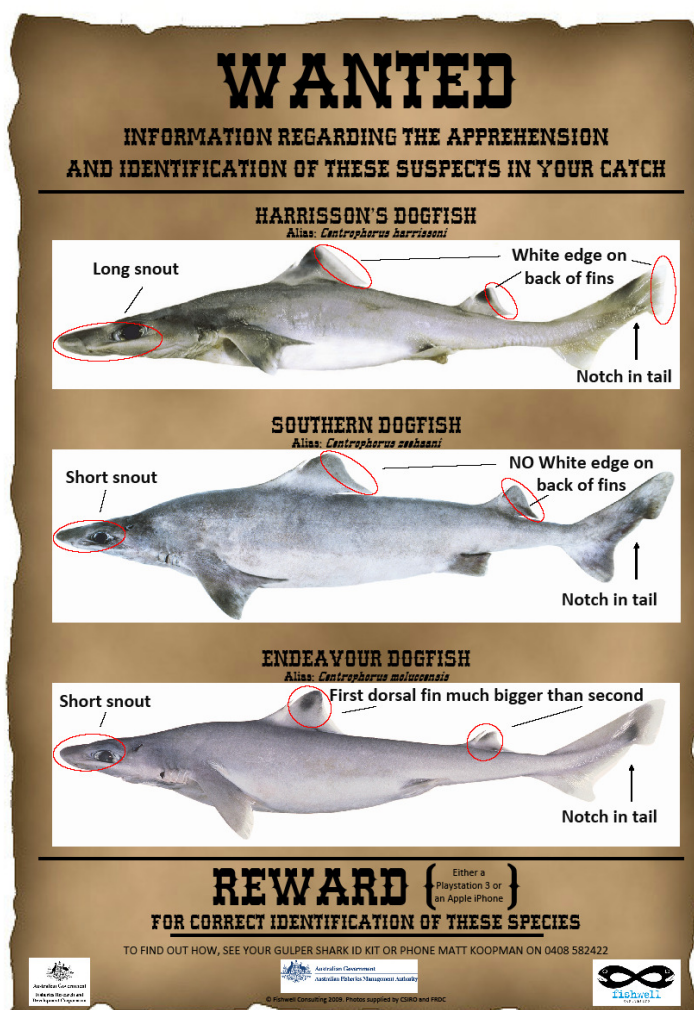


# Industry monitoring and sampling of gulper shark catches in the SESSF



Matt Koopman, Ian Knuckey and Ross Daley

2011

FRDC Project 2009/023

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## **Objectives**

1. Increase gulper shark identification skills of SESSF Industry members to facilitate the collection of meaningful catch and effort data in commercial logbooks.
2. Scientifically verify the veracity of industry identification of gulper sharks through DNA samples.
3. Improve our understanding of the distribution and abundance of gulper sharks in the SESSF.
4. Facilitate ongoing Industry monitoring of gulper sharks.

## **Non-technical Summary**

<b>OUTCOMES ACHIEVED</b>
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<p>Evaluation of the nomination of Harrison's Dogfish, Endeavour Dogfish and Southern Dogfish for listing under the EPBC Act suffered from a paucity of information on catch, catch rates and distribution of those species from commercial logbooks. Increased awareness of this problem, and improved identification skills of Industry members has lead to an increased reporting of either retained and/or discarded captures of 'Endeavour Dogfish' in two sectors of the Southern and Eastern Scalefish and Shark Fishery (SESSF). With training, crew can distinguish gulper sharks from other dogfish species and a generic "gulper shark" group code may be developed for fishermen to record in their logbooks. Ongoing education and improved reporting will improve data available for future evaluation of the status of gulper sharks.</p>
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Gulper sharks (*Centrophorus species*) are caught as bycatch of the Gillnet, Hook and Trap Sector (GHaTS), Commonwealth Trawl Sector (CTS) and Great Australian Bight Trawl Sector (GABTS) of the Southern and Eastern Scalefish and Shark Fishery (SESSF). Recently completed ecological risk assessments of these fisheries identified upper-slope gulper sharks as high priority species which require focused management attention. Furthermore, concerns about previous overfishing of these species has led to Harrison's Dogfish (*Centrophorus harrissoni*), Southern Dogfish (*C. zeehani*) and Endeavour Dogfish (*C. moluccensis*) being nominated for endangered species listing under the Environment Protection and Biodiversity Conservation Act (*EPBC Act* - 1999).

Information on gulper shark species in the SESSF is generally poor. The species are difficult to differentiate and identify down to the species level – even by experienced scientific observers – which has compromised Industry's ability to correctly record the species in commercial catch and effort logbook data. When combined with their low biological productivity and high historical depletion levels, this lack of high quality and accurate data makes these species a critical concern to SESSF operators and other fishery stakeholders.

A review of information available to support management options for upper-slope gulper sharks (Wilson *et al.*, 2009) made the following recommendations:

1. Develop a gulper shark Identification Key and field guide suitable for use onboard SESSF vessels — Priority: very high
2. Train scientific observers and SESSF crew on how to use the key/guide effectively in the field — Priority: very high
3. Develop and maintain a regular program of training/review on using the key/guide for gulper shark identification — Priority: high
4. Explore the use of genetic techniques as a means to periodically validate identifications of both logbook and scientific observer data — Priority: low

This project addresses these recommendations and specifically aims to:

1. Increase gulper shark identification skills of SESSF Industry members to facilitate the collection of meaningful catch and effort data in commercial logbooks;
2. Scientifically verify the veracity of industry identification of gulper sharks through DNA samples;

3. Improve our understanding of the distribution and abundance of gulper sharks in the SESSF; and,
4. Facilitate ongoing Industry monitoring of gulper sharks.

An easy-to-use Identification Key and sampling kit was developed for use by Industry members, which included DNA sampling equipment and a disposable camera. During repeated port visits, skippers and crew of most of the active otter trawl vessels in the CTS, and of numerous vessels from other sectors, including NSW State endorsed trawlers (who are entitled to fish inside State waters or north of the SESSF), were given identification kits, educated on the identification of gulper sharks, and how to take DNA and photographic samples.

Over the term of the project, nineteen samples were submitted by Industry members, which included photographs and/or DNA samples. Of samples submitted by Industry members that had undergone identification training, all were one of the three species of gulper sharks. This indicates that with appropriate education, Industry members could readily identify down to the genus level. Of the 18 samples for which identifications have been confirmed genetically or visually, seven of those were correctly identified — most of those were Harrison's Dogfish. The incorrect identifications were mostly a result of confusion between Endeavour Dogfish and Southern Dogfish, probably caused by the diversity of characteristics within each species, and the similarities between species. Pictorial evidence is provided to demonstrate the difficulty in visual identification of the different species.

Based on the generally rare occurrence of these species in the catch and the difficulties in species identification, although they may be identified as gulper sharks, it appears to be optimistic to expect a high level of accurate identification to species level under normal commercial working conditions.

Ongoing education of gulper shark identifications for Industry members has been facilitated by: the inclusion of the Identification Key in the SESSF Management Arrangements Booklet; training of AFMA observers; and, the direct education of Industry members through inclusion in the FRDC funded TAFE course developed by SETFIA titled "*SETFIA Accreditation of Commonwealth Trawl Sector skippers toward improved environmental operation in fishery*".

Although this project may have improved the general ability of Industry members to identify gulper sharks, it has also highlighted that a number of issues remain that could prevent accurate recording of all catches of gulper sharks in commercial catch and effort logbook

data. Many of the gulper sharks caught in the fishery are relatively small, and are therefore of little commercial value and likely to be discarded. If they appear only rarely in the catch, they would often be overlooked as they are discarded along with the bulk of other non-commercial species. Exacerbating this is the continued lack of reporting of discards in general in the CTS, but even if this does improve, industry cannot be expected to examine and identify the hundreds of small species that are discarded. Despite this, however, there was increased reporting of discarded catches of Endeavour Dogfish in both the CTS and GHaTS that can be directly attributed to this project. Poor recording and identification to species level in logbooks is likely to be due to a number of other factors including: maintaining old habits; uncertainty regarding future gulper shark management arrangements; and therefore, fear of losing fishing grounds as a result of reporting gulper sharks; ongoing difficulties in identifying species within the gulper shark group; and, the push to return live gulper sharks to the ocean without harm.

**Keywords: gulper shark, upper-slope dogfish, identification, Southern and Eastern Scalefish and Shark Fishery, DNA, Industry education**

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## Background and Need

Gulper sharks (*Centrophorus species*) are a bycatch of the Gillnet, Hook and Trap Sector (GHaTS), Commonwealth Trawl Sector (CTS) and Great Australian Bight Trawl Sector (GABTS) of the Southern and Eastern Scalefish and Shark Fishery (SESSF). Recently completed ecological risk assessments of these fisheries identified upper-slope gulper sharks as high priority species which require focused management attention. Furthermore, concerns about previous overfishing of these species has led to Harrison's Dogfish (*Centrophorus harrissoni*), Southern Dogfish (*C. zeehani*) and Endeavour Dogfish (*C. moluccensis*) being nominated for endangered species listing under the Environment Protection and Biodiversity Conservation Act (*EPBC Act* - 1999).

In general, the life history of sharks makes them susceptible to overfishing. This is particularly true of gulper sharks which can have a life span of up to 70 years, may not reach maturity until 12 years of age, have gestation periods of over 12 months and may only give birth to one or two live pups (Graham *et al.*, 1997; Walker, 1998; Graham *et al.*, 2001). Studies have shown that since the mid 1970s, populations of the three gulper shark species nominated for listing under the *EPBC Act* have declined significantly in some areas (Andrew *et al.*, 1997; Graham *et al.*, 1997).

Despite concerns about their conservation status, gulper shark catch and effort data from commercial vessels are limited and unreliable, largely because species identification of gulper sharks is difficult, particularly for untrained personnel. Recent industry surveys with onboard scientists have found gulper shark species in regions that are commercially fished but from which they have not been reported at species level in logbooks. This has consequences not only for information on relative abundance, but also on the reported distribution of the species.

More comprehensive and accurate data on the commercial catch of these species could have important implications for assessment of their stock status. Further, a review of information available to support management options for upper-slope gulper sharks (Wilson *et al.*, 2009) made the following recommendations:

1. Develop a gulper shark Identification Key and field guide suitable for use onboard SESSF vessels — Priority: very high

2. Train scientific observers and SESSF crew on how to use the key/guide effectively in the field — Priority: very high
3. Develop and maintain a regular program of training/review on using the key/guide for gulper shark identification — Priority: high
4. Explore the use of genetic techniques as a means to periodically validate identifications of both logbook and scientific observer data — Priority: low

This project addresses these above recommendations and specifically aims to:

1. Increase gulper shark identification skills of SESSF Industry members to facilitate the collection of meaningful catch and effort data in commercial logbooks;
2. Scientifically assess the veracity of industry identification of gulper sharks through DNA samples;
3. Improve our understanding of the distribution and abundance of gulper sharks in the SESSF; and,
4. Facilitate ongoing Industry monitoring of gulper sharks.

## **Methods**

The main components to this project were: 1) training a number of research scientists to identify gulper shark species and developing gulper shark ID kits; 2) scientists training Industry to identify gulper sharks during port visits and maintain regular contact with Industry to ensure continued participation in the identification and recording of gulper shark catches in the logbooks including feedback on identifications from genetic samples and photographs; 3) facilitation of ongoing Industry monitoring of gulper sharks; and, 4) examination of fishing logbook data to look for increased reporting of gulper sharks.

### ***Scientist training and production of gulper shark ID kits***

Project scientists were trained to identify gulper shark species by Ross Daley at CSIRO, Hobart on 29 October 2008. Will Mure attended this workshop to provide an Industry perspective on on-board identification. Preserved specimens of each species were observed and their key characteristics were noted and discussed in relation to the design of a pictorial key that could be easily used by crew members. The general requirements and specific scientific methods to be used in the project were also discussed; including material

requirements for the identification sampling kits that were provided to Industry to collect photographic and DNA samples to verify identifications.

An Identification Key (Appendix 1) was designed to be included in the sampling kit. This poster contained an easy to use pictorial key that informed Industry members on the identification of gulper sharks as well as other similar shark species. A promotional “Wanted” poster (Appendix 2) was also designed to place on vessels and in fish co-operatives to raise awareness of this project, and also educate industry on identification of gulper sharks. It offered a reward for participation and provided contact details to obtain an identification kit. These posters were developed in consultation with Ross Daley (CSIRO), and benefitted from comments made by Carolyn Stewardson, Peter Horvat and Crispian Ashby (FRDC), Ken Graham (NSW Fisheries) and David Wilson (BRS).

Sampling kits were assembled containing instructions, a hole punch, vials containing 70% ethanol, an Identification Key, a Wanted poster, a flexible measuring board, pencils and an eraser, a disposable camera, zip lock bags and labelling paper.

### ***Port visits – training industry***

Promotional “Wanted” posters were sent to major fishing co-operatives and fisheries offices throughout south-east Australia (Table 1). Co-ops were asked to display the poster in a place that would likely be seen by fishermen. These posters resulted in two enquiries. One fisherman from Coffs Harbour submitted photographs of mis-identified gulper sharks, while another from the Wallis Lake Fishermans Co-operative reported a potential local sighting, however did not submit a sample.

Most of the major ports of the SESSF were visited during three separate trips over 2009–2010, with the purpose of training the crews of as many vessels as possible in the correct identification of gulper sharks (Table 2). This included the distribution of sampling kits, and instruction on taking genetic samples and photographs to verify industry identifications.

Before the port visits commenced, contact was made with the Executive Officers of the South East Trawl Fishing Industry Association (SETFIA — Simon Boag), and of the Great Australian Bight Industry Association (GABIA — Jeff Moore) to outline the project, and contact their members to encourage participation.

Visits were undertaken during times when many vessels were in port. This involved taking into consideration weather conditions and general fishing patterns, and was a significant

challenge for the project. Unless the weather was particularly bad, it was usual that some vessels in each port were at sea, making it difficult to get 100% coverage of vessels.

During meetings, fishers were generally co-operative and interested in improving their identification skills. Some fishermen vented frustration about the potential for information to be included in the assessment for listing under the *EPBC Act*. It was also clear they were fearful of losing more fishing grounds on top of the extensive closures currently in place. Further, Commonwealth CTS operators from NSW felt that there was an unfair and large disparity in management controls imposed to reduce their impact on gulper sharks compared to the imposition on State endorsed fishers.

Table 1. Distribution list for promotional Wanted posters.

Location	Address	Town	State	Postcode
Wollongong Fishermans Cooperative Ltd	PO Box 553	Wollongong East	NSW	2520
Wallis Lake Fishermen's Co-operative Ltd	1 Wharf Street	Tuncurry	NSW	2428
Ulladulla Fishermen's Co-operative Society Ltd	PO Box 21	Ulladulla	NSW	2539
Bermagui Fishermen's Cooperative Ltd	PO Box 47	Bermagui	NSW	2546
Twofold Bay Fishermen's Co-op	PO Box 389	Eden	NSW	2551
Coffs Harbour Fishermen's Co-op Ltd	69 Marina Drive	Coffs Harbour Jetty	NSW	2450
Sydney Fish Market Pty Ltd	Locked Bag 247 Bank Street	Pymont	NSW	2009
LEFCOL	Bullock Island	Lakes Entrance	VIC	3909
Coffs Harbour Fisheries Office	PO Box J154	Coffs Harbour Jetty	NSW	2450
Far South Coast Fisheries Office	PO box 37	Eden	NSW	2551
Wallis Lakes Fisheries Office	PO Box 89	Tuncurry	NSW	2428
Fisheries Victoria	PO Box 337	Lakes Entrance	VIC	3909
Fisheries Victoria	8-12 Julia Street,	Portland	VIC	3305

### ***DNA verification of Industry identifications***

Upon receipt of gulper shark samples from fishers, DNA samples were posted to Ross Daley (CSIRO) for analysis. Methods for DNA analysis of Harrison's Dogfish, Southern Dogfish and Endeavour Dogfish were relatively untested, and it was initially hoped that collaboration with the National Institute of Water and Atmosphere (NIWA) in New Zealand would lead to efficient and accurate analyses. Four Industry specimens were sent to NIWA for genetic comparison with known samples from the CSIRO National Fish Collection using the Genetic marker "Co1". This marker has wide application in species identification, but unfortunately, it was not successful in distinguishing between the known species.

Table 2. Ports, vessels and skippers/owners visited during the three rounds of port visits undertaken during this project.

Port	Date	Vessel	Skipper/Owner	Gear type
Portland	12-13 Mar 2009	<i>San Tangaroa</i>	John McHugh	Trawl
		<i>Zeehaan</i>	Bert Tober / Rangi	Trawl
		<i>Moir Elizabeth</i>	Tom Bibby / Ray	Trawl
Geelong	18 Mar 2009	<i>Western Alliance</i>	David Guillot / Neil McCallum	Trawl
Sydney	20 Mar 2009	<i>Francesca</i>	Tony and Vince Bagnato	Trawl
		<i>Kirrawa</i>	Vince Bagnato	Trawl
		<i>Arakiwa</i>	Paul Bagnato	Trawl
		<i>Sea Port</i>	Richard Bagnato	Trawl
		<i>Maybell</i>	Diego Bagnato	Trawl
		<i>Immacolata</i>	Andy Panto	Trawl
		<i>Tasman Explorer</i>	Joe Dimento	Trawl
		<i>Kimbarra</i>	Joe Dimento	Trawl
Wollongong	20 Mar 2009	<i>Guiseppa</i>	Rocco Musumeci	Trawl
Greenwell Point	20 Mar 2009	<i>Anne Marie 5</i>	Kevin Gray	Trawl
Lakes Entrance	6 Apr 2009	<i>Lady Miriam</i>	Tony Gurnaccia	Trawl
		<i>Tullaberga</i>	Rod Casement / Robert White	Trawl
		<i>Sarda</i>	Chris Curry	Longline
Port Lincoln	5 Apr 2009	<i>Explorer S</i>	Semi Skoljarev	Trawl
Williamstown	28 Jul 2009	<i>Empress Pearl</i>	David Guillot/Russell Bradford	Trawl
Sydney	14 Aug 2009	<i>Francesca</i>	Tony and Vince Bagnato	Trawl
		<i>Kirrawa</i>	Vince Bagnato	Trawl
		<i>Arakiwa</i>	Paul Bagnato	Trawl
		<i>Sea Port</i>	Richard Bagnato	Trawl
		<i>Maybell II</i>	Diego Bagnato	Trawl
Ulludulla	15 Aug 2009	<i>Shoalhaven</i>	Tony Lavalle	Trawl
	16 Aug 2009	<i>Rockfish</i>	Rocky Pirrello	Trawl
Eden	16 Aug 2009	<i>Imlay</i>	John Jarvis	Trawl
Lakes Entrance	17 Aug 2009	<i>Tullaberga</i>	Rod Casement / Robert White	Trawl
Portland	24 Nov 2009	<i>Moir Elizabeth</i>	Tom Bibby / Ray	Trawl
		<i>Celtic Rose</i>	Ben Maas	Trawl
Adelaide	14 Dec 2009	<i>Explorer S</i>	Semi Skoljarev / Tim Parsons	Trawl
Eden	19–22 Jan 2010	<i>Talisman</i>	Michael Ballentine	NSW State dropliner
		<i>Tauranga</i>	Monty Thompson	Trawl
		<i>Rubicon</i>	Russell Wannell	Trawl
		<i>Shira</i>	Troy Nammensma	Trawl
		<i>Twofold Bay Fishermen's Cooperative</i>	Glen Richardson	Co-op

Known samples were re-tested using different genetic markers at CSIRO, Hobart. Tests using the marker “16S” rRNA were successful in distinguishing between known samples, and were adopted for validating Industry identifications. This represents the first practical application of using this marker to identify these species. Genetic testing methods were as follows:

1. Total genomic DNA (from approximately 25mg tissue) was extracted using Wizard SV Genomic DNA Purification Systems (Promega, USA) as per the manufacturer's instructions, except for elution volumes which were reduced to a total of 160 µl. If any tissues remained these were stored, along with an aliquot of the extracted DNA, at -80° C. Genomic DNA for each individual was then diluted to 15 ng/µl where possible using a NanoDrop ND1000 Version 3.0 (NanoDrop Technologies Inc, USA). The DNA aliquots were stored at 40° C for working applications. Samples were used for mtDNA amplification.
2. The 16S rRNA and COI mtDNA fragments were amplified in each of 16 samples. The COI amplification needs to be further optimised. PCR reactions were undertaken in a Perkin Elmer GeneAmp® System 9700 thermal cycler (Applied Biosystems, USA) in a total volume of 50 µl. The PCR cycling conditions were as follows: initial denaturation at 930° C for 10 min, 40 cycles of 930° C for 30 s, 540° C for 1 min 30 s, and 720° C for 1 min. A final extension cycle of 720° C for 10 min was followed by an indefinite 150° C cycle.
3. PCR products were run on 2.5% TAE (Tris, acetic acid, EDTA) buffer agarose gels containing Sybr-Safe at 120V for 1 hour against a Hyperladder size standard (Bioline, USA). Fragments were visualized under blue light and photographed with a digital camera. Products from the 16S gene fragment were purified using AMPure™ magnetic beads (Agencourt, USA) according to the manufacturer's instructions. Approximately 20 ng of purified PCR product as template for bi- directional sequencing using ABI Big Dye® Terminator v. 3.1, Cycle Sequencing Kits (Applied Biosystems). Products were sequenced using the same 16S primer set that generated the initial PCR products.
4. Sequenced products were purified with CleanSEQ magnetic beads (Agencourt) according to the manufacturer's instructions. Fragments were sequenced on an Applied Biosystems 3130XL DNA autoanalyser following ABI protocols.
5. Forward and reverse sequences were analysed in SeqScape v2.1 (Applied Biosystems) (and additionally checked by eye) with consensus sequences extracted. Each mtDNA fragment was analysed separately. Subsets of sequences were compared with the NCBI databases (<http://www.ncbi.nlm.nih.gov/>, all GenBank+EMBL+DDBJ+PDB sequences) using the basic local alignment search tool (BLASTn) feature to ensure



that the correct gene fragment had been amplified. While there are no Harrison's Dogfish, Southern Dogfish or Endeavour Dogfish sequences in GenBank, the sequences here closely matched *Centrophorus squamosus* and *Centrophorus spp* (99%, match to Accession Numbers GU130628.1; HM239665.1), thereby indicating that *Centrophorus* 16S fragments had been sequenced.

6. Aligned sequences for each sample were analysed alongside previously taxonomically identified and sequenced samples of Harrison's Dogfish, Southern Dogfish and Endeavour Dogfish (S. Appleyard, pers. comm.) with a *Squalus acanthia* sequence used as an outgroup. The clustering analysis was undertaken in MEGA v3.3 (Kumar *et al.*, 2004) and neighbour-joining (NJ) trees of K2P distances were produced which enabled visualisation of the distances and patterns for gulper shark samples. Bootstrapping (n = 2000) was used to estimate the reliability of the NJ tree.

## Results and Discussion

### *Industry identifications*

Industry members, mostly from the CTS of the SESSF, submitted DNA and/or photographic samples of a total of nineteen suspected gulper sharks (Table 3) which they tried to identify. A further six samples were collected during a fishery independent survey to be identified by the Principal Investigator. These six samples were taken to test the identification skills nearly two years after the training workshop at CSIRO, Hobart. All DNA samples were sent to CSIRO for genetic testing.

Nineteen of the DNA samples have been tested to date. This test clearly separated the three gulper shark species and the outgroup, *S. acanthia* (Figure 1). All six reference samples also fell into the correct cluster, confirming the correct separation of species. Thirteen of the samples were identified as Harrison's Dogfish, two as Endeavour Dogfish and four as Southern Dogfish (note that two genetic identifications of Harrison's Dogfish and one of Southern Dogfish were made in a different laboratory, and so they do not appear on the cluster tree).

The six samples collected during the fishery independent survey were identified by the Principal Investigator as Harrison's Dogfish (Table 3). This was confirmed as correct by genetic comparison (Figure 1). Identification of these samples was very difficult, and only possible through repeated morphometric measurements of dorsal fin heights and snout

lengths. Despite all being the same species, and covering a small size range (86–97 cm), the samples displayed numerous morphological differences including colouration, snout length and eye size and shape (Figure 2). Some of these differences are clearly a result of damage during trawling, but nevertheless would add to the difficulty that would be experienced by fishing crews when attempting to identify gulper sharks.

Samples 42673, 42674 and 42675, caught by the same vessel in the same shot on 28 August 2009 were all identified by the fisherman as Southern Dogfish (Table 3). One of those samples was confirmed genetically as Southern Dogfish, while the other two were Endeavour Dogfish (Table 3 and Figure 1). Photographs clearly show white margins on the caudal and pectoral fins on each of these three specimens (Figure 3) — the lack of which is a trait of Southern Dogfish, however the white margin has previously been observed in a small number of Southern Dogfish (Ross Daley, personal observation). A further confusion to these identifications is that a short snout is one of the key characteristics of both Southern Dogfish and Endeavour Dogfish. The one characteristic that does distinguish the Southern Dogfish (the animal at the top of the image) from the two Endeavour Dogfish, is the size of the second dorsal fin relative to the size of the first dorsal fin. As for Southern Dogfish, the second dorsal fin in the top animal is closer in size to the first dorsal fin, while in the lower two animals, the second dorsal fin is much smaller. It is easy to see how this fisherman was confused in the identification of these specimens, and this is a good example of the difficulties faced in trying to improve identification skills of industry members throughout the fishery.

Sample 42676 was identified as a Harrison's Dogfish by the same fisherman that submitted samples 42673, 42674 and 42675 (Table 3). This specimen was 55 cm in length, and caught in close proximity to the previous three samples. Genetic testing identified that specimen to be a Southern Dogfish (Figure 1). Looking at the photographs submitted, it is easy to see how this misidentification occurred (Figure 4). Sample 42676 is the animal in the bottom of the photograph, which has both distinctive white fin margins, and a second dorsal fin that is not much smaller than the first, characteristics of Harrison's Dogfish. The snout however, does appear to be relatively short. The animal in the top of the photograph was not submitted as a sample, but included in the photograph to further highlight possible confusion in identifying gulper sharks. That animal is likely to be a Mandarin Shark (*Cirrhigaleus barbifer*), and possesses some of the key traits of a Harrison's Dogfish: two large dorsal spines of similar length; white fin margins; second dorsal fin not much smaller than the first; and no anal fin.

Apart from the barbell-like nasal lobes and the lack of a deep caudal notch, that animal could very easily be confused with a Harrison's Dogfish.

Sample 42677 was submitted with help from an experienced NSW-based scientific observer. The fisherman identified the animal as a gulper shark, and brought it to port for closer examination by the observer. The animal was incorrectly identified as a Harrison's Dogfish, and was later confirmed as an Endeavour Dogfish by genetic testing (Table 3 and Figure 1). Photographs show the white fin margins (Figure 5), however the second dorsal fin appears to be only slightly smaller than the first. From the side profile view, the snout looks distinctly short, a characteristic of Endeavour Dogfish. Comparing relative heights of fins is very subjective without morphometric measurements, particularly without samples of other species against which to make comparisons.

The three samples (42678, 42679 and 42680) that were submitted from a cruise ending on 9 September 2010 were all correctly identified by the fisherman as Harrison's Dogfish (Table 3 and Figure 1). They were all females and measured 87 cm, 76 cm and 62 cm in total length. Photographs of each sample are displayed in Figure 6, and show some variation in the extent of white margins on the fins and snout length.

Samples 42681 and 0805092 were submitted from a catch taken 8 May 2009. Sample 0805092 was one of those sent to NIWA, and as such, has not yet been genetically tested using the 16S rRNA marker. Both samples were identified by the fisherman as Endeavour Dogfish, but from the photographs, Ross Daley identified them both as Southern Dogfish. This was confirmed for sample 42681 through genetic testing (Table 3 and Figure 1). As with previous samples of Southern Dogfish, the confusion with these specimens is likely to have come from the white markings on the fin edges. The short snout is a common characteristic of both Endeavour Dogfish and Southern Dogfish. These specimens do appear to have second dorsal fins that are only slightly smaller than the first.

Sample 42683 was correctly identified as a Harrison's Dogfish with the help of an observer. This was later confirmed by genetic testing (Table 3 and Figure 1). The fisherman initially identified it as a gulper shark, and identification to species was made with the help of the observer and the Identification Key. This Harrison's Dogfish was a 37 cm female, and clearly displayed the distinctive characteristics of that species.

Sample 3004101 was identified by the fisherman as an Endeavour Dogfish, but because it was only submitted during early December 2010, it was not genetically tested. No photograph was submitted with the sample.

Sample 1206091 was identified by the fisherman as a Harrison's Dogfish, however no photographs were submitted. Results of genetic testing were revealed that the specimen was a Southern Dogfish. Without the photograph, it is impossible to comment on how the cause of the error in identification was made.

Samples 2404091 and 2404092 were both identified by the fisherman as Harrison's Dogfish, and genetic testing confirmed that identification. Photos of only one of these samples was successfully developed, and it also appears to confirm the identification as a Harrison's Dogfish with white fin margins, a relatively large second dorsal fin and a long snout (Figure 9).

Samples 1111091–1111094 were submitted as photographs in response to the Wanted poster displayed at the Coffs Harbour Fishermen's Co-op (Figure 10). The fisherman, who identified them as 'Gulper sharks', had not undergone training in the identification of gulper sharks, and did not have an Identification Key. From the photographs, three of the samples are most probably Longsnout Dogfish (*Deania quadrispinosa*), while the third is most probably a Lantern Shark (*Etmopterus* sp.). This highlights the value of the project's education and identification material.

Table 3. Samples submitted by Industry members for confirmation of identification. Shaded rows indicate samples that were collected during the trawl survey. Identifications marked with \* indicates specimens identifications that have so far only been confirmed by examination of photographs. # indicates that DNA analysis did not conclusively identify the sample to species level, but most likely a Southern Dogfish. Identifications marked with <sup>x</sup> were made by a skipper who had not undergone training in gulper shark identification.

Sample code	Date caught	Industry identification	Total length	Sex	Photo (Y/N)	DNA sample (Y/N)	Confirmed identification
42667	15/08/10	Harrisson's Dogfish	86 cm	Male	y	y	Harrisson's Dogfish
42668	5/08/10	Harrisson's Dogfish	90 cm	Male	y	y	Harrisson's Dogfish
42669	6/08/10	Harrisson's Dogfish	97 cm	Female	y	y	Harrisson's Dogfish
42670	15/08/10	Harrisson's Dogfish	86 cm	Male	y	y	Harrisson's Dogfish
42671	5/08/10	Harrisson's Dogfish	90 cm	Male	y	y	Harrisson's Dogfish
42672	14/08/10	Harrisson's Dogfish	88 cm	Male	y	y	Harrisson's Dogfish
42673	28/08/09	Southern Dogfish	56 cm		y	y	Endeavour Dogfish
42674	28/08/09	Southern Dogfish	60 cm		y	y	Endeavour Dogfish
42675	28/08/09	Southern Dogfish	65 cm		y	y	Southern Dogfish
42676	15/09/09	Harrisson's Dogfish	55 cm		y	y	Southern Dogfish
42677	4/03/10	Endeavour Dogfish			y	y	Harrisson's Dogfish
42678	9/09/09	Harrisson's Dogfish	76 cm	Female	y	y	Harrisson's Dogfish
42679	9/09/09	Harrisson's Dogfish	87 cm	Female	y	y	Harrisson's Dogfish
42680	9/09/09	Harrisson's Dogfish	62 cm	Female	y	y	Harrisson's Dogfish
42681	8/05/09	Endeavour Dogfish	43 cm		Y	Y	Southern Dogfish
42683	12/02/10	Harrisson's Dogfish	37 cm	Female	y	y	Harrisson's Dogfish
3004101	30/04/10	Endeavour Dogfish			n	y	#Unconfirmed
1206091	12/06/09	Harrisson's Dogfish			n	y	Southern Dogfish
0805092	8/05/09	Endeavour Dogfish	48 cm	Female	y	y	*Southern Dogfish
2404091	24/04/09	Harrisson's Dogfish		Female	y	y	Harrisson's Dogfish
2404092	24/04/09	Harrisson's Dogfish			y	y	Harrisson's Dogfish
1111091	11/11/09	Harrisson's Dogfish			Y	n	<sup>x</sup> *Longsnout Dogfish
1111092	11/11/09	Harrisson's Dogfish			Y	n	<sup>x</sup> *Longsnout Dogfish
1111093	11/11/09	Harrisson's Dogfish			Y	n	<sup>x</sup> *Longsnout Dogfish
1111094	11/11/09	Gulper Shark			y	n	<sup>x</sup> *Lantern Shark

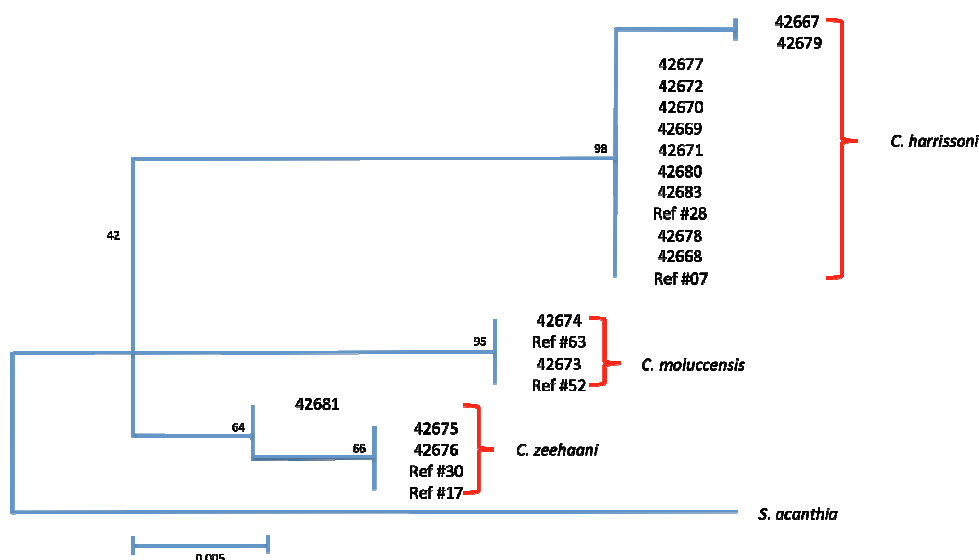


Figure 1. Cluster tree showing 16S rRNA gulper shark sequences clustered with neighbour-joining trees of K2P distances. Ref #28 and Ref #07 were reference samples of Harrisson's Dogfish (*C. harrissoni*), Ref #63 and Ref #52 were reference samples of Endeavour Dogfish (*C. moluccensis*) and Ref #30 and Ref #17 were reference samples of Southern Dogfish (*C. zeehaani*). Samples 1206091, 2404091 and 2404092 were tested at a different laboratory and do not appear on this cluster tree.

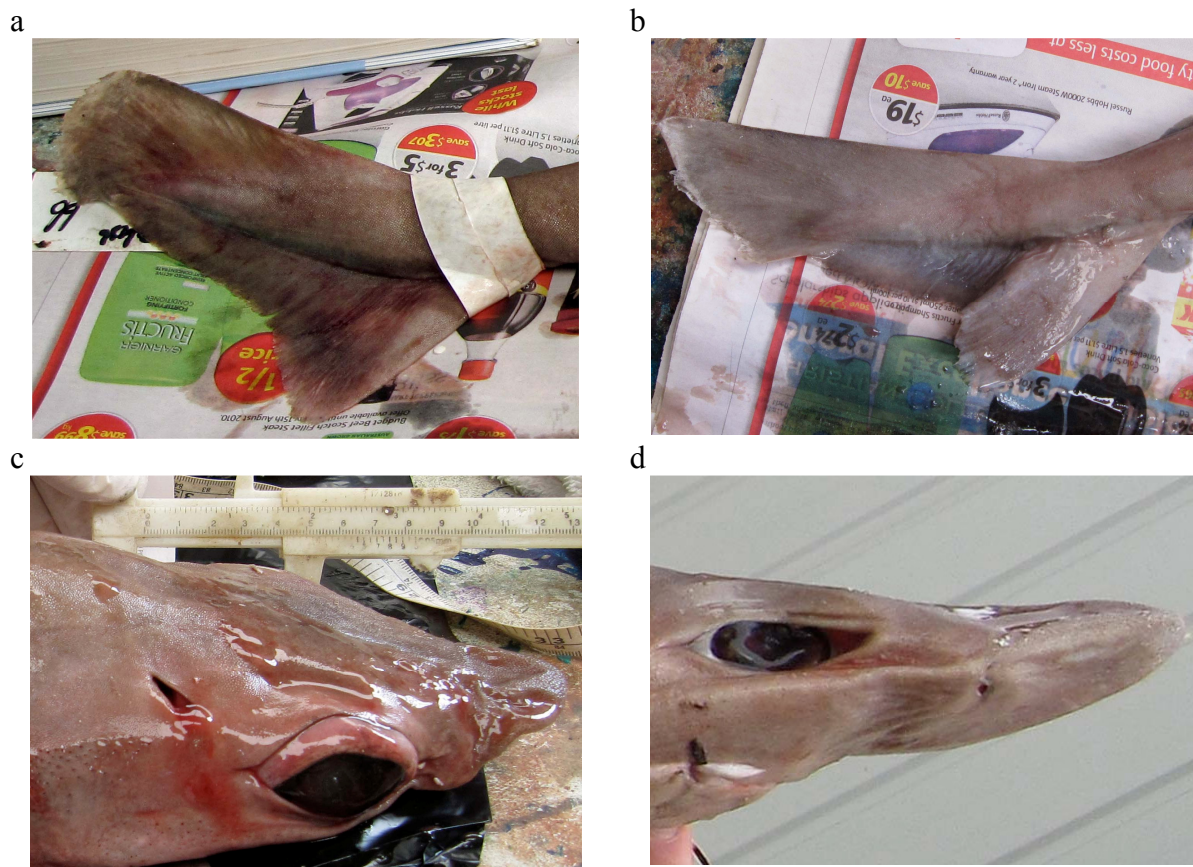


Figure 2. Photographs of the Harrison's Dogfish identified from the fisheries independent survey showing morphological differences in a) and b) distinction of the white margin on caudal fin, and c) and d) differences in eye size and shape and in snout length.



Figure 3. Three samples identified by a fisherman as Southern Dogfish (samples 42673, 42674 and 42675). Each animal displays white margins on caudal and pectoral fin, and a short snout. The bottom two animals were subsequently identified as being Endeavour Dogfish through genetic testing, and the top animal was confirmed as a Southern Dogfish.



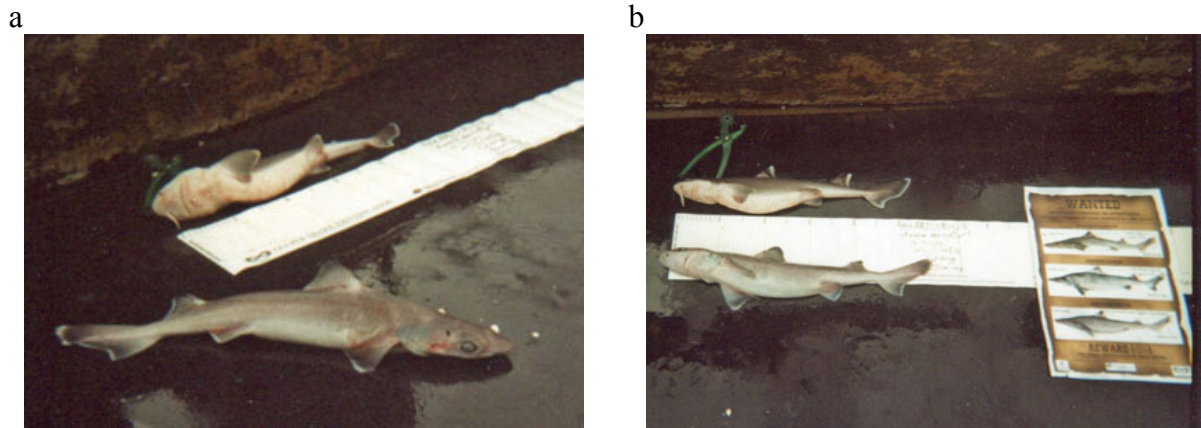


Figure 4. Photographs of the sample (animal at the bottom of the image) submitted for genetic testing and identified by a fisherman as Harrison's Dogfish (42676). The submitted sample was subsequently identified as being a Southern Dogfish through genetic testing. The animal in the top of the image is likely to be a Mandarin Shark (*Cirrhigaleus barbifer*).

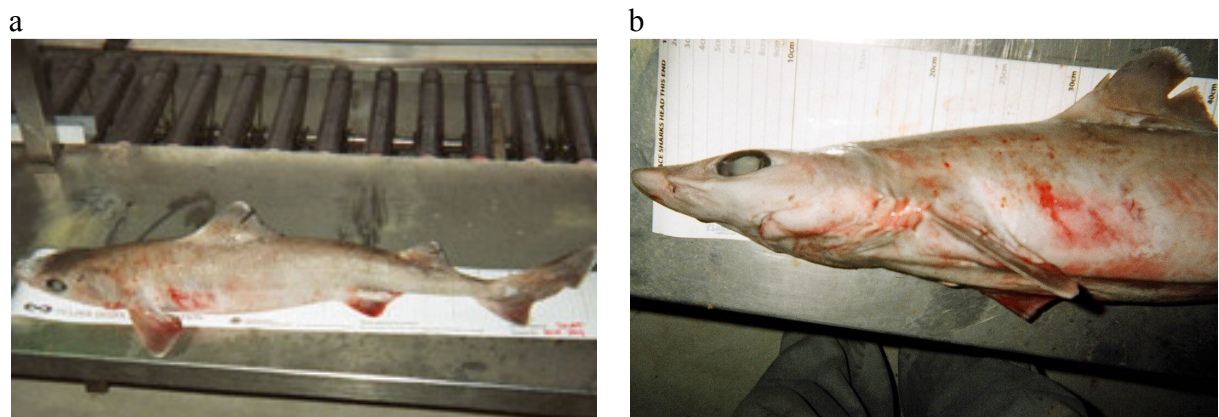


Figure 5. Photographs of the sample submitted and identified by a fisherman as a Harrison's Dogfish (42677), but subsequently identified as being an Endeavour Dogfish through genetic testing.

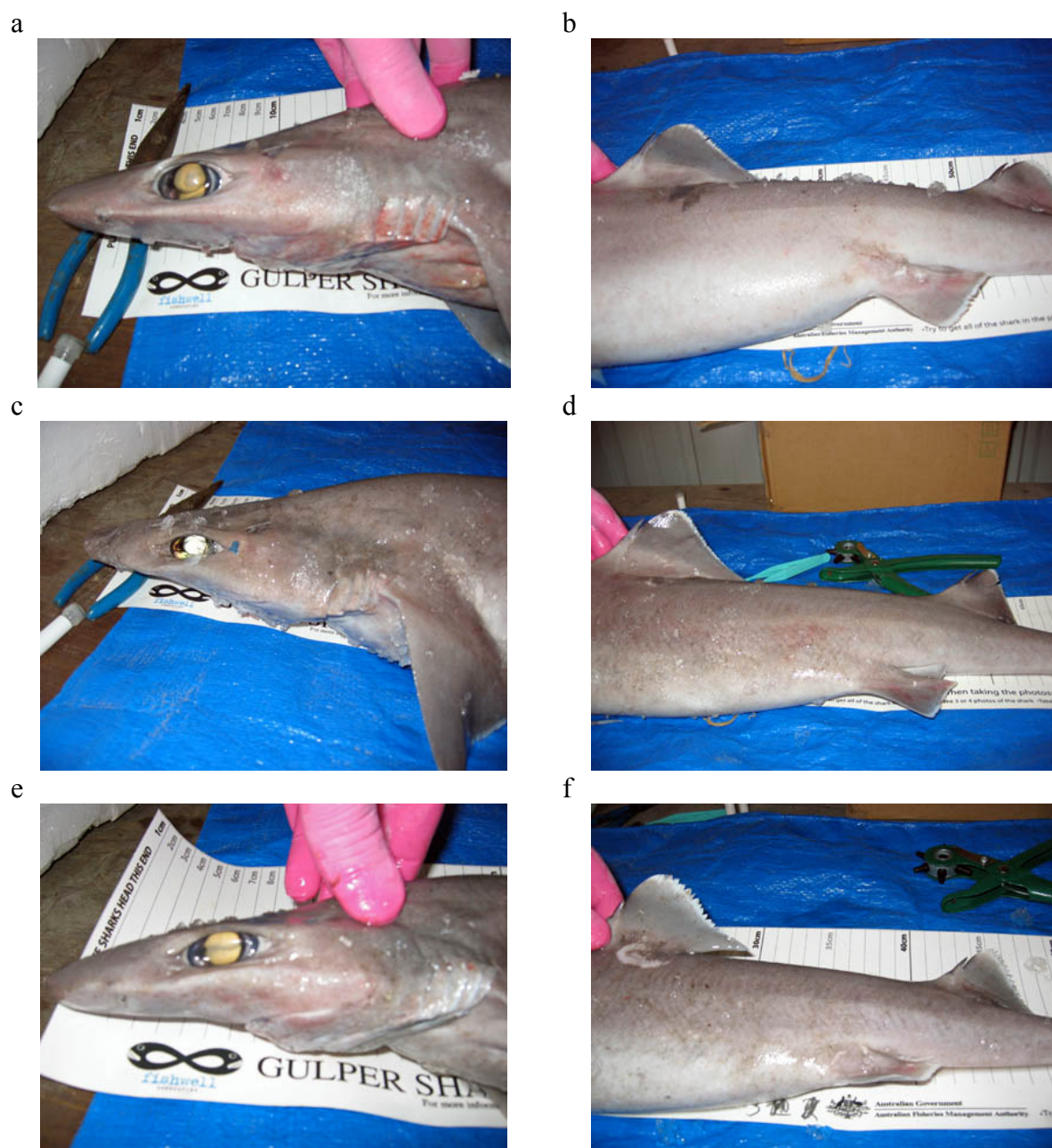


Figure 6. Photographs of the three correctly identified Harrison's Dogfish samples submitted from a cruise that concluded on the 9 September 2009. Photographs show the heads and both dorsal fins of samples 42678 (a and b), 42679 (c and d) and 42680 (e and f).



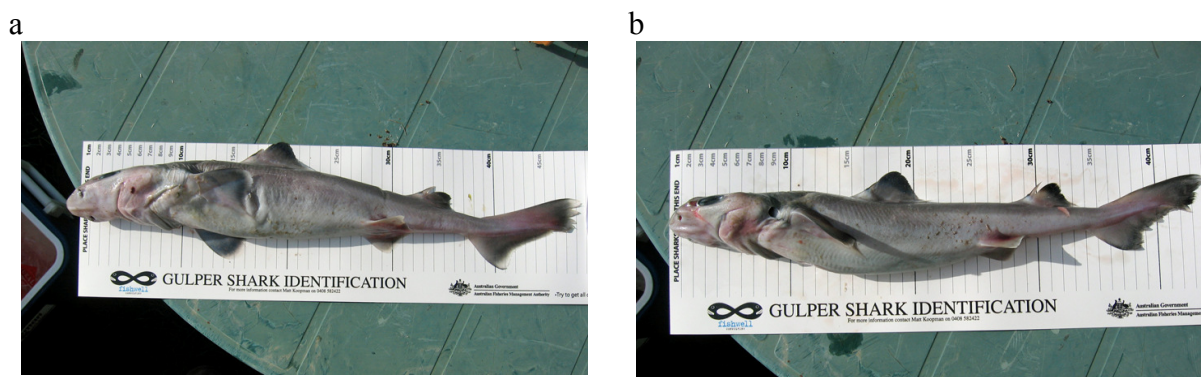


Figure 7. Photographs of the two animals identified as Endeavour Dogfish by the fisherman, a) is sample 42681 and was identified a Southern Dogfish by genetic testing, and b) is sample 0805092 and is also likely to be a Southern Dogfish, but is awaiting re-testing for confirmation.



Figure 8. Photograph of sample 42683 that was correctly identified as a Harrison's Dogfish.

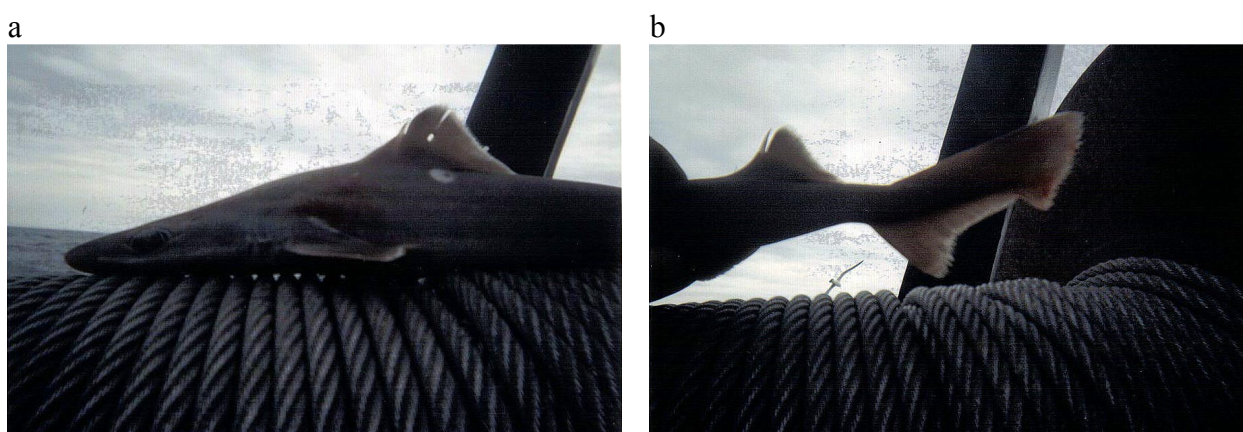


Figure 9. Photographs of sample 2404091 or 2404092 that was identified as a Harrison's Dogfish by the fisherman. Genetic testing has yet to be conducted on this sample, however, the identification is likely to be correct.



Figure 10. Photograph of samples 1111091–1111094 that were incorrectly identified as gulper sharks by a fisherman responding to the Wanted poster displayed at the Coffs Harbour Fishermen's Co-op. Note the white fin margins and two dorsal fins with spines. The fisherman had not undergone the project education.

Submission of samples by some Industry members was encouraging, but most of these samples were submitted by only a small number of fishers. The success of identifications was mixed, and appeared to depend on the species caught. The positive outcome was that those fishers that had participated in the project identification training correctly identified all of the specimens submitted as gulper sharks. All but two of the gulper sharks identified as a Harrison's Dogfish were confirmed as correctly identified (Table 3). This is likely to be because of their distinctively long snout in most cases. In comparison, only one Southern Dogfish, and no Endeavour Dogfish have so far been correctly identified. The white fin margins on Southern Dogfish samples, and the height of the second dorsal fin relative to the first were the major sources of confusion in these samples.

Overall, Industry participation was somewhat disappointing, given the number of port visits conducted and crews instructed on identification and sampling procedures. There are a number of contributing factors that we believe accumulated to cause this. First, the gulper shark must be actually caught by the fishing gear and, with the significant depletions that have occurred over the last 30 years (Wilson *et al.*, 2009), fishermen report that they are now only rarely caught on trawlers and are only caught on longlines in very specific areas. This may well be true, and is supported by the decline in catch rates reported by ISMP observers during 1996–2006 (Walker and Gason, 2007). While some vessels occasionally catch large numbers of Endeavour Dogfish, captures of Harrison's Dogfish and Southern Dogfish are generally

rare. In recent longline surveys designed to locate gulper sharks (Williams *et al.*, 2010), there have been only a few very specific areas of relatively high abundance of gulper sharks between Fraser Island and the Great Australian Bight. In the 2010 fishery independent survey (Knuckey pers. comm. 2010), out of 320 shots, only 14 gulper sharks were caught from 6 shots. Further compounding the rare captures is that fishermen are being asked to avoid known areas of these species. Second, following a rare capture event, the gulper shark must then be seen and recognized by a crew member that has undergone identification training. Gulper sharks are often caught along with other deepwater dogfishes such as Longsnout Dogfish, which could easily be confused with a gulper shark, as evidenced in this project from the samples submitted from Coffs Harbour. It would take a keen eye just to spot a gulper shark from these other species. Finally, the crew member that observes a gulper shark then must have the time and willingness to collect and submit that sample. Crews are usually under pressure to process catches quickly to maintain the highest quality fish for the market and to get enough time for adequate sleep. There is significant time burden in the identification and sample collection being requested. It is possible that if a gulper shark was caught, and then was spotted and identified, that there was just not enough time to collect the sample. Also, in recent years, Industry members are being encouraged to return live specimens to the ocean as soon as possible.

Apart from the issues mentioned above, there is probably one other significant reason for the lack of Industry participation. Smith *et al.* (2011) highlights that over the last decade, there have been huge changes in all sectors of the SESSF to ensure the fishery is conducted in an ecologically sustainable manner: stringent harvest strategies have been introduced which have resulted in large reductions in TACs and catches; bycatch reduction has required significant modification to fishing gear and practices; the fleet has been almost halved through Government buyouts; and, large fishery closures and Marine Protected Areas have been introduced across the fishery for protection of various species and biodiversity. It is probably this last point that has most influenced the willingness of industry to report gulper shark catches. It is well known that area closures are likely to be the most appropriate way of protecting the reasonably sedentary gulper shark species, and Industry have also been instrumental in initiating significant closure areas to protect gulper sharks (Williams *et al.* 2010). It is understandable that crew members would be frightened – particularly during the EPBC nomination process – that by reporting captures from one of their fishing grounds there is a risk it will be closed. This risk outweighs the potential benefits of increased reporting. In

truth, it is unlikely that the odd capture on trawl grounds would result in such a management outcome, but the wholesale changes in the industry over the last decade have made them very wary about potential management decisions.

#### ***Additional stakeholder communication***

A summary of this project and preliminary results were presented at the Harrison's Dogfish Management Workshop in Melbourne on 24 March 2009. An updated presentation was delivered at the upper-slope dogfish workshop in Melbourne on 18 August 2009. Participants at these workshops agreed that it is important to increase available data required for assessment of the nominations or listing as endangered species.

An unplanned collaboration to this project has been made with Ross Shotton from the Southern Indian Ocean Deepsea Fishers Association. This group are undertaking a similar identification education program and have agreed to share information regarding captures of Southern Dogfish which may inhabit their area of operation. An Identification Key and a description of methods used during this project were made available to Ross Shotton for use in that Fishery.

#### ***Ongoing Industry monitoring of gulper sharks***

Ongoing education of gulper shark identifications by Industry members was important to ensure continued improvements in logbook data collection. This education has been achieved in three ways.

1. The Principal Investigator gave a presentation to Australian Fisheries Management Authority (AFMA) observers during their training day on 3 March 2010 in Canberra. During this presentation, observers were trained in identification of each of the gulper shark species. They were also made aware of the importance of educating industry members in gulper shark identification, and were encouraged to talk to skippers and crews about identifying and reporting gulper shark captures.
2. The Identification Key produced during this project was printed in the SESSF Management Arrangements Booklet, April 2010 (Page 63). The purpose of this booklet is to serve as a guide to the management arrangements that apply to SESSF concession holders during the 2010/11 fishing year, and states that "*it is the responsibility of the concession holder to familiarise themselves with these documents*".



3. Identification of gulper sharks was included in one of the units of the accredited TAFE course that was developed during FRDC Project 2010/330 “SETFIA Accreditation of Commonwealth Trawl Sector skippers toward improved environmental operation in the fishery”. This course was delivered to a total of 80 trawl skippers working in the SESSF, during courses held in Lakes Entrance, Eden, Portland and Wollongong. Further, this course will remain as an accredited TAFE course, and be run in the future to re-educate current skippers, and educate those that become new to the fishery.

### ***Examination of logbook records***

Logbook catch records of all Centrolophoridae species from the CTS, GHaTS and GABTS were requested from AFMA covering the period from 1 January 2004 to the most recent data available (May 2010). In that time, no captures of Harrison’s Dogfish or Southern Dogfish were recorded as either retained or discarded. Fishers have continued to record captures of gulper sharks as either Endeavour Dogfish, or the group code Dogfishes, the latter of which may include all species of Centrolophoridae, not just gulper sharks. The grouping of gulper shark captures into the code for Endeavour Dogfish was reported by Daley *et al.* (2002), Walker and Gason (2007) and Wilson *et al.* (2009), and despite the efforts made during this project, remains a problem. Apart from the difficulty of identification, fishermen are not in the habit of reporting individual fish in logbook data. Often, very small catches of individual species are boxed together as “mixed fish” or in this case “Endeavour Dogs” or “Dogfish”.

Reported retained catch of Endeavour Dogfish by CTS operators have decreased since 2004, as has the number of different vessels reporting their capture (Figure 11). Declines in catches of Endeavour Dogfish are consistent with results in Wilson *et al.* (2009) who reported data up until 2008. Results in Figure 11 show that trend continuing in 2009. The large reduction in retained catch of Endeavour Dogfish between 2004 and 2009 cannot be explained by a change in effort in the preferred depth range of gulper sharks (the upper slope). Wilson *et al.* (2009) showed that there was only a very small decrease in effort at those depths during 2004–2006, and that effort increased during 2007. This decline likely reflects either an effort shift away from areas where gulper sharks are caught (but at similar depths) or a reduction in catchability/availability/abundance of gulper sharks. Alternatively, it may reflect increasing reluctance to report the species in logbooks.

Importantly, reporting discards of Endeavour Dogfish has increased since the first round of port visits in this project. From 2004–2008, 0 kg of discards were recorded in logbooks by

CTS operators. During 2009 and 2010, however, discarded Endeavour Dogfish were reported in logbook data (quantities cannot be reported here because the data comprise less than 5 vessels). The increase can be directly attributed to this project as reporting by those vessels came after those particular skippers and/or crew were educated on gulper shark identification during port visits. It is unknown if these sharks were actually Endeavour Dogfish or other species of gulper sharks, and the lack of reporting of captures of Harrison's Dogfish and Southern Dogfish is disappointing. The lack of identification to species in logbooks is likely to be due to a number of factors including maintaining old habits, fear of losing fishing grounds as a result of reporting gulper sharks, uncertainty regarding future gulper shark management arrangement, difficulties in identifying gulper sharks, the push to return live gulper sharks to the ocean without harm and continued lack of reporting discards in general. Actions taken to sustain ongoing improvements in reporting of gulper sharks are discussed in the section titled *Ongoing Industry monitoring of gulper sharks* of this report.

Reported captures of gulper sharks by the GABTS are small and infrequent. As with the CTS, captures are reported as either Endeavour Dogfish, or under the Dogfishes group code. Independent scientific monitoring of the GABTS shows that captures of gulper sharks are low. Captures cannot be shown here because they comprise of data from less than 5 vessels. There was no reported discarding of Endeavour Dogfish, however there was a high rate of reporting of discarding of Dogfishes, some of which may include gulper sharks.

Reporting of retained captures of Endeavour Dogfish by the GHaTS increased during 2009, however figures cannot be shown here because the data comprises of less than 5 vessels. Reporting of discarded Endeavour Dogfish also increased greatly during 2009, from 0 kg (or close to 0 kg) in the previous 5 years. It is probable that this increase in reporting was directly related to this project, because the owners/skipper of vessels reporting discards were either visited during port visits, and/or attended the "upper-slope dogfish workshop" held in Melbourne on 18th August, 2009 where this project was described.

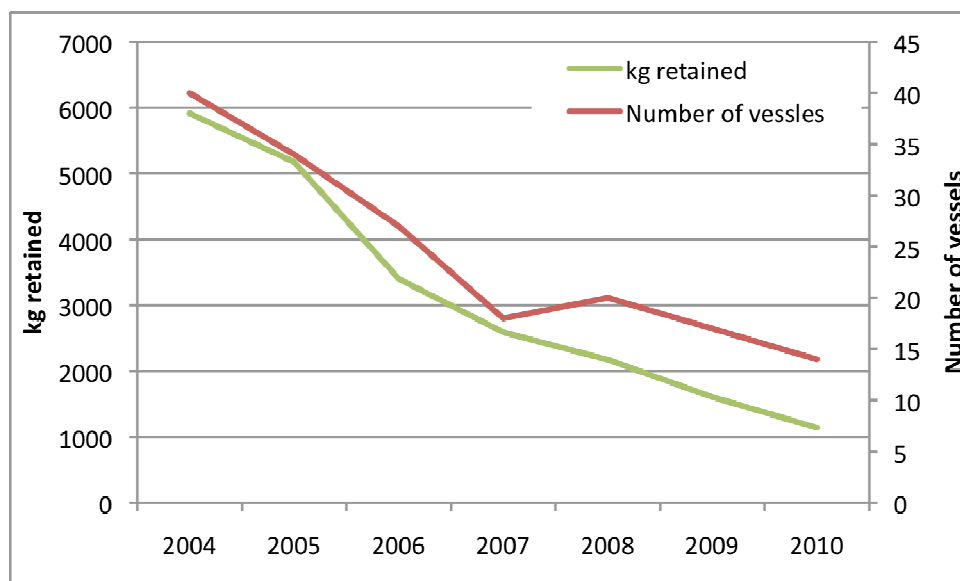


Figure 11. Total weight (kg) of Endeavour Dogfish reported in CTS logbooks from 2004 to 2010, and the number of different CTS vessels reporting retained captures of Endeavour Dogfish. Note that 2010 data only includes catches up until May of that year.

## Benefits and Adoption

The main benefits of this project are the increased education of fishers and increasing the amount of data available on the catch and distribution of gulper sharks through the improved identification skill of Industry members. Some Industry members displayed their ability to identify gulper sharks to species, particularly Harrison's Dogfish. Examination of photographs submitted along with incorrectly identified samples clearly show the difficulties faced with accurate identification of Endeavour and Southern Dogfish. While there were no records of Harrison's Dogfish or Southern Dogfish in commercial logbooks from 2004–May 2010, there was some increase in reporting of retained and discarded captures of Endeavour Dogfish which are likely to be directly related to this project, because the vessels reporting those captures were visited during port visits. The small increase in reporting is a positive step, but a higher rate of reporting was expected given the number of Industry members engaged during this project. Logbook data and data collected from samples submitted during this project will augment information available on the catch and distribution of gulper sharks throughout the SESSF. In addition, efforts to ensure ongoing Industry identifications will continue to further improve available data.

## **Further Development**

Processes set in place to ensure ongoing Industry education and identification skills should be maintained into the future, however it has become obvious throughout this project that it is probably unreasonable to expect a high level of accurate reporting of gulper shark catches down to the species level. This is because of the rarity of their captures, the difficulties in identifying them to species, and the lack of time available to crews for such a difficult task.

It appears that the best source of information on captures on gulper sharks will be collected by AFMA observers and during research surveys such as the CTS and GABTS fishery independent surveys. It is important the observers used during these programs are adequately trained in the identification of gulper sharks to species, and take the time to carefully examine specimens caught. This may include taking morphological measurements of fin heights and snout length, or taking tissue samples for DNA analysis.

A further development stems from the positive indications that skippers and crew with a minimal amount of training can distinguish gulper sharks from other dogfish species. This being the case, it has been suggested that a “gulper shark” group code be developed for fishermen to record in their logbooks. This possibility has been raised with AFMA at the South East Management Advisory Committee and is being considered.

## **Planned Outcomes**

Performance indicators listed in the application for this project were:

1. Conducting gulper shark identification training workshops with the majority of skippers and crews involved in the SESSF.
2. Increased awareness and identification skills of gulper shark species and the incidence of reporting of capture of gulper sharks identified at the species level in commercial logbooks that will provide information of catch, catch rates and distribution of these species.

Throughout the project, it was realised that rather than aiming to cover the “majority of skippers and crews involved in the SESSF”, it would be more beneficial to target skippers and crews of vessels likely to catch gulper sharks. As such, Danish seine vessels were not targeted at all, because they do not fish the upper-slope, and little effort was expended educating skippers and crew from the GABTS where little fishing effort occurs on the upper-



slope. The skipper and crew of one GABTS vessel were visited. Skippers and crews of 20 of the 36 active otter trawl vessels in the CTS were educated in the identification of gulper sharks, and the taking of DNA samples. With knowledge that NSW State endorsed operators also catch gulper sharks, skippers and crews of four State trawlers (who are entitled to fish inside State waters or north of the SESSF) and one State drop-liner were also visited (NSW State drop-liners are entitled to fish up to 80 nm off the coast of NSW). Only one auto long-liner from the GHaTS was visited because the two main vessels that operate out of Tasmania have regularly participated in gulper shark surveys, and their crews were already familiar with the issues and identification of those species.

Through meetings with stakeholders, port visits, inclusion of the Identification Key in the Management Arrangement Booklet and education through the accredited TAFE course, the issues surrounding gulper sharks have been extensively communicated, resulting in increased awareness and identification skills. This has resulted in some increase in reporting of gulper sharks in logbooks, some of which can be directly related back to this project. It is hoped that there will be continued improvement in logbook reporting of gulper shark catches, but this is likely to depend on the outcomes of the EPBC nomination and what management arrangements are implemented to protect these species. Despite continuing problems identifying gulper sharks to species level, increased Industry reporting of gulper sharks to the genus level may still be somewhat useful, as over time, these data could provide a broad indication of the response of the stock status to changes in management arrangements.

## **Conclusions**

- Scientists were successfully trained in the identification of Harrison's Dogfish, Endeavour Dogfish and Southern Dogfish, and developed a simple, picture based identification for use by Industry members.
- DNA sampling kits were compiled for distribution to fishing vessels. These included an identification guide, hole punch, vials, preservative, labelling material and a disposable camera.
- During port visits, skippers and crews of 20 of the 36 active otter trawl vessels in the CTS, one auto long-line vessel in the GHATS, one otter trawl vessel in the GABTS, four NSW State endorsed trawl vessels, and one NSW state endorsed drop-line vessel were educated in the identification of gulper sharks, and the taking of DNA samples.

- Promotional Wanted posters were distributed to 13 fishing co-ops and fisheries offices.
- Nineteen attempts at identifying gulper sharks were made by Industry members and submitted for verification.
- Genetic techniques were developed to successfully separate gulper shark species. This was the first time that this test has been used for a practical application to identify gulper sharks.
- Of the 18 Industry submitted samples for which genetic testing and/or photographic confirmation of identification has been made, seven identifications were confirmed as being correct. An additional six samples were examined by the Principal Investigator two years after initial training and were all successfully identified to species, but only through morphometric measurements.
- Photographs submitted clearly show the difficulties in separating the three gulper sharks of interest because of the diversity of characteristics within each species, and the similarities between species.
- It is unreasonable to expect a high level of accurate identification of gulper sharks to species level under commercial conditions.
- This project has directly resulted in an increase in reporting of gulper sharks in SESSF logbooks, however there continues to be no records of either Harrison's Dogfish or Southern Dogfish in these logbooks.
- Ongoing education of gulper shark identifications for Industry members has been facilitated through the Identification Key being included in the SESSF Management Arrangement Booklet, direct education of Industry members through inclusion in the FRDC funded TAFE course developed by SETFIA titled "*SETFIA Accreditation of Commonwealth Trawl Sector skippers toward improved environmental operation in fishery*", and through training given to AFMA observers.
- With training, crew can distinguish gulper sharks from other dogfish species and a generic "gulper shark" group code may be developed for fishermen to record in their logbooks.

## **Acknowledgments**

We would like to thank fishing vessel crews throughout south-east Australia for giving up their time during port visits, for collecting samples to verify improvements in Industry identification and for their cooperation. The cooperation of SETFIA (particularly Simon Boag) greatly assisted the success of this project by facilitating port visits, and also by including gulper sharks in the accredited TAFE course. The Identification Key and Wanted poster were improved after comments made by Carolyn Stewardson, Peter Horvat and Crispian Ashby (FRDC), Ken Graham (NSW Fisheries) and David Wilson (BRS). Dr Sharon Appleyard (CSIRO) conducted the genetic testing and provided a small report on the results.

## **Intellectual Property**

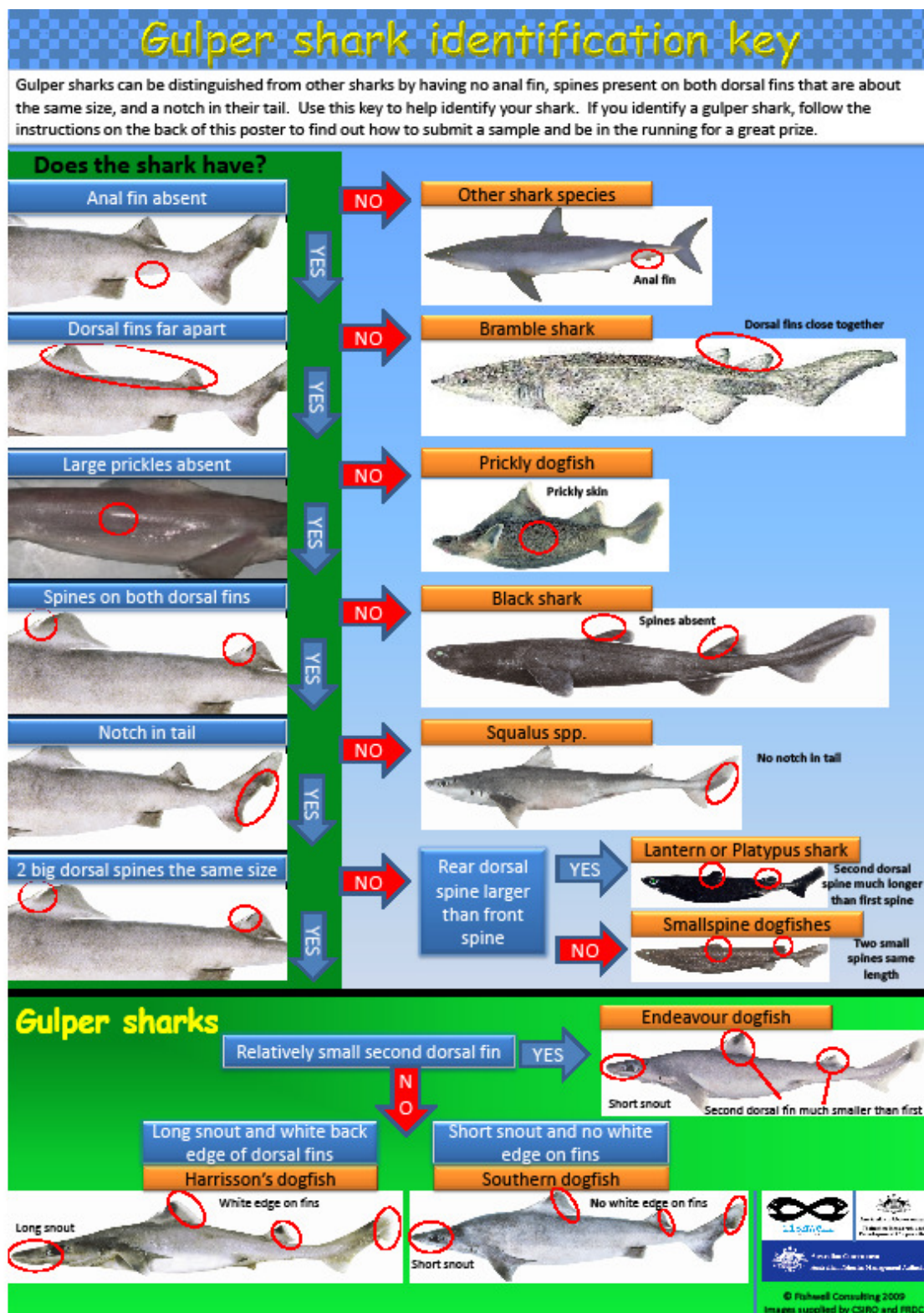
There is no intellectual property associated with this project.

## **References**

- Andrew NL, Graham KJ, Hodgson KE and Gordon GNG (1997) Changes after twenty years in relative abundance and size composition of commercial fishes caught during fishery independent surveys on SEF trawl grounds. FRDC Project No. 96/139. NSW Fisheries Final Report Series No. 1. 108 pp. NSW Fisheries Research Institute, Cronulla, New South Wales, Australia.
- Daley RK, Stevens JD and Graham KJ (2002) Catch analysis and productivity of the deepwater dogfish resource in southern Australia. FRDC Final Report 1998/108. Fisheries Research and Development Corporation, Canberra.
- Graham KJ, Andrew NL and Hodgson KE (2001) Changes in relative abundance of sharks and rays on Australian South East Fishery trawl grounds after twenty years of fishing. *Marine and Freshwater Research* 52:549–561.
- Graham KJ, Wood BR and Andrew NL (1997) The 1996–97 survey of upper slope trawling grounds between Sydney and Gabo Island (and comparisons with the 1976–77 survey). Kapala Cruise Report No. 117. Fisheries Research Institute, NSW Fisheries.
- Kumar JP, Jamal T, Doetsch A, Turner FR and Duffy JB (2004) CREB binding protein functions during successive stages of eye development in *Drosophila*. *Genetics* 168(2): 877-893.

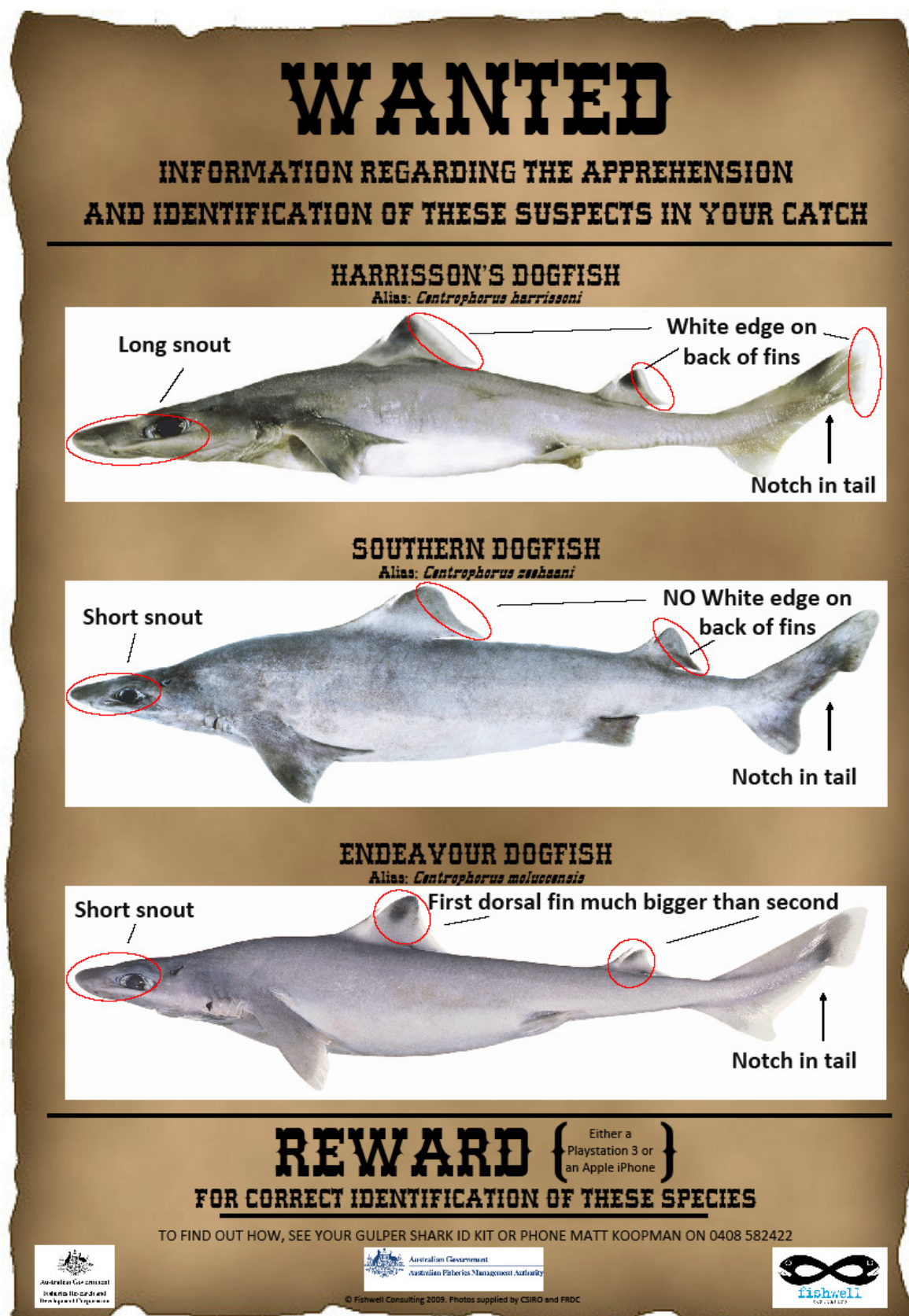
- Smith, A.D.M., A. Williams, I. Knuckey, A. Morison, N.L. Klaer, B. Gibson (2011). Evaluating the progress of Australia's temperate trawl fisheries towards ecosystem based fisheries management. Draft Final Report to the Australian Fisheries Management Authority.
- Walker TI (1998) Can shark resources be harvested sustainably? A question revisited with a review, of shark fisheries. *Marine and Freshwater Research* 49(7): 553-72.
- Walker, TI and Gason, AS (2007) Shark and other chondrichthyan byproduct and bycatch estimation in the Southern and Eastern Scalefish and Shark Fishery. FRDC Project No. 2001/07, PIRVic, Queenscliff.
- White, W.T., Ebert, D.A and Compagno, L.J.V. (2008) Description of two new species of gulper sharks, genus *Centrophorus* (Chondrichthyes: Squaliformes: Centrophoridae) from Australia, pp. 1-21. In: P.R. Last, W.T. White & J.J. Pogonoski (eds). *Descriptions of New Australian Chondrichthyans*. CSIRO Marine and Atmospheric Research Paper 022, 358 pp.
- Williams, A., Daley, R., Knuckey, I., SETFIA, SESSF Longline sector and Fortuna Fishing. (2010). Spatial closures to protect gulper sharks – options for consideration in AFMA's Upper-Slope Dogfish Management Strategy.
- Wilson, DT, Patterson, HM, Summerson, R and Hobsbawn, PI (2009) Information to support management options for upper-slope Gulper shark gulper sharks (including Harrison's Dogfish and Southern Dogfish). Final Report to the Fisheries Research and Development Corporation Project No. 2008/65. Bureau of Rural Sciences, Canberra.

## Appendix 1 - Gulper Shark Identification Key





## Appendix 2 - Promotional Wanted Poster



### **Appendix 3 - Staff**

Name	Organisation	Project Involvement
Matt Koopman	Fishwell Consulting	Principal Investigator
Ian Knuckey	Fishwell Consulting	Co-Investigator
Ross Daley	CSIRO	Taxonomist