AFMA Project RR2014-0823:

Defining the status of Torres Strait Spanish mackerel to inform future fisheries allocation and sustainable fishing

Report on the acoustic monitoring.

Executive Summary.

Despite successful use of acoustic monitoring technology to understand and describe aggregating and movement behaviours of Spanish mackerel on the Queensland east coast, this replicate project in the Torres Strait was hampered by too few data and community sensitivities to make any substantive conclusions. Regardless, some field observations are made and management implications are discussed. We appreciate the efforts of local stakeholders that assisted the project, and gave every effort to encourage useful outcomes.

Introduction.

Spanish mackerel is very important finfish resource of the Torres Straits that currently provides a business base for the Torres Strait Regional Authority (TSRA) (quota ownership and lease) as well as traditional (TIB) and non-traditional (TVH) fishers and fishing businesses alike. The Spanish mackerel resource is also shared with Papua New Guinea (PNG), and although PNG do not currently access the fishery, participation may occur in future years. Most of the contemporary catch is landed by TVH fishers, however through training programs and initiatives and the work of the TSRA, TIB participation may increase in future years.

Spanish mackerel are a highly productive species that can support valuable long-term fisheries provided management is based on robust science. Spanish mackerel is susceptible to overfishing because of an obligate transient aggregating behavior (Tobin et al., 2013). Some spawning aggregations have been fished to economic extinction on the Queensland east coast as a result of unmanaged fishing (Buckley et al 2017). Although the aggregating behavior of Spanish mackerel can allow fisheries to operate with economic efficiency harvesting large numbers of fish in short periods of time, transient aggregating species may also be prone to rapid depletion.

The Spanish mackerel fishery in the Torres Straits is considered fully fished (O'Neil & Tobin 2017). The fishery has a long history of production for both Torres Strait Islanders and commercial non-Islander fishers. There is a need to better understand the movement and aggregating characteristics of Spanish mackerel within the major TS fishing grounds around Bramble Cay, Ugar (Stephen) and Erub (Darnley) Islands. There are concerns that increased participation (fishing platform numbers) in the Bramble Cay fishery may jeopardise future economic viability, while the effectiveness of the 10 mile exclusion zones around Ugar (Stephen) and Erub (Darnley) Islands for the protection of local Spanish mackerel fisheries are not yet known.

Future management complexities include catch sharing among TIB, TVH and PNG and the outputs of this research will better inform those decision processes. Simultaneously, the project outputs will allow the TSRA and TIB and TVH fishers alike to more confidently assess fishing business structures and potential investments. This component of the research used acoustic monitoring methods to better understand the aggregating and movement characteristics of Spanish mackerel within the major fishing grounds of Bramble Cay, Ugar and Erub Islands. If Spanish mackerel are unique to individual reefs and islands (as the case is for Queensland east coast Spanish mackerel (see Tobin et al 2014)), then the fishing activities at Bramble Cay may not affect local island mackerel. Alternately, if mackerel move widely throughout the TS, fishing effort and catch at Bramble Cay may impact on local island mackerel stocks. This knowledge will improve understand and the information basis for sustainable future management.

Methods.

Study site and acoustic array. The study primary focus was Bramble Cay (09.08.500 S 143.52.500 E); the clear primary fishing site for Spanish mackerel in all the waters of Torres Strait (Figure 1). Secondarily, the study was interested in the nearby community waters surrounding Ugar Island (09.30.500 S 143.32.500 E) and Erub Island (09.35.000 S 143.46.000 E). The acoustic monitoring was replicated across two years; 2014 and then again in 2016. Receivers were anchored on the reef slope at depths of approximately 15 metres and in positions that allowed for unobstructed "listening" towards the deeper waters abutting reef edges where Spanish mackerel aggregate. Receivers were suspended in the water column approximately 1.5m above the substratum by a subsurface float suspended approximately 2.0m above the substratum (Figure 2). In October 2014 seven Vemco VR2W acoustic receivers were deployed, with 4 at Bramble Cay and 3 in waters nearby Erub and Ugar Islands (Figure 3a). The receivers were retrieved in December 2014. In September 2016 nine Vemco VR2W acoustic receivers were deployed, with 5 at Bramble Cay and 4 in waters nearby Erub and Ugar Islands (Figure 3b). These receivers were retrieved in January 2017.

Acoustic transmitter deployment. Spanish mackerel were tagged with Vemco V9 acoustic transmitters with a 60 to 120 second random delay (giving a tag life of 152 days). The transmitters were fitted with Vemco holed end-caps and wired to umbrella-style darts using stainless steel wire. The length of wire between the dart and transmitter was approximately 15cm. A short hand-held tagging pole was used to tag mackerel in the anterior dorsal

musculature with the dart inserted to a depth of approximately 10cm leaving the transmitter to trail externally (Figure 4). In both years 20 Spanish mackerel were tagged together at Bramble Cay while 10 mackerel were tagged in waters nearby Erub and Ugar Islands. Mackerel were captured using standard commercial line trolling gears although a single barbless 10/0 hook was used in placed of the usual two 10/0 hooks ganged, and baited with a single hemirhapid. Mackerel were generally tagged and released within 90 seconds of being hooked.

Figure 1. Northeastern Torres Strait was the location of the acoustic monitoring research. The research focused on two sites: 1 Bramble Cay, and 2. the waters about Erub Island and Ugar Island. Acoustic tags were fitted to Spanish mackerel at both sites and acoustic receivers were anchored in both sites to listen for the tagged fish. The two broad questions asked: how do mackerel use the waters about their tagging site? Do mackerel move between sites?

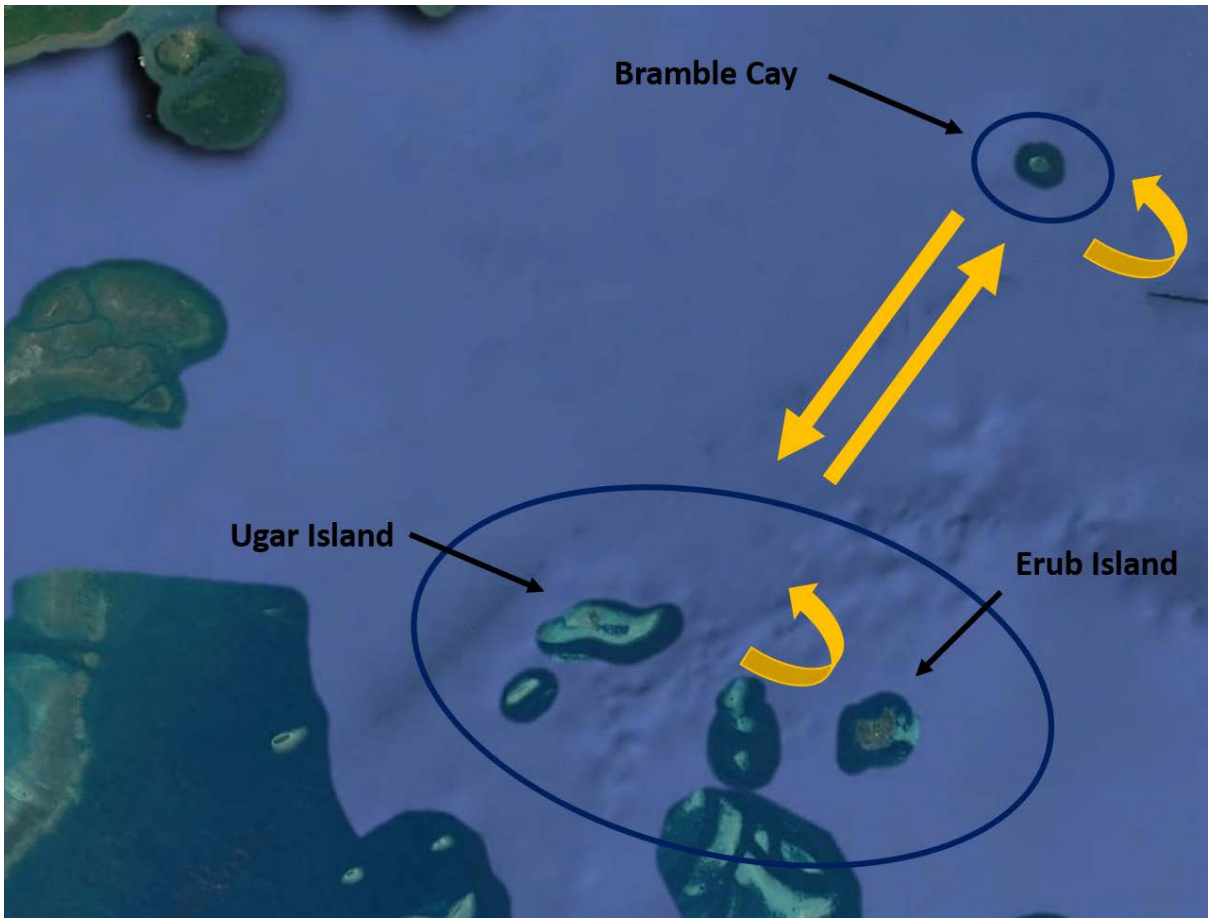


Figure 2. An example of a receiver *in situ* anchored on the reef crest to enable unobstructed "listening" to the deeper waters abutting the reef where Spanish mackerel are known to aggregate.

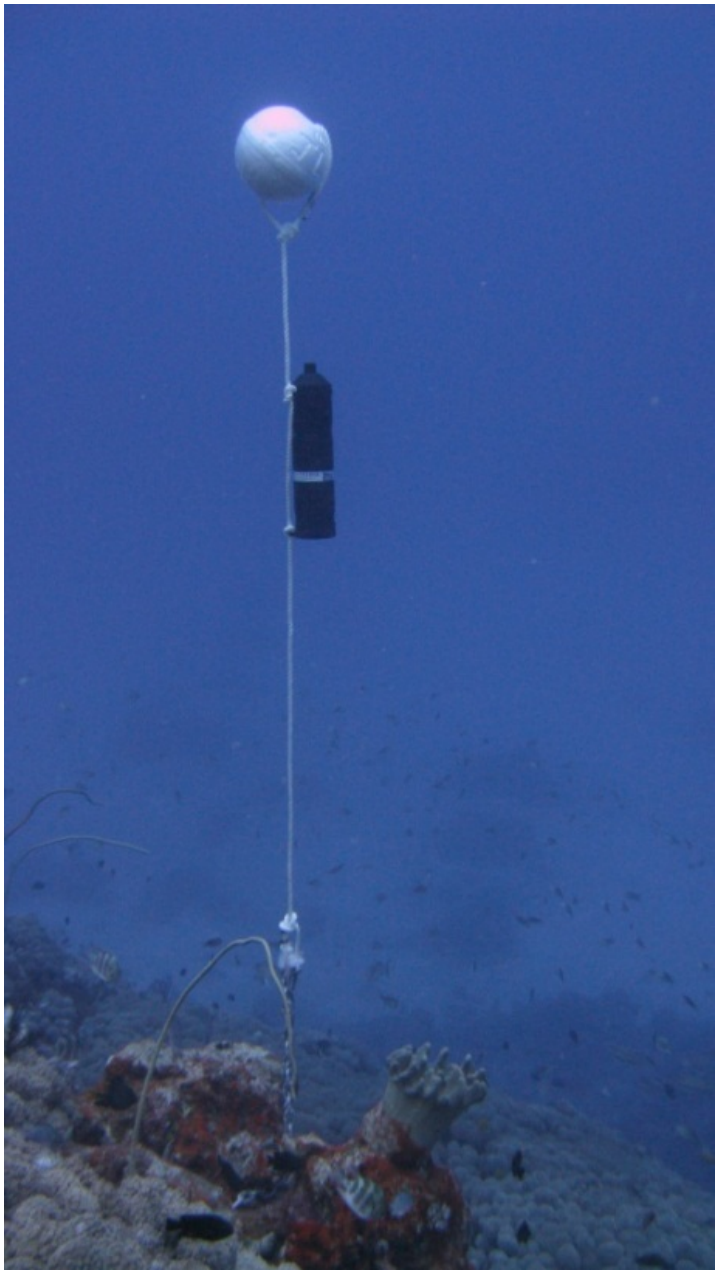
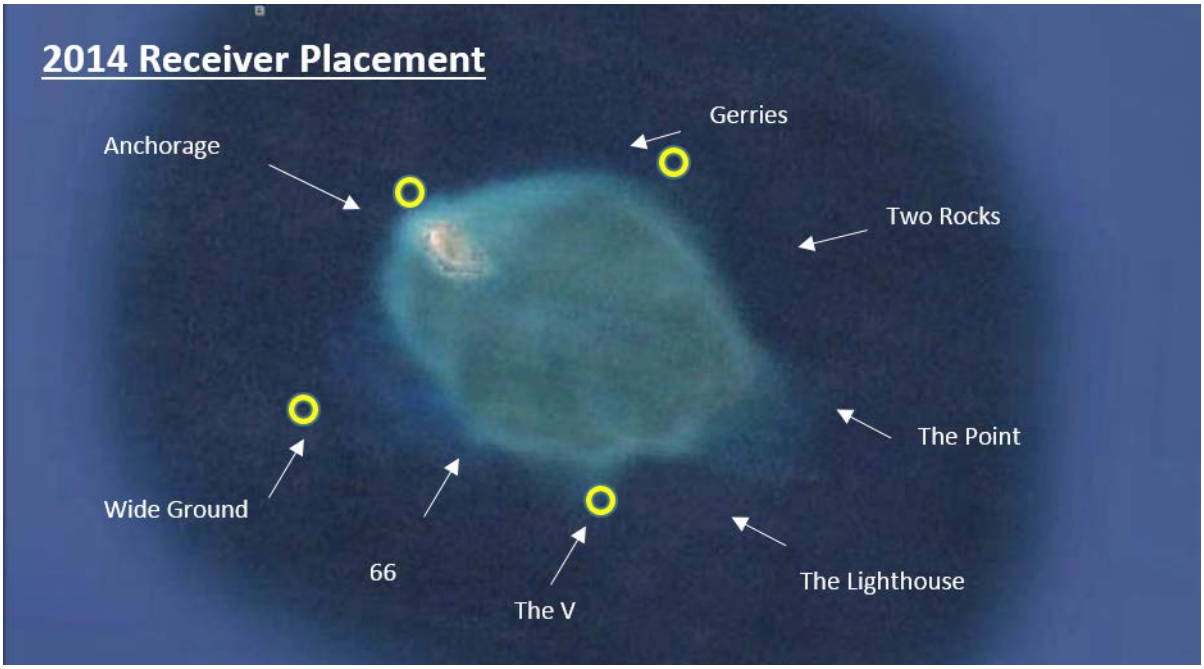


Figure 3. Bramble Cay in far northeastern Torres Strait with commercial fishers colloquial names for fishing sites indicated. The circles depict acoustic receiver placement, with red indicating receivers that were lost during the course of the study. The receiver placements of **a.** 2014 and **b.** 2016 are given. Due to community concerns, the receiver placements about Ugar and Erub Island waters are withheld.



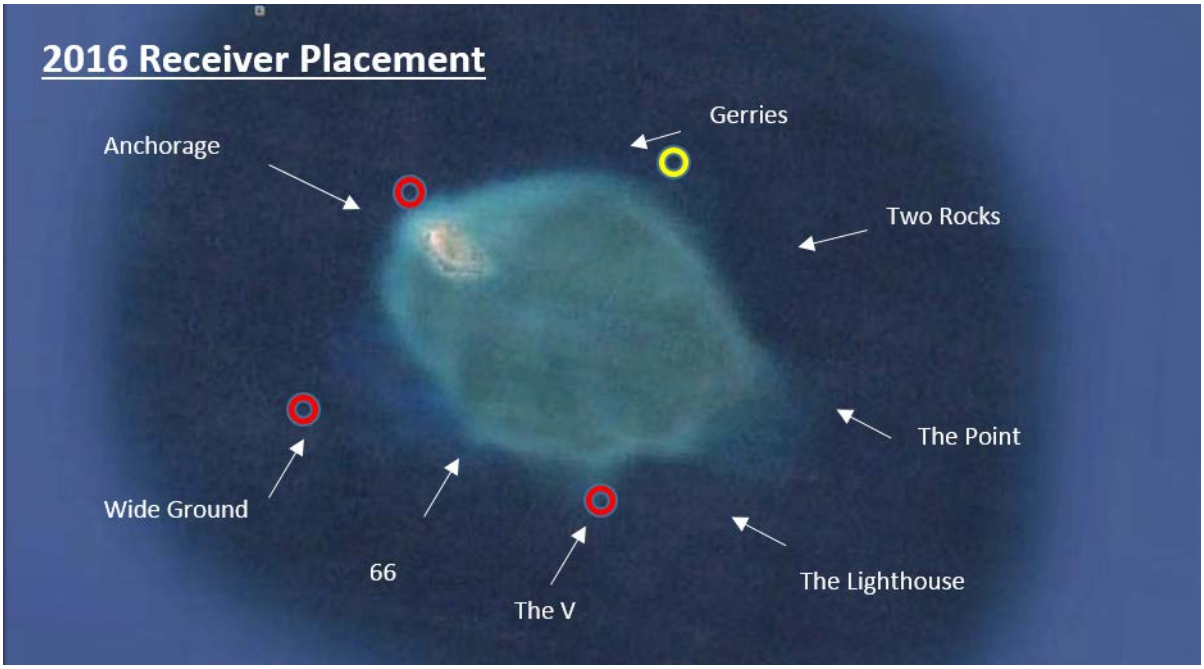
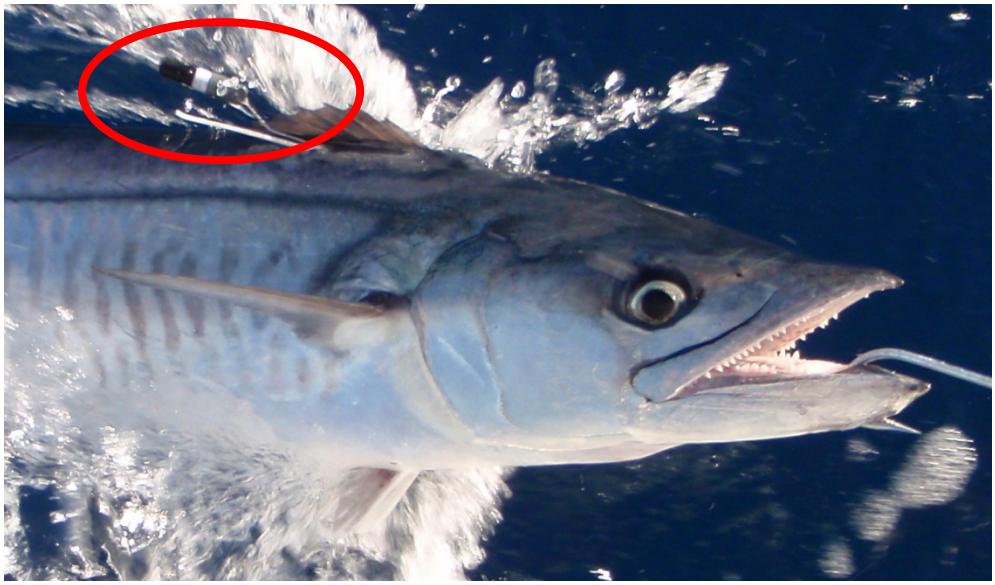
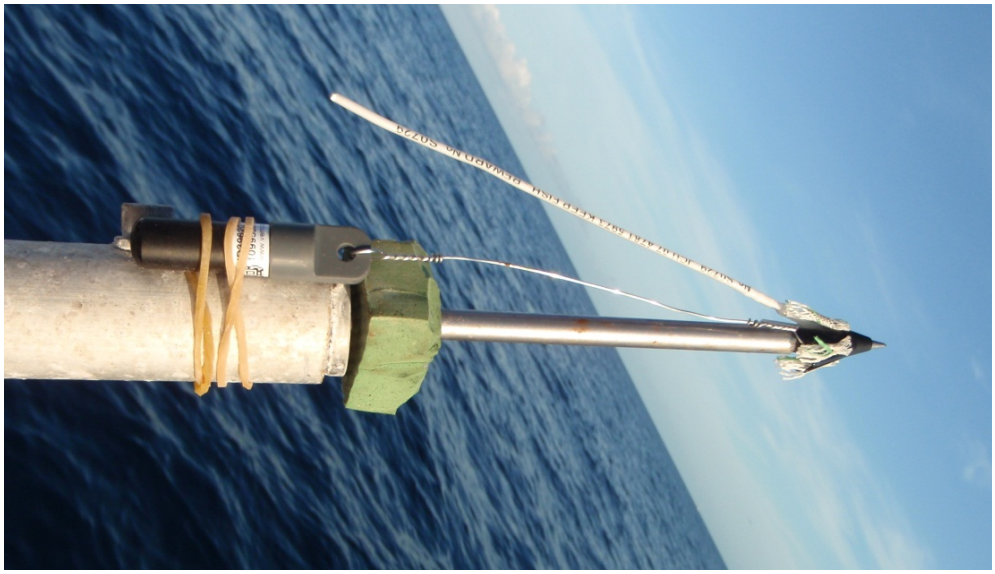


Figure 4. Captured mackerel were tagged in the dorsal musculature so that the V9 acoustic transmitters (circled) trailed the fish from the shoulder area. Domeier umbrella tag heads were used for intramuscular placement, while allowing transmitters to be trailed externally via approximately 50mm of stainless wire.





Results.

Despite some concerted efforts in communicating and engaging with Torres Strait communities, the project was unsuccessful in gaining participation from some stakeholders. As a result, some of the data generated by the project have been withheld at the request of community members and the AFMA.

The with-holding of some data combined with the general paucity of field data (compared with the volume of data generated by a similar exercise conducted on the Queensland east coast (see Tobin et al 2010)), means there are few results to report.

Round 1: October to December 2014 acoustic monitoring.

A total of nineteen mackerel were successfully tagged at Bramble Cay in early October 2014. The tagged mackerel ranged between 4 and 12 kg in weight, with an average weight of 7.1 kg. A further ten mackerel were successfully tagged in waters around Erub and Ugar Islands, and this group of fish ranged in weight from 4 to 8 kg, averaging 6.3 kg (Table 1).

Four acoustic receivers were deployed about Bramble Cay in October 2014 and retrieved in December 2014 (Figure 2a). A further three acoustic receivers were deployed within the waters about Erub and Ugar Island in October 2014 and retrieved in December 2014.

Data were collected from six mackerel only can be reported. Of these six fish, data on movement between Bramble Cay and nearby waters about Erub and Ugar Islands cannot be reported for two fish, and the remaining four fish did not move between sites. Of these four fish, one was likely sharked as indicated by a persistent presence to a receiver located at the Bramble Cay anchorage. This "mackerel" continued to be present at the anchorage mostly during processing time when large numbers of sharks gather around the TVH vessels to scavenge discarded mackerel frames.

The remaining five mackerel for whom data was collected, were present at Bramble Cay for an average of 2.8 days suggesting short periods of aggregation. The number of times each mackerel was detected ranged between 1 and 117, with an average of 32.8 detections per mackerel.

There were no patterns to suggest the detected mackerel displayed a preference for a particular site around Bramble Cay. It should be noted however, that data were sparse and this needs to be considered when evaluating the confidence behind these results and statements.

Round 2: October 2016 to January 2017 acoustic monitoring.

A total of eighteen mackerel were successfully tagged about Bramble Cay in Ocotber 2016. The estimated weight of tagged mackerel ranged from 3 to 12 kg, with an average weight of 6.3 kg (Table 2). A further ten mackerel, ranging in weight between3 and 12 kg and averaging 6.2 kg, were tagged in waters about Erub Island.

The second round of monitoring was hampered by both the community sensitivities limiting data presentation, as well as some heavy gear loss around Bramble Cay. Three of four receivers placed around Bramble Cay were lost (Figure 2b).

Accordingly, data was collected from just a single mackerel at Bramble Cay. This average sized mackerel was detected across three separate days at only one site at Bramble Cay. No movements at the Cay were recorded and no movements between the Cay and Island waters were recorded.

Table 1. The data collected from the 2014 acoustic tagging exercise. Fish # 1 through to 20 were tagged at Bramble Cay, and sites of tagging were recorded using fishers names for specific sites about the Cay. A weight was estimated for each fish. The number of detections recorded by the acoustic receivers are listed along with the cumulative number of receivers detecting each fish. The number of days (not necessarily consecutive) a fish was detected is also given.

DW denotes fish for which data were withheld in response to community concerns about the project.

Fish #	Transmitter ID	Date	Location	Est Wt	Data	Detections	Receivers	Days	Move
1	18760	9-Oct-14	Point	8	no				
2	18761	9-Oct-14	Point	7	no				
3	18762	9-Oct-14	66	5	yes	1	1	1	DW
4	18763	9-Oct-14	66	9	no				
5	18764	9-Oct-14	Point Sth	lost	no				
6	18765	10-Oct-14	2 Rocks	7	yes	117	3	4	no
7	18766	10-Oct-14	66	10	yes	24	4	6	DW
8	18767	10-Oct-14	Wide Ground	8	yes	1272	1		Sharked
9	18768	10-Oct-14	Wide Ground	8	no				
10	18769	10-Oct-14	Wide Ground	5	no				
11	18770	10-Oct-14	Wide Ground	5	no				
12	18771	10-Oct-14	Wide Ground	7	no				
13	18772	11-Oct-14	66	4	no				
14	18773	11-Oct-14	Point Sth	10	no				
15	18774	11-Oct-14	Gerries	4	no				
16	18775	11-Oct-14	Gerries	4	yes	6	2	1	no
17	18776	11-Oct-14	Gerries	8	no				
18	18777	11-Oct-14	Gerries	8	no				
19	18778	12-Oct-14	Wide Ground	12	yes	16	3	2	no
20	18779	13-Oct-14	Gerries	6	no				
21	18780	14-Oct-14	DW	4	DW				
22	18781	14-Oct-14	DW	7	DW				
23	18782	14-Oct-14	DW	8	DW				
24	18783	14-Oct-14	DW	4	DW				
25	18784	14-Oct-14	DW	6	DW				
26	18785	14-Oct-14	DW	6	DW				
27	18786	14-Oct-14	DW	6	DW				
28	18787	14-Oct-14	DW	4	DW				
29	18788	14-Oct-14	DW	6	DW				
30	18789	14-Oct-14	DW	8	DW				

Table 2. The data collected from the 2016 acoustic tagging exercise. Fish # 1 through to 20 were tagged at Bramble Cay, and sites of tagging were recorded using fishers names for specific sites about the Cay. A weight was estimated for each fish. The number of detections recorded by the acoustic receivers are listed along with the cumulative number of receivers detecting each fish. The number of days (not necessarily consecutive) a fish was detected is also given.

DW denotes fish for which data were withheld in response to community concerns about the project.

Fish #	Transmitter ID	Date	Location	Est Wt	Data	Detections	Receivers	Days	Move
1	37144	4-Oct-16	Gerries	4	no				
2	37145	4-Oct-16	Gerries	5	no				
3	37146	4-Oct-16	Gerries	6	no				
4	37147	4-Oct-16	2 Bricks	5	no				
5	37148	4-Oct-16	Lighthouse	8	yes	3	1	1	no
6	37149	4-Oct-16	66	6	no				
7	37150	4-Oct-16	66	8	no				
8	37151	4-Oct-16	66	5	no				
9	37152	4-Oct-16	2 Bricks	5	no				
10	37153	5-Oct-16	2 Bricks	3	no				
11	37154	5-Oct-16	2 Bricks	6	no				
12	37155	5-Oct-16	Gerries	6	no				
13	37156	5-Oct-16	2 Bricks	6	no				
14	37157	6-Oct-16	Gerries	8	no				
15	37158	6-Oct-16	Gerries	12	no				
16	37159	6-Oct-16	Gerries	10	no				
17	37160	6-Oct-16	Gerries	6	no				
18	37161	6-Oct-16	Gerries	6	no				
19	37162	11-Oct-16	Erub Island	3	no				
20	37163	11-Oct-16	Erub Island	6	no				
21	37164	11-Oct-16	Erub Island	8	no				
22	37165	11-Oct-16	Erub Island	5	no				
23	37166	11-Oct-16	Erub Island	5	no				
24	37167	11-Oct-16	Erub Island	7	no				
25	37168	11-Oct-16	Erub Island	12	no				
26	37169	12-Oct-16	Tobin Cay	6	DW				
27	37170	12-Oct-16	Tobin Cay	6	DW				
28	37171	12-Oct-16	Nepean	4	DW				
29	37172	12-Oct-16	Lost						
30	37173	12-Oct-16	Not deployed						

Discussion.

The results of the acoustic monitoring are disappointing. While collected data were sparse in the first instance, data withheld due to community concern further limited the outputs from the project. The data are too few to make any substantive conclusions about the aggregating and movement behaviours of Spanish mackerel about the Bramble Cay and Ugar and Erub Island waters.

A similar exercise conducted on reefs off Townsville was very successful indicating the methodology is applicable. Tobin et al (2014) tagged mackerel with acoustic tags off Townsville with many fish detected thousands of times by the deployed acoustic receivers. Some individual mackerel were monitored for 98 days.

The general pattern observed by Tobin et al (2014) –

groups of mackerel aggregate at a specific site about a reef generally in the days following the full moon;

that aggregation of mackerel will remain tightly associated with that reef and site until the next full moon, when the aggregation disperses;

some occasional movements between reefs may occur by individual mackerel, and interestingly, these movements appear to occur at night.

the tight association mackerel display to a particular reef site for a extended period of time indicate high vulnerability to fishing, should fishers be aware of these behaviours.

The aggregation and movement patterns observed off Townsville strongly support Spanish mackerel has an obligate transient aggregating behavior particularly around spawning. This ecology means vulnerability to fishing can be high and even extreme. Buckley et al (2017) has recently reported fishing has driven some Spanish mackerel spawning aggregations to commercial extinction. This inadvertently contracts the fishing fleet to increase effort in areas where Spanish mackerel fishing remains viable. Serial over-exploitation may occur if fishing effort and/or catch remain unmanaged.

Despite the paucity of data resulting from the acoustic monitoring project, some field observations made during the course of the project are relevant here. Firstly, the catch rates possible (at Bramble Cay in particular) when fishing is good are exemplary. While it must be acknowledged that fisher skill and hyperstability may confound catch rate metrics, it remains

that the very high catch rates that do occur from time-to-time may reflect a reasonably healthy fishery. Secondly, Spanish mackerel at Bramble Cay do display very high levels of site attachment. Fishers are aware of the “hot spots” and race to these at the start of each fishing session. These sites are few, small and very location specific. The observation suggest that like Spanish mackerel on the Queensland east coast (see Tobin et al 2014), Torres Strait Spanish mackerel show at extreme attachment to very small sites about a reef. Thirdly, while the TVH fishing is concentrated about Bramble Cay, a very large resource of Spanish mackerel is available in the waters about Erub and Ugar Islands. Even with a relaxed approach to Spanish mackerel fishing, good to excellent catches of mackerel can be made in these waters with ease.

Future management considerations

1. The concentration of TVH fishing effort and catch at Bramble Cay needs to be carefully monitored and managed. The commercial extinction of Spanish mackerel aggregations is possible (Buckley et al 2017). The TVH fishery provides an important economic return to the TSRA and the Torres Strait through lease fees, and this may be eroded without careful management of the Bramble Cay fishery.
2. Significant potential to build economically viable Spanish mackerel fishing businesses that fish in areas away from Bramble Cay should be investigated. The mackerel resource appears to be abundant and wide spread through the Torres Strait.
3. Despite the paucity of data from the acoustic monitoring, a precautionary presumption should be that Spanish mackerel of the Torres Strait are obligate transient aggregators particularly during spawning, and should be managed accordingly - carefully.

References

Buckley S, Thurston R, Tobin A, Pandolfi J. 2017. Historical spatial reconstruction of a spawning aggregation fishery: a neglected dimension in shifting baselines. *Conservation Biology*

O'Neil M & Tobin A. 2017. Torres Strait Spanish mackerel stock assessment II. Torres Strait AFMA Project Number RR2014/0823.

Tobin A, Currey L, Simpfendorfer C. 2013. Informing the vulnerability of species to spawning aggregation fishing using commercial catch data. *Fisheries Research* 143: 47-56.

Tobin A, Heupel M, Simpfendorfer C, Pandolfi J, Thurstan R, Buckley S. 2014. Utilising innovative technology to better understand spawning aggregations and the protection offered by marine protected areas. FRDC Final Report 2010-007.