

**National Environmental Science Program** 



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### **Cover images**

Front: A sub-adult green sawfish (*Pristis zijsron*) captured in a gillnet in the Skardon River, Gulf of Carpentaria, CSIRO.

Back: Juvenile largetooth sawfish (*Pristis pristis*) in the upstream freshwater reaches of the Daly River, NT, TropWATER.

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# **Executive summary**

The virtual workshop was attended by 49 people from 24 institutions including Commonwealth Scientific Industrial Research Organisation (CSIRO), Australian Fisheries Management Authority (AFMA), Fisheries Research and Development Corporation (FRDC), Northern Prawn Fishery Industry (NPFI), Great Barrier Reef Marine Park Authority (GBRMPA), James Cook University (JCU), Charles Darwin University (CDU), Australian Institute of Marine Science (AIMS), Queensland Department of Agriculture and Fisheries, Northern Territory Fisheries, Western Australia Department of Primary Industries and Regional Development, Western Australia Fishing Industry Council, Northern Territory Seafood Council (NTSC), Gulf of Carpentaria Commercial Fishing Association, Queensland Seafood Industry Association (QSIA) and representatives from the Department of Agriculture, Water and Environment (DAWE) Sustainable Fisheries and Biodiversity Conservation Division. The workshop was facilitated by Mr Dave Brewer, and Dr Sue Pillans was engaged as a visual artist to create a visual summary of the meeting.

State and Federal fisheries departments provided summaries of historical and recent sawfish bycatch reporting in gillnet and trawl fisheries. There was widespread acknowledgement that sawfish bycatch has historically been underreported in all fisheries. However, there have been recent improvements in some fisheries within the last two years.

Identified impediments to reporting included a fear that reporting would be penalised and a lack of trust between industry and management. Industry figures reported that the concept of data paucity leading to higher threat levels is not well understood at the boat level and there is a need to better communicate both the legal reporting requirements and the value of accurate data. Time constraints and overly complex and repetitive logbooks were also raised by industry groups as impediments to reporting.

There are currently no effective mitigation measures that prevent sawfish from becoming entangled in trawl or gillnets. Previous research in Australia demonstrated that electric pulses were unlikely to be useful in reducing sawfish bycatch in prawn trawlers. Current research on sawfish mitigation is focussed on prawn trawl gear and is investigating where sawfish are entangled and whether changes to the mesh can reduce entanglement. International research has found indications of reduced elasmobranch bycatch in gillnets fitted with green LED (light-emitting diode) lights; however, this would require testing in the turbid northern Australian conditions where sawfish occur.

To improve sawfish reporting and obtain an estimate of sawfish abundance and stock structure, the CSIRO proposed a large-scale collaborative project between industry, State and Commonwealth agencies, and research institutions led by CSIRO to gather tissue samples from across northern Australia. These would be used to conduct an assessment of sawfish abundance and stock structure using Close-Kin Mark-Recapture (CKMR), which is the only currently viable tool for this task. In addition to obtaining genetic samples, this project is aimed at improving logbook reporting and improving communication between industry, management and research in relation to sawfish and other threatened species.

### **Research priorities**

The workshop identified the following key research areas as being top priorities for moving Australian sawfish populations toward sustainability and recovery:

- Use CKMR to obtain abundance estimates of sawfish to enable DAWE to assess the recovery plan and listing criteria and the sustainability of ongoing sawfish bycatch across northern Australia.
- Obtain fine scale, contemporary population structure of Australian sawfish species at scales relevant to fishery management to determine if multiple fisheries interact with genetically distinct populations.
- 3) Improved logbook reporting to enable widespread, comprehensive and speciesspecific catch data across northern Australia.
- 4) Establish direct engagement and begin relationship building with commercial fishers to improve trust, reduce fear and communicate the value of accurate reporting.
- 5) Investigate the effectiveness of proposed methods for reducing bycatch of sawfish in gillnet (green LED lights) and trawl fisheries (modifications to TED flap material, net design).
- 6) Obtain robust species and fishery-specific estimates of post-release survival.

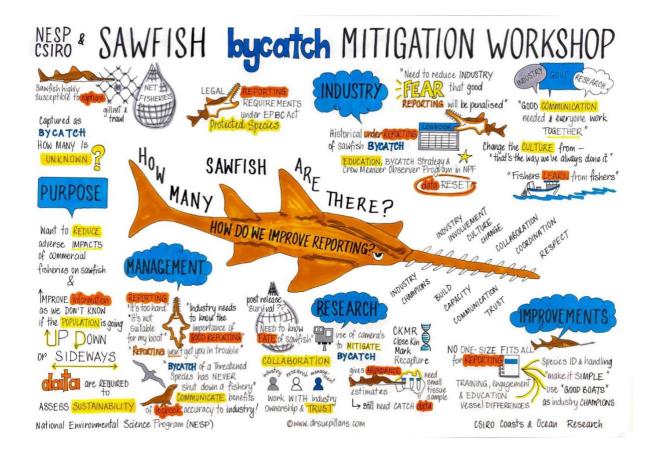
### Rationale

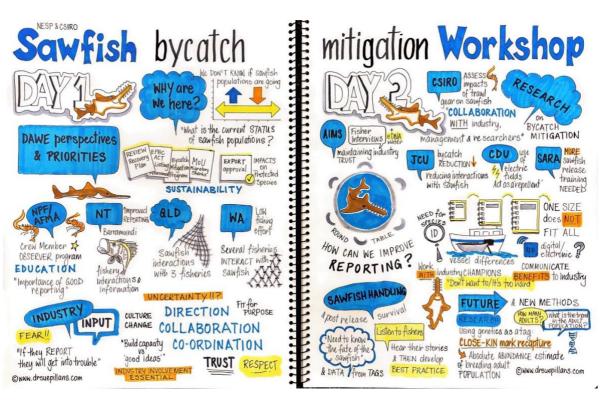
Priority 1 describes the most urgently needed research output for stemming declines in sawfish: abundance estimates. These will address our current near-complete lack of knowledge.

Priorities 2–4 support priority 1 by establishing the tissue sample "supply lines" which would facilitate the use of CKMR to estimate the abundance and contemporary population structure/ connectivity of sawfish in northern Australia. In other words, the success of this project will be built on engagement and effective relationship-building with the commercial fishing industry to facilitate the collection of tissue samples and improve logbook reporting.

Priority 6 seeks to investigate practical measures that can reduce the impact of fishing on sawfish populations. Again, this relies crucially on a cooperative approach with industry. Any potential mitigation measures will require industry support and the development of a qualitative framework to assess animal health on release. Priority 5 and 6 could potentially be funded by the Federal Government's "Threatened and Migratory Species Fisheries Bycatch Mitigation Program".

### **Visual summary**





### 1 Introduction

### 1.1 Background

This project arose from consultation with the DAWE Marine and Freshwater Conservation Section and aims to provide a synthesis of the key issues around Environment Protection and Biodiversity Conservation (EPBC) listed sawfish bycatch in state and commonwealth fisheries in northern Australia.

Three species are listed under the EPBC act (*Pristis pristis*, *P. zijsron* and *P. clavata*) with *Anoxypristis cuspidata* listed as a migratory species. There is currently a nomination to up-list this species as well as *P. pristis* to Endangered.

CSIRO is currently leading a project with NPFI and AFMA that is attempting to obtain population estimates of *A. cuspidata* using CKMR which will extend the results of the NESP A1 project that investigated population structure in this species (Feutry et al. 2021). Recent estimates of species-specific sawfish catch rates in the NPFI are available due to crew member observers (CMOs) and scientific observers, however data from gillnet fisheries that interact with all four sawfish species are largely lacking. This creates a major knowledge gap as it is the gillnet fisheries in QLD and NT that chiefly interact with the other three sawfish species (*P. pristis, P. clavata* and *P. zijsron*).

To address the issue of poor understanding of the extent of sawfish interactions across the larger suite of fisheries operating around Australia's northern coasts, we held a 2-day workshop with state and commonwealth fishery managers, fishing industry bodies, fisheries biologists, sawfish researchers and relevant DAWE staff to understand the issues around sawfish bycatch and develop methods to improve data recording to enable estimates of sawfish catch rates. The long-term goal of the meeting was to develop a nationwide monitoring strategy for sawfish that will enable DAWE to assess the EPBC status of sawfish and the effectiveness of the recovery plan actions. The data from a comprehensive large-scale national monitoring strategy would also inform on whether any potential mitigation measures are reducing bycatch and facilitate moving toward more sustainable sawfish populations.

There are currently two ongoing assessments on sawfish population status that are significantly hampered by a lack of data on the population status of both *P. pristis* and A. *cuspidata*. Again, this indicates a significant gap in understanding which urgently needs to be addressed with the collection of representative bycatch/interaction data and robust estimates of current population abundance.

### 1.2 Report structure

The report is structured around the project objectives, along with content presented and discussed in the workshop linked with the specific objectives of the project. The Objectives form the main sections of the report and were preceded by an overview of the current knowledge of sawfish (presented by R. Pillans, CSIRO) and an overview presentation by DAWE.

The objectives of the project were:

- 1. Present the available data on logbook reporting of sawfish in relevant state and commonwealth fisheries around Australia
- 2. Identify industry issues and challenges around under-reporting, lack of reporting and species identification
- 3. Identify best practice industry standards for obtaining data on bycatch of Threatened Endangered and Protected Species (TEPS)
- 4. Outline steps to develop methods and protocols to improve bycatch reporting of sawfish and other TEPS (e.g. dugong, turtles, crocodiles and dolphins) in remote fisheries.
- 5. Canvas options with relevant stakeholders for the establishment of a national tissue collection initiative for sawfish across northern Australia. This would primarily contain samples collected by commercial fishers but would also include sawfish researchers. Tissue collections are necessary to enable CKMR estimates of abundance once sufficient samples accumulate. Tissues/DNA would also be available to a suite of researchers for other genetic studies.

# 2 Workshop overview

### 2.1 Summary of sawfish status report – why are we here?

This section summarises the overview of the current status of sawfish in Australia given by R. Pillans given at the start of the workshop.

Sawfish are one of the most endangered groups of species on the planet and worldwide their numbers have declined significantly (Dulvy et al. 2016). All five species of sawfish are classified as Critically Endangered on the International Union for Conservation of Nature (IUCN) Red List and of 90 countries where sawfish occurred, 43 have lost one or more sawfish species, while sawfishes (all species) are now extinct in at least 20 geographic areas. Australia has four of the five sawfish species in the world. Three species are listed as Vulnerable under the EPBC Act. These species are the Dwarf Sawfish (*Pristis clavata*), Largetooth Sawfish (*P. pristis*) and Green Sawfish (*P. zijsron*). The Narrow Sawfish (*Anoxpristis cuspidata*) is listed as a Migratory Species under the EPBC Act and is afforded similar protection as species listed as Vulnerable. Interactions with all four species of sawfish are therefore required to be reported by state and commonwealth commercial fisheries.

Female philopatry (females returning to the area they were born in to drop their pups) has been documented in all four species of sawfish (Phillips et al. 2011; Feutry et al. 2015; Green et al. 2018; Feutry et al. 2021). This fidelity of females to their natal area results in genetically distinct populations of sawfish across Australia. In some species, such as the Largetooth Sawfish, structuring can be river specific, with each river drainage across the species' range considered a discrete management unit (Feutry et al. 2015). Recent research on Narrow Sawfish indicated that there were barriers to gene flow between at least eight regions across northern Australia with these results attributed to female philopatry. While additional data are required to fully understand the population structure across Australia, it is clear that all species have population structuring that requires management of discrete populations. This structuring means that not all populations will be the same size and while populations of sawfish in unfished areas such as the Kimberley are likely to be relatively intact, other populations in heavily fished areas may require urgent management intervention. However, abundance estimates are required to understand the differences between regions with varying historical and contemporary fishing efforts.

Sawfish are not targeted by any fishery in Australia; however, their toothed rostrum makes them highly susceptible to capture in gillnet and trawl fisheries. This extremely high susceptibility to capture combined with their K-selected life history (long-lived, late age at maturity, production of small numbers of well-developed young) makes them highly vulnerable to and slow to recovery from exploitation. Other threats to sawfish include habitat destruction, water extraction, capture in illegal, unreported and unregulated (IUU) fisheries, Indigenous harvest and recreational fishing (Sawfish and River Sharks Multispecies Recovery Plan, 2015). Within Australia, there have been range contractions, regional extinctions (https://www.dpi.nsw.gov.au/fishing/threatened-species/what-current/species-presumed-extinct/green-sawfsh), declines in catch per unit effort (CPUE) (Giles et al. 2007) and it is widely accepted that abundance is significantly lower than historical levels based on interviews with fishers and historical images. However, the extent of the decline is unquantified and there are currently no estimates of sawfish abundance. The lack of data on

sawfish population size combined with inadequate reporting data from Australian commercial fisheries (Pillans et al. 2022) makes it impossible to determine the impact of ongoing bycatch on sawfish populations. Pillans et al. (2022) concluded that there was an urgent need for effective monitoring of sawfish in commercial fisheries and that CKMR would be an effective method to establish estimates of sawfish abundance.

Bycatch (the unintentional capture of non-target species during fishing because of low selectivity in fishing gear) is a significant challenge to fishers and fishery managers around the globe (Suuronen et al. 2012). Approximately 10.8% of global fisheries catch is classified as bycatch and the majority is discarded back into the ocean (Perez Roda et al. 2019). However, levels of discards are highly uncertain with under-reporting/no reporting an issue, that is exacerbated with threatened endangered and protected species due to rarity and or negative consequences for the fishery (Gray and Kennelly, 2018).

Bycatch is widely recognised as a major threat to elasmobranch populations (Davies et al., 2009) with Perez Roda et al. (2019) estimating that approximately 10 million sharks are discarded annually. Elasmobranch populations are particularly susceptible to overfishing with Dulvy et al. (2014) estimating that one-quarter of all species are regarded as threatened by overfishing.

Kennelly (2020) recently quantified the levels of discards in Australian commercial fisheries. This research also included an assessment of the quality of data (i.e., the ability of individual fisheries across Australia to monitor bycatch) using a method developed by the United States National Marine Fishery Service (NMFS, 2011). The NMFS developed a tool to measure the quality of bycatch data which can be used to quantify and track the effectiveness and accuracy of bycatch monitoring programmes as well as the success (or otherwise) of bycatch reduction programmes.

This system provides a measure of the relative quality of bycatch estimates via a prescriptive allocation of point scores (maximum score of 73) against 22 criteria using a series of guidelines (see Table 3.1 in NMFS, 2011). The criteria assess aspects of the information used including programme design, longevity, coverages, availability of expansion factors for extrapolations, data collection biases, data set management systems, analyses, levels of peer review, etc.

Once scored using the system, each fishery/method is then placed into five tiers ranked from 0 (for fisheries/methods with no data) through to 4 (those with the best quality information). The scores in the US scheme do not account for the relative level of discards that are estimated to have come from each fishing method. Kennelly (2020), therefore calculated the percentage quality scores weighted by the amount of discards estimated to be associated with each fishery/method with scores (out of 73) converted to a percentage (Table 1 in Kennelly, 2020).

The values from Kennelly (2020) for the fisheries in northern Australia that are known to interact with sawfish are shown in Table 1 and illustrate the different ability of Australian fisheries to record and monitor bycatch. However, we note that recent changes to some fisheries will not be incorporated here. Also of note is that some fisheries were assessed using data that were based on historical reporting/observer programs and at least for some fisheries these observer programmes are no longer operating. The data presented in Kennelly (2020) indicates a need for improvement in how some fisheries monitor bycatch. While sawfish were the focus of this workshop, the lack of data on bycatch of other TEPS is

an issue for other species groups. For example, Tulloch et al. (2020) examined bycatch of cetaceans in Australian fisheries and concluded there was a need for improved standardised data recording and reporting by all agencies. Recommendations of this research include a national approach, improved liaison with fishers and fisheries agencies, identify source of mortality for stranded animals, provision of adequate funding to devise and implement effective mitigation and increase accuracy of bycatch data to enable status of threatened cetacean species to be assessed.

Table 1. Percentage discard rates and data quality scores (%) and tiers for northern Australian commercial fisheries and fishing methods known to interact with sawfish (values are from Table 2 in Kennelly, 2020). The source of data used to score each fishery is provided. Only fisheries/methods with more than 100 t of landings or estimated discards are provided.

Jurisdiction	Fishery	Method	% Discard	Data quality score %	Data qual	Reference
NT	Barramundi	gillnet	24.2	62	2	NT fisheries observer
NT	OFN&L	gillnet/ longline	15.5	62	2	NT fisheries observer
NT	Fish trawl	trawl				no data in Kennelly
QLD	ECIFF	nets	5.7	47	2	Halliday et al. 2001
QLD	GOCIFF	nets	4.9	44	2	Halliday et al. 2001; Roelofs 2004b
QLD	East coast trawl	trawl	77	69	3	Wang et al. 2019
QLD	GOC fish trawl	trawl	39	29	1	DEEDI 2011b
QLD	River/inshore	trawl	20	51	2	DEEDI 2009
WA	Pilbara fish trawl	trawl	34.2	40	1	DPIRD 2019b
WA	Kimberley prawn	trawl	40.3	26	1	DPIRD 2019b

WA	Nickol Bay	trawl	40.3	26	1	DPIRD 2019b
WA	Kimb_Barra	gillnet				no data in Kennelly
Cmwlth	NPF_banana	trawl	57.6	69	3	AFMA observer
Cmwlth	NPF_tiger	trawl	79.7	69	3	AFMA observer
Cmwlth	Torres prawn	trawl	13.1	71	3	AFMA observer

### 2.2 DAWE overview

Lesley Giddings Reeve, leader of the DAWE Aquatic TEPS section, was a late apology for the workshop. As a result, Peter Yates gave a presentation that provided an update on sawfish-related activity currently underway within DAWE. This included an overview of the review of a multispecies recovery plan for River Sharks and Sawfish that is due by 2025.

DAWE has also supported the nomination to uplist *Pristis pristis* and *Anoxypristis cuspidata* to Endangered under the EPBC Act. An overview of the Threatened and Migratory Species Fisheries bycatch mitigation program with a timeline for funding was provided. This \$5 million program is part of the \$100 million Oceans Package and will focus on the development of practical on-ground mitigation following a prioritisation process. Peter Yates also provided an update on the Conservation of Migratory Species (CMS). Australia currently represents Oceania on the Advisory Committee to the Sharks Memorandum of Understanding (MOU) and is a range state for 24 species of sharks and rays currently listed in Annex I of the CMS Sharks MOU. The Australian Government is implementing conservation and management actions to address our national and regional priorities for these species through a range of initiatives, including:

- National Plan of Action for the Conservation and Management of Sharks (NPOA-Sharks).
- Sawfish and River Sharks Multispecies Recovery Plan 2015.
- Listings: 4 sawfish species (Narrow Sawfish, Dwarf Sawfish, Largetooth Sawfish and Green Sawfish) listed as migratory species under the EPBC Act; plus three also listed as threatened species in the Vulnerable category (Dwarf Sawfish, Largetooth Sawfish and Green Sawfish).
- \$40K voluntary contribution to the CMS Sharks MOU to support the implementation of the Programme of Work 2019.
- \$160K voluntary contribution to the CMS Sharks MOU to support the development and implementation of a Regional Strategy and Conservation Plan for Sawfish and

- other Rhinopristiformes \$80K 2021; \$80K 2022.
- Targeted funding: e.g. NESP A1; Australian Commonwealth Our Marine Parks Grant program.

Josh Davis from the Sustainable Fisheries section of DAWE provided an overview of the reporting requirements for the ecologically sustainable management of fisheries and the need for sufficient, reliable information to assess, monitor and manage impacts on species.

Under the Wildlife Trade Office (WTO), DAWE regularly assesses 117 Commonwealth, state and territory-managed fisheries for export approval and their impacts on protected species. Sawfish cannot be targeted but are accidentally caught by commercial fisheries across northern Australia. These are primarily set-net and demersal trawl fisheries.

Commercial fishers are required to report any interactions with sawfish to their respective fisheries management agencies. These agencies then report the interactions to DAWE. This information is used by DAWE to assess the fisheries under the EPBC Act and *Guidelines for the Ecologically Sustainable Management of Fisheries*.

Commercial fisheries are also assessed under export and protected species provisions of the EPBC Act. The department considers the management arrangements for each fishery:

- It requires fishers to take all reasonable steps to minimise their interactions with protected species.
- It considers whether the impacts of the fishery are likely to impact the conservation status or survival of the species in the wild.
- It ensures there is sufficient, reliable information to assess, monitor and manage impacts on species (including protected species). This may require some level of independent data collection and validation.
- It ensures risks are assessed and appropriately managed and states that all risks should be managed in a precautionary way.

Where necessary conditions are applied to address risks. If not met, this may result in approvals being revoked.

All fishery approvals and associated conditions are available on the DAWE website. Assessment reports for each fishery, as well as copies of the Guidelines are also available on the DAWE website (https://www.awe.gov.au/environment/marine/fisheries).

# 3 Objectives

### 3.1 Objective 1: Present data on logbook reporting of sawfish in Australia.

In February 2022, organisers of the workshop emailed fisheries managers within Commonwealth (AFMA and NPFI), State and Territory Fisheries agencies (QLD, NT and WA fisheries) inviting them to provide a presentation at the workshop (see Appendix B). Each jurisdiction was asked to provide a summary of sawfish reporting (logbook records and confidence in this reporting with regards to underreporting and species identification), mitigation measures in place to reduce sawfish bycatch (e.g., seasonal closures, area closures, effort reductions), as well as research (historical and current) to mitigate sawfish bycatch.

All agencies provided a presentation, and these are summarised below.

### 3.1.1 Northern Prawn Fishery (Joint presentation by AFMA and NPFI)

AFMA presented data on fishing effort in the NPF (Northern Prawn Fishery) showing the reduction in fishing effort from 300 boats in 1970 to 52 boats in 2007. Fishing effort has been relatively constant since 2007, with around 8000 boat days per year. Data on seasonal and spatial closures were also presented. The NPF has a complex suite of seasonal and permanent closures (https:// www.afma.gov.au/sites/default/files/npf\_directions\_2021.pdf).

Between 2007 and 2019 there were around 200–600 sawfish reported annually in logbooks (Figure 1). More than 1200 sawfish were reported in 2020 and 2021, with the increase in sawfish reported in 2020 and 2021 attributed to improved reporting rather than increased catches of sawfish.

It was acknowledged that there has been a historical underreporting of bycatch and Protected species in all Commonwealth Fisheries. For the NPF, there have significant improvements in reported Sawfish interactions in 2020 and 2021. Species identification was historically poor, with a majority of sawfish being reported under 'Sawfishes'. There were significant improvements in species identification in 2020 and 2021, with 86% of interactions reported to species level in 2021.

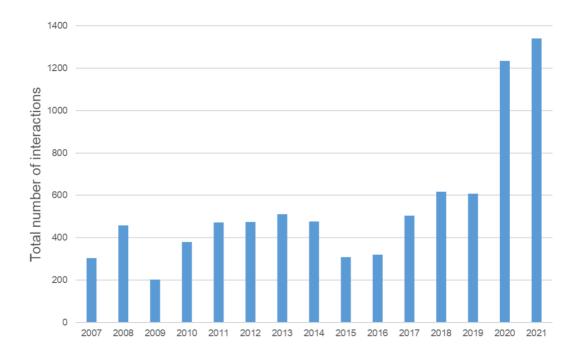


Figure 1. Number of sawfish (all species combined) reported in NPF logbooks.

### 3.1.2 Northern Territory Fisheries summary presented by Thor Saunders

Sawfish are caught by Commercial, Indigenous and recreational fishers in the NT. The commercial sector has the largest number of interactions. Three commercial fisheries interact with sawfish: Demersal Trawl Fishery, Offshore Net and Line Fishery and Barramundi Fishery (Table 2).

The offshore nature of the Demersal and Offshore Net and Line fisheries means that they tend to interact with smaller numbers of mature individuals compared to the Barramundi fishery. The Barramundi fishery has the most interactions and provides the most information on the distribution and abundance of sawfish species, and therefore potentially poses the most risk to the sustainability of populations of these species in the NT. This fishery's management is currently undergoing a review and has had a recent risk assessment as well as a threatened species mitigation workshop.

Table 2. Average number of sawfish captured in each fishery within the Northern Territory. Data presented by Thor Saunders.

Fishery	Dwarf	Green	Largetooth	Narrow
Barramundi	374	292	40	890
Demersal trawl	0	5	10	165
Offshore Net and Line	0	<1	<1	6

The (relatively) low numbers of sawfish interactions in the Demersal Trawl Fishery have been confirmed by 100% electronic monitoring (EM) coverage as well as ~10% onboard observer coverage. The low numbers of sawfish interactions in the Offshore Net and Line Fishery have been confirmed by 100% EM coverage of the long line gear and ~10% onboard observer coverage for gillnet gear.

There has been limited recent observer coverage in the Barramundi Fishery. However, observer coverage from 2004–2013 indicated relatively low interactions (however these trips were primarily during the dry season which would be expected to see fewer interactions). There has been a significant increase in sawfish reporting in the last few years due to the entry of a new licence holder into the fishery. Wild Barra Fisheries now owns 70% of the Barramundi Fishery licences in the NT. Data on the monthly catch rates of Dwarf, Green and Largetooth sawfish were presented as well as heat maps showing where interactions occur. While these data are currently confidential (and cannot be presented within this report), they illustrate that data on the species-specific catch rates of sawfish are being reported and also that the numbers of interactions could support sample collection in sufficient numbers to be highly informative regarding the status of NT sawfish populations.

### Summary of Risk Assessment on sawfish within NT fisheries

For the Demersal Trawl Fishery 2017 assessment, all four species were considered to be at a high risk of unsustainable interaction levels. However, this was primarily due to the low levels of observer coverage not being able to validate the low number of reported interactions.

For the Offshore Net and Line Fishery 2020 assessment, all four species were considered to be at a moderate risk of unsustainable interaction levels.

For the Barramundi Fishery 2021 assessment, all species were considered to be at a high to severe risk of unsustainable interaction levels. A TEPS working group was formed in 2022 to identify priority research areas and mitigation measures that could be undertaken to try and lower these interaction levels in the Barramundi Fishery.

Priority research/knowledge gain areas identified in the TEPS working group included understanding the population levels and stock structure for all sawfish species, validating logbook entries through the implementation of an EM program and investigating the potential of green LED lights to reduce interactions.

Mitigation options have been discussed but not implemented. Mitigation measures included changing the fishing season to avoid interactions during and after pupping (April– November or May–December season), permanently closing critical habitat areas, move on provisions once 'limit' interaction levels are reached, reducing soak times and being in attendance of nets.

### 3.1.3 Queensland Fisheries summary presented by Tony Ham

Queensland fisheries are currently undergoing management reform (sustainable fisheries strategy 2017–2027). Harvest Strategies for each fishery include vessel monitoring systems (VMS) on all boats, Regional-specific fishing rules and implementation of new technologies more effectively.

Table 3. Input and Output controls, seasonal closures, fishing season and presence/absence of harvest strategy in Queensland fisheries that interact with sawfish.

Management Method	GOCIF ECIF		Trawl	
	Limited entry		Limited entry	
	Gear restrictions: Maximum numbe mesh size	•	Boat size restrictions: length, hull size, engine size	
Input Controls	Vessel restrictions	S:	Gear restrictions: Net	
	Maximum boat siz		head rope length, mesh size	
	Net and assisted restrictions	fisher distance	Spatial and temporal closures	
Output Controls	Sawfish No Take			
		1 January – 31 December	1 March – 15	
Fishery Season	7 October – 31 January	Barramundi closure: 1	December: Central and Northern regions	
		September – 1		
Harvest Strategy (Y/ N)	N Y		Υ	

Sawfish are reported in East Coast Inshore Finfish Fishery (ECIFF), Gulf of Carpentaria Inshore Finfish Fishery (GOCIFF) and East Coast Otter Trawl Fishery. There is no specific management of sawfish in any fishery. Management is largely limited entry, closed season and harvest strategy (Table 3). Sawfish are a no-take species in all fisheries.

Efforts in both the GOCIF and ECIF fisheries have undergone declines. In 2021, there were 67 active licences in the GOCIFF (Figure 2A) and around 300 in the ECIFF (Figure 2B). Effort in the east coast otter trawl fishery has been relatively stable at round 3000 days since 2010 (Figure 2C).

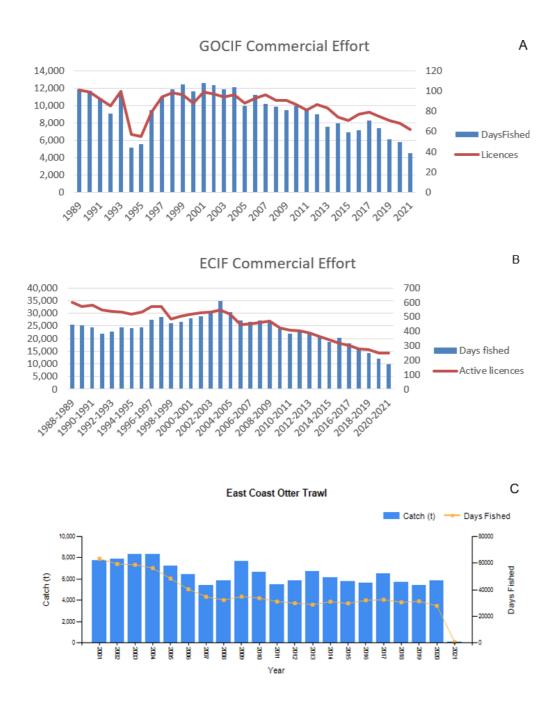


Figure 2. Days fished (LHS Y-axis) and number of licences (RHS Y-axis) in the GOCIF (A) and ECIF (B) fishery. Total catch (tonnes) and fishing effort (days fished) in the east coast otter trawl fishery (C).

### Reported interactions with sawfish

Sawfish are reported in the threatened, endangered and protected animal logbook; however, Fisheries Queensland acknowledged that under/nil reporting was an issue. The values reported are therefore not a true indication of sawfish interactions. Reported sawfish interactions were provided for ECIF and GOCIF fisheries with the number of reported interactions per year ranging from <10 to >250 for the east coast and Gulf of Carpentaria (GoC). There was an increase in sawfish reporting in 2018/2019, followed by a decline in 2020 (Figure 3). The majority (92%) of sawfish were reported from net fisheries (gillnet, haul net and tunnel net fisheries) with all other records from otter trawl fisheries.

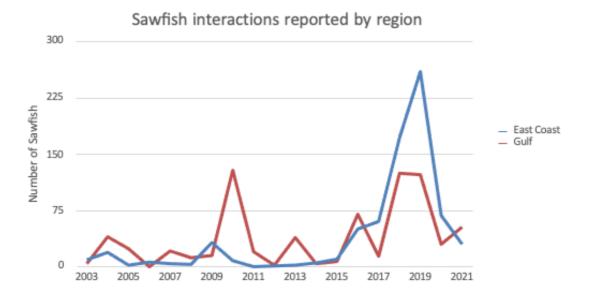


Figure 3. Number of sawfish (all species combined) in gillnet and trawl fisheries on the east coast and Gulf of Carpentaria, Queensland.

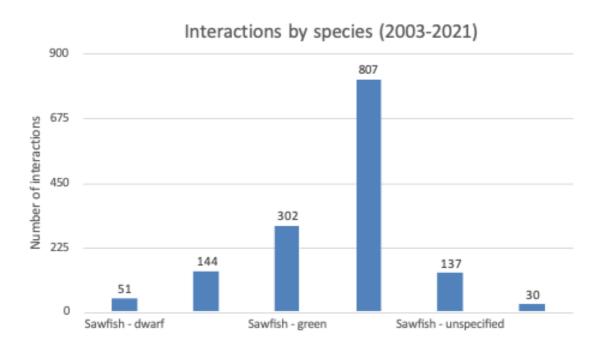


Figure 4. Number of reported interactions with sawfish species in Queensland between 2003–2021. Wide sawfish are the same as narrow sawfish.

The majority of records were for Narrow Sawfish (57%), followed by Green Sawfish (20%), Largetooth Sawfish (10%), and Dwarf Sawfish (3.5%) with 9% of sawfish not identified (Figure 4).

### Fate of sawfish

Logbooks enable fishers to record the fate of animals. Overall, 85% of sawfish were reported as alive, with 9% as dead and 6% as injured (Figure 5A). Trawl fisheries reported more dead (21%) and injured (20%) animals than nets (7.6% and 5.4%, respectively) (Figure 5B). No species-specific data were provided.

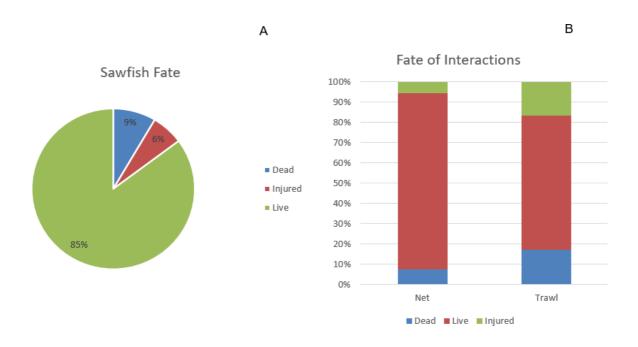


Figure 5. Reported sawfish fate across all fisheries/gear types (A) and for net and trawl fisheries (B).

### Risk assessment and management triggers

All sawfish interactions must be reported in the Threatened, endangered and protected animal logbook (see Figure 6 and Figure 7 for logbook details).

### ECIFF – Level 1 and Level 2 Ecological Risk Assessments (ERA) have been completed

- Narrow, Green, Largetooth and Dwarf sawfish species all identified as high risk.
- Protected Species Management Strategy (PSMS) implemented to reduce risk. The PSMS outlines the mitigation strategies in place "to minimise and mitigate high ecological risks arising from fishing related activities on protected species". Dwarf, Green and Largetooth sawfish are prioritised as species subject to escalating management responses. This includes two main management measures:
  - 1) Implementation of a Best Management Practice (BMP) program for new and existing licence holders.
  - 2) Individual accountability limits with escalating management responses to interactions which include:

- Any interaction must be reported within 14 hours.
- For the first mortality event, Fisheries Queensland (FQ) contact the fisher and undertake an evaluation of the event.
- For the second mortality event, FQ assist fisher to develop an individual mitigation plan for approval prior to recommencing fishing.
- For subsequent mortality events, FQ will review the fisher's mitigation plan to identify any improvements.
- Fisher will be subject to a show cause notice and may have the fisher's operation further conditioned.

### GOCIF – Level 1 and Level 2 ERAs have been completed

- Narrow, Green, Largetooth and Dwarf sawfish species identified as high risk.
- Reform process underway to address high ecological risks.

### • Trawl – Level 1 ERA completed

- Batoids identified as intermediate risk.
- Progressed to a monitoring and research plan.

	Threatened, endangered and protected animal logbook (TEP01 Ver						Version 01)		
Boat Mark	Commerc	ial Fisher's Name	e (Printed)	Commercial Fisher Licence#			Logbook No.		Page No.
	Location of	interaction				Release Condition		ion	
Date of interaction	Latitude (or grid)	Longitude (or site)	Fishing method code (see instructions page)	Species code (see instructions page)	Interaction type code (see instructions page)	Number dead	Number alive and uninjured	Number alive but injured	Tag or band details
Comments		•			•		•		
I certify that the inform	ation I have provided on	this form is a complete a	and accurate record.						
				Commercial fisher's signature:					

Figure 6. The Queensland Fisheries threatened, endangered and protected animal logbook.

# **Interaction Type List**

Interaction Type	Code
Hooked	Н
Netted	N
Entrapped - in a pot	EP
Entangled - in a float line	EF
Entangled - in a fishing line	EL
Contact with apparatus (but	CT
not entangled/entrapped)	O1
Collisions	CL

Figure 7. The Queensland Fisheries Interaction type list (Interaction type code).

### Map of sawfish interactions

Aggregated interactions for each 30 nautical mile grid in Queensland are shown in Figure 8. For grids with less than five boats the data are confidential and not provided. The highest number of sawfish interactions were reported around the Norman and Gilbert River (GoC), followed by the Kirke, Archer, Wenlock and Ducie rivers with vast majority of grids classified as confidential.

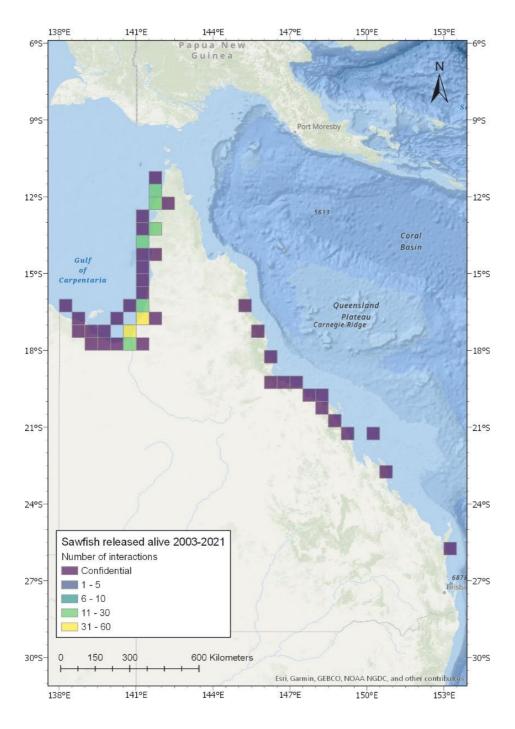


Figure 8. Number of reported sawfish interactions (all species) per 30 nautical mile grid. Data for grids with less than five boats (Confidential) were not shown.

### Future management

GOCIF reform is underway with the development of a Harvest Strategy and PSMS. Fisheries Queensland have provided grant funding for an industry-led project to trial EM in the GoC.

For the east coast trawl, the T4 Stout whiting fishery has a data validation plan in place using onboard observers. The Gulf of Carpentaria Inshore Developmental Trawl Fishery currently undertakes observer and independent data validation programs in the GoC.

Fisheries Queensland is investigating options for independent data validation with EM (onboard cameras) and fishery observers are being considered. A range of solutions are likely to be needed to address different fisheries and gear configurations.

The priority fisheries based on ERAs are:

- Large mesh net fisheries for GoC (N3 and N12/13 fisheries).
- Large mesh net fisheries for East coast (N1, N2 and N4 fisheries).
- East coast trawl (T1, T2, M1 and M2 fishery) and Stout whiting trawl fisheries (T4).

Within Queensland fisheries, the following were identified as priorities: data validation, reporting interactions of species of conservation concern (SOCC), sawfish fate and potentially developing PSMS in the gulf. A data validation plan would be a significant piece of work.

### 3.1.4 Western Australian Fisheries summary by Mathew Hourston

There are four fisheries that interact with sawfish in WA. These are the Pilbara Fish Trawl, Exmouth Gulf Prawn Trawl, Shark Bay Prawn Trawl and Kimberley Gillnet and Barramundi.

### Reported interactions with sawfish and sawfish fate

Logbook reports from 2020 suggest that Green Sawfish are the main species encountered (62% of reports), with Narrow Sawfish accounting for 12%, Dwarf Sawfish 1% and unidentified sawfish 26% (Table 4). Reported survival of captured sawfish was 68% with similar survival for Green and Narrow sawfish. Reported survival was lower than that reported in QLD (85%) and similar to the NT (70%).

Table 4. Number of sawfish captured (alive and dead) for each species in Western Australia in 2020.

Species	Total	Alive	Dead
Green sawfish	58	33 (57%)	25 (43%)
Dwarf sawfish	1	0	1 (100%)
Narrow sawfish	11	7 (64%)	4 (36%)
Unspecified	24	24 (100%)	0

There is reasonable confidence in trawl sawfish data from research surveys and observers. Currently, the CMO program in trawl fisheries is in a state of flux due to new ownership and there is therefore uncertainty regarding what will happen to the CMO program going forward.

Overall, the message from WA fisheries regarding sawfish is that there is limited concern for the impact of bycatch on sawfish populations. This was due to a combination of very low commercial fishing effort in coastal habitat (e.g. 3 gillnet licences north of Exmouth), large areas closed to fishing due to state and commonwealth marine parks, low historical fishing effort, intact historical range, evidence of recruitment in numerous areas including the southernmost nursery (Gascoyne River) and high abundance in other nursery areas (Admiral Bay).

# 3.2 Objective 2: Identify issues around under-reporting, lack of reporting and species identification.

### 3.2.1 How do we improve on data collection?

Data on species-specific catch rates are required as part of the components necessary for monitoring population status. Catch rate data alone will not enable population estimates to be made; however, they are crucial to determining if current catch rates are sustainable and in monitoring changes in abundance. The need to obtain better data on spatial and temporal changes resulting from other impacts, such as habitat modification or water extraction, was also discussed. It was noted that the issue of bycatch is much bigger than just sawfish and better data are required for a range of TEPS (turtles, dugong, crocodiles and cetaceans).

The primary impediments to reporting were noted by stakeholders to be:

### Lack of understanding, fear, trust, lack of time and overly complex reporting requirements.

It was generally acknowledged in the industry that the concept of data paucity leading to higher threat levels isn't well understood at the boat level (where the data needs to be collected). An example of this is the GOCIF and ECIF fisheries, where the lack of data

(underreporting) and inadequate logbook data validation resulted in the WTO being revoked by the Federal Environment Minister.

At the boat level, there is a fear that reporting interactions will get individual crew "in trouble", and this leads to under/no reporting. Trust was another major factor seen to be inhibiting accurate reporting. There was a perception amongst industry that good reporting was being or will be used against them and generally it was noted that there is a lack of confidence in how the data were used.

Lack of time and complexity of logbooks (with respect to sawfish and TEPS) was also viewed as an impediment to reporting. From a Queensland industry perspective, there was a comment that the logbooks need to be made easier to use and with less repetition. The industry perspective was that

"It needs to be made more simple and then they will get more data".

### 3.2.2 What can be done to improve reporting?

### Increased communication

The workshop discussion identified a need to communicate both the legal reporting requirements (what needs to be reported and why these data are required) and the value of accurate data as well as how data are being/will be used. The issue of lack of data was viewed as a shared problem across stakeholder and research groups. It was also noted that including acknowledgement of the problem needing to be owned across management and industry sectors, in the messaging to stakeholders, may assist with improving future reporting. Improved messaging and communication with industry also includes communicating research results and for improved communication as to why scientists are requesting certain samples/data that are not part of standard logbook reporting.

It was noted that cohesion among the industry was something that makes it easier to communicate the importance of better data. Evidence from the NPF and NT Barramundi fishery suggested that increased cohesion among the industry has resulted in improved data collection.

Industry suggested the use of appropriate language to reassure that reporting of sawfish interactions won't lead to legal consequences for fishers. However, it was noted in the discussion that management agencies also need to be clear that both underreporting and better reporting can lead to changes in management.

It was reported to the workshop that from a Commonwealth management perspective, there is a legacy of extensive EM in southern shark fisheries for logbook verification. In southern Australia, EM became mandatory, which increased the reporting of interactions with other species, such as dolphins. This necessitated additional management measures due to improved data and increased confidence in the data. It was noted that it is not a management objective to shut fisheries (and this has not occurred); however, fisheries have a responsibility under the EPBC Act to implement additional management measures as a result of interactions with EPBC-listed species that are deemed to put populations at risk of decline.

The industry noted that how and to whom communication is directed to is also important. Communication needs to be at all levels from licence owners, fleet managers, skippers and deck crew, as it is generally the deck crew who collect the samples but support from the skipper or licence holder is also required. For successful outcomes, fishers need to be genuinely engaged in the process and that requires taking the time to build relationships and directly engage with fishers.

The workshop discussed the need for more education/training in species identification and how to avoid certain areas. Western Australia has a threatened species identification guide which was presented (Figure 9). It was widely acknowledged that most fishers have their own fit-for-purpose (vessel size and scenario dependent) methods for releasing sawfish and this can involve the use of tools such as net hooks, broom handles, knives, ropes, additional persons and vessels to make releasing sawfish safer and more effective.

It was acknowledged by the workshop that more effort is needed to ensure that there is uptake and capacity building within industry. This includes providing documents on handling and release, ID guides, updates on results of research projects (both ongoing and completed) and EBPC reporting requirements.

Annie Jarret (NPFI) proposed a centralised hub where current research projects and research findings were stored. This was seen as both a means of keeping industry updated and also aware of the research so that it can contribute to existing projects and provide input into future research. However, who funds the maintenance of this was uncertain.

### Building trust and reducing fear

Much of the discussion focused on the need for both industry and management to develop good relationships. This was envisaged as a two-sided relationship. It was noted that in the NPF, industry has invested time and effort into developing strong relationships with managers and NPFI have spent a lot of time with individual operators to address any fear that good reporting is going to be penalised.

The notion of "working with the willing" was raised as a means of obtaining data from operators who would bring a high confidence in the supplied data. The rationale would be to build a platform focusing on providing good data rather than a lot of data. This approach would involve working with selected "Industry champions" to obtain this high-quality data. The point of this would be to demonstrate concrete examples of positive outcomes and to encourage other operators to follow suit once they realise the value of providing good quality data.

QSIA suggested that involving a group such as OceanWatch in the research/reporting may result in improvements. OceanWatch Australia Ltd is a national not-for-profit environmental company that works to advance sustainability in the Australian seafood industry.

### Improving logbooks

While there was discussion around reducing complexity and repetition of logbooks to improve reporting, this was framed in general terms and no specific issues or proposals to reduce this complexity were raised.

Two Queensland initiatives were discussed:

- Industry members have been working with Stirling Peverell to develop a system to improve reporting. This system is a whole-of-business management system, not just a logbook system and was reported as having the support of industry. However, how this system will be integrated with the current logbook requirements was uncertain and any new measures will need to be approved by Fisheries Queensland.
- EM and observers are being considered to improve data (data validation) in 'highrisk' fisheries (as identified by ERAs). Queensland Fisheries have funded trials of fitfor-purpose cameras on small vessels in the GoC. It was noted that commercial
  fishers in the GoC did not support the use of EM due to concerns over data security.

It was further noted that cameras being developed in the NT were voluntary and that the aim was to use them as part of a voluntary suite of tools to get better data, rather than making them mandatory.

3.3 Objectives 3 & 4: Identify best practice industry standards for obtaining data on bycatch of TEPS & develop methods/protocols to improve reporting of TEPS bycatch in remote fisheries.

### 3.3.1 Current successful measures

Management agencies and industry were asked to provide examples of what was working with respect to obtaining data on sawfish bycatch.

### Northern Prawn Fishery (NPFI/AFMA)

Clear research objectives/priorities are driving change within the NPF, with sawfish as the number one research priority for the NPF.

- The NPFI reported that it has invested the time to combat the perception among industry that comprehensive reporting will be penalised.
- The CMO program in the NPF is viewed as a successful method of using industry to collect accurate and validated data on bycatch. It was also acknowledged that data collection in the NPF would not have had this success without crew involvement and the ability to convince industry members of the need for the research and therefore the collaboration with the researchers.
- Social licence and public perception of responsible marine stewardship were important factors in motivating better reporting. One licence holder in the NT has started a voluntary CMO program that has resulted in significant improvements in reporting.

NPFI gave an overview of the CMO program which has been running since 2010.

- CMOs funded (paid) by NPFI to collect data on TEPS interactions.
- Dedicated project officers within NPFI oversee the CMO program.
- Annual CMO training program/workshop.
- Required to take photos of interactions which are identified to a species level by NPFI/CSIRO.
- Generally 2–3 boats for banana prawn season and 8–10 boats for tiger prawn season.
- CMOs have Key Performance Indicators (KPIs) and must collect data from over 80% of shots per boat, with accompanying photos in order to be paid.
- Since 2010, there have been 1363 sawfish interactions reported (mostly Narrow Sawfish), and 62,525 TEPS interactions total.
- 3,392 fishing shots covered in 2021 (Minimum target: 2350).

### Skipper and crew briefings in the NPF

In addition to the CMO program, NPFI briefings for skippers/mates are conducted in Darwin, Karumba and Cairns in March & July each year. Threatened, endangered and protected species reporting and sawfish identification has been a strong focus in recent years with NPFI emphasising the importance and legislative requirement of good reporting. As a result of this, sawfish reporting, sawfish identification and reporting of other TEPS have improved significantly. It was also reported that skippers are taking the initiative to experiment with different mesh on Turtle Exclusion Device (TED) flaps to help reduce sawfish interactions with additional gear trials occurring in 2022.

### Northern Territory

In the NT, recent data improvements (see section 3.1.2) were due to improved reporting and the associated significant increase in the number of sawfish being reported. Although the status of these populations is unknown, the high catch rates could indicate that some populations may not require management intervention.

In the NT, managers and industry have strived to strike a balance between voluntary initiatives and mandatory ones. These include:

- A voluntary suite of tools (including trialing cameras on small gillnet dory's) are being used to get better data.
- Industry-led CMO program has improved data collection.
- NT fisheries have formed a TEPS working group that is investigating a range of mitigation and research options.

 In NT, all fishers (including those operating the dinghies) need an interview to become an Approved Operator (not just coxswains). This process can include management aspects and can therefore be used to communicate information to approved operators.

### **QLD Fisheries**

There is widescale management reform ongoing across Queensland, with changes to TEPS reporting and increased consequences in the ECIFF. Individual operators are contributing to data collection and research.

### WA Fisheries

Reasonable confidence was reported in the trawl sawfish data from research surveys and observers. Marine Stewardship Council (MSC) certification for Exmouth Gulf prawn and Shark Bay prawn trawl fisheries had species-specific conditions relating to individual species (bycatch species). Conditions involved the level of interactions to a finer level of detail. WA fisheries has a Marine Protected Species Identification guide that includes sawfish (Figure 9).

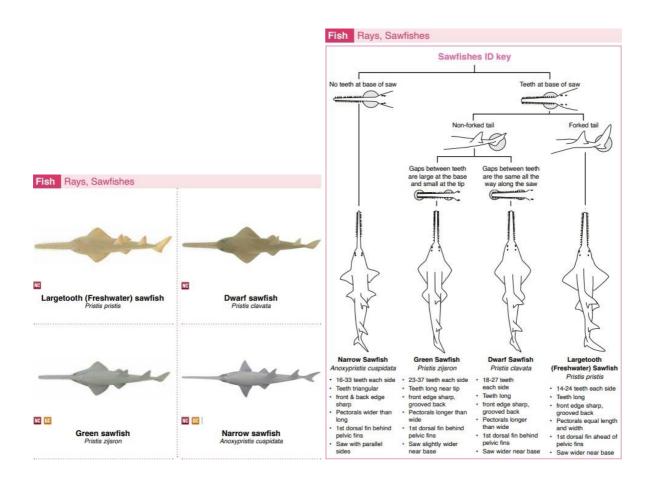


Figure 9. Sawfish identification guide within the Marine Protected Species Identification guide.

### 3.3.2 Sawfish bycatch mitigation research

Researchers provided information on current and recently completed projects that are relevant to sawfish bycatch mitigations.

### Recently completed projects

- Can sawfish bycatch within the NPF be mitigated using an electric field? Funded by FRDC. Collaboration between NPFI/Flinders University/Charles Darwin University (completed).
  - Although sawfish reacted to and were repelled by electric fields in some trials, they did not display a fleeing behaviour from a distance far away enough to avoid entering trawl nets. Sawfish exposed to the electric fields tested did not consistently lead to reactions conducive to escaping.
  - The report concluded that electric pulses tested were unlikely to be useful in reducing sawfish bycatch in prawn trawlers. Increasing pulse voltage, frequency or duration could potentially improve the usefulness of an electric field repelling sawfish, but higher energy waveforms would:
    - (i) be more challenging to implement,
    - (ii) increase potential stress and harmful side-effects in sawfish and other non-target species, and
    - (iii) be more dangerous to humans. The authors suggested that the use of electric fields as sawfish deterrents should be revisited if/when technological advances allow for electric field propagation to be increased to elicit fleeing behaviour from greater distances.
- Narrow sawfish population structure in northern Australia. Funded by NESP.
   Collaboration between NPFI, CDU, CSIRO, NT Fisheries, Menzies Institute (completed).
  - Genomic approaches were used to analyse the population structure of *A. cuspidata* across northern Australia (Feutry et al. 2021). Mitochondrial DNA revealed evidence of barriers to gene flow between all regions where more than three samples were collected. This provides evidence of female philopatric behaviour at an even finer spatial scale than previously suspected. In contrast, there was no evidence of population structure using over 2,000 SNP nuclear markers, suggesting male-biased dispersal. Additional research is required to better characterise philopatric behaviour and determine the extent of non-breeding movements.
- How does trawl gear configuration affect sawfish catches? Mitigating commercial fishing interactions with sawfish in the North and North-West Marine Parks Networks. Funded by Parks Australia. Collaboration between NPFI and CSIRO (completed).
  - CSIRO monitoring trends in catch within the NPF and produces speciesspecific catch rates and maps of catch that are published in the

- sustainability report produced every 3 years. Narrow sawfish CPUE in the NPF was stable between 2010–2019.
- >900 photos from CMOs used to identify where sawfish are entangled in the net (2010–2018). The net is divided into 9 regions with these data showing small (<1.4 m total length (TL)) sawfish mainly in the cod end and large sawfish in the first 2 m of net before the TED. There were also differences between bottom and top opening TEDs.
- Cameras in the net were used to investigate if animals escaped and also where they were caught in the net.

### Current projects

- How does trawl gear configuration affect sawfish catches: mitigating interactions with sawfish in the NPF. Funded by FRDC. Collaboration between NPFI and CSIRO. Underway: 2020–2023.
  - Cameras mounted in the nets are obtaining additional data on where sawfish are captured and if they escape.
  - Cameras are being used to test Industry designed/modified nets to determine if they reduce sawfish bycatch – trial different mesh types before the TED and on the TED flaps.
  - Proposal to investigate post-release survival (tank trials, satellite and dart tagging).
- Close Kin Mark Recapture abundance estimates of Narrow Sawfish Funded by FRDC. Collaboration between NPFI, CSIRO. Underway: 2022–2025.
- Shared knowledge of sawfish and river sharks through interviews with 16 commercial fishers who on average have 40 years' experience. This project also aims to build relationships between fishers, researchers, industry and fishery managers. Funded by Our Marine Park grant funding from the Australian Government. Collaboration between NT Seafood Council, AIMS and Research Institute for the Environment and Livelihoods, CDU.
- Identifying mechanisms and data collection options to aid socio-economic analysis of the NT seafood industry. The project seeks to provide the NT seafood industry with a clear understanding of suitable and cost-effective data systems and data collection processes that could be adopted. Supported funding from the FRDC on behalf of the Australian Government.
- Opportunity for some historic sawfish rostra (some from the 1970s) to be donated
  to a museum, but also used for genetic research. Northern Territory Seafood
  Council (NTSC) is working through the pathways so that industry is aware of
  options to contribute to scientific understanding should they be in a position to do
  so.

- Bycatch reduction in ECIFF. This project is investigating the potential of fish traps that can reduce interaction and handling with TEPS. No sawfish captured, but hammerheads were captured, and traps reduce handling. Funded by FRDC. Research being undertaken by JCU.
- JCU working with a behavioural psychologist and talking to fishers in net and trawl fisheries on the east coast (ECIFF) about their perceptions of EM. Project aimed at investigating what would alleviate their fears and ease the adoption of EM.
- Geoff Diver is trialing the use of a cost-effective camera for small craft as it is not always possible to get observers on boats. Trials are being conducted voluntarily in the NT and FQ have funded trials in the GOCIFF.

### Recently submitted proposals

 Our Marine Parks Grant 3 application – satellite/ dart tagging project to estimate post-capture survival and movement (NPFI/CSIRO). Since the workshop the proponents were informed that this project was not funded.

### 3.3.3 Research ideas raised at the workshop

NT have identified some factors that might reduce sawfish catches in gillnets. These include:

- tide
- net tightness
- changing the fishing season to avoid interactions during and after pupping (April– November or May–December season)
- permanently closing critical habitat areas
- move on provisions once 'limit' interaction levels are reached
- reducing soak times and being in attendance of nets

The use of green LED lights attached to gear were also discussed. Green LED lights have been shown to reduce bycatch of elasmobranchs in some gillnet fisheries that operate at night (Senko et al. 2022). Additional testing in turbid inshore environments is required to determine whether green LED lights will reduce sawfish bycatch and what impact they will have on target species catch.

### 3.3.4 Proposed workshops/documents

Two aspects were considered:

- 1. Sawfish handling and removal workshops were raised as an option.
- 2. Development of an industry-led Code of conduct including information on where not to fish in order to avoid sawfish. However, it was noted that sawfish are highly mobile and frequent similar areas to barramundi, so this strategy won't eliminate bycatch.

### 3.3.5 Sawfish handling and post-release survival

There are no quantitative estimates of sawfish mortality/survival for any fishery. Sawfish survival is influenced by gear type and species. Sawfish respire through spiracles on the top of their head and can therefore survive for long periods when their rostrum is entangled in a net.

Survival is reduced when animals cannot respire normally because they are wrapped up in nets or cannot get enough water across their gills. If nets dry out when the tide recedes, animals will usually not survive. Anecdotal evidence from researchers and commercial fishers suggests that Narrow Sawfish are less likely to survive capture in trawl and gillnets than the other species.

There is recent evidence that the practice of removing the rostrum from live sawfish as means of getting them out of the net still occurs. Historically there was a perception that sawfish survive and that since they don't get entangled in nets without a rostrum it was assumed that this would prevent them from being captured again. However, while sawfish can initially survive this practice, they will eventually starve to death as the rostrum is their primary means of capturing fish and crustaceans.

Handling and releasing large (>2 m TL) sawfish can be difficult and there are reports of fishers being seriously injured while attempting to release large animals. While all fishing operations are slightly different many fishers operate out of small (<5 m) open aluminum boats and in most instances, there is only one person in the boat. This makes releasing larger sawfish difficult; however, fishers have developed methods to safely release animals by using the net to pull the sawfish close to the boat. By using the net and without touching the animal, the rostrum can be secured to either the gunwale or the net horns at the front of the boat. Once the rostrum is in a vertical position and the net is secured on either side to prevent the animals from moving the net can be removed. This can take up to 10-20 minutes depending on how badly the animal is entangled. However, since the mouth and spiracles are located anterior to the base of the rostrum the animal can respire for long periods of time. Sawfish >3-4 m TL are too large to handle from small boats and are normally pulled up onto the bank where they are easier to handle. However, animals of this size are dangerous and difficult to handle. Largetooth, Green and Dwarf sawfish are therefore highly likely to survive capture and release from gillnets if animals are released alive and without significant injuries (e.g., rostrum removed or crocodile/shark bites).

### Several handling guides have been produced:

- Queensland fisheries produced a sawfish handling guide in 2011 and this document is still relevant today (https://www.daf.qld.gov.au/data/assets/pdf\_file/0005/49109/Sawfish-Guide-Final-Nov-2010.pdf).
- The Northern Territory Seafood Council has also produced a factsheet on sawfish that outlines reporting requirements and safe release methods (https://www.ntsc.com.au/documents/item/825).
- While designed primarily for researchers, a protocol for surveying and tagging sawfish and river sharks has been developed (https://www.nespmarine.edu.au/system/files/KynePillans\_Protocols%20for%20s urveyingtagging%20sawfishesriver%20sharks\_20 14\_FINAL.pdf).

The anecdotal evidence of relatively high survival of sawfish captured in gillnets is supported by qualitative estimates of survival in logbook data. Estimates of survival from logbook data in the NT were around 70% for all species combined. In Queensland, survival of sawfish in gillnets was estimated at around 85–90% with lower survival (around 60%) in trawl fisheries. In WA fisheries, survival of sawfish for both gillnet and trawl fisheries combined was estimated at 68%. In WA, survival estimates for Green and Narrow Sawfish (the species most commonly captured) were similar. No other species-specific data were provided.

Queensland logbook data suggest that mortality in trawls was nearly double that in gillnets. This may potentially be species-related, with Narrow Sawfish more commonly captured in prawn and fish trawls, and as previously noted this species is assumed to have lower survival. Irrespective, releasing large sawfish from prawn trawls is difficult and animals need to be lifted out of the water to enable release. This process can be time-consuming and can also result in internal injuries if the tail or rostrum is supporting the weight of the animal.

In the NPF, qualitative estimates of survival from CMOs range from around 45% for Narrow Sawfish and between 71–75% for Freshwater, Green and Dwarf Sawfish.

While these qualitative estimates are a useful baseline, underreporting combined with evidence of animals intentionally being killed and rostrums being removed indicates that better estimates of total mortality are required to inform assessments.

Quantitative data on survival from satellite tags and recapture data from released animals are the best way to obtain data on post-release survival. Sawfish in coastal areas can spend a lot of time in shallow water and there are issues with tags detaching prematurely. In general, miniPAT tags are better for obtaining estimates of post release survival as they will detach from the animal and transmit their data. Towed SPOT tags do not have a built-in detachment mechanism and if the animal does not go near the surface, no data will be transmitted. Towed SPOT tags are therefore better suited to obtaining movement data in shallow environments.

# 3.4 Objective 5 & 6: Establish a national tissue collection initiative for sawfish across northern Australia that will enable CKMR estimates of abundance once sufficient samples are available.

CSIRO provided an overview of CKMR and how this method is able to provide estimates of adult abundance. CKMR can also provide estimates of population growth rate/trend (change in number of kin-pairs through time), adult survival rate (parent survives over the time between birth year of two individuals) and connectivity (presence/absence of pairs of related individuals between local populations).

Within Australia, CKMR has been used to obtain estimates of adult abundance in Speartooth and River sharks (NT and QLD), Grey Nurse and White shark (NSW, WA/SA), Southern Bluefin Tuna (CKMR informs international CCSBT assessment/quota decision rules), School Shark (Southern and Eastern Scalefish and Shark Fishery) and Flatback Turtles (WA). There is an ongoing project in collaboration with NPFI using CKMR to estimate Narrow Sawfish abundance in northern Australia.

With the current uncertainty around sawfish status in Australia, CKMR is seen as the most viable method for obtaining an estimate of adult population size for sawfish populations around Australia required to enable recovery plan objectives and listing status to be evaluated.

By partnering with industry, the CSIRO aims to obtain samples from bycaught sawfish to enable estimates of adult abundance for species and populations where sufficient samples are collected. Obtaining estimates of adult population size would underpin a national assessment and monitoring strategy and would be a necessary first step to determining what levels of sawfish bycatch are sustainable or allow for recovery.

CKMR is currently being pioneered within the NPF for Narrow Sawfish and the CSIRO aim is to expand to other species in partnership with other sectors of industry (primarily gillnet fishers in the NT Barramundi, NT ONLF, QLD ECIF and QLD GOCIF).

This will involve working with willing industry participants to initiate tissue collection and associated data collection, including the establishment of a qualitative framework to estimate post-release mortality. Estimates of post-release mortality will be validated through satellite tagging and mark-recapture (using genetics) rather than physical tags, as tag shedding and difficulty reading and recording tag numbers are likely to be an issue.

CSIRO noted enthusiasm to work with NT seafood council, GoC fisherman's association, QSIA and FRDC to communicate the objectives of the research, disseminate research findings and attempt to get more participants through positive messaging and face-to-face conversations with commercial fishers in the regions.

While the proposed approach will be centered around collecting tissue samples and associated data on location, size and sex we will also utilise relationships with "industry champions" to get better estimates of interaction/catch rates of sawfish and other TEPS to obtain realistic rates of underreporting and improve logbook reporting.

#### 3.4.1 Collaboration between institutions and tissue storage

In addition, to working with industry, optimal research impact must be underpinned by cross-institutional collaboration between relevant research institutions who are currently involved in sampling programs either directly through research or those involving industry.

Data sharing agreements between industry (who will provide the majority of samples) and CSIRO as well as CSIRO and collaborating agencies (e.g., CDU) will be developed as required.

It was mentioned at the workshop that some researchers would like samples that they have contributed stored at a centralised repository and for historical contributors to be recognised.

CSIRO has explored some of external storage options. However, there are a number of problematic aspects with this.

- The biggest issue is that many external storage institutions charge a fee to subsample (i.e., you pay if you want to access your samples).
- Logistically, it makes sense if the lead agency undertaking CKMR analysis
  maintains the samples and extracts the DNA required (rather than paying a third
  party to do this). However, collaboration and reuse of samples can be easily
  facilitated as follows.
- Once DNA has been extracted from the tissue samples, the unused extracted DNA as well as any remaining tissue can then be sent back to the data custodians who are they are then free to use a centralised storage facility.
- Note that DNA preserves better once extracted and it's easier to split than tissues.

## 4 Conclusions

Improved sawfish reporting in logbooks as well as the collection of tissue samples at sufficient scale through onboard observers and training of fishers in sampling will clearly enable increased samples to be collected. Despite sawfish being relatively rarely encountered species, at the rates of collection presented in this workshop, sampling over 2–3 years will allow the first deployment of CKMR methods for estimation of abundance and other population parameters. While uncertainty will remain, especially in initial estimates, obtaining improved abundance estimates is the single most important piece of information for understanding sawfish population status. It will also allow for the first estimates of sustainable bycatch rates.

Therefore, establishment of a coordinated, nationwide approach to a long-term tissue collection program is essential to obtain an improved understanding of sawfish population status and to underpin significant and impactful set of research projects which will allow industry and managers to address the current sustainability concerns.

This project arose from consultation between CSIRO and DAWE regarding ways to improve reporting of sawfish bycatch and to initiate processes which can eventually enable an assessment of sawfish status which is currently impossible. As a result of the workshop and following discussions with gillnet and prawn trawl industry representatives in the Commonwealth, Northern Territory and the Gulf of Carpentaria, CSIRO has developed a research proposal to address the lack of adequate reporting data and lack of abundance estimates. This proposal is squarely centred around direct industry engagement and collaboration to establish an industry sawfish tissue collection program and associated data on sawfish catch (location, size, sex, animal condition).

Initial planning of this workshop with NESP indigenous engagement officers and hub leaders agreed that this workshop should concentrate on improved collaboration between researcher and industry. However, these meetings did identify interest from traditional owners in the outcomes of the workshop. This also highlights the need for the next steps beyond this workshop to seek input from traditional owner groups.

Therefore, the proposed future NESP project would also develop engagement with key traditional owner groups whose country contains crucial sawfish populations. Existing relationships between researchers at institutions like CSIRO and CDU would be developed so that indigenous ranger groups will gain access to key scientific monitoring capability and contribute their knowledge into the sustainable management and recovery of sawfish populations.

If a successful program collects sufficient samples, this program will provide the data to estimate abundance of sawfish population across the NT and Queensland Gulf of Carpentaria and population connectivity for sawfish. The program would provide estimates of post-release survival and improved reporting of sawfish bycatch through a strong relationship with industry designed to build trust between research and industry.

By establishing a meaningful dialogue between industry, managers and researchers this workshop has outlined a set of steps to address the key issues for sawfish conservation. These are achievable over the next 3-5 years, will engage the key research groups in Australia and will partner with traditional owners. This collective and large-scale effort will be critical for addressing the state of the species in Australia while simultaneously enhancing the social licence of northern fisheries.

## 5 References

Dulvy, N. K., Davidson, L. N., Kyne, P. M., Simpfendorfer, C. A., Harrison, L. R., Carlson, J. K., & Fordham, S. V. (2016). Ghosts of the coast: global extinction risk and conservation of sawfishes. Aquatic Conservation: Marine and Freshwater Ecosystems, 26(1), 134-153.

Feutry, P., Kyne, P. M., Pillans, R. D., Chen, X., Marthick, J. R., Morgan, D. L., & Grewe, P.M. (2015). Whole mitogenome sequencing refines population structure of the Critically Endangered sawfish *Pristis pristis*. Marine Ecology Progress Series, 533, 237-244.

Feutry, P., Laird, A., Davies, C. L., Devloo-Delva, F., Fry, G., Johnson, G., G., Gunasekara, R.M., Marthick, J. & Kyne, P. M. (2021). Population structure of Narrow Sawfish *Anoxypristis cuspidata* across northern Australia.

Giles, J., Pillans, R., Miller, M. & Salini, J. (2007). Sawfish catch data in northern Australia: a desktop study. Report produced for FRDC Project 2002/064 Northern Australian Sharks and Rays: the sustainability of target and bycatch fisheries, phase 2.

Green, M. E., Anastasi, B. R., Hobbs, J. P. A., Feldheim, K., McAuley, R., Peverell, S., & van Herwerden, L. (2018). Mixed-marker approach suggests maternal philopatry and sex-biased behaviours of narrow sawfish *Anoxypristis cuspidata*. Endangered Species Research, 37, 45-54.

Kennelly S. J. Bycatch Beknown: Methodology for jurisdictional reporting of fisheries discards – Using Australia as a case study. *Fish Fish*. 2020;21:1046–1066. https://doi.org/10.1111/faf.12494Phillips, N. M., Chaplin, J. A., Morgan, D. L., & Peverell, S. C. (2011). Population genetic structure and genetic diversity of three critically endangered *Pristis* sawfishes in Australian waters. Marine Biology, 158(4), 903-915.

Pillans, R.D., Hillary, R., Patterson, T. (2022). Assessing the effect of ongoing bycatch of sawfish in northern Australia. Report to Department of Agriculture Water and Environment. CSIRO Oceans and Atmosphere.

Senko, J. F., Peckham, S. H., Aguilar-Ramirez, D., & Wang, J. H. (2022). Net illumination reduces fisheries bycatch, maintains catch value, and increases operational efficiency. Current Biology.

Sawfish and River Sharks Multispecies Recovery Plan, Commonwealth of Australia 2015.

# 6 Appendices

# Appendix A – Glossary of acronyms

AFMA Australian Fisheries Management Authority

AIMS Australian Institute of Marine Science

BMP Best Management Practice

CDU Charles Darwin University

CKMR Close-Kin Mark-Recapture

CMO Crew Member Observer

CMS Conservation of Migratory Species

CPUE Catch per unit effort

CSIRO Commonwealth Scientific Industrial Research Organisation

DAWE Department of Agriculture, Water and Environment

ECIFF East Coast Inshore Finfish Fishery

EM Electronic monitoring

EPBC Environment Protection and Biodiversity Conservation

ERA Ecological Risk Assessment

FQ Fisheries Queensland

FRDC Fisheries Research and Development Corporation

GBRMPA Great Barrier Reef Marine Park Authority

GoC Gulf of Carpentaria

GOCIFF Gulf of Carpentaria Inshore Finfish Fishery

IUCN International Union for Conservation of Nature

IUU Illegal, unreported and unregulated

JCU James Cook University

KPI Key Performance Indicator

LED Light-emitting diode

MOU Memorandum of Understanding

MSC Marine Stewardship Council

NMFS National Marine Fishery Service

NPF Northern Prawn Fishery

NPFI Northern Prawn Fishery Industry

NESP National Environmental Science Program

NTSC Northern Territory Seafood Council

PSMS Protected Species Management Strategy

QSIA Queensland Seafood Industry Association

SESSF Southern and Eastern Scalefish and Shark Fishery

SOCC Species of conservation concern

TED Turtle Exclusion Device

TEPS Threatened Endangered and Protected Species

TL Total length

VMS Vessel monitoring system

WTO Wildlife Trade Office

# Appendix B - Workshop invite email

#### Dear [Name],

I'm writing to you in relation to the NESP Sawfish Bycatch mitigation workshop that you have indicated you or a nominated member of your agency will be attending on 4–6 April 2022. This workshop resulted from a request from DAWE to address reporting of sawfish bycatch across northern Australian fisheries.

The workshop will be held online due to concerns over travel and workplace restrictions resulting from COVID-19.

The draft final report on sawfish status in northern Australia "Assessing the effect of ongoing bycatch of sawfish in northern Australia" that you/your agency has provided feedback on, will form the basis of the meeting. The main outcomes of this report included:

- We lack the data for all species to defensibly estimate current population size and status of sawfish.
- Additionally, we don't know how many remain and we therefore don't know to what extent the populations have declined.
- Levels of catch/interactions reported in logbooks from most fisheries were significantly lower than the number of sawfish reported by observers or scientific surveys. This makes estimating the total sawfish number of sawfish captured and/or determination of relative abundance trends from logbook records extremely difficult.

As a result of this, a primary objective of the workshop is to outline the current status of logbook reporting as well as mitigation strategies (either targeted or indirect) to reduce sawfish bycatch in individual fisheries.

In order to get a jurisdictional perspective, I was hoping that each state could provide us a presentation or summaries that cover sawfish interactions and management. For example topics of relevance include:

- Summarise logbook reporting of sawfish for each fishery (e.g. for QLD this would include GoC inshore and offshore net fishery, east coast net fishery, various trawl fisheries excluding the NPF).
- Confidence in logbooks to accurately reflect sawfish bycatch.
- Identify issues around under-reporting, lack of reporting and species identification.

- Any observer or EM in recent years that was able to identify sawfish/improve CPUE estimates.
- Any specific communication with fishers around sawfish reporting, release techniques and identification.
- A summary of fishing effort (active licences and days fished) for each fishery.
- A summary of spatial and or fishery closures as well as effort reductions that are likely to result in reduced interactions with sawfish. For these, if possible, please provide quantifiable measures such as effort in 2015 was xx and in 2021 was xy.
   For spatial closures please provide details on timing and extent of closure.
- Current and future programs/research to improve data on sawfish collection (please indicate whether these have commenced, start date and or proposed funding agency).
- We would welcome other relevant data summaries or management aspects pertinent to your jurisdiction.

If you would prefer to summarise this information in a table and it presented at the workshop let me know, however we think it would be better for each state/commonwealth fishery to present this.

If you'd like to discuss any of this or prefer not to provide this information, please get in touch.

We look forward to hearing from you.

Dr Richard Pillans

# **Appendix C – Workshop participants**

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# Appendix D – Workshop visual summaries

Visual summaries of the workshop prepared by Dr Sue Pillans.

Image 1: presented at the completion of the workshop to summarise the outcomes.



Image 2: Key outcomes of the NESP sawfish bycatch mitigation workshop.



# Appendix E – Workshop summary notes

The following is a summary of what was presented at the workshop by State and Commonwealth management agencies as well a summary of round table discussions, presentations by researchers on recently completed and current projects as well as an overview of close kin mark recapture. A detailed version of this summary will be provided to the NESP as the meeting minutes.

#### What attendees are wanting out of the workshop

Most common themes:

- Coordinated effort across research and management needed
- Update on other research occurring in other jurisdictions to work on a combined approach
- Confident collaboration between industry and researchers

#### Overview of objectives and background on sawfish status

#### Richard Pillans (CSIRO)

Workshop objectives and outcomes were covered. An overview of the current understanding of sawfish status in northern Australia was presented. Sawfish are not targeted but are highly susceptible to capture in net fisheries. There is insufficient data from state and commonwealth fisheries to enable an assessment of the cumulative impact of sawfish bycatch. Urgent need for effective monitoring and methods to estimate sawfish abundance.

#### Management overview of legislation and reporting

#### High level DAWE overview - Peter Yates

NESP workshop outputs will be used by DAWE. Review of multispecies recovery plan due by (2025). EPBC – nomination to uplist *P. pristis* and *A. cuspidate*. Overview of Threatened and Migratory Species Fisheries bycatch mitigation program with timeline provided. Focus on development of practical on-ground mitigation following prioritisation process.

#### Josh Davis (DAWE – Sustainable Fisheries)

There is a need for sufficient, reliable information to assess, monitor and impacts on species. The Department requires fishers to take all reasonable steps to minimise their interactions with protected species, and determines whether the impacts of the fishery are likely to impact

the conservation status or survival of the species in the wild. All risks should be managed in a precautionary way.

#### Brodie McDonald (AFMA), Josh Cahill (NPFI)

Significant improvements in sawfish reporting in 2020 & 2021. This includes species ID with 86% of sawfish reported to species level. Previously reported as 'sawfish'.

Improved reporting due to education (preseason briefings) and CMO program. NPFI emphasising the importance and legislative requirements of good reporting.

Narrow sawfish trends: stable catch rate since 2010 but not enough data before then. Summary of research projects currently occurring and recently completed in the NPF.

#### Thor Saunders (NT)

Currently reviewing management of Barra Fishery and these data will be published.

The NT barramundi fishery (gillnet) has the most interactions with sawfish but fish trawl and NTONL also interact.

EM in fish trawl fishery (last 3-4 years). Observer coverage ~10% in fish trawl and NTONL. Historical observer data paints an inaccurate picture as most observer data was in the dry season when catches of sawfish may be lower since pupping occurs in wet season.

Mitigation options that have been discussed but not implemented. These include changing fishing season to minimise interactions, closing critical habitat areas, implement move-on provisions if catches of sawfish are high, reduce soak times and being in attendance of the net.

#### Tony Ham (Qld)

Sawfish occur in ECIFF, GOCIFF and East Coast Trawl Fishery. Decline in catch of sawfish and in effort. Level and 1 & 2 ERAs completed for ECIFF and GOCIFF with all sawfish identified as high risk.

Onboard cameras (first aim is inshore fishery, but then offshore) and fishery observers are being considered.

Spike in sawfish interactions reported in 2017 and 2018 (300 - 380) vs <100 in other years. No explanation for this. Most interaction in gillnet fisheries (92%).

Survival was estimated at 85%.

EM and observers being considered to improve data (data validation) in 'high risk' fisheries (as identified by ERAs). Big issues – data validation; reporting interactions of species of conservation concern (SOCC), sawfish fate and potentially developing PSMS in the gulf. Data validation plan would be a significant piece of work.

#### Mat Hourston (WA)

Pilbara fish trawl and Kimberly gillnet and barramundi fishery have most reported sawfish interactions. Exmouth Gulf prawn and Shark Bay prawn have few interactions.

Low number of sawfish reported in 2020 (all fisheries) with 94 sawfish reported in. Green sawfish contributed 61%, narrow ~ 12% and 25% were not identified to species.

Mortality estimated at ~ 25% in logbooks.

CMO program in trawl fisheries in a state of flux due to new ownership. Uncertain what will happen to the CMO program.

Reasonable confidence in trawl sawfish data from research surveys and observers.

MSE certification for EG prawn and Shark Bay prawn trawl had species specific conditions relating to individual species (bycatch species). Conditions involved the level of interactions to finer level of detail.

Overall, in WA sawfish are considered to be at low risk from fishing due historical and current low fishing pressure as well state marine parks that provide protection. Fishing effort is at a 50 year low with 30 years since intensive effort (foreign fish trawl). Sawfish range is intact and evidence of recruitment to known nursery areas.

Industry input – Identify issues around under-reporting, lack of reporting and species identification & Identify best practice industry standards for obtaining data on bycatch of TEPS.

#### Geoff Diver (Wild Barra)

Geoff is doing elements of the camera work (EM) as a company initiative (no funding in the NT). Trialling a cost-effective (\$50) camera for small craft as it is not always possible to get observers on boats. It is expensive and survey requirements sometimes don't enable an extra person on board if the commercial vessels (mothership and net tender vessels) are too small. The aim with cameras is to use them as part of a voluntary suite of tools to get better data (not to be made mandatory once it is found they work well).

People think if they report an interaction that they will get in trouble, and this leads to under/no reporting.

Need to talk to all levels (GM, skipper, crew, etc). Connectivity between researchers and industry, is critical.

#### Katherine Winchester (NT Seafood Council)

Geoff's contribution to Wild Barra has meant there is now cohesion amongst the fishers which is critical to improving data collection.

More capacity is needed to take tools and documents to industry to ensure there is uptake and build capacity.

Opportunities for genetic samples are quite low. But it's not that industry don't want to, but how do they do it in a safe, efficient way. Fit for purpose for the vessels. (Opportunity to develop protocols/videos of how to do this safely.)

Lot of fear that knee jerk reactions from management could result from providing data.

NT seafood council working on a sustainability strategy. Transparent reporting to the public is something that is coming through.

"Fisherman learn from fisherman"

Need to put fisheries into context, e.g. - GDP in NPF is ~100 million which is more than entire NT wild caught and aquaculture fisheries.

#### Annie Jarrett (NPFI)

We need industry involvement and support for these projects.

Data collection in the NPF wouldn't be where it is without crew involvement and the ability to convince industry of the need for the work and collaboration with the researchers.

Crew needed to be incentivised to join the programs. NPFI pays CMOs an incentive. Set very specific KPIs, so CMOs didn't get payment if they didn't meet KPIs.

Leadership that is oversighting – project officers (Adrianne and now Josh) are very important. 15 years ago (and before that), it was difficult to get industry to be involved. NPFI have spent a lot of time to get rid of their fear that good reporting is going to be penalised.

#### Stirling Peverell (GoC Inshore Fishery Working Group research member)

QLD GoC led the way in 2000's with a range of initiatives to improve interactions between industry and management (code of conduct, high level of industry participation, how to handle and release sawfish).

Industry in the gulf is one of the most proactive group of commercial fishermen around.

Fear of how TEPS data are being used/reported. Industry are keen to be proactive and are keen to participate in improving data.

Fishers are disappointed with Qld fisheries – they've lost their WTO.

Gulf fishers are proactive, but some have indicated they aren't as familiar with their reporting than they should be. Some are deliberately not reporting. And when they do, they feel that other agencies use that as a stick to beat them with.

#### Response from management

Reporting of sawfish is not imposed by fisheries Queensland but it is by DAWE who want these reported. The imposition of the TEP logbook is part of that.

#### Shawn McAtamney (ISP Fish Market)

We need to learn from other areas/fisheries (e.g. NPF) – GOC can learn from this.

Culture change is needed (fear driving this) – don't understand reporting requirements or fearful of ramifications.

How is the data being used? There's mistrust and lack of confidence.

Intent from industry is definitely there (GoC). There's a lot of strong participants in the working group. They will assist with data collection – but needs to be done in the appropriate way. Trust is the big issue. Industry is prepared to work with any agency – we want a sustainable fishery.

#### Eric Perez (QSIA)

Buy-in for better practice – carrot vs stick approach.

Concern about PSMS approach – all stick and no carrot. It's all regulatory. Ownership of data will be important into the future. Wanting to introduce harvest strategies. Need good data sharing agreements. This is an ongoing conversation.

#### Management

TEP reporting is imposed by external agencies, it is not part of fisheries monitoring. It's never been used to close a fishery.

#### **General discussion**

#### Industry comments

Need for industry to develop good relationships with managers and fisheries. When there's broken trust (like in Qld) it's going to take a lot to fix. Industry needs to try and develop good relationships with management too.

This workshop alone is forming connections.

Unfortunately, we don't have enough data to know what the sawfish populations are, so this is the reason we need better data and this a great opportunity for "shared problem".

We would like more workshops (how to remove sawfish, hammerheads, crocs etc from the net). We are going to start getting new data but we don't have a baseline already. Fishermen aren't targeting them. If they see them, they pick-up their nets and move.

The pressure to perform is huge. Costs are going up. We as an industry find that some are really good at reporting – maybe even at the detriment of the catch.

In regard to the new project, Qld GoC fishers don't support the use of cameras in regard to data security.

#### Management comments

The issue of trust takes time. But in Qld time isn't on our side – export approvals all have time-stamped conditions with regards to bycatch reporting.

There's drive from industry to make sure they stay active in the space.

Training mechanisms have been removed, opportunity for industry to be leading this. eNGOs need to be involved in this as well.

#### Researcher comments

If we can get samples from these animals, we can remove some of this uncertainty. We don't need to have the long, long time series data.

We have recovery teams, but we don't have one for sawfish or river sharks. We need to bring together industry, researchers and government.

Offer co-authorship and co-ownership of data. But don't hold data back. Need research as an intermediate between government and fishermen.

#### **Current research**

There are a number of projects in northern Australia which are a collaboration between industry, management and researchers. Current project and proposals from the following organisations were detailed:

- CSIRO
- AIMS
- JCU
- CDU
- SARA

#### Management questions

Q re CSIRO project: Re turtles, do changes to the net material comply with legislation?

A: TEDs and turtles – no change to specifications of the flaps or size of mesh (only the gauge is different – heavier), so won't have enormous impact on the escapement.

Q re CSIRO project: What are the positive impacts of this work on reducing sawfish bycatch?

A: A lot of the bigger sawfish are caught near the front of the net, so using the heavier gauge in the front 2 metres before the TED is likely to reduce bycatch. But it won't help the small sawfish (<1.3 m) that get into the codend.

#### Industry comments

Ocean Watch might be a good bridge for fisheries that doesn't have high sophistication. Would be useful to have a sawfish research hub – all past and current data/reports are housed centrally.

#### Management comments

Would be beneficial to get a list of all the research that's happening across northern Australia. Could we run some "all of northern Australia" projects and prioritise the funding? Research group (sawfish) tabled.

#### Researcher comment

Industry are owners of the video data (restricted data) but the derived data will be available publicly.

#### **Round table**

#### How do we improve on data collection (logbooks, collection)?

The key is that we need species specific data that can be used to assess abundance.

#### Industry comments

Time available to compile the data for logbooks can prevent recording.

Reminder of the legal obligations and the value of accurate data. Tools fit for different vessels.

More education/training in species ID.

You need willing participants, then you have confidence that the data from 3-4 boats is good (claim this as a win), then use those boats as industry champions. Look for more cooperative and collaborative ways – a \$2000 camera is a lot of money for small fisheries. Build platform on good data rather than a lot of data. What gets the best outcome and not the fastest data? Apps might be useful but issues on small boats.

Industry-led (with gulf fishermen) looking at technological advancements for better reporting (using tablets). Would like to address the issues re quality of logbooks. We can present the data in real time, with video and photographs. Data security is critical. Trying to meet with QLD fisheries. Whole of business management system, not just a logbook system.

We need a set of appropriately pitched words, along the lines of "reporting won't lead fishers to trouble".

Work with the willing for the longer-term benefit. Understanding what people need and that one size doesn't fit all. Opportunity to recognise what commercial fishers bring to the table. Voluntary implementation.

Importance of industry leadership, bringing the champions along. The benefits of working together. The social licence and benefits of industry working with researchers.

Don't underestimate the time it takes and the importance to engage with fishers on the ground level. Sit down with fishers and discuss and explain logbooks – what do we get from the logbooks and how can we make it easier/more efficient?

In Queensland there are new logbook out, which are horrible to fill out, and lots of repetition. Repeating size/lengths of nets every day. It needs to be made more simple and then they will get more data.

The NPF has always had industry, researchers, management, NGOs working together and we've been building on that early work. We worked really closely. We have always made sure that we have involved our key stakeholders. Its hard work and it takes time.

Relationship between industry and management can be affected by relationship between industry and compliance. Heavy handed compliance can affect long term relationships between industry and management.

#### Management comments

The success of NT getting extra data is because they let fishers develop their own system. Under reporting has led to the big stick and that leads to problems. Is underreporting occurring because they don't want to report, or is it too hard?

In Qld, they are small-boat dominated which limits ability of observers to be on boats. Need validation. Getting fishers where they are behaving responsibly. Trust is a 2-way street. Defending industry when some of them are doing the wrong thing is difficult.

Better reporting will/can lead to management changes – need to communicate this with the fishers up front. Stress the benefits of the good reporting.

#### Researcher comment

Underreporting can lead to more conservation management action.

#### Sawfish handling and post-release survival

We need to know the fate of the released animal – not just that is appeared healthy or didn't have any obvious injury. Need quantitative data on survival and satellite tags is the best way to get data on post release survival. But tags need to be configured properly. Sawfish in coastal areas can spend a lot of time in shallow water and there are issues with tags thinking they are dry and detaching prematurely. CSIRO recently deployed 13 satellite tags on sawfish and happy to assist with setting tags up.

miniPAT tags are better for post release survival than SPOT tags, and movement data and post release survival are two separate questions.

#### Industry comments

The fishers' release procedures varied significantly. Universally accepted that they unpluck meshes as much as possible. Large sawfish are often beached but now more crocodiles which makes this more difficult. If you ask fishermen to get the sawfish out, they'll get them out – using the tools they have at hand (screwdriver, etc.) and they use the best practise fit for their purpose. There is a handling document that was written with fishermen. Sometimes they do cut the net to get them out.

Fishermen are doing this every day. Safety is number one. Most know what to do to handle sawfish, but maybe not everyone is aware of what resources are available.

#### Researcher comment

Work going on in the US could be useful to inform us. They have a recovery team.

#### **Future research and methods**

#### **CKMR**

CKMR gives you adult abundance and trend in adult population if sufficient samples can be collected. It also gives you population connectivity and adult survival rates and is much quicker than waiting for catch trends.

#### Answers to various questions

- If multiple stocks, you need samples from across different stocks, but there's no problem if you get samples from enough stocks.
- Cost scales with the number of samples being processed. Usually, \$15-20 a sample. And the cost is coming down.
- You can males and females and if they are breeding every year or every other year. And multiple paternity is not a problem.
- CKMR works well with both small and large populations. First bunch of samples starts slowly. But they build up really quickly.
- Not a problem if you skip a year. It took 3 years of sampling for the first estimate
  in the Wenlock River. Not a huge issue if you have a break. The earlier you start
  collecting the samples, the better.
- You can't reconstruct a past population and say where they are now, relative to where they used to be. But you can always look forward.
- CKMR is not only for long-lived species?
- You can't use eDNA for this you can't get enough quality DNA to do it. Certainly not at the moment.

- We need to try and get to a system where we have as many of whichever species of animals that can be sampled is practical.
- We will be able to determine how sustainable a given level of take will be.
- CKMR with some of these other programs will be really good to allow us to determine abundance estimates and catch rates.

#### Industry comments

Sawfish is the Achilles heel – it's our biggest social license risk and biggest risk to our MSC accreditation, etc. I strongly encourage other industry participants to talk to their managers about being involved in this project. Huge kudos in being involved in projects that help answer research projects (especially TEPS). The interest from fishers in being involved in research is really high. And when you get fishermen to do some work they feel like quasi-scientists.

#### Management comments

There should be a discussion about how often population estimates need to be made. Worth investing in a sample collection as soon as possible. It's not that expensive. What you do beyond that is what needs to be discussed. Cost does come down through time (genetics gets cheaper).

Different jurisdictions are at different places and have different needs, so whole of Australia sampling is a good idea, but hard.

But we still need population size estimates for all these regions anyway.

National approach that coordinates sampling Vs coming up with a national number.

There are southern fisheries in AFMA, where CK is being used and it seems to be a very positive way ahead.

Can see value of CK giving us estimates of abundance. Will talk to partners about collecting more samples. But we still need to improve rate of interaction in fisheries (i.e. level of reporting in the fishery dependent data). When talking about commercial fishing report (fishery dependent data), we keep hearing (during this workshop and when I talk to fishers) that they don't want to catch sawfish and they try to avoid them. So how bad is the underreporting? How is this incorporated into our models – how do you account for that fisher behaviour? However, I am a supporter of CK type of approach to get abundance and trends, but we still need to have the level of interactions and how they contribute to sustainability.

#### Researcher comments

This is certainly a conversation we need to have. But we need to have it carefully. Has advantages from the assessment point of view.

Need to make sure we get data sharing/ acknowledgements all sorted from day 1. It would

be valuable to expand this research to indigenous ranger groups as well.

This CKMR work is the sort of topic that NESP is looking at. We have our mandate to develop new technologies for monitoring – this is the research stage. In this case, the idea of having a national program that potentially does similar monitoring using CKMR in different jurisdictions has some appeal.

When you don't know how many there are, how can you work out what state the stock is in? So we need this info and CKMR can do this quickly.

We have staff in ports and getting samples off boats is a simple job. The logistics isn't hard if you get in contact with CSIRO.

#### Centralised sawfish tissue collection

#### Industry comment

Centralising info/samples is a great idea. Hub would mean that everyone can see what everyone else is doing. The solutions are people-driven, so we need to understand the barriers of what industry can/can't do. Solutions will be different for each region.

#### Management comments

There should be a repository for all endangered species. A detailed discussion needs to occur.

We don't want to bite off more that we can chew and do every single TEP species. In terms of reporting, should it be done at the national level.

#### Researcher comments

It would be valuable to synthesise all the things that are happening. To understand the types of things that need to happen. What can be collected together, etc.

Would be good to have a centralised repository. It recognises the past contributors. Have opportunity to be involved in funding proposals and projects (not just a name on a project). A research coordination group to oversee/advise on these samples. Logistic – where that might sit – Australia Museum, Aust Centre of genomics, etc. We've explored some of these external storage options and there are challenges in doing this.









