

# Use of an excluder device to mitigate gulper shark interactions in a deep-water prawn fishery

Project number F2013/3634

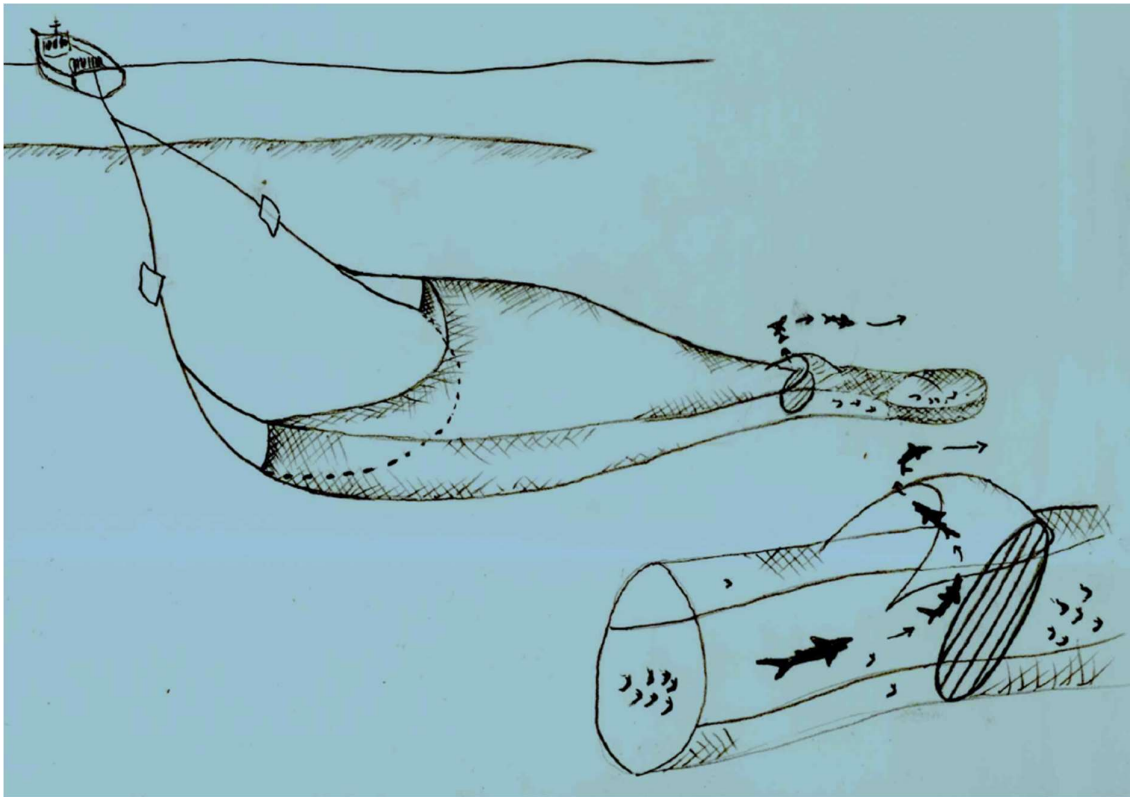
Proof of concept final report

27 January 2016

Report prepared by Simon Boag<sup>1</sup> & Andrew Trappett<sup>2</sup>

<sup>1</sup>Project Principle Investigator and EO, South East Trawl Fishing Industry Association

<sup>2</sup>AFMA-SETFIA Liaison Officer, Australian Fisheries Management Authority



**Figure 1:** Schematic view of gulper excluder device in action showing orientation of the gulper excluder grid and escape hatch during deployment. Sharks are shown being ejected up the grid and out through the escape hatch on top of the net while prawns continue through the grid into the cod end (at right).

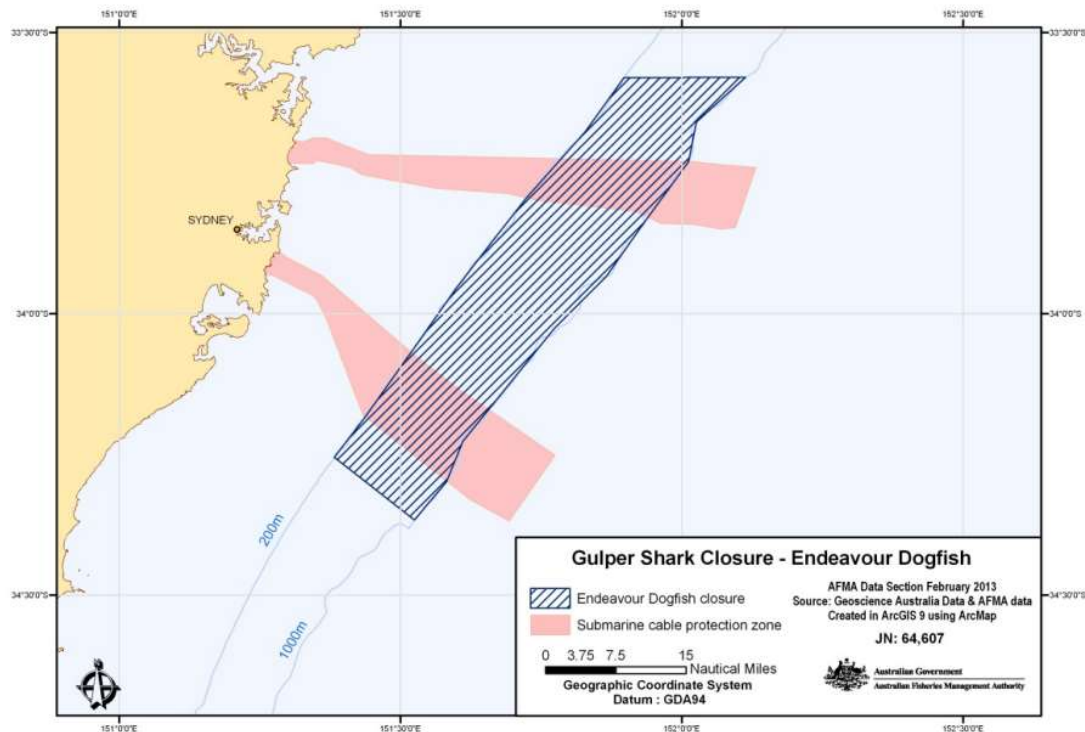
## 1. Background

The Commonwealth Royal Red Prawn (RRP) fishery, now part of the AFMA managed Southern and Eastern Scalefish and Shark Fishery, started nearly 30 years ago. Catches between 1990 to 2003 were relatively stable ranging from 329 tonnes to 690 tonnes (averaging 514 tonnes yearly).

Prior to 2011, a fishery area closure to help rebuild depleted stocks of conservation dependent gulper sharks (also known as upper slope dogfishes) was already in place in Commonwealth waters off Sydney. The recovery of these conservation dependent gulper sharks are managed by AFMA under the Upper Slope Dogfish Management Strategy. The species of interest to this study are:

- Endeavour Dogfish, *Centrophorus moluccensis*, 100cm length maximum.
- Harrison's Dogfish, *Centrophorus harrissoni*, 114cm length maximum.
- Southern Dogfish, *Centrophorus zeehaani*, 103cm length maximum.

This closure impacted on deepwater fishing for RRP between 400-550 m depth. In addition to this fishery closure, two large closures running perpendicular to the shore were also in place to protect the large telecommunication cables that service metropolitan Sydney. Additional closures extending the size of the Endeavour Dogfish closure were implemented during 2011 and 2012 for further protection of gulper sharks which further reduced the remaining RRP grounds off Sydney and Wollongong (Figure 2 below).



**Figure 2:** Gulper shark closure off Sydney (SESSF Direction No.1 2015, Schedule 13)

The combination of these closures has bisected the traditional RRP fishing grounds. Open Commonwealth fishing grounds are now a four hour steam from the port of Sydney, adding significant production costs. Australian RRP vessels have faced increasing competitive

pressure from cheaper imported prawns and following the closures, a number of RRP fishing boats have been tied up because their fishing operations are no longer commercially viable. Recent seasons catches have been low at 178t (2013/14 season) and 146t (2014/15 season).

There is evidence to suggest that gulper sharks have generally been associated with the catch of RRP trawling. With the aim of re-opening the Sydney gulper shark closure to RRP fishing, fishers from the South East Trawl Fishing Industry Association under contract to AFMA have worked collaboratively with AFMA to find a way to mitigate gulper shark interactions while allowing vessels inside the closure. Here we detail the results from a brief pilot study and show how a bycatch reduction device (a metal grid called a Gulper Excluder Device) can significantly reduce interaction rates with gulper sharks.

### ***A note on revised project scope***

The original scope of this project was to be two phased approach. Phase one was to involve a number of operational trials of the GED outside the area of the RRP closure (and gulper shark habitat) to establish the efficacy of the device while posing minimal risk to gulper sharks. Phase two was designed to test the device inside the gulper shark closures. Due to logistical delays in collecting data the scope of the project was revised in November 2015. It was agreed by the project principle investigator and AFMA that the research vessel would conduct a number of short trips with the intention of providing a proof of concept trial in the area outside of the gulper shark closure.

## **2. Objectives**

The objective of this pilot study was to provide a proof-of concept to support potentially allowing future trawl fishing for RRP within the Sydney closure by conducting the following work:

- Construct and deploy a GED at sea during commercial RRP fishing operations
- obtain underwater video of the GED as it ejects gulper shark proxies
- analyse catch composition of what is brought onboard and video footage to determine the efficacy of the device at ejecting gulper sharks/proxies.
- Make recommendations to AFMA management on the efficacy of the GED.

## **3. Methods**

### ***Steering committee***

A steering committee was formed to provide oversight and advice to the project team. The committee included stakeholders such as AFMA management, SETFIA members and EO, RRP fishers and Fishwell Consulting.

### ***Proxy gulper shark species***

The depth range of Royal Red Prawns (*Haliproides sibogae*) is between 220 – 820 metres depth, however off the NSW coast, they are typically found between 365 – 550 metres (Reference). This overlaps with the with the known distribution of Harrison's and Endeavour dogfish (Reference).

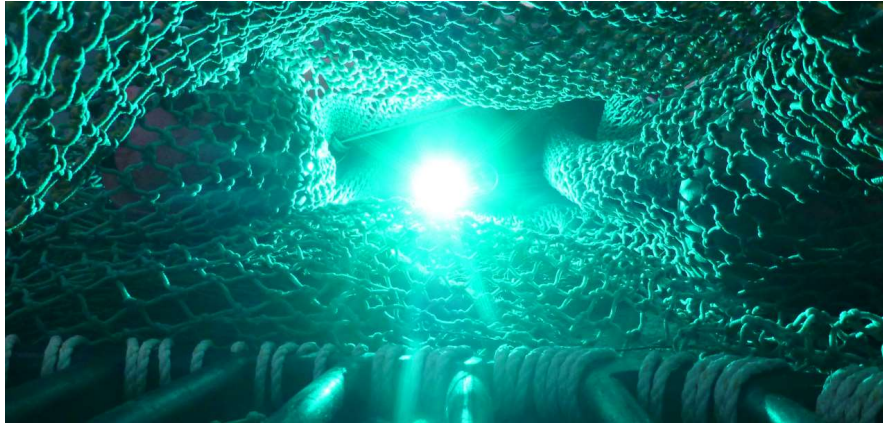
As this trial took place outside of the Sydney gulper shark closure, a number of gulper shark stand-in 'proxies' were determined (Appendix A). These included sharks of the genera *Squalus* and *Entmopterus* of similar size and length to gulper sharks.

### ***Gulper excluder device***

In this trial a GED was constructed based on recommendations of the project steering committee. The GED used was an angled aluminium grid stitched into the net that acts to deflect gulpers and other large fishes up and out of the net unharmed, while the smaller royal red prawns pass through to be caught (Figure 1, front page).

### ***Monitoring***

An AFMA scientific observer was utilised to deploy a JT Electric *Trawl Camera* low lux colour camera system with LED light. The observer mounted the camera on the net to assess the efficacy of the GED during deployment at depth. For the first shot of each trip the camera was deployed on the 'ceiling' of the net facing rearwards with a view of the GED and opening into the escape hatch (Figure 3).



**Figure 3.** Primary camera position (in this instance looking forwards from the GED towards the LED light and rearwards facing camera). Photo: David Schubert, AFMA

For the second shot of each trip the camera was relocated to the outside of the net and was stitched to the 'roof' of the net facing rearwards providing a view of animals emerging from the escape hatch (Figure 4).



**Figure 4.** Secondary camera position on 'roof' of net facing rearwards (to the right of the picture). Photo: David Schubert, AFMA

The observer's duties were to monitor the catch brought on board, observe catch composition and identify any gulpers captured. Following the end of the at-sea data collection the observer analysed the numbers of sharks observed on the recorded footage seen to be escaping the net via the hatch.

In addition to the onboard observer, the vessel was also fitted with an electronic monitoring system consisting of sensors and cameras. Monitoring from this system was not required during this pilot study due to the use of an onboard observer.

#### 4. Results

##### ***Efficacy of device***

Table 1 details the total number of sharks, skates and rays successfully ejected through the trial. Four shots were recorded in October 2015, two on one trip and two shots on a second trip later in the breaking at the end of the linemonth (Appendix B details results by shot). All shots were conducted along the 500 m depth contour. The device successfully ejected 78 per cent of all sharks observed and 100 per cent of all skates and rays observed (Table 1 and Appendix B).

Table 1. Summary of underwater video footage.

Summary for all four shots	Total	% Successfully Escaped
Footage Reviewed (minutes)	515	
Sharks landed on deck <sup>1</sup>	22	
Sharks Escaped	78	78%
Skates landed on deck	0	
Skates Escaped	24	100%
Rays landed on deck	0	
Rays Escaped	3	100%

<sup>1</sup> - The 22 sharks landed on deck included sawtail sharks (*Figaro boardmani*) and lanternsharks of the genus *Etmopterus* likely due to the small sizes and narrow body profile of these species.

Two gulper shark interactions occurred during this trial both identified as Harrison's gulper (*Centrophorus harrissoni* Appendix C).

Video of the GED during deployment is available on the SETFIA YouTube channel at the following address: <https://www.youtube.com/watch?v=IFvs0bRLtMc>

##### ***Loss of prawn catch***

Loss of prawn catch from trip one was estimated at approximately 26 prawns per minute (extrapolated from a 15 min count). Prawns were observed being lost through the escape hatch rather than travelling rearwards into the codend. This was attributed to the steep, 60 degree angle of the grid and the 'sagging' escape flap covering the escape hatch. Some periods of higher loss (in excess of 45 prawns per minute) were observed. The vessel skipper attributed this to periods of water back-pressure which were creating eddies in the area of the escape hatch which acted to 'bump' prawns up and out the hatch.

This issue was addressed prior to the second trip by reducing the angle of the grid by about five degrees. Additionally the number of meshes used in the escape flap was reduced which acted to increase the stiffness of the hood. These modifications were judged by the crew and observer to have reduced the loss of prawns and to have increased the effectiveness of the GED.

### **Species observed**

The majority of sharks seen ejected on underwater video were piked spurdogs (*Squalus megalops*) of around 60 to 65 cm in length. These were positively identified through video analysis by a CSIRO gulper shark expert.

A number of small sharks were found to have passed through the GED and were captured in the codend. These were identified as small catsharks (sawtail catshark, *Figaro boardmanii* no longer than 60cm in length), lanternsharks of the genus *Entmopterus*, blacksharks (*Dalatias licha*) and small prickly dogfish (*Oxynotus bruniensis*). The capture of these sharks was attributed to their small size and narrow body profile which likely enabled them to slide between the bars of the excluder device.

A number of other species were incidentally observed during the trial were large pink ling (seen to pass successfully off the GED and through the escape hatch), deepwater flathead, bailer shells (species) and smaller finfish species such as banded bellowsfish (species) and whiptails (Family Macrouridae).

## **5. Discussion**

This trial demonstrates that the gulper exclusion device, as deployed here, is effective at reducing interactions with gulper shark proxies such as piked spurdogs. Two gulper shark interactions occurred during this trial both identified as Harrison's Dogfish (*Centrophorus harrissoni*). The sharks were of a small size class (~50 cm) which likely led to them being able to fit between the bars of the GED.

Though none were encountered during the trial, the device is likely to be effective at ejecting gulper sharks with a larger body size (~100cm) because they have similar morphology to piked spurdogs.

The device was shown to be relatively easy to deploy and the skipper and crew were incredibly supportive of its usage during the trial. There were no issues of entanglement or failing to deploy the GED correctly.

Additionally, the device shows good potential in reducing unwanted bycatch of other non-target species such as skates and rays as per the usage of similar bycatch reduction devices in prawn fisheries in northern Australia. The vessel skipper has remarked that the device leads to very clean shots of prawns compared to normal shots, requiring less sorting and discarding by deckhands.

## **6. Recommendation**

We recommend that AFMA management pursue an additional research project aimed at securing further GED data from within the gulper shark closure. While this study provides a sound proof of concept, to provide confidence before allowing fishers into the closure the device would ideally be tested and be seen to be ejecting actual gulper sharks rather than proxies.

The crew of the research vessel have indicated they would be willing to facilitate carriage of researchers over the Autumn-Winter 2016 prawn fishing season, should further research shots be required. SETFIA will discuss the results of the trial at their 9 Feb 2016 general meeting and likely provide continued support to any future research.

**Acknowledgements:** SETFIA and AFMA would like to acknowledge: Tony and Vince Bagnatos and the skipper and crew of the FV Francesca for their cooperation, David Guillot for his work in constructing the GED and AFMA observer David Schubert for his diligent work onboard FV Francesca.

#### **Appendix A** List of gulper shark proxies to be used in study

Major shark species common in these depths are likely to be various *Squalus* spp including:

- Eastern Highfin Spurdog (*Squalus albifrons*),
- Greeneye Spurdog (*Squalus chloroculus*),
- Philippines Spurdog (*Squalus montalbani*),
- Eastern Longnose Spurdog (*Squalus graham*).

The Blackbelly Lanternshark (*Etmopterus lucifer*) is also common at those depths – but it is a much smaller species, so is likely to have lower selectivity

The following species could also be used as proxies although they tend to occur >650 m depth:

- Leafscale Gulper Shark (*Centrophorus squamosus*)
- Portuguese Dogfish (*Centroscymnus coelolepsis*)
- Golden Dogfish (*Centroscymnus crepidater*)
- Owstons Dogfish (*Centroscymnus owstoni*)
- Plunkets Dogfish (*Centroscymnus plunketi*)
- Black Shark (*Dalatias licha*)
- Brier Shark (*Deania calcea*)
- Longnose Dogfish (*Deania quadrspinosa*)

## Appendix B Breakdown of results by shot.

Summary of trial information for trip one.

Trip 1 - OB15/192	Shot 1	% Successfully Escaped	Shot 2	% Successfully Escaped
Footage Reviewed (minutes)	125		130	
Sharks landed on deck <sup>1</sup>	2		2	
Sharks Escaped	18	90%	30	93.75%
Skates landed on deck	0		0	
Skates Escaped	3	100%	12	100%
Rays landed on deck	0		0	
Rays Escaped	1	100%	1	100%

<sup>1</sup> - Sharks landed on deck excluding Sawtail sharks (*Galeus boardmani*) due to the small sizeclass of the species.

### Summary of trial information for trip two.

Trip 2 - OB15/203	Shot 1	% Successfully Escaped	Shot 2	% Successfully Escaped
Footage Reviewed (minutes)	120		140	
Sharks landed on deck <sup>1</sup>	11		7	
Sharks Escaped	23	68%	7	50%
Skates landed on deck	0		0	
Skates Escaped	7	100%	2	100%
Rays landed on deck	0		0	
Rays Escaped	0	N/A	1	100%

<sup>1</sup> - Sharks landed on deck excluding Southern/Blackbelly Lantern sharks (*awaiting ID*) due to the small sizeclass of the species.



**Appendix C** – Gulper shark species captured.



**Figure. 5** Gulper shark captured identified as *Centrophorus harrissoni* based on characteristic tail notch, long snout, white edges to rear of dorsal fins and tail and relative size of the second dorsal fin.