Mano LLC
02/03/2020
Version 2.0

Exmouth Project Summary Report

Abstract:

Shark depredation, a growing phenomenon, occurs in oceans worldwide with destructive effects on the ecosystem and economy. In September 2019, Mano LLC became aware that Exmouth, Western Australia, was experiencing higher than average shark depredation rates and began planning a project to document the use of mitigation devices in the area. The company hypothesized that standard gear for hook and line fishing could be modified with permanent magnet equipped prototype devices (the devices) to prevent depredation of a hooked fish and/or increase the amount of time between the moment the fish was hooked and a depredation event. Based on prior research cited and video evidence filmed in the Bahamas and in Exmouth, WA, the company believed that the project would show a significant reduction in depredation events when fishing with rigs equipped with the devices vs those not equipped. Based on video evidence captured over the three days of fishing trials, footage strongly suggested that lines equipped with devices (1) were depredated less frequently than lines not equipped (2) increased the time between the event of a fish being hooked and a depredation event compared to lines not equipped and (3) significantly reduced the number of demersal fish depredations compared to the average from the last 13 months in the Exmouth area. Despite the limited timeframe of this project but given the promising observations, The Company will move forward with bringing these devices to the USA and Australian markets in 2020. These products will (1) make an immediate impact at reducing economic losses in areas prone to high shark depredation (2) allow fisheries management to more actively create policy, educate fishermen on depredation, and plan to maintain and restore abundance to fisheries and (3) create a more enjoyable experience for new fishermen, restore the pleasure of fishing for seasoned veterans, encourage return customers in the charter fishing business, and help tackle shop owners instill more confidence in their customers.

Background:

Shark depredation, as detailed in Mitchell et al. 2018, is where “a shark partially or completely consumes an animal caught by fishing gear before it can be retrieved to the fishing vessel, occurs in commercial and recreational fisheries worldwide” and causes “a range of negative biological and economic impacts”. Mano LLC (DBA Sharkbanz) employs patented permanent magnetic technology to reduce shark encounters. As early as 2015, numerous recreational and commercial fishermen inquired via Sharkbanz.com with an urgent need for a product that would reduce depredation, with the number of inquiries increasing over the last 5 years. Mano (the Company) having specialized in personal shark deterrents since 2014, discovered in late 2018 through video evidence filmed in The Bahamas of an early prototype, that permanent magnets could be deployed on trolling-specific fishing gear to potentially reduce shark depredation on a global scale. Previous research suggested “they may therefore have potential as deterrents when mounted close to the hooks of pelagic longline gear (Kaimmer and Stoner 2008; Brill et al. 2009; Tallack and Mandelman 2009; O’Connell et al. 2011, 2014). Indeed, research has recorded

reduced catch rates of sharks when magnets were deployed close to hooks, although the effectiveness varied widely depending on the shark species involved (Brill et al. 2009; Tallack and Mandelman 2009; Robbins et al. 2011; O'Connell et al. 2014)." A more recent study from the University of Newcastle (Richards et al. 2018) indicates "that the incorporation of magnets into fish traps significantly reduced incidences of elasmobranch bycatch (mainly Brachaelurus waddi) by over a third, while increasing the amount of target fish caught by an equivalent amount."

In September 2019, The Company became aware that Exmouth, Western Australia, was experiencing higher than average shark depredation rates and began planning a project to document the use of mitigation devices in the area. Data from the prior 13 months provided by the Exmouth Game Fishing Club showed that when fishing for demersal species in the area, approximately 65% of fish were depredated. Total Mortality is not accounted for in daily bag limits, and in a high percentage of day trips, this data showed that more fish were depredated than would have been within the legal bag limits, demonstrating a significant, unaccounted for loss to the fishery. (Graph 1)

Through conversations with tackle shop owners, charter captains, the EGFC and Recfishwest, The Company became aware that recreational fishermen were abandoning fishing as an activity in the Exmouth area because the depredation problem prevented them from enjoying it. Losing most fish to depredation meant wasted fuel, tackle, and for many – the cost of hiring a charter. Those costs together add up to thousands of dollars per family/day, and with the real possibility of returning from a trip empty handed, many had begun to look elsewhere for recreational fun. The effects of depredation have reduced economic gains for Exmouth, prevented recreational fishing enjoyment of Exmouth waters, and reduced the possibility of maintaining an abundant fishery.

Introduction:

Upon the publishing of *Shark Depredation in Commercial and Recreational Fisheries* (Mitchell et al. 2018), The Company became aware of the extent of the problem of shark depredation in that it:

1. "Leads to costly losses of commercially valuable fish and fishing gear"
2. "Increases the mortality of target fish species"
3. "Causes injury to the depredating sharks"
4. "Is sparsely documented" (Mitchell et al. 2018)

The Company decided to pursue the development of products to reduce shark depredation in order to mitigate negative biological and economic impacts. Due to the pressing need to mitigate this issue because of growth in recreational fishing worldwide (Coleman et al 2004; Cooke and Cowx 2004; Arlinghaus and Cooke 2009) and other environmental concerns leading to fish stock depletion, The Company devised this project to (1) Document the ability of the Company's product prototypes to prevent instances of shark depredation when hook and line fishing for

demersal fish (2) identify which of the prototypes were most effective in preventing depredation and (3) define the best methods for deploying the products (to later be mass produced) on hook and line fishing gear to optimize their effectiveness, limit gear loss, and improve the fishing experience for the angler.

The company chose Exmouth, WA to conduct the project because all processes underlying depredation (feeding behavior and energetics, auditory cues, visual and electrical cues, and habituation and associative learning) would be present in this environment (Mitchell et al. 2018). From Mitchell et al. 2018:

In recreational fisheries in South Africa and Western Australia, widespread anecdotal reports suggest that sharks associate the sound of engine and echosounder noise with the availability of easy prey in the form of hooked fish, as well as fish that are injured after being released (Exmouth Game Fishing Club, pers. comm., Labinjoh 2014). A preliminary study in the Ningaloo Marine Park in northwest Western Australia also recorded progressively faster arrival times of sicklefin lemon sharks (Negaprion acutidens, Carcharhinidae) to a baited camera system deployed over six consecutive days in an area that received regular fishing pressure, whereas in no-take sanctuary zones, very few sharks were attracted (Schifiliti 2014). Furthermore, tracking data from a large bull shark (Carcharhinus leucas, Carcharhinidae) in the Breede Estuary in South Africa showed the predator remaining underneath the hull of up to ten different recreational fishing vessels for short periods of time, as well as moving towards and following a vessel that hauled its anchor and began trolling (McCord and Lamberth 2009).

The company hypothesized that standard gear for hook and line fishing could be modified with permanent magnet equipped prototype devices (the devices) to prevent depredation of a hooked fish and/or increase the amount of time between the moment the fish was hooked and a depredation event. Based on prior research cited and video evidence filmed in the Bahamas and in Exmouth, WA, the company believed that the project would show a significant reduction in depredation events when fishing with rigs equipped with the devices vs those not equipped.

Methods:

The company employed the services of a seasoned charter captain (Terry Maxwell) to provide reliable service and experience locating areas with high shark depredation rates. The Company booked Capt. Maxwell for 3 days and acknowledged ahead of the trip that it would be impossible to produce precise data on the effects of the devices on depredation in this short time frame. Instead, the focus centered on documenting video evidence of (1) shark depredation, (2) the effect the devices would have on shark behavior and (3) whether the devices would give the angler more time to land the fish.

Locations (fishing ground):

Capt. Maxwell was instructed to captain the boat to the areas where he had experienced the highest levels of shark depredation

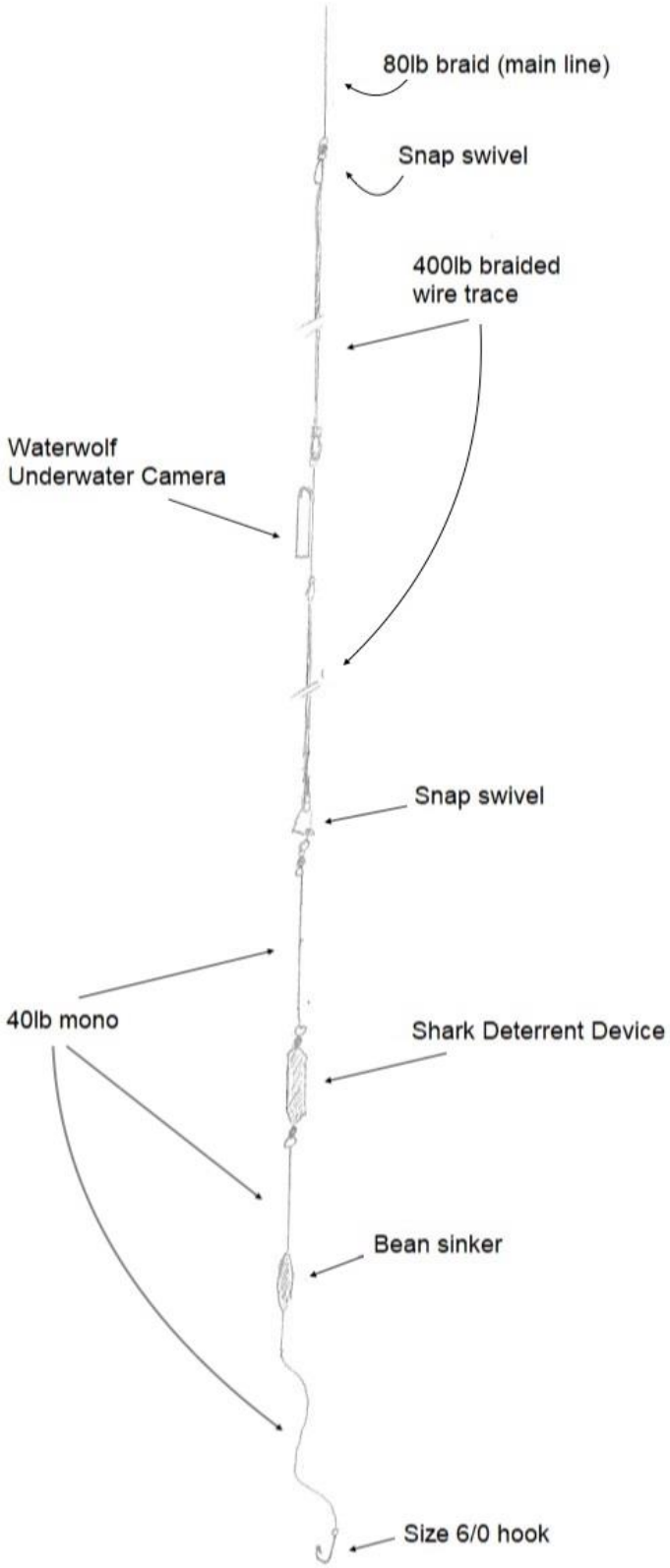
Mano LLC
02/03/2020
Version 2.0
Day 1: North of Exmouth Point
Day 2: West of Exmouth Cape
Day 3: West of Helby Bank “Shark Alley” – Maxwell hadn’t fished this ground for up to two years prior because no fish had been landed without a shark depredating it first.

The Rigs:

Three different magnetic prototype devices were deployed for the project (the DD8, the 6 spinner, and the Simon spinner) in two different fishing rig types.

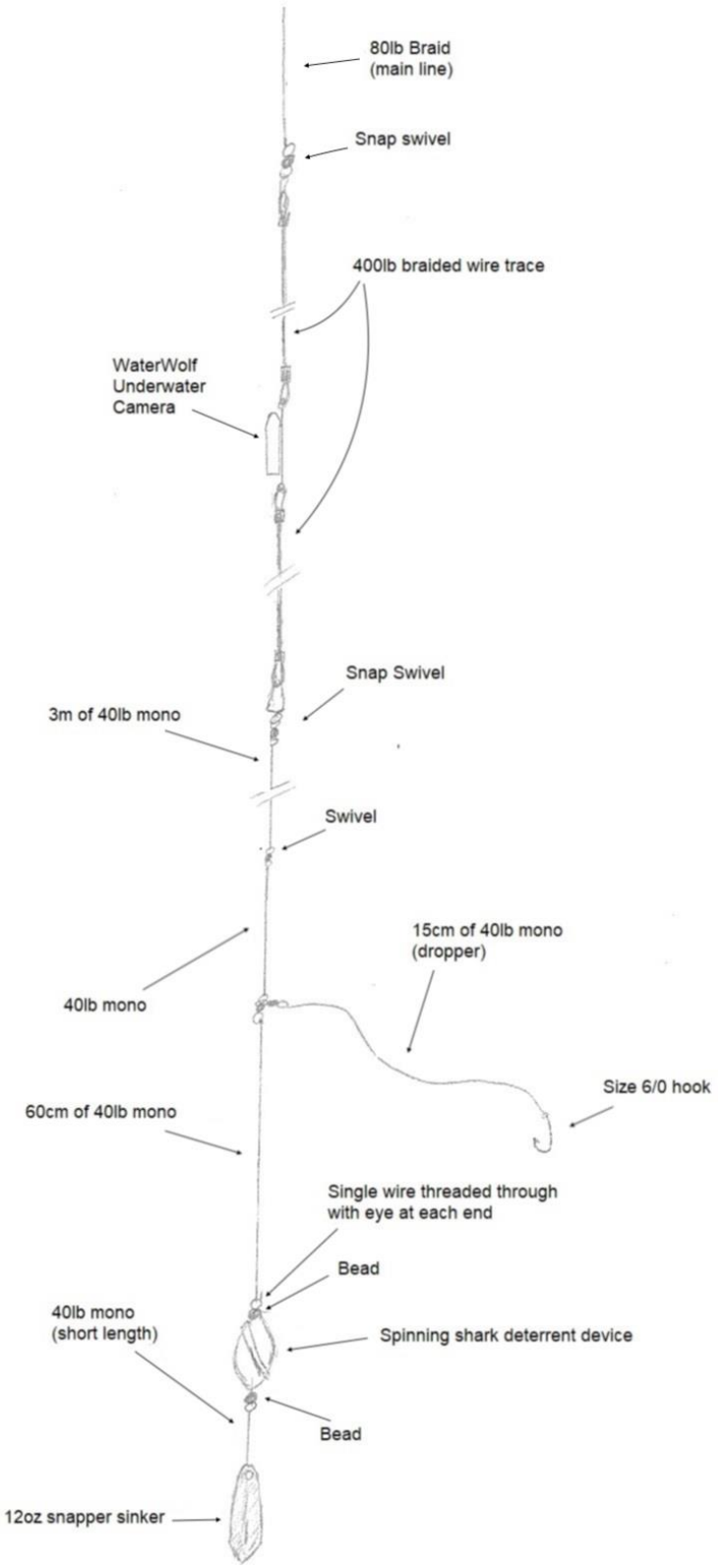
Mano LLC
02/03/2020
Version 2.0

Rig Diagram A (Device Arrangement: Running Sinker Rig, placed between main line and rig connection)



Mano LLC
02/03/2020
Version 2.0

Rig Diagram B (Paternoster Rig, device placed above sinker)



Fishing Procedures (applies to both rig types):

Action	Description	Justification
1	Fish area without device until depredation occurs	This verifies that sharks are present and provides footage of depredation occurring on both rig setups.
2	Fit devices to 50% of anglers and continue fishing the same ground. Fastest possible retrieval of fish.	This gathers data of success rates with and without a device. Will provide footage of device effects on shark behavior.
3	Fit devices to 50% of anglers and continue fishing the same ground. Slow/normal retrieval of fish (playing the fish to the surface).	This gathers data and video of the amount of time the device is effective. (Risk of losing devices)
4	Fit devices to all anglers and continue fishing the same ground	This gathers data and video evidence to suggest how much total depredation can be reduced and if the sharks will habituate to the devices over time at the same ground.

Bait:
A bait mix of squid, mulie, and fish was used throughout the project.

Habituation and Associative Learning Factors:

The boat sounder was turned on for the duration of all trips.

Fishing Data Points:

Each event of a fish being hooked was documented with these data points.

Time Hooked
Fight time
Sharked (depredated)
Depth
Fish species
Device type used
Bait type
Camera #

Mano LLC
02/03/2020
Version 2.0

Anglers:

2 anglers (Steve Riley and Simon Munkelt) were utilized for the testing on all days. Both have experience (extensive experience in Steve's case) fishing the different ground off Exmouth.

Documentation:

All results were documented at the time of each event, written on a notepad, and then transferred to an Excel document for clear viewing and organization within a week of the trip.

Video evidence was documented using several means:

1. Primary – Waterwolf cameras were initially attached on the morning of day one to the fishing lines approximately 1-2 meters from the bait. This distance was then increased starting on the afternoon of day one to 3-4 meters from the bait to allow for a greater radius from the device to be captured by the camera in order to document shark behavior and proximity to a hooked fish more clearly.
2. Secondary – GoPro cameras on extender poles were used to film the sharks reactions to the hooked fish and the devices from just beneath the surface by extending them over the rail of the boat.
3. Tertiary – A GoPro camera on a gimbal handle was used to film the rigging setup, baiting, the process of landing fish, and filming shark behavior from above the surface.

The Devices:

DD8	Designed to mimic a standard sinker weight and either substitute for that weight, or replace an additional weight for deeper depth fishing.
6 Spinner	A football-shaped device about 3 inches long (7.6cm) and 1.5 inch (3.8cm) in diameter employing a specific magnet configuration and concave grooves designed to spin when traveling through the water column while being reeled in by the angler.
Simon spinner	A football shaped device about 6 inches long (15cm) and 3 inches (7.6cm) across with a specific magnet configuration different from the 6 spinner with convex grooves designed to spin when traveling through the water column while being reeled in by the angler. About twice the size of the 6 spinner.

Results (data):

Day 1

fish sharked without device	6
fish sharked with device	0
Fish landed without device	9
Fish landed with device	6

Day 2

fish sharked without device	5
fish sharked with device	2
Fish landed without device	3
Fish landed with device	6

Day 3

fish sharked without device*	0
fish sharked with device	2
Fish landed without device*	0
Fish landed with device	21

Totals

fish sharked without device	11
fish sharked with device	4
Fish landed without device	12
Fish landed with device	33

*devices were utilized on both anglers' lines the entire day in order to capture maximum video footage of the devices effects on shark behavior.

Results (video):

*note for all videos – footage revealed that sharks were present beneath the boat at all times when it was stopped on all three days during fishing.

1. Fish sharked without device

https://youtu.be/Qx_WoNp3NvA

*note – these are all the depredation events of this type captured on video, as multiple cameras were lost to water flooding on days 1 and 2, which contained more clips of this behavior.

2. Fish landed with device

https://youtu.be/4uptqP2TWxo

note* - (1) some events were lost due to camera flooding and (2) some successful landings are not included here because shark(s) did not enter the field of the camera.

3. Fish sharked with device

https://youtu.be/5V3kzIbl-VM

*note – this video captures three out of the four depredation events that took place when anglers fished with devices.

4. Fish landed without device

https://youtu.be/XkGNGEVDwDo

note* - (1) some events were lost due to camera flooding and (2) some successful landings are not included here because shark(s) did not enter the field of the camera.

5. Other significant results observed on camera
    a. Sharks deterred by devices from baited hooks
        i. https://youtu.be/Z2CQnWubn1E
    b. Sharks behavior beneath the boat
        i. Sharks were observed on camera (but not visible from the surface) emerging from under the boat as soon as lines were dropped.
        ii. Sharks were observed on camera (but not visible from the surface) bumping the lines shortly after they entered the water.
        iii. Sharks were observed on camera eating baits and sometimes being caught
        iv. Sharks were observed following the baits for hundreds of meters waiting for fish to be caught
            1. https://youtu.be/bfwo_7MHQHg

Time lapsed between shark sighting hooked fish and depredation event (without device)*

Interaction #	Time lapsed	Depth
Interaction 1	3.5 seconds	20 m
Interaction 2	3.5 seconds	20 m
Interaction 3	6.5 seconds	20 m
Interaction 4	4 seconds	20 m

*data only available for interactions captured on video

Time lapsed between shark sighting hooked fish and depredation event (with device)*

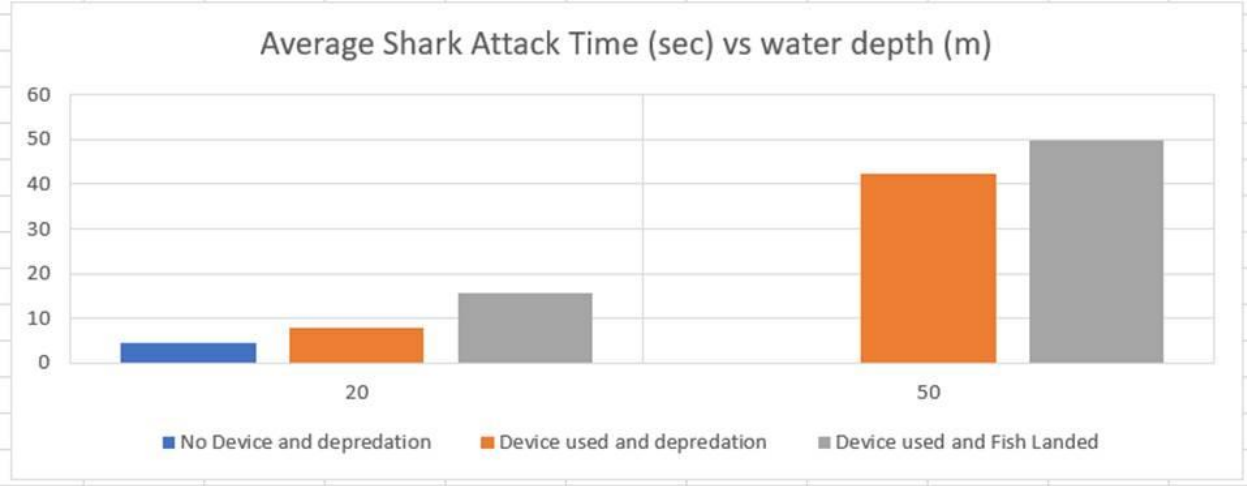
Interaction #	Time lapsed	Depth
Interaction 1	8 seconds	20 m

Interaction 2	42 seconds	50 m
Interaction 3	43 seconds	50 m

*data only available for interactions captured on video

Time lapsed between shark sighting hooked fish and landing fish (with device)*

Interaction #	Time lapsed	Depth
Interaction 1	10 seconds	20 m
Interaction 2	19 seconds	20 m
Interaction 3	18 seconds	20 m
Interaction 4	42 seconds	50 m
Interaction 5	1:10 seconds	50 m
Interaction 6	37 seconds	50 m



Species:

The Company did not attempt to identify all the shark species recorded on camera. A marine biologist will need to complete this work if of interest.

Discussion:

Based on video evidence captured over the three days of fishing trials, footage strongly suggested that lines equipped with devices (1) were depredated less frequently than lines not equipped (2) increased the time between the event of a fish being hooked and a depredation event compared to lines not equipped and (3) significantly reduced the number of demersal fish depredations compared to the average from the last 13 months in the area.

Video evidence also consistently implied that sharks (1) displayed minimal to no cautious behavior towards lines not equipped with devices when approaching a hooked fish to depredate it (2) displayed avoidance behaviors towards devices attached to the lines and (3) consistently displayed opportunistic feeding behaviors around the fishing boat due to their near omnipresence while fishing took place.

Lines equipped with devices allowed the angler to bring the fish to the surface and land it in all cases but four. Data provided by the Exmouth Game Fishing Club from the prior 13 months (21 trips) showed that an average of 11 demersal fish were depredated every trip. That same data showed the highest number depredated on a trip was 22 and the lowest number was three. Since anglers on the project fished ground with the highest incidence of shark depredation rates, it was reasonable to hypothesize that depredation rates would match, if not exceed, the average from the prior year data gathered by the EGFC. Conversely, all three days showed depredation rates significantly below EGFC average while anglers utilized devices. Despite limitations in the quantity of data, the average from this project of 1.3 fish depredated per day vs 11.5 fish per day (88% decrease) for the EGFC fishermen shows potential for this technology to significantly improve all the negative variables associated with depredation.

Another striking observation when comparing the project data to the EGFC data: 13 more fish were landed on Day Three for a total of 33 fish than the highest number of fish (20) landed by all anglers reporting data for the EGFC in a single day. This was the only day where devices were utilized for the entire duration. Fishing also occurred at the deepest depth of all three days, and at the area most known for depredations, so optimal conditions were in place for high depredation rates.

Rig Types & Methodology Observations

Anglers experiences over the three days quickly proved that the paternoster rig was far superior in deploying the devices to reduce depredation and gear loss than the running sinker rig. This rig is easy to set up for the average angler and was effective at reducing depredation when the device was placed in the location detailed in Diagram B, thus it has the potential to improve the overall fishing experience. The team made note to include specific instructions for the paternoster rig that was utilized in the project with mass produced products to ensure the best customer experience. This project also illustrated the need for the devices to come partially pre-rigged for easy application straight from the box.

The design of the paternoster rig used during the testing was an important factor in maximizing its effectiveness to deter a depredation attempt. The dropper length, target fish length and distance between dropper knot and sinker are variables that were taken into account during the project. By placing the device directly above the sinker in the paternoster rig, the following formula was able to be applied to the dimensions of the rig and suggests optimum results:

$$(dropper\ knot\ to\ sinker\ distance) - (dropper\ length) \approx \frac{target\ fish\ length}{2}$$

The effectiveness of the device is dependent on keeping the fish within the range of the protective field of the device (most effective inside 1 meter). The longer the dropper, the further the fish is able to swim up the rig or out to the side of the rig where the protective field of the device is at its weakest. Therefore, the positioning of the device and lengths of the elements used are an important factor to maximize effectiveness.

To mitigate the risk of losing WaterWolf cameras, the paternoster rig was always constructed using monofilament with a breaking strength of 50% of the strength rating of the main line. For the tests conducted, the main line was rated to 80lb, therefore the paternoster rig was constructed using 40lb monofilament.

Ahead of the trip, the team discussed potential for the devices to interfere in fishing activities by getting snagged on the bottom or lost to depredation. Given expected price points for the devices on the marketplace ($30 - $50 USD), the team understood it was critical to ensure an easy, repeatable technique that would prevent loss of the device as much as possible. During the three days of fishing, there were only two incidents of a line snag, both of which appeared to be caused by the weight and not the device. If depredation occurs with this paternoster rig setup, the bait and hook are likely the only elements lost, which saves the device, the weight, and the swivels.

The team also discussed the potential of the devices to disrupt normal demersal fish feeding behavior. No incidents of this were observed on camera compared to footage filmed by Terry Maxwell on lines not equipped with devices. Given the number of fish hooked and landed during the three days, future concern for this is minimal in demersal bottom fishing.

Observations on which devices and the specific elements of their designs that make them most effective are being withheld from this report to protect sensitive intellectual property of The Company.

In-line fishing cameras such as the Waterwolf are an excellent tool for observing shark depredation behavior. They can be difficult to use because of battery charging, memory cards, and leakage, and are prone to human and mechanical error, but there is no other tool available which better allows fishermen and scientists to document this behavior.

Behavioral Observations

Once sharks initiated chasing a hooked fish, if they interacted with the field from the device and were deterred and thus unsuccessful at depredating the fish, they appeared less likely to continue attempting to depredate hooked fish. This phenomenon could exist because sharks “have to balance the energetic tradeoff between the energy gained from feeding versus the energy capturing and consuming a prey item, according to the Optimal Foraging Theory” (Mitchell et al 2018; Charnov 1976; Pyke 1984). The team initially raised concerns that sharks would habituate to the unpleasant field emitted by the devices and begin to depredate hooked fish more as their exposure increased. Actual observations from the WaterWolf Cameras contradict this original hypothesis. The more energy the sharks expended attempting to chase hooked fish, the less likely they were to return for another attempt. At depths of 50 meters, this became more apparent. After two sharks gave chase to a hooked 65 cm spangled emperor on a line equipped with a device for

1 minute, 10 seconds, the animals did not attempt to depredate two additional spangled emperors of the same size that were later hooked at the same fishing ground. Video evidence confirmed the continued presence of the sharks at the bottom. It appeared that the sharks actually lost interest in what they perceived as difficult to catch prey.

In observing sharks behavior recorded on video, the animals showed higher preference and persistence for larger fish when attempting to depredate them. This is congruent with the Optimal Foraging Theory.

Consistent with other trials where The Company tested permanent magnetic devices on sharks, the animals displayed the strongest avoidance behavior when in "attack" mode. All the strongest repellent action from the devices occurred when sharks were swimming at high speeds while making a vigorous attempt to depredate the fish. The electrical sense is heightened when the sharks are actively seeking prey, so this behavior was not a surprise, but is important to note for the untrained observer. Another reason the sharks exhibit greater avoidance behavior towards the devices when attacking is because according to the laws of magnetics, the devices are generating a more intense field when moving through the water. So, greater field strength of the device meets higher sensitivity to the field from the shark, creating avoidance behavior.

Habituation and associative learning

Sharks beneath boat – Video footage from the Waterwolf camera showed that sharks were consistently right under the boat or waiting at the bottom during all three days of fishing.

Sharks depredating baits - Video footage also suggested, but less strongly than for demersal finfish depredation, that the devices reduced incidences of sharks depredating baits.

Sharks bumping lines – Sharks frequently bumped the fishing lines while they were descending and also once they reached the bottom. A shark biologist would need to view and assess this footage if this behavior is of interest.

Sharks following baits – Sharks were often observed on camera following baited lines. Oftentimes, the sharks seemed to hinder their own abilities to depredate fish because they followed the lines too closely, thus scaring away the fish before they were able to take the bait. Some sharks may learn to remain farther away from the baits until a fish is hooked before attempting to depredate the fish. A shark biologist would need to view and assess this footage if this behavior is of interest.

Certain species may show more of these behaviors than others, and again, a shark biologist would need to view and assess this footage if this behavior is of interest.

Weaknesses

As acknowledged in the introduction, the main weakness of the project was the lack of sufficient time to gather robust data. Further research is needed by independent universities or other organizations with the resources to take on a long term study. Additional trials with dedicated

fishing groups in different geographic regions who understand the problem and can quantify their gains and losses with and without the use of these deterrent devices should be quite helpful in determining the true effectiveness of the devices.

Another weakness pertained to lack of time to test the devices on longer fish, such as mackerel, which are often depredated during trolling. Future projects will document the ability of these devices to prevent depredation during trolling.

Broader Conclusions

Despite the limited timeframe of this project but given the promising observations, The Company will move forward with bringing these devices to the USA and Australian markets in 2020. Given that no active alternatives exist, we suspect that:

1. These products will make an immediate impact at reducing economic losses in areas prone to high shark depredation.
2. These products will allow fisheries management to more actively create policy, educate fishermen on depredation, and plan to maintain and restore abundance to fisheries.
3. These products will create a more enjoyable experience for new fishermen, restore the pleasure of fishing for seasoned veterans, encourage return customers in the charter fishing business, and help tackle shop owners instill more confidence in their customers.

Citations:

Arlinghaus R, Cooke SJ (2009) Recreational fisheries: socioeconomic
importance, conservation issues and management challenges. In: Dickson B, Hutton J, Adams WM (eds) Recreational hunting, conservation and rural livelihoods: science and practice. Blackwell Publishing Ltd., Oxford, pp 39–58

Brill R, Bushnell P, Smith L, Speaks C, Sundaram R, Stroud E, Wang J (2009) The repulsive and feeding-deterrent effects of electropositive metals on juvenile sandbar sharks (Carcharhinus plumbeus). Fish Bull 107:298–307

Coleman FC, Figueira WF, Ueland JS, Crowder LB (2004) The
impact of United States recreational fisheries on marine fish populations. Science 305:1958–1960. https://doi.org/10.1126/science.1100397

Cooke SJ, Cowx IG (2004) The role of recreational fishing in global fish crises. Bioscience 54:857–859. https://doi.org/10.1641/0006-3568(2004)054[0857:trorfi]2.0.co;2

Kaimmer S, Stoner AW (2008) Field investigation of rare-earth
metal as a deterrent to spiny dogfish in the Pacific halibut fishery. Fish Res 94:43–47. https://doi.org/10.1016/j.fishres.2008.06.015

Labinjoh L (2014) Rates of shark depredation of line-caught fish
on the Protea Banks, KwaZulu-Natal. MSc Thesis, University of Cape Town

McCord ME, Lamberth SJ (2009) Catching and tracking the world's largest Zambezi (bull) shark Carcharhinus leucas in the Breede Estuary, South Africa: the first 43 h. Afr J Mar Sci 31:107–111. https://doi.org/10.2989/ajms.2009.31.1.11.782

J. D. Mitchell, D. L. McLean, S. P. Collin, T. J. Langlois (2018)
Shark depredation in commercial and recreational fisheries Reviews in Fish Biology and Fisheries, 2018, Volume 28, Number 4, Page 715

O'Connell CP, Abel DC, Stroud EM (2011) Analysis of permanent
magnets as elasmobranch bycatch reduction devices in hook-and-line and longline trials. Fish Bull 109:394–401

O'Connell CP, Stroud EM, He P (2014) The emerging field of electrosensory and semiochemical shark repellents: mechanisms of detection, overview of past studies, and future directions. Ocean Coast Manag 97:2–11. https://doi.

org/10.1016/j.ocecoaman.2012.11.005

Richards, R & Raoult, Vincent & Powter, David & Gaston, Troy. (2018). Permanent magnets reduce bycatch of benthic sharks in an ocean trap fishery. Fisheries Research. 208. 16-21. 10.1016/j.fishres.2018.07.006.

Robbins WD, Peddemors VM, Kennelly SJ (2011) Assessment of permanent magnets and electropositive metals to reduce the line-based capture of Galapagos sharks, Carcharhinus galapagensis. Fish Res 109:100–106. https://doi.org/10.1016/j.fishres.2011.01.023

Schifiliti M (2014) Are depredation rates by reef sharks influenced
by fisher behaviour? MSc Thesis, University of Western Australia

Tallack SM, Mandelman JW (2009) Do rare-earth metals deter spiny dogfish? A feasibility study on the use of electropositive ‘‘mischmetal’’ to reduce the bycatch of Squalus acanthias by hook gear in the Gulf of Maine. ICES J Mar Sci 66:315–322. https://doi.org/10.1093/icesjms/fsn215