FIELD NOTE

Effectiveness against Bull Sharks of the RPELA Shark Deterrent Device

Abstract

Introduction

Shark depredation, where a shark partially or completely consumes an animal caught by fishing gear before it can be retrieved, occurs in commercial and recreational fisheries worldwide, causing a range of negative biological and economic impacts [Mitchell et al. 2018, Casselberry et al. 2022]. Shark depredation is a growing source of human-wildlife conflict within the Queensland fishing community. Anecdotal reports suggest that shark depredation has increased over the last 10-20 years. Shark depredation is not evenly distributed across space and time. Mitchell et al (2018) reported substantial spatial variation in depredation rates, with higher depredation in areas that received greater fishing pressure. Quantitative rates of depredation varied between 0.9 and 26% in commercial and recreational fisheries worldwide with a mean depredation rate of 11.5 - 13.7% for demersal fishing. Fishers are changing their fishing practices, such as moving fishing location, stop- ping fishing, and changing fishing methods, to reduce or avoid depredation (Coulson et al. 2022)

A variety of methods are used as a non- lethal means to deter sharks from an area or activity, based purely on manipulation of their sensory cues (References). The most well studied form of non-lethal deterrent to date is the Shark Shield (References). Electric deterrents are designed to over-stimulate the shark's electrosensory system while causing minimal or no effect on non-target species such as fish that do not possess this sensory modality (References). Shark deterrents offer the potential of a non-lethal solution to protect individuals from negative interactions with sharks, but the claims of effectiveness of most deterrents are based on theory rather than robust testing of the devices themselves (Egeberg et al. 2019). Furthermore, whilst these non- lethal methods may have potential for conservation measures the long term impacts of this manipulation on the shark species.

The RPELA company is of Western Australian origin, has introduced and created one of a kind shark deterrent devices with over 9 years of research and development (RPELA website, 2022). These devices have been primarily developed for surfing and other recreational activities, as they are an attachment style device for these watercraft. Studies of the RPELA and other deterrent devices have demonstrated that whilst electromagnetic sources have proven to deter sharks from recreational fishing lines (Robbins, et al. 2011), there is little literature of their true effectiveness when being used in this instance.

The aim of this preliminary trial was to examine the practicality and effectiveness of a shark deterrent device (RPELA) for use with recreational fishing equipment. Specifically, we aimed to investigate a prototype device compared to controls for (a) fish catch, (b) gear lost to sharks, and (c) fish depredated by sharks. We collected supplementary information on the species of fish captured by fishers and the species of shark interacting with fishers.

Methods

Location

Experiments were conducted over several days in August 2022 off Townsville, Queensland, Australia (Figure 1, Table 1, Appendix 1). This area was chosen due to its calm conditions and the large population of sharks that frequent reefs and shoals and interact with recreational and commercial fishers. Testing was conducted at five locations (Figure 1) in water depths of 25-32m between approximately 7am and 5 pm on each trial day.
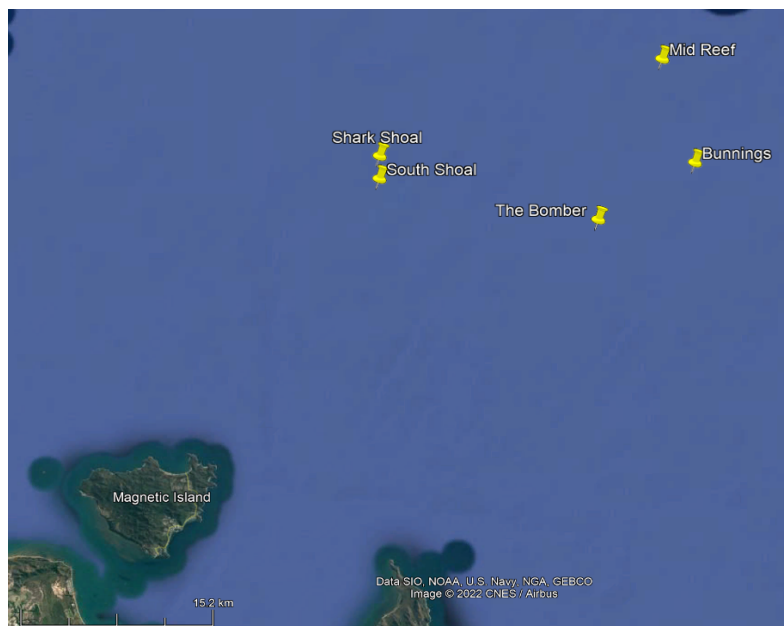

Figure 1. Location of fishing spots visited during August 2022

Table 1. Sample dates and numbers for testing RPELA device

Date	Vessel	Control	Device	Observer	Comments
16/08/2022	Life of Brine	1	1	2	cameras on device, drone
17/08/2022	Audacity	2	2	1	?any camera

Add photos of the device?

On day one we used two recreational fishing rods, one was a control with af hook, swivel, sinker and bait and another rod was the device with a hook, swivel, sinker, bait and added the shark deterrent device and a gopro video camera to film the interactions underwater. On day two we did not attach the underwater camera (GoPro x) to the device. An underwater drone (QYSEA Fifish V6) was deployed on day one but not day two.

<u>Statistical Analysis</u>
A two way t- test was conducted to examine the means between the control and device treatments for fish catch, gear loss and shark depredation.

Results

On day one there were two recreational fishing rods from 10:30- 5pm totalling 13 hours effort. On day two there were four recreational fishing rods from 7:00-12:00 totalling 20 hours effort. A total of x control deployments (fishing) and x active deployments (RPELA device) were conducted (totalling 33 hours of fishing), which resulted in 42 fish caught (28 control; 14 device) (Figure x), six gear interactions \ losses \ bite-off with sharks (5 control; 1 device) (Figure x) and eighteen depredations of fish by sharks (18 control; 0 device) (Table x, Figure x).

Table x. Fish catch, gear lost and fish depredated by sharks using Control (C) and Device (D) over two days

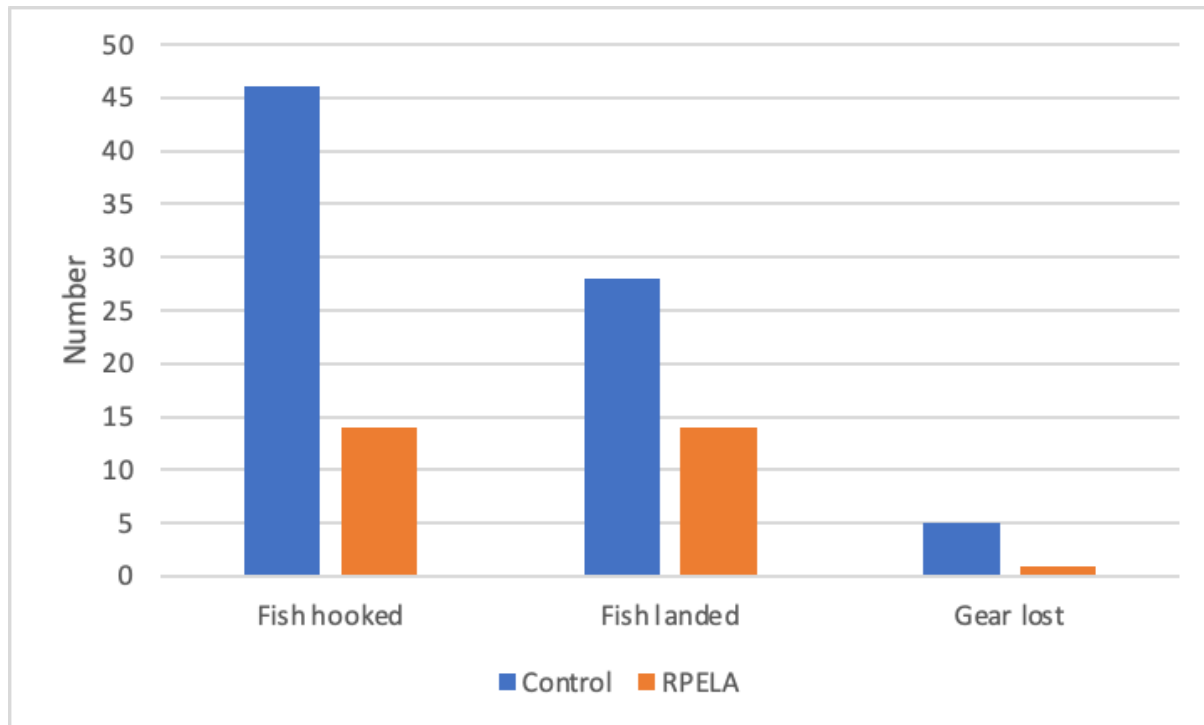|	Fish catch		Gear lost		Fish depredation	
	C	D	C	D	C	D
Day 1	19	1	5	1	3	0
Day 2	9	13	0	0	15	0
Total	28	14	5	1	18	0

Figure x. Comparison of fish hooked, fish landed and gear lost for the control compared to RPELA device. Data collected on the 16- 17 of August.

Table x. Fish species captured by control and RPELA device

Common name	Scientific name	Control	Device
Red emperor snapper	*Lutjanus sebae*	x	x
Grass emperor	*Lethrinus laticaudis*	x	
Spotcheek emperor	*Lethrinus rubrioperculatus*	x	
Longfin rockcod	*Epinephelus quoyanus*		
Barcheek trevally	*Craterognathus plagiotaenia*		
Bludger	*Turrum gymnostethus*		
Starry triggerfish	*Abalistes stellatus*		
Sharksucker	*Echeneis naucrates*		
Barracuda			
Mackerel			
Leopard shark			

The daily depredation rate of fish by sharks varied from 13% (3\23) to 41% (15 \37) and averaged 30% (18\60) or and the overall impact of lost gear and lost fish was 36% (24\66). A comparison of depredation rate for control was 39% (18/46) compared to 0% (0/14) for the RPELA device (Figure x).

Observation of up to eight Bull Sharks (*Carcharhinus leucas*) at one location within a 3 minute period at depths of between 0.5 and 20m were made using the underwater drone. Underwater

video and still images were obtained with information such as depth and time (Figure x). Observations of up to four sharks following a hooked fish from the bottom to the surface indicate that the device may be deterring sharks from depredation (add video link)

Figure x.
and
Bull shark

associated sharksuckers photographed with underwater drone at water depth of 4.52m

Discussion

The Rpela v2 is an electric device for surfers that significantly reduced the probability of a bite from a Great White Shark (*Carcharodon carcharias*) at Salisbury Island, Western Australia (0.75 to 0.25, a 66% reduction) and interaction (i.e. bite or touch) (0.80 to 0.50, a 38% reduction) occurring compared with when it was inactive. Our preliminary trials tested a prototype RPELA shark deterrent device designed to reduce negative interaction of sharks with fishers. The two day trial showed that whilst there were differences in numbers of fish caught and type / size of the species, there were no fish taken from the line with the device (0.00, 0%) compared to 0.39. 39% loss of catch with no device.The sample sizes were relatively small (60 fish in total) but the statistical analysis indicate xxxx

Practical observations from the fishers included the line with the device and GoPro camera (Day 1) was significantly heavier and made it difficult to detect a bite and hook a fish. On day two when there was no GoPro camera the catchability of fish was similar between the device and the control.

Recommendations

The preliminary trials indicating the deterrent is a potentially useful fishing tool and larger sample sizes (n=100-200 fish) are recommended. We recommend an experimental design to

deploy each fishing rod with either an inactive RPELA (control treatment) or an active RPELA (active treatment). n=100 for each treatment

References

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Appendix

Appendix 1. Summary of field conditions, people, location, time, catch and results of device

<u>Field Conditions</u>

16th August 2022

- Field conditions were calm with Easterly winds tending 3-5 knots
- Weather was fair, with the outside temperature being 25- 27 degrees celsius and sunny with little to no clouds
- Names of fishers (Michael Deroy, Adam Smith)
- Names of observers (Georgia Hodgson, Dave Smith)

17th August 2022

- Names of fishers (?)
- Names of observers (Dave Smith)

Date	Location	Time	Catch	Depredation (lost fish)	Lost gear (bite-off)	Gear (control, device)	Comments
16/8/2022	Shark Shoal	10:30	Sharksucker	-	-	Control	Released (?)

		Time	Species				Notes
	Stie 2 (West Shoal)	11:10	Sharksucker	-	-	Control	Released (?)
		11:15	Grassy	-	-	Control	Keep (60cm)
		11:20			Lost gear	Control	Possible bull
		11:30					TRIAL 1
		11:40	Triggerfish			Control	Released 35cm
		11:45	Red Emp.			Control	Released 40cm- Bull and Grey Reef sighted
		11:54	Trevally			Control	Released 30cm- Sharks sighted following
		11:58	Red Emperor			Control	Released 35cm- sharks sighted following with 4 on surface
		12:15	unknown		Lost Gear	Device	Potentially sharked lost all gear
		12:15					
		12:20	Trevally landed			Control	TRIAL 2
		12:25	Red Emp.			Control	Released 30cm- No sharks following some sighted after
		12:34		Sharked		Control	
		12:56	Sharksucker			Control	Released 35cm- No sharks sighted
		1:03					Released (?)- No sharks sighted
							Leave site 2

	Site 3 (Bomber)	1:45					TRIAL 3- Shark spotted under boat (couldn't identify)
		1:51	unknown		Lost gear	Control	
		2:04	unknown	Sharked		Control	
		2:10					TRIAL 4
		2:32	unknown animal		Lost gear	Control	
		2:40					TRIAL 5
		2:50					Leave site 3

Site	Time	Species				Notes
Site 4 (Mid reef)	3:10					TRIAL 6
	3:15	Triggerfish			Control	Released 50cm
	3:18	Triggerfish			Control	Released 40cm
	3:25	Unknown		Lost Gear	Control	
	3:36	Red Emp.			Control	Released 30cm
	3:38	Red Emp.			Control	Released 40cm
	3:40					TRIAL 7
	3:42	Red Emp.	Sharked		Control	Shark sighted 10m below boat when landing
	3:47			Lost gear	Control	
	3:48	Triggerfish			Device	Released 40cm
	3:54	Honeycomb cd.			Control	Released 35cm
	4:05	Cod			Control	Released 35cm
	4:17					TRIAL 8
	4:28	Trevally			Control	Released 45cm
	4:31	Triggerfish			Control	Released 30cm
	4:35					Leave site 4
Site 5 (Bunnings)	4:54 5:11					TRIAL 8 CONT. Last cast

Table 2.

17/08/2022	Site 1	6:54	Trevally			Control	Released (?)
		6:56	Shark sucker			Control	Released (?)
		6:58	Trevally			Control	Released (?)
		6:58	Trevally			Control	Released (?)
		7:00	Trevally			Control	Released (?)
		7:01	Trevally			Control	Released (?)
		7:02	Unknown	Sharked		Control	
		7:03	Unknown	Sharked		Control	
		7:04	Unknown	Sharked		Control	
		7:05	Unknown	Sharked		Control	
		7:06	Unknown	Sharked		Control	
		7:10	Unknown	Sharked		Control	
		7:10	Unknown	Sharked		Control	
		7:15					TRIAL 1
		7:20	Barracuda			Device	
		7:25	Trevally			Device	
		7:30					Move Site
Site 2		8:15					No bites- Leave Site
Site 3		8:39					Some bites- Leave site

Site 4		9:25					Some bites-Leave site

Site 5		10:05	Mackerel			Control	Released (?)
		10:15					Leave site
		10:16	Unknown	Sharked		Control	
		10:17	Unknown	Sharked		Control	
		10:19	Trevally			Device	Released (?)
		10:21	Trevally			Device	Released (?)
		10:23	Sharksucker			Device	Released (?)
		10:25	Trevally			Device	Released (?)
		10:35	Trevally			Device	Released (?)
		10:40	Leopard shark			Device	Released (?)
		10:45	Trevally			Device	Released (?)
		11:20					Leave site
		11:25	Unknown	Sharked		Control	
		11:30	Unknown	Sharked		Control	
		11:34	Trevally			Control	Released (?)
		11:35	Unknown	Sharked		Control	
		11:35	Unknown	Sharked		Control	
		11:37	Trevally			Control	Released (?)
		11:38	Unknown	Sharked		Control	
		11:40-	Unknown	Sharked		Control	
		11:41-	Unknown	Sharked		Control	
		11:49-	Trevally			Device	Released (?)

		11:49	Unknown			Control	
		11:50	Trevally			Device	
		11:50	Trevally			Device	
		11:55	Trevally			Device	
		12:25- Last cast					

Table 3. Fish Caught

	Control	Device
Day 1	19	1
Day 2	9	13
Total	28	14

Table 4. Depredation of fish

	Control	Device
Day 1	3	0
Day 2	15	0
Total	18	0

Table 5. Lost Gear

	Control	Device
Day 1	5	1
Day 2	0	0
Total	5	1