior to the commencement of the Hooked on Tuna event. They were shown a presentation on sampling of tuna, sharks and billfish at NSW and WA tournaments, followed by demonstration of sampling on SBT brought to the cleaning tables on each of those two days. This included training in locating gonads, sexing fish by macroscopic examination of gonads, labelling and storing samples and recording data.

As many SBT as possible that were landed during the four weekends of the Hooked on Tuna event were examined and sampled. Each fish was measured from the tip of the lower jaw (with mouth closed) to the centre of the rear of the tail (length to caudal fork, or LCF). Weights of fish weighed on the official scales by the event organizers were recorded and noted if these were whole weights or gilled and gutted weights. If permitted to do so by anglers, a cut was made along the midline of the ventral surface of each fish and gonads were examined to determine sex. A number of fish, especially some of the larger specimens, had been cleaned at sea before being brought back to the tables. It was found that by carefully examining the body cavities of these fish, gonads could sometimes be located adhering to connective tissue on the dorsal surface of the cavity. Because CSIRO had requested only ovaries from female fish in excess of 110 cm LCF, all such gonads were sampled where possible. Cross-section slices about 0.5 cm wide of both left and right ovaries were cut from near the middle of the ovary and placed in histopots containing 10% formalin. Slices of testes were also taken from mainly larger male fish to check for maturity. Identifying labels were placed inside each pot.

Again if permitted by anglers, otoliths were extracted as follows: Using a reciprocating saw fitted with a long blade, a transverse section of the head was made at a level behind the eye, beginning at the top of the head at a point marked by a soft depression. The exact position of the cut was determined by trial and error on the first two fish sampled, so that the cavities containing the semi-circular canals would be transected just anterior to the otoliths themselves. Otoliths were then extracted using fine-tipped forceps, membranes and moisture removed and sealed in plastic phials together with identifying labels. It was found that making the transverse (vertical) cut behind the eyes was a superior method to the recommended horizontal cut above the eyes (see Appendix II).

Preserved gonad samples were shipped to the CSIRO Ocean and Marine laboratories in Hobart while the otoliths were delivered to Fish Ageing Services Ltd in Queenscliff for processing and ageing of fish in due course.

The weighing of large tuna each day attracted many onlookers who would also gather to watch the sampling of fish. As often as possible, the opportunity was taken to answer questions and to explain the aims of the work being undertaken.

Results

Biological sampling

The rules of the competition stipulated eligible fishing days as the four weekends in April 2019. Fishing times on those days were 6.30am to 5.00pm each Saturday and 6.30am to 3.00 pm each Sunday. About 60 boats entered the competition to fish at least one weekend. Weather conditions were good for the first three weekends but fishing was cancelled for the fourth weekend due to high seas and winds. Sampling of fish took place on each of the competition fishing days, as well as on the three days before commencement of the competition, and on Fridays before each weekend. An additional trip was made to Portland on 23 April to take advantage of good fishing at that time. In total 14 fishing days were sampled for the Project.

Table 1 shows all details of SBT measured, sexed and sampled for gonads or otoliths during the field component of the project. A total of 114 SBT were observed, 110 of those over the first three weekends. Of those, lengths of 106 fish were measured and 40 weights recorded (27 whole fish, 13 gilled and gutted). Otoliths were extracted from 80 fish, 53 fish were sexed (34 males, 19 females) and gonad samples preserved from 32 fish (17 males, 13 females and two probable females).

A number of factors determined how many observed fish were able to be measured, weighed and sampled for gonads and/or otoliths on any given day. The focus of sampling was mainly on the larger fish, not only to sample gonads but also to take the opportunity to collect otoliths from these older fish since CSIRO has relatively few of these in its extensive SBT database (Farley et al 2014). However, because of their size, extraction of their otoliths was difficult and time consuming, meaning that other smaller fish being landed were not always able to be sampled. Where possible, length measurements of those were quickly taken, but as Table 1 indicates, numbers of fish were also unable to measured or sample because anglers preferred to take them away whole.

The total catch of SBT was under-sampled since there are two boat ramps and sets of fish cleaning tables in Portland about 600 metres apart. Fortunately, creel survey clerks working on the SBT recreational catch survey and covering both sites were often present at the same times as the sampling staff, and would let samplers know if any larger fish were brought in to the other area. Even so, this would only account for some of the larger fish and few of the smaller fish brought into the other area.

Above: Locating the otoliths, only about 1cm long, inside the skull of a 100 kg southern bluefin tuna. After initial training, students achieved excellent results in finding at least one otolith in all tuna attempted.

Table 1: Details of biological samples taken from recreationally-caught southern bluefin tuna landed at Portland fish during the course of the project.

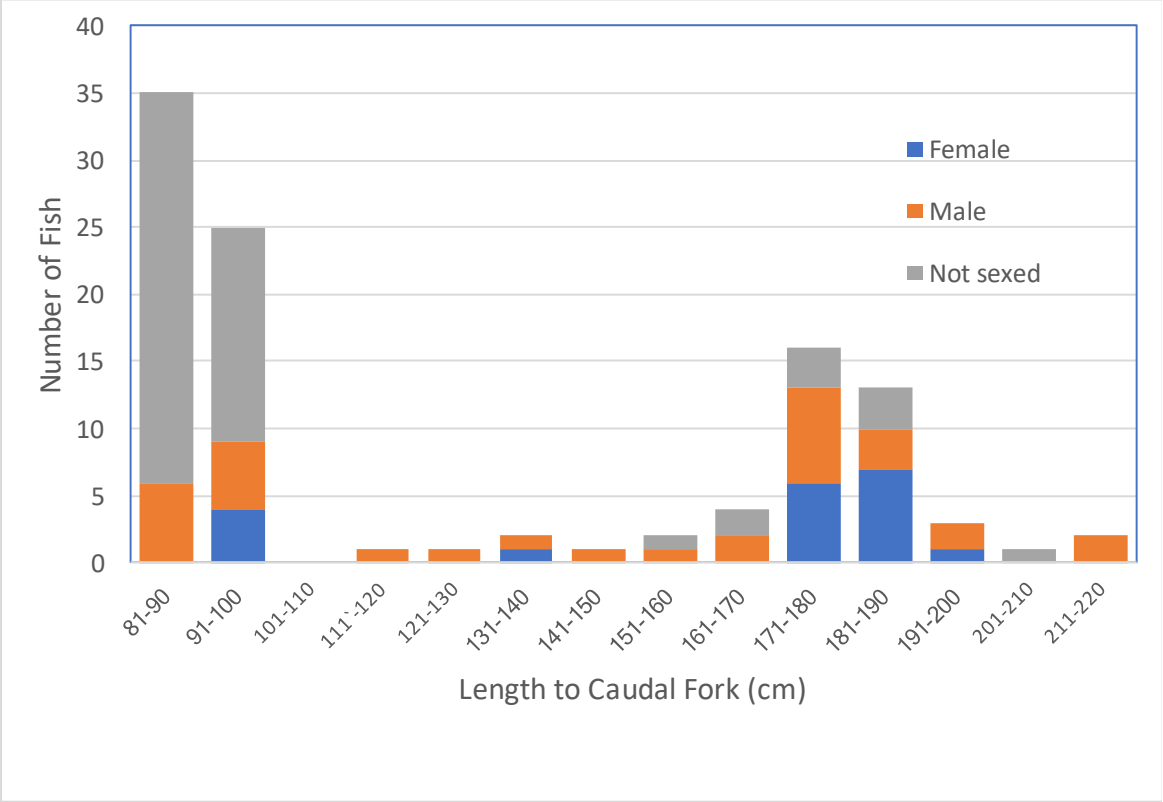
No.	DATE	SPECIES	LCF (cm)	WHOLE WT (kg)	G&G WT* (kg)	SEX	Otoliths?	Gonad?	COMMENTS
	WEEKEND 1								
1	3/4/19	SBT	169	87		?	Y	N	Not sexed
2	3/4/19	SBT	180	112		F	Y	Y	
3	3/4/19	SBT	160	95.6		?	N	N	Angler took home to clean
4	4/4/19	SBT	154			?	Y	N	Cleaned at sea, not weighed
5	5/4/19	SBT	172	102		F	Y	Y	Check Samples
6	5/4/19	SBT	175		81	M	Y	Y	Gilled and Gutted
7	5/4/19	SBT	172		72	F	Y	Y	Gilled and Gutted
8	5/4/19	SBT	177		105	M	Y	Y	Gilled and Gutted
9	5/4/19	SBT	179	122.4		M	Y	Y	
10	5/4/19	SBT	174	94.3		M	N	Y	
11	5/4/19	SBT	179	99.2		F	Y	Y	Bled at sea, weighed whole
12	5/4/19	SBT	193		108	F	Y	N	Gutted only, gills intact
13	6/4/19	SBT	189	118		F	Y	N	Caught 2/4/19, frozen
14	6/4/19	SBT	137			F	Y	Y	Not Weighed
15	6/4/19	SBT	211		116	M	N	Y	Gills and Guts 19KG
16	6/4/19	SBT	200	135		M	Y	Y	
17	6/4/19	SBT	181		104.9	?	Y	N	Likely female
18	6/4/19	SBT	128			M	Y	N	Not Weighed
19	6/4/19	SBT	169	81		F	N	Y	Sexed as M, lab showed was F
20	6/4/19	SBT	159	75		M	N	Y	
21	6/4/19	SBT	176	103		F	Y	Y	
22	6/4/19	SBT	186	121		M	N	Y	
23	6/4/19	SBT	211	135.1	116.1	M	N	N	Angler took home to clean
24	7/4/19	SBT	188	124		M	N	Y	
25	7/4/19	SBT	175	106.8		?	N	N	Angler took home to clean
	WEEKEND 2								
1	12/4/19	SBT	134		42.5	M	Y	N	
2	12/4/19	SBT	116			M	Y	N	Cleaned at sea, not weighed
3	13/4/19	SBT	187	102.4		M	Y	Y	Sexed as F, lab showed was M
	13/4/19	SBT	95			?	N	N	Angler retained whole fish
	13/4/19	SBT	90			?	N	N	Angler retained whole fish
	13/4/19	SBT	92			?	N	N	Angler retained whole fish
	13/4/19	SBT	90			?	N	N	Angler retained whole fish
	13/4/19	SBT	88			?	N	N	Angler retained whole fish
	13/4/19	SBT	86			?	N	N	Angler retained whole fish
	13/4/19	SBT	90			?	N	N	Angler retained whole fish
	13/4/19	SBT	84			?	N	N	Angler retained whole fish
	13/4/19	SBT	89			?	N	N	Angler retained whole fish
	13/4/19	SBT	93			?	N	N	Angler retained whole fish
4	14/4/19	SBT	146		49	M	Y	Y	
5	14/4/19	SBT	181	112		M	Y	Y	Sexed as F, lab showed was M
6	14/4/19	SBT	180		103	F	Y	Y	Bled at sea, weighed whole
7	14/4/19	SBT	179		80	?	Y	N	Gender undetermined
8	14/4/19	SBT	172		75	M	Y	Y	
9	14/4/19	SBT	91			?	Y	N	Cleaned at sea, not weighed
10	14/4/19	SBT	94			?	Y	N	Cleaned at sea, not weighed
	14/4/19	SBT	89			?	N	N	Angler retained whole fish

Table 1 (continued): Details of biological samples taken from all southern bluefin tuna observed at Portland cleaning tables during the course of the study.

No.	DATE	SPECIES	LCF (cm)	WHOLE WT (kg)	G&G WT* (kg)	SEX	Otoliths?	Gonad?	COMMENTS
	WEEKEND 3								
1	19/4/19	SBT	187	112.2	96	F	Y	Y	2 X Gonad Samples
2	19/4/19	SBT	90	18			Y	N	
3	19/4/19	SBT	181	117		M	Y	Y	Bled at sea, weighed whole
4	19/4/19	SBT	176	100	91	M	Y	Y	
5	20/4/19	SBT	186	106		F	Y	Y	
6	20/4/19	SBT	89			?	Y	N	
7	20/4/19	SBT	92			?	Y	N	
8	20/4/19	SBT	89			?	Y	N	
9	20/4/19	SBT	92			?	Y	N	
10	20/4/19	SBT	92			?	Y	N	
11	20/4/19	SBT	89			?	Y	N	
12	20/4/19	SBT	88			?	Y	N	
13	20/4/19	SBT	93			?	Y	N	
14	20/4/19	SBT	90			?	Y	N	
15	21/4/19	SBT	95			M	Y	N	1 otolith
16	21/4/19	SBT	97			F	Y	N	
17	22/4/19	SBT	87			?	Y	N	
18	22/4/19	SBT	85			?	Y	N	
19	22/4/19	SBT				?	N	N	Not weighed or sampled
20	22/4/19	SBT				?	N	N	Not weighed or sampled
21	22/4/19	SBT	203	134.6		?	Y	Y	
22	22/4/19	SBT	88			?	Y	N	
23	22/4/19	SBT	95			?	Y	N	
24	22/4/19	SBT	95			?	Y	N	
25	22/4/19	SBT	94			?	Y	N	
26	22/4/19	SBT	84			M	Y	N	
27	22/4/19	SBT	184		122	F	Y	Y	
28	22/4/19	SBT	191	114		M	Y	N	
29	22/4/19	SBT	175			M	Y	N	Not weighed
30	22/4/19	SBT				M	Y	Y	
	22/4/19	SBT	184	108		?	N	N	Angler took home
	22/4/19	SBT	88			?	N	N	
	22/4/19	SBT	91			?	N	N	
	22/4/19	SBT	85			?	N	N	
	22/4/19	SBT	90			?	N	N	
	22/4/19	SBT	90			?	N	N	
	22/4/19	SBT	184	110		?	N	N	Angler took home
	22/4/19	SBT				?	N	N	
	22/4/19	SBT		149.7		?	N	N	Angler took home- pending world rec
	22/4/19	SBT		141		?	N	N	Angler took home
31	23/4/19	SBT	185	101**		F	Y	Y	Missing tail
32	23/4/19	SBT	87			?	Y	N	1 otolith
33	23/4/19	SBT	88			?	Y	N	
34	23/4/19	SBT	87			?	Y	N	1 otolith
35	23/4/19	SBT	87			?	Y	N	
36	23/4/19	SBT	96			F	Y	N	Broken otolith- Small piece
37	23/4/19	SBT				?	N	N	Not weighed or sampled
38	23/4/19	SBT	90			M	Y	N	
39	23/4/19	SBT	88			?	Y	N	1 otolith
40	23/4/19	SBT	94			M	Y	N	
41	23/4/19	SBT	91			M	Y	N	
42	23/4/19	SBT	92			M	Y	N	
43	23/4/19	SBT	95			F	Y	N	Broken otoliths
44	23/4/19	SBT	96			?	Y	N	Broken otoliths
45	23/4/19	SBT	94			F	Y	N	
46	23/4/19	SBT				?	N	N	Not weighed or sampled
47	23/4/19	SBT	179			?	Y	Y	Check gonads
48	23/4/19	SBT	92			?	Y	N	
49	23/4/19	SBT	88			?	Y	N	1 otolith
50	23/4/19	SBT	88			?	Y	N	
51	23/4/19	SBT	93			?	Y	N	Broken otolith
52	23/4/19	SBT	91			M	Y	N	
53	23/4/19	SBT	170		91	M	Y	Y	
54	23/4/19	SBT	167	86		F	Y	Y	
	WEEKEND 4	Comp called off for the whole weekend. Huge seas, hardly any boats fished at all							
1	27/4/19	SBT	90			M	Y	N	Fish caught on 25/4/19
2	27/4/19	SBT	85			M	Y	N	Fish caught on 25/4/19
3	27/4/19	SBT	89			M	Y	N	Fish caught on 25/4/19
4	27/4/19	SBT	90			M	Y	N	Fish caught on 25/4/19

*Gilled and gutted at sea
**Tail removed at sea

Figure 1: Size distribution of all recreationally-caught southern bluefin tuna measured at Portland, April 2019.



The size distribution of all measured fish, together with their sex where known, is shown in Figure 1. This shows that the catch was largely dominated by smaller fish in the 80 to 100 cm size range, with very few fish in the 100 to 170 cm range but then with another marked peak of fish measuring 170 to 190 cm, tapering off to a few fish measuring over 2 metres. The capture of a SBT weighing 100 kg or more has become a goal for many anglers, with the term 'barrel' conferred on fish in that size class. During the project, while samplers were present, 23 fish were landed which weighed 100 kg or more, the heaviest being 149.7 kg. As well, seven gilled and gutted fish weighed more than 100 kg, while three other cleaned fish weighing more than 90 kg would likely have weighed over 100 kg whole. This is based on one fish that was bled, gilled and gutted at sea but the gills and internal organs brought back to the weigh station. The cleaned carcass weighed 116.1 kg while the gills and organs weighed 19 kg, or 14% of the whole weight. In summary, 33 fish landed during the 14 days of sampling weighed 100 kg or more and therefore qualified as 'barrels'. While there are no reliable records of the number of 100 kg plus fish weighed through time, anecdotal information from local anglers and tackle shop proprietors suggested that this was very likely a record number of 'barrels' to be weighed in Portland over a similar period. As a side observation, anglers indicated that many of these large fish were caught close to shore actively feeding on baitfish. The aims of the project did not include dietary analysis, but

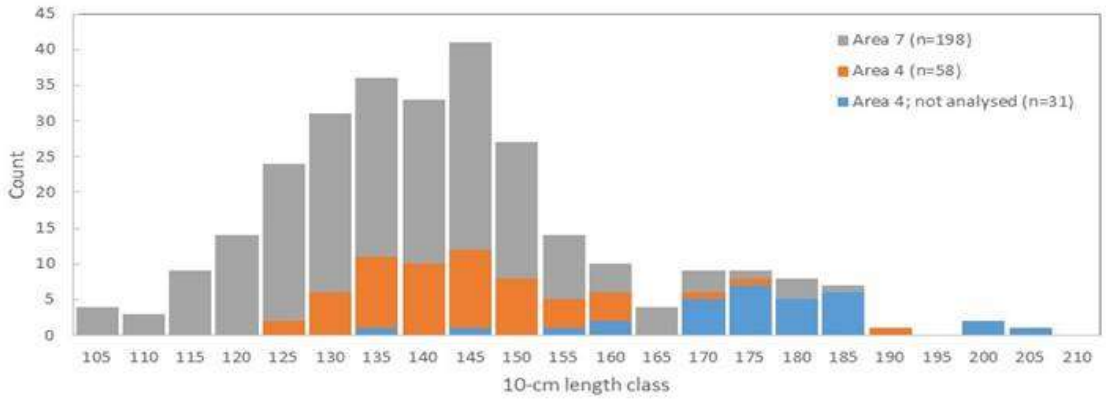
opportunistic inspection of some stomach contents showed the fish to be feeding heavily on both pilchards and redbait.

Following initial training on the first weekend, determination of sex by student samplers was very good. Of the 32 gonad samples sent to CSIRO laboratories, only three had been wrongly assigned (two assigned as females were found to be males and one assigned as male was found to be female).

The gonad samples sent to CSIRO were analysed. As expected, the smaller female fish (91-100 cm) were immature, while all of the large female fish, measuring over 170 cm, were mature and in a post-spawning, resting condition. Only one female fish in the size range 110 to 135 cm was sampled and interestingly, that fish also proved to be a mature adult, which, because of the virtual lack of fish in that size range off southern Australia, was a useful addition to the overall biological data on the species (see Figure 2.).

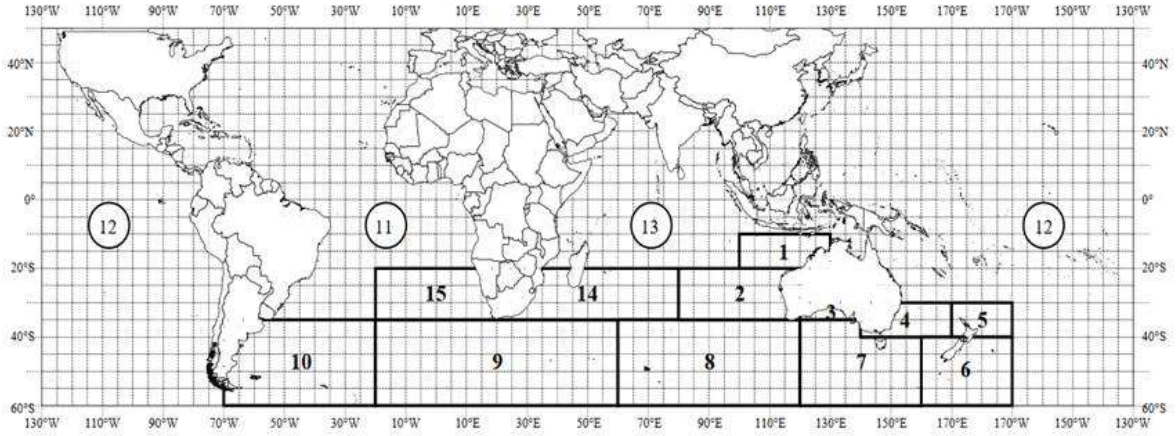
Above: Gonads sampled from 100 kg + southern bluefin at Portland. Left: Mature, spent/resting ovaries. Right: Mature resting testes. **Below**: Data recording during sampling.

Figure 2: Size distribution of SBT measured by CSIRO personnel for the study on size at first maturity (grey and orange). Recreationally-caught fish measured in the current study are shown in blue. Note the length classes are in 5 cm bins, not 10 cm as per the label. See Figure 3 for delineation of areas.



This figure also demonstrates the value of this project to the CSIRO study of size and age at maturity and age distribution of the population in that our samples constitute the majority taken from fish measuring over 170 cm LCF, and nearly all of those over 180 cm. For reference to the two areas noted in the graph, Areas 4 and 7 are shown in Figure 3.

Figure 3: Map of statistical areas as used by CCSBT. Note Areas 4 and 7, referred to in Figure 2.



Ageing of the fish from which otoliths were extracted had not been undertaken at the time of writing of this report. However, they are in the queue to be processed and read and results will be publicised in due course. Again, CSIRO scientists were pleased to obtain these samples, especially those from the larger (170 cm plus) fish since otoliths from fish of those sizes are difficult to obtain and very important in determining longevity and variability of growth rates over decadal scales of time.

Tagging

Tags and tagging equipment were only issued to anglers who requested them. Anglers from 14 boats (of 60 competing boats) requested tags while a further four not in competition were also provided with tags on request.

Despite the pre-publicity regarding tagging and promotion of tagging during the event via project staff and Portland Bait & Tackle, no SBT were tagged as part of the Hooked on Tuna event, with the result that the tagging trophy and prize were not awarded. Possible reasons for the lack of tagging are alluded to in the Discussion.

Interestingly, the overall tagging database of NSWDPI shows that just two SBT were tagged in Victorian waters on the weekends of the event, both off Warrnambool. The database further shows a total of 988 SBT were tagged in Australian waters for the year 2018/19, which was considerably less than the average of about 2,000 tagged over the past 12 years. Of that number 176 were tagged in Victorian waters, 84 of those off Portland. For comparison, 392 were tagged off South Australia, 124 off Port MacDonnell (Pepperell 2020).

Publicity for the Project

An article announcing the commencement of the project and its aims appeared in the magazine: 'Bluewater Boats & Game Fishing' (see Appendix I). The magazine is a high-end production and is widely read in game and sport fishing circles.

A front page article was published in the Portland Observer newspaper on the first weekend of the Hooked on Tuna event outlining the project and its objectives (see Appendix I).

Interviews on ABC radio about the project were conducted in early April 2019 with Dr Julian Pepperell, one with Daniel Miles on ABC South Western Victoria and one on ABC Drive.

Dr Pepperell attended the presentation of prizes and trophies for the event and presented a short talk on its aims and outcomes.

Discussion and Conclusions

The project was highly successful in undertaking biological sampling of SBT caught by recreational anglers during the Portland Hooked on Tuna competition during April 2020. Fortunately, the weather cooperated over three of the four weekends of the event, and good numbers of fish were caught, including more than 30 fish weighing in excess of the magic 100 kg mark. The opportunistic access to these larger fish was quite fortuitous, enabling the collection of otoliths that will be very important in further understanding of the growth rate of this important species.

This was the first biological sampling of the recreational catch of SBT to have been undertaken. Through local awareness of the project and through more widespread media messages, the project was able to demonstrate to the general public and the recreational fishing community a high degree of cooperation and commitment towards research and knowledge from the recreational sector targeting SBT from Portland. Direct feedback to the fishery via the project has obvious benefits, especially with respect to continued cooperation from the fishery.

As well as the benefits from collaboration with Deakin University and CSIRO, a major benefit of the project has been in providing hands-on training for undergraduate fisheries and marine science students. All three of the student samplers from Deakin University who were recruited for this project benefited from the experience and volunteered to continue to assist in this kind of work in the future.

One of the aims of the project was to promote and potentially increase participation in tagging of SBT in the Portland region. As noted, it had previously been observed that relatively few tuna were routinely tagged off Portland compared to many hundreds off Port MacDonnell in South Australia where anglers effectively fish the same group of fish. It was thought that a main reason for lack of tagging by anglers fishing from Portland might be due to visiting anglers not being members of fishing clubs, and their being more interested in taking fish back for food than in tag and release. After the project had been approved, it came to the attention of the principal investigator that tagging or 'marking' of any fish in Victoria was effectively illegal without a specific permit. Under this legislation, a general permit for tagging was held by the Game Fishing Association of Victoria (GFAV) which allowed any member of a club affiliated with that Association to tag recognized species of gamefish, including SBT. Due to this realization, and the likelihood that many anglers fishing in the Hooked on Tuna event may not be members of affiliated clubs, approaches were made through VRFish and the peak angling national body, the Australian Recreational Fishing Foundation (ARFF) to allow tagging at least for the duration of the event. It was conveyed to the principal investigator just before the event that permission had been granted under the auspices of VRFish, so the distribution of tags to competing anglers went ahead. As noted in the Results, no fish were tagged during the four weekends of the event. Subsequently, there was some discussion as to whether the arrangement would have allowed anglers who were not affiliated with member organizations of VRFish to tag fish (for example, charter boat clients who were not members of any fishing club). As at the writing of this report, the situation had apparently not been resolved.

Notwithstanding the above, 180 tags were distributed to anglers from 18 boats during the period of the competition, so it was somewhat of a surprise that none were used. On the other hand, several factors are likely to have contributed to this result. Because unusually high numbers of very large fish (100 kg plus) were in the Portland area for the whole period much of the fishing effort of competition boats is likely to have been directed at those because of the substantial prizes for heaviest fish on each weekend and overall. This meant that there were probably few opportunities to tag smaller school fish, which did not really appear in the area until the third weekend in any case. The situation regarding legality of tagging any fish in Victorian also may have played a role, especially since the local fishing club, the Portland Sport Fishing Club, is not affiliated with the Victorian Game Fishing Club and therefore its members have not been permitted to tag fish in the past. Even so, our general observation and conclusion is that interest in tagging SBT by anglers fishing from Portland is not high at present and may benefit from a concerted promotional program if general tagging by all anglers and charter operators were to be permitted in future.

Acknowledgements

We are very grateful to a number of organizations and personnel who supported the development and the carrying out of this project. In 2017, the Mayor of Glenelg Shire Council, Cr Anita Rank indicated strong in-principle support from Council for a project that offered to undertake both a sampling and a tag-and-release components, especially in conjunction with the Hooked on Tuna event.

The Portland Lions Club, one of the organizers of the Hooked on Tuna competition, through Mr Michael Hunter, strongly supported the project, seeing considerable benefits to the image of Portland's recreational SBT fishery as a result. Mr Hunter also greatly assisted the project in many ways during its field work phase. We also sincerely thank the other organizers of the Hooked on Tuna event, Glenelg Shire Council and the Portland Sport Fishing Club.

Mr John Johnstone, proprietor of Portland Bait & Tackle was extremely helpful in providing advice on catches of SBT prior to and during the project, in keeping and freezing a 112 kg fish before the commencement of field work, in helping to distribute tags to anglers and in providing a welcoming venue for meeting and liaising with anglers and organizers of the Hooked on Tuna event. Sadly, Mr Johnstone passed away

Other organizations which enthusiastically lent support the project were VRFish, The Portland Sportfishing Club, The Game Fishing Association of Victoria and VRFish and , Magnet Fishing Charters (Captain Jason Farrugia.

Dr Justin Rizzari of Deakin University's Geelong campus took a strong interest in the project, recruiting three of his Fisheries Science students to conduct the field work. He attended the first weekend of the Hooked on Tuna event, helped in the training of students and assisted in shipping gonads to CSIRO and delivering otoliths to Fish Ageing Services. We are also grateful to Dr Jessica Farley, CSIRO, for encouraging the sampling of the recreational catch, for advice in collecting gonads and otoliths and for histological examination of the material collected during the project.

We particularly thank Scott Gray, contracted by IMAS Tasmania to conduct the SBT recreational fishing survey, for his help in locating otoliths in large SBT and, together with survey clerk Greg Rutter, for assistance in notifying project personnel of captures of tuna and estimated times of arrival and at which of the two cleaning table sites.

The student samplers recruited for this project, Stephanie Chessum, Darren Wong and Bailey Thomas, all performed their tasks to a high degree of diligence. Their persistence and careful work and record keeping are much appreciated.

Lastly, we thank all the anglers, boat owners and charter operators who permitted their fish to be examined, poked, prodded, measured and dissected. Their interest and patience were always appreciated.

We gratefully acknowledge funding from the Recreational Fishing Grants of the Victorian Fisheries Authority without which this project would not have been possible.

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Appendix I

Publicity for the project

DR PEPPERELL

Southern bluefin tuna project

Inspired by the number of anglers catching southern bluefin tuna off Victoria's seaside town of Portland, Dr Pepperell heads south to encourage more tag and release, and to begin a new research program in conjunction with a month-long tuna fishing festival.

A couple of years ago, I wrote a piece on this page about a visit I had made to Portland, Victoria – the coastal town famous for its southern bluefin tuna (SBT) fishing. Portland is a magnet for hundreds of trailerboats which flock there from Melbourne and other centres to take advantage of the great fishing to be enjoyed since the apparent resurgence of SBT along the coast of southern Australia.

I had been invited to the 'Hooked on Tuna' festival, a month-long event running over four consecutive April weekends, with cash and other prizes on offer for various categories – most notably for the three largest tuna caught over that period.

I became enthralled by the daily ritual of anglers bringing their two fish bag limit of 15kg-plus SBT to the impressive stainless-steel cleaning tables specially set up for this fishery. What surprised me though was how few tuna were being tagged and released in the region – a mere handful per year in stark contrast to the many hundreds tagged annually off neighbouring Port MacDonnell, just 50km away over the border in South Australia.

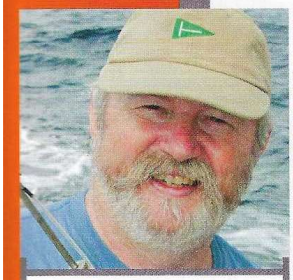
> "What surprised me was how few tuna were being tagged and released in the region."

Apart from the apparent need for more tagging, it seemed to me that here was a great opportunity to do some biological work on the fish being brought to a central processing location each day. As a result, I put an application together for some funding from the Recreational Fishing Grants Program, managed by the Victorian Fisheries Authority, and I'm pleased to announce that the application was successful. In fact, by the time you read this, the project will be well underway, kicking off with the 2019 Hooked on Tuna event.

Titled 'Enhancement of citizen science in the recreational fishery for southern bluefin tuna in Victoria', the main aims of the project are to add value to the fish brought in to the public weighstation and cleaning tables. It will do so by collecting biological data and material from otherwise difficult-to-access specimens, providing these for the purposes of research and management. The second thrust of the project is to encourage far greater involvement in tagging of SBT, which will provide scientific information from releasing fish – something that is happening anyway either because of bag limits, or because anglers and charter clients choose to do so. Data generated by tagging released fish will not only increase knowledge of the movements of fish via reported recaptures, but also help to understand the effects of environmental variables on availability of SBT through analysis of release data. The project is also running in parallel with the 'Tuna Champions' program, which is helping provide anglers with information on how to best tag tuna for release, as well as how to look after their catch if kept for the table.

In addition to the scientific information flowing from the biological sampling and increased tagging, the project will also provide opportunities for students to receive hands-on training and gain experience in fisheries-related field work. This year, after initial training, four bright and willing marine science students from Deakin University campus in Queenscliff will be on hand during each fishing day of the festival to extract otoliths (ear bones) for ageing of the catch. The ovaries from larger female fish landed over that period will also be collected. The otoliths and gonads will then be sent to the CSIRO Marine labs in Hobart for incorporation into a larger investigation into the growth rates and reproduction of SBT throughout the range of the species.

It's great to see the project receiving support from the local and wider fishing and non-fishing communities. For example, sponsorship of a prize for the boat tagging the most SBT during the event is being provided by Portland Bait and Tackle, and a handsome trophy in the form of a Perspex tagged tuna is being presented by the Portland Lions Club. I'm packing my bags for Portland as I write, and crossing my fingers that the tuna turn up on cue. To be continued...



DR JULIAN PEPPERELL is a recognised world authority on billfish and other pelagic species. He is especially well-known for developing the Australian gamefish tagging program. Julian formed his own research company in 1991 and conducts research in partnership with universities, government and the private sector. He is also an adjunct professor at several Australian universities. He provides a rare gift in his ability to bridge the gap between the scientific community and recreational anglers.

Appendix I (contd.)

Publicity for the project

Decades behind the camera P. 5

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Fishing for facts

THERE was no room for the weak-stomached on Friday as a group of scientists began their research into the make-up of southern bluefin tuna that frequent our waters each year. Marine biologist Dr Julian Pepperell (left), and Deakin University students Stephanie Chessum and Darren Wong were among a team of specialists taking samples of large tuna caught in the region. Read more about the scientific project on PAGE 6.

Picture: ELLY HATELEY 190405ah15

Marine biologists investigate southern bluefin tuna

BEN FRASER

AMONGST all the excitement of anglers hauling in massive tuna each week, a group of dedicated scientists are looking into the finer details of southern bluefin tuna.

Marine biologist Dr Julian Pepperell, four students from Deakin University and a host of industry specialists were in Portland last week investigating the majestic species to best understand the steady stream of tuna that frequent Portland each year.

Dr Pepperell's 'Enhancement of citizen science in the recreational fishery for southern bluefin tuna in Victoria' project collected important biological data and material from otherwise difficult-to-access species for the purposes of research and management.

"We're taking samples of the fish's gonads (testis or ovary) and otoliths (ear bones)," Dr Pepperell said.

While the data collection is scientific, the method is rudimentary, with Dr Pepperell and the students used a hand-held powersaw, knife and tweezers to extract the ovaries and otoliths from a 102kg tuna on Friday.

"The gender of the fish is important because the males and females grow at different rates.

"The otoliths are used to tell how old the fish is.

"The otoliths and gonads will then be sent to the CSIRO Marine labs in Hobart for incorporation into a larger investigation of growth rates and reproduction of southern bluefin tuna throughout the range of the species."

In Portland from last Wednesday to Monday, Dr Pepperell said the process serves as valuable hands-on training and experience for students from Deakin University's Geelong campus in fisheries-related field work.

Funded by the Recreational Fishing Grants Program and managed by the Victorian Fisheries Authority, Dr Pepperell was also in Portland to advocate a tag-and-release practice in the region.

He said while thousands are tagged annually in Port MacDonnell, a mere handful is tagged per year in Portland.

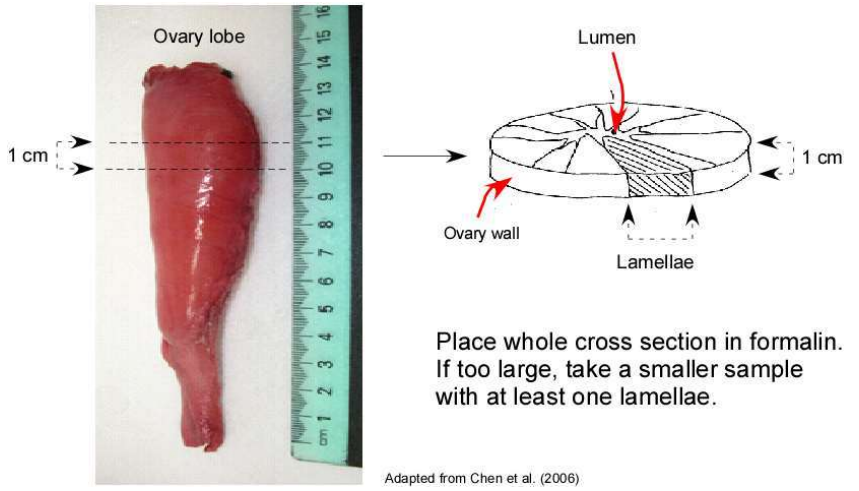
"Data generated by tagging released fish will not only increase knowledge of the movements of fish via reported recaptures, but also help to understand the effects of environmental variables on the availability of southern bluefin tuna through analysis of release data."

TO locate the otholiths, the team used a powersaw and tweezers to extract the tiny bones, which are located on either side of the tuna's brain. Picture: ELLY HATELEY 190405eh13

WHILE the massive 102kg tuna stretched for two metres, tweezers were needed (left) to remove its otoliths (ear bones) which measured no bigger than 10mm in length. The bones are used in conjunction with the gonads to determine the age of the fish. Picture: ELLY HATELEY 190405eh09/10

Appendix II

Sampling protocols



Adapted from Chen et al. (2006)

Appendix II (contd.)

Sampling protocols

Otoliths

To remove the otoliths:

- Using a large knife, cut the head off just posterior to the operculum (cut A in Fig 1).
- Make a second cut about 2 cm above the eye (cut B in Fig 1) to meet the first cut. Remove the tissue to expose the brain. You may need to adjust the position of cut B, so that it is made through the top or middle of the brain. If the cut is too deep, the otoliths will be lost. For first attempts, it is better to make a "shallow" cut, and to do successive small cuts then until the brain appears.
- Position the fish mouth towards you and use the blunt end of a pair of forceps to gently scrape out the brain tissue. The sagittae will be in two small cavities posterior to the brain cavity (Fig. 2).

Remove, clean and place the otoliths in a vial and then place the vial inside a plastic bag with a label and freeze.

Figure 1. Diagram and photo showing where to cut to view the brain and remove otoliths.

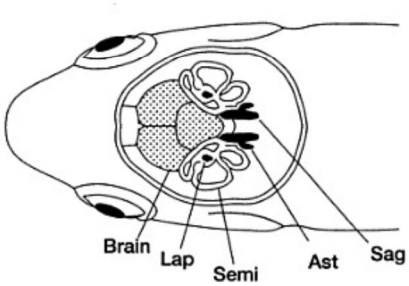


Figure 2. Dorsal view of the inner ear and location of sagitta (Sag) in relation to the brain in a cutaway skull of a fish (adapted from Campana 2004).