



Improving outcomes of fisher interactions with sharks, rays, and chimaeras

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Abbreviations

AFMA – Australian Fisheries Management Authority

AMCS – Australian Marine Conservation Society

CSIRO – Commonwealth Scientific and Industrial Research Organisation

DEW – Department for Environment and Water (South Australian Government)

FRDC – Fisheries Research and Development Corporation

IMAS – Institute for Marine and Antarctic Studies

MRFAC – Minister’s Recreational Fisheries Advisory Council (South Australia)

NSW DPI – New South Wales Department of Primary Industries

PIRSA – Primary Industries and Regions South Australia

SARDI – South Australian Research and Development Institute

UTAS – University of Tasmania

VFA – Victorian Fisheries Authority

VNPA – Victorian National Parks Association

VRFish – Victorian Recreational Fishing Peak Body

WA DPIRD – Western Australian Department of Primary Industries and Regional Development

Executive Summary

A consortium of recreational fishing advocates, fisheries managers, and marine scientists from Monash University, Victorian Recreational Fishing Peak Body (VRFish), Flinders University, and the Victorian Fisheries Authority collaborated to create best-practice capture, handling, and release guidelines for recreational fishing of sharks and rays. The guidelines were communicated to the recreational fishing community in southern Australia by creating of a multi-media extension campaign called *Shark Mates*. Informational resources, such as a best-practice guidelines booklet, six YouTube videos, a website, stickers and brochures, are now available to the public and are being promoted through the peak recreational fishing body in Victoria, VRFish. Prior to the creation of the guidelines and subsequent extension activities, a national workshop was conducted in collaboration with SARDI in Adelaide to discuss current knowledge related to handling and post-release survival of sharks and rays (Reina *et al.*, 2020). Priority species were identified at the workshop and a vulnerability analysis was conducted to assess all anthropogenic risks to these species. A survey of over 1000 recreational fishers was then conducted to assess current behaviours and attitudes of the community fishing of sharks and rays which then informed the *Shark Mates* extension campaign. The educational resources created for *Shark Mates* enable improved outcomes during capture and release of sharks and rays.

A need for fisher behavioural change in the capture of sharks and rays in recreational fisheries was identified after a series of ethical incidents impacting the social licence of fishing in southern Australia. The goal of this project was to develop and further refine best-practice capture, handling, and release guidelines for sharks and rays to ensure safety of fishers and improved outcomes for sharks and rays.

The objectives of this project were to:

1. Cause behavioural change of fishers in their interactions with captured sharks, rays and chimaeras in Victoria.
2. Form an expert steering committee to oversee and guide this project and the SARDI project addressing recreational fisheries' impact on sharks, rays and chimaeras.
3. Execute an informed, comprehensive, cost-effective and targeted communications strategy leading to behavioural change in Victorian fishers.
4. Complete a vulnerability risk analysis of chondrichthyan species impacted by recreational fishing in Victorian waters.
5. Co-host a multi-jurisdictional workshop with SARDI to identify species of importance, develop and agree upon capture, handling and release protocols for chondrichthyans across states to ensure high post-release survival and humane treatment of these sharks and rays and the safety of fishers.

In 2019, the vulnerability risk analysis was completed (Walker *et al.*, 2021) along with the national workshop (Reina *et al.*, 2020). The results of the recreational fisher survey highlight that a large proportion of respondents, 84%, are concerned with the behaviour of other fishers. In 2020, we designed the best-practice guidelines and educational materials and completed filming of a series of six informational videos accessible online. The *Shark Mates* extension campaign was launched in early 2021, involving the development of a website and social media accounts including instructional YouTube videos. These useful informational resources remain available to the recreational fishing community. There has been some good initial support for the extension campaign by members of the recreational fishing community. The most successful platform used by the campaign at the moment is Instagram, with 130 followers of *Shark Mates* on that platform. The continued upkeep of communications about best-practice guidelines for shark and ray fishing, achieved specifically by regular maintenance and updating of the *Shark Mates* website and social media channels is advised. Further effort to disseminate the information to a larger proportion of the recreational fishing community is also encouraged. With adoption and championing of best-practice behaviours within the recreational fishing community outcomes from interactions with sharks and rays during fishing will continue to improve.

Keywords

Chondrichthyans, elasmobranchs, recreational fishing, post-release survival, capture, handling, release, guidelines, best-practice, behaviour change, sharks, rays, and chimaeras

Introduction

Australia has the highest diversity of chondrichthyan species (sharks, rays and chimaeras) globally, with 328 species, representing 26% of the global fauna (Last and Stevens, 2009; Simpfendorfer *et al.*, 2019). About 40% of these species (138) are endemic to Australia. A recent assessment of the IUCN Red List extinction risk status for all 328 Australian species found that 12% are Threatened with a further 10% Near Threatened (Kyne *et al.*, 2021). It is evident that Australia is an important hot spot for chondrichthyan diversity and has been referred to as 'Life Boat Australia' for population persistence to increasing anthropogenic threats (Kyne *et al.*, 2021). Effective management of chondrichthyan populations within Australia is important not only to support Australian fisheries sustainability but also global shark conservation efforts (Stein *et al.*, 2018).

Understanding relative risks from anthropogenic stressors, such as fishing pressure, for different species can be achieved using ecological vulnerability analysis (Walker *et al.*, 2021). A recent analysis for all chondrichthyan species in the Exclusive Economic Zone of southern Australia highlighted the current and future risks for shark species from fishing, climate change and other anthropogenic hazards. (Walker *et al.*, 2021). That broad analysis included 132 chondrichthyan species and all commercial and recreational fishing activities. For the purpose of the present project, some of the results of that analysis are produced in this report for 33 species that recreational fishers in southern Australia interact with.

Recreational fisheries across Australian states are affected by similar policy drivers from a management perspective, such as maintaining sustainable fish stocks and high-quality fishing activities that provide for economic, social and physical well-being of communities (Brooks *et al.*, 2015; Dovers, 1994; Mackay *et al.*, 2018). Ensuring compliance with rules and regulations in recreational fisheries is difficult due to the extensive Australian coastline and high costs of monitoring and enforcement (Mackay *et al.*, 2018). Fisheries managers and recreational fishers understand there can be problems with the behaviour of some recreational fishers, recommending improved education of best-practice capture, handling, and release to address inadequate behaviour (Bose and Crees-Morris, 2009; Heard *et al.*, 2016; Mackay *et al.*, 2020). Recent incidents related to the capture, handling, and treatment of shark and ray species focused attention on recreational fishing across southern Australia, including in Victoria. Rays and sharks were mutilated and killed in inhumane circumstances on multiple occasions in 2017 in Victoria, South Australia, and Western Australia. These multiple isolated events attracted significant media coverage and negatively impacted the social licence of recreational fishers. Despite these instances, previous surveys found that most recreational fishers hold positive values towards sharks and rays (Heard *et al.*, 2016). Furthermore, fishers generally value stewardship of the fishery and the use of humane capture and release techniques (Crandall *et al.*, 2018; Heard *et al.*, 2016; van den Heuvel *et al.*, 2020). However, values do not always align with behaviour (Cinner, 2018; Heard *et al.*, 2016; Mackay *et al.*, 2018). Some fishers, especially those with limited experience, may not be aware of what constitutes best-practice despite wanting to ensure the best outcomes for released sharks and rays. This may lead to situations where their actions do not result in positive welfare outcomes, and reflect an overall lack of understanding of the best approaches to catch, handle, and release sharks and rays. Therefore, providing information and extension to the recreational fishing community about best-practice capture, handling, and release of sharks and rays is warranted (Cooke *et al.*, 2013).

Fisheries in general, and especially recreational fisheries, are particularly challenging to study accurately with respect to catch rates, release rates, current practice, and behaviours (Andrews *et al.*, 2021). Most studies rely on self-reported survey responses and there is a paucity of data on self-reported handling techniques. Although studies of fisher behaviour and development of best-practice guidelines have been completed for some commercial fisheries, such as for the tropical tuna purse-

seine fisheries (Poisson *et al.*, 2014). There is, however, a lack of information about current fisher behaviour during interactions with sharks and rays in recreational fisheries. Therefore, studies that improve our understanding of current practices and behaviours by recreational fishers when catching sharks and rays would be useful in order to understand trends in inappropriate treatment and provide insights for improving these interactions.

There are at least four existing best-practice guidelines for the capture, handling, and release of sharks and rays in recreational fishing (Reina *et al.*, 2020). However, two are species-specific, such as the guides for thresher sharks in Victoria or the United States. The NOAA “Careful catch and release” guide for large pelagic fish does not focus exclusively on sharks and rays and is limited to a small double-sided three-page pamphlet. The South Australian government has produced broad guidelines to suit most species caught in South Australia, but again these guidelines are limited to a small double-sided three-page pamphlet. There are plans for the South Australian guidelines to be refined further (FRDC Project 2018-055). There is a clear need for further development and refinement of best-practice guidelines for the capture, handling, and release of sharks and rays in recreational fisheries within Australia. Furthermore, there is a need for subsequent extension activities to enable awareness and uptake of the best-practice behaviours by the recreational fishing community. When coupled with an effective extension campaign the guidelines will enable positive behavioural and cultural change within recreational fishing communities that will lead to improved outcomes for fishers and sharks.

To address these needs, the goal of this project was to develop and further refine best-practice guidelines for the capture, handling, and release of sharks and rays to ensure safety of fishers and improved outcomes for sharks and rays. Guidelines and key messaging are being disseminated to recreational fishers through various ongoing extension activities. The project used surveys to assess current behaviour and attitudes of recreational fishers. Prior to conducting this work, a workshop was jointly organised in Adelaide by investigators from this project and a closely aligned FRDC Project (2018-055) to meet the objectives of both projects.

Objectives

1. The overarching objective of this project was to cause behavioural change of fishers in their interactions with captured sharks, rays and chimaeras in Victoria.
2. Form an expert steering committee to oversee and guide this project and the SARDI project addressing recreational fisheries impact on sharks, rays and chimaeras.
3. Execute an informed, comprehensive, cost-effective and targeted communications strategy leading to behavioural change in Victorian fishers.
4. Complete a vulnerability risk analysis of chondrichthyan species impacted by recreational fishing in Victorian waters.
5. Co-host a multi-jurisdictional workshop with SARDI to identify species of importance, develop and agree upon capture handling protocols for chondrichthyans across states to ensure high post-release survival and humane treatment of sharks and rays and the safety of fishers.

Method

Steering committee

An expert steering committee was formed to oversee and guide this project and the linked FRDC project (2018-055). The steering committee was made up of:

Name	Organisation
Dr Richard Reina	Monash University; Primary Investigator FRDC Project 2018-042
Dr Paul Rogers	SARDI; Primary Investigator FRDC Project 2018-055
Dr Matias Braccini	WA DPI
Mr Michael Gilby	VFA / Indigenous Representative Group
Mr Scott Gray	Recreational Fisher
Dr Chris Izzo	FRDC
Dr Jo Klemke	VFA
Dr Vic Peddemors	NSW DPI
Mr Keith Rowling	PIRSA
Dr Sean Tracey	IMAS / UTAS
Dr Sean Williamson	Monash University

Workshop on chondrichthyans in recreational fisheries

A multi-jurisdictional workshop was held at the South Australian Research and Development Institute (SARDI) – Aquatic Sciences in Adelaide on the 26th of November 2019. This workshop was jointly organised with Dr Paul Rogers in collaboration with FRDC Project 2018-055. Fourteen presentations were given across the following three sessions: (1) Priority species (groups) in recreational interactions; (2) Handling guidelines for priority-species (groups): Design principles and considerations when developing post-release survival studies to inform best-practice guides in recreational fisheries; and (3) Communication, engagement and cultural change.

The following people attended the workshop:

Name	Affiliation
Ms Skye Barrett	PIRSA
Dr Phil Bolton	NSW DPI
Dr Matias Braccini	WA DPI
Mr Mike Burgess	VRFish
Mr Jamie Crawford	Industry / Recreational Fishery
Mr Mike Gilby	VFA / Indigenous Representative Group
Dr Leonardo Guida	AMCS
Mr Troy Harris	SARDI / PIRSA
Dr Matt Heard	DEW
Ms Jamie Hicks	DEW
Ms Shannon Hurley	VNPA
Dr Charlie Huveneers	Flinders University
Dr Christopher Izzo	FRDC
Mr Graham Keegan	MRFAC
Dr Jo Klemke	VFA
Dr Vic Peddemors	NSW DPI
Dr Julian Pepperell (Pepperell Consulting)	Pepperell Consulting
Dr Richard Reina (Monash University)	Monash University
Dr Paul Rogers (SARDI / PIRSA)	SARDI / PIRSA
Dr Troy Rogers (SARDI / PIRSA)	SARDI / PIRSA
Dr Sean Tracey (IMAS / UTAS)	IMAS / UTAS
Dr Terence Walker (Monash University)	Monash University
Dr Jessica Walsh (Monash University)	Monash University
Dr Sean Williamson (Monash University)	Monash University

A full summary of the workshop can be found in the Proceedings Report authored by Reina *et al.* (2020) on the FRDC website for both Projects 2018-042 & 2018-055.

Vulnerability risk analysis

The present report summarises information on the vulnerability of 33 species of chondrichthyes (sharks, rays and chimaeras) identified as priority species caught by recreational fishers in Victoria and South Australia by a workshop held on 26 November 2019 as part of the projects FRDC 2018-042 and FRDC 2018-055. The information was extracted from a comprehensive vulnerability analysis of 132 chondrichthyan species, each of which has more than 20% of its distribution inside the Exclusive Economic Zone off southern Australia between Cape Leeuwin in WA (longitude ~115.13° E) and Cape Barrenjoe north of Sydney in NSW (latitude 33.58° S) (Fig.1) (Walker *et al.*, 2021).

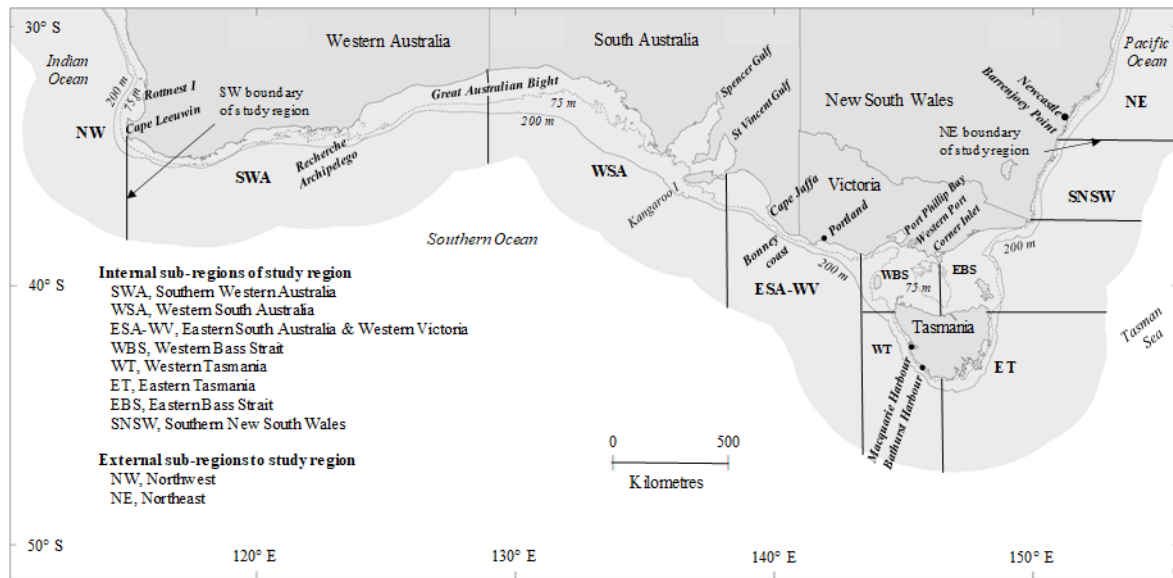


Figure 1. Exposure, sensitivity, and adaptability (ESA) – exposure, susceptibility, and productivity (ESP) region of southern Australia and its internal and external sub-regions within the boundary of the Exclusive Economic Zone.

Vulnerability analysis assesses chondrichthyan species exposure to anthropogenic stressors in the marine environment and was developed by combining and extending two widely-applied methods developed in Australia. The framework combines three components of vulnerability analysis (exposure, sensitivity, and adaptability) (ESA) applied for assessing the effects of climate change (Chin *et al.*, 2010) and productivity-susceptibility analysis (PSA) applied for assessing the effects of fishing (Hobday *et al.*, 2011) expanded from two to three components (exposure, susceptibility, and productivity (ESP)) by redefining the term “Availability” of PSA as Exposure x Regionality, where Regionality is 1 when assessing risk within the study region.

For anthropogenic stressors associated with climate change,

$$\text{Vulnerability} = \text{Exposure} \times \text{Sensitivity} \times \text{Adaptability},$$

and for anthropogenic stressors associated with fishing and other hazards,

$$\text{Vulnerability} = \text{Exposure} \times \text{Susceptibility} \times \text{Productivity}.$$

In each of these equations, the component exposure is extrinsic to the species and can be managed, whereas sensitivity, adaptability, productivity, and susceptibility are intrinsic to the species (and related to species resilience) and cannot be managed. See Walker *et al.* (2021) for details of the

calculation of exposure and risk associated with each resilience component comprising one or more risk factors associated with specific attributes (traits) of the species.

The 12-step method of ESA–ESP can assess the vulnerability of each species (the risk of a marked reduction of its population) in a defined region for past, present, envisaged, and mitigation scenarios. For climate change, risks are assessed for the climate pathway to the year 2100 based on projected standard low, medium, and high greenhouse gas emissions scenarios developed by the Intergovernmental Panel for Climate Change. Vulnerability relates to the exposure of each species to eight climate-change stressors and to the species' sensitivity and adaptability to changing habitat conditions. Other risks are related to past (2000–06) and recent (2018) exposure to stressors associated with five types of fishing and seven types of other-anthropogenic hazards and to the species' productivity and susceptibility to the effects of fishing and other non-climate anthropogenic hazards. Biological attributes are used as risk factors to evaluate the risks at a species or higher taxonomic level.

Evaluation of exposure of a species to anthropogenic stressors required assigning each species to one of six ecological groups based on its lifestyle (demersal versus pelagic) and habitat, defined by bathymetric range, substrates, and topography (Table 1). Exposure to fishing was assessed for the period 2000–06 and the year 2018 because fishing intensity in the offshore commercial fisheries of southern Australia peaked during 2000–06 and was then reduced to below half the peak levels by 2018 following a decade of major fisheries management reforms. Values of exposure determined for individual or groups of anthropogenic stressors for each climate change and fishing scenario are presented in Table 2 and the data used to calculate risk for individual risk factors and the resilience components are presented in Table 3 (Walker *et al.*, 2021).

Table 1. Ecological groups identified for categorising species in preparation for evaluating their exposure to anthropogenic stressors.

Ecological group	Distributional criteria for categorizing a species into an ecological group
Shelf-inshore	The species inhabit only nearshore areas, estuaries, bays, gulfs, or inlets, where they encounter numerous stressors associated with recreational and artisanal fishing, climate change, and 'other-anthropogenic' hazards.
Shelf-reef	The species inhabit mainly rocky or rubble hard substrates on the continental shelf in depths <200 m, where only hooks are occasionally used and where it is impractical to use demersal trawl and shark gillnets without damaging the gear.
Shelf-sand	The species inhabit mainly sandy, muddy or silty soft substrates on the continental shelf in depths <200 m, where demersal trawl and shark gillnets occur without damaging the gear.
Bathyal-upper	The species inhabit mainly the upper continental slope in depths 200–699 m, where the use of demersal trawl occurs, but the use of demersal gillnets and hooks is negligible.
Bathyal-lower	The species inhabit mainly the continental slope in depths ≥700 m, which since 2007 has been closed to all types of fishing apart from occasional short-term demersal-trawl seasons for orange roughy (<i>Hoplostethus atlanticus</i>)
Pelagic	The species have a pelagic lifestyle in the waters from shore to the ocean 200-NM boundary of the Exclusive Economic Zone, where fishing effort from hooks (including game fishing) and purse seine is low (small catches of the species occasionally occur in demersal fishing gear).

Table 2. Exposure of each ecological group to stressors from three climate change scenarios to 2100 and two recent periods of fishing and ‘other’ anthropogenic hazards.

The three climate change (CC) scenarios are LE, ME, and HE for low, medium and high emissions scenarios, respectively, and two recent fishing and 'other anthropogenic' hazards (FO) scenarios are for 2000–06 and 2018; L is low, M is medium, and H is high exposure based on the proportion of the distributional area of a ecological group exposed within the ESA–EPS study area (see Figure 1).

Anthropogenic stressors	Description of stressors contributed by anthropogenic hazards	Emissions or Fishing & other hazards scenario	Exposure risk to stressors contributed by future climate change to 2100 and by recent fishing and 'other' anthropogenic stressors					
			Demersal continental shelf (<200 m)			Demersal continental slope (≥200m)		Pelagic waters
			Shelf-inshore	Shelf-reef	Shelf-sand	Bathyal-upper (200–699 m)	Bathyal-lower (≥700 m)	
Climate change hazard								
Climate change stressors	Rising water temperature (particularly the surface 75 m), rising sea level, changing rainfall and freshwater runoff, increasing storm frequency and intensity, changing currents and upwelling, increasing UV light radiation, decreasing dissolved oxygen concentration, and increasing ocean acidity.	CC LE	M	L	L	L	L	L
		CC ME	H	M	L	L	L	M
		CC HE	H	H	M	L	L	M
Fishing and other anthropogenic hazards								
Non-industrial demersal inshore fisheries and 'other anthropogenic' stressors	Recreational use of rod and reel and artisanal use of hooks, gillnets and seine nets from small boats and shore cause fishing mortality to chondrichthyan species as target catch, byproduct and bycatch. This fishing occurs at high intensity in gulfs, bays, inlets and estuaries and at low intensity in coastal ocean waters. Other anthropogenic stressors adding to fishing mortality in these localities include underwater environmental modification, artificial electric and electromagnetic fields, artificial noise, artificial light, hydrocarbon and other chemical contamination, nutrient enrichment, and invasive species. Most 'other anthropogenic' stressors are inshore, but isolated hydrocarbon extraction, seismic survey, and high voltage direct current cables occur mainly offshore on sandy substrates (see Walker <i>et al.</i> 2021).	FO 2000–06	H	L	L	L	L	L
		FO 2018	H	L	L	L	L	L
Industrial demersal trawl	Industrial demersal trawl cause fishing mortality to chondrichthyan species as target catch, byproduct and bycatch from high fishing effort over most of the upper continental slope areas & moderate fishing intensity in some areas on the continental shelf, but prohibited on the continental slope at depths greater than 700 m and in the bays, inlets and estuaries, and fishers avoid rocky and other hard substrates to minimise damage to the fishing equipment.	FO 2000–06	L	L	M	H	H	L
		FO 2018	L	L	M	M	L	L
Industrial demersal shark gillnet (150–165 mm mesh-size)	Industrial demersal shark gillnets cause fishing mortality to chondrichthyan species as target catch, byproduct and bycatch from high fishing effort over large areas on the continental shelf mostly at depths <75 m targeting <i>Mustelus antarcticus</i> , but is prohibited in bays, inlets, estuaries, within 3 nm of the Victorian coast, and large areas off South Australia. Fishers avoid rocky and other hard substrates to minimise damage to the fishing equipment. Gillnets are highly length-selective depending on size and body shape of animal.	FO 2000–06	L	L	H	L	L	L
		FO 2018	L	L	M	L	L	L
Industrial demersal longline	Industrial demersal longlines with baited hooks cause fishing mortality to chondrichthyan species as target catch, byproduct and bycatch from high fishing effort over large areas on the continental shelf and continental slope in the past, but has been mostly phased out in favour of other fishing methods. Nevertheless, a small amount of targeting of specific species such as wobbegongs persists on reefs on the continental shelf. Also, there is potential for its re-introduction following closure of large coastal areas off South Australia on the use of gillnets to protect sea lions.	FO 2000–06	L	L	L	L	L	L
		FO 2018	L	L	L	L	L	L
Industrial and game pelagic fisheries	Pelagic fisheries causes fishing mortality to chondrichthyan species as target catch, byproduct and bycatch from low fishing effort over the EEZ of southern Australia concentrated in specific areas targeting squid, tunas, and clupeoids. Game fishers target <i>Isurus oxyrinchus</i> but also catch <i>Lamna nasus</i> and <i>Prionace glauca</i> .	FO 2000–06	L	L	L	L	L	L
		FO 2018	L	L	L	L	L	L

Table 3. Available information used in calculating risk for the components of vulnerability for each recreational chondrichthyan species in the waters off southern Australia.

The information is extracted from Walker *et al.* (2021). Ecological groups are defined in Table 1. The ESA–ESP region and sub-regions are defined in Figure 1 and presence (P) or absence (blank) of a species in each sub-region. T, targeted species; B, byproduct, or blank, mostly discarded bycatch. L_{Max}, maximum length (used for calculating risk from selectivity); longevity a_{Max}, longevity (required for calculating productivity risk); –, insufficient or no information available.

Taxonomic grouping	Order	Family	Scientific name	Common name	Ecological group	Presence-absence of species in each sub-region										Non-gillnet mean annual catch during 2000–06			Shark gillnet survey 2007–08 (number caught)	Attribute values			
						N	S	W	E	W	W	E	E	S	N	N	Estimate (t)	Retained propn		L _{Max} (mm)	a _{Max} (y)	Trophic level	
						W	A	A	V	S	T	T	B	S	W	E							
Squalomorphii (Squalomorph sharks)																							
Hexanchiformes (Sixgill & sevengill sharks)																							
			<i>Notorynchus cepedianus</i>	Broadnose sevengill shark	Shelf-sand		P	P	P	P	P	P	P	P	P	P	3	0.910	B	247	3000	–	4.55
Galeomorphii (Galeomorph sharks)																							
Carcharhiniformes (Ground sharks)																							
			<i>Carcharhinus brachyurus</i>	Bronze whaler	Shelf-sand	P	P	P	P	P				P	P		17	0.900	B	101	2950	31	4.24
			<i>Carcharhinus obscurus</i>	Dusky shark	Shelf-sand	P	P	P	P	P	P	P	P	P	P	P			B		3650	32	4.23
			<i>Prionace glauca</i>	Blue shark	Pelagic	P	P	P	P	P	P	P	P	P	P	P	1	0.970			3830	22	4.13
			<i>Cephaloscyllium laticeps</i>	Draughtboard shark	Shelf-sand		P	P	P	P	P	P	P	P	P	P	227	0.470		1463	1500	27	3.84
			<i>Sphyrna zygaena</i>	Smooth hammerhead	Shelf-sand	P	P	P	P	P	P	P	P	P	P	P	3	0.960	B	78	3500	21	4.20
			<i>Furgaleus macki</i>	Whiskery shark	Shelf-sand	P	P	P	P	P				P			1	0.990	B	109	1600	11	4.20
			<i>Galeorhinus galeus</i>	School shark	Shelf-sand	P	P	P	P	P	P	P	P	P	P	P	35	0.940	B	2814	1750	42	4.22
			<i>Mustelus antarcticus</i>	Gummy shark	Shelf-sand	P	P	P	P	P	P	P	P	P	P	P	185	0.940	T	6010	1850	16	3.96
Heterodontiformes (Horn sharks)																							
			<i>Heterodontus portusjacksoni</i>	Port Jackson shark	Shelf-reef	P	P	P	P	P	P	P	P	P	P	P	211			976	1650	35	3.46
Lamniformes (Mackerel sharks)																							
			<i>Alopias vulpinus</i>	Thresher shark	Pelagic	P	P	P	P	P	P	P	P	P	P	P	16	0.940		7	5700	22	4.21
			<i>Carcharodon carcharias</i>	White shark	Shelf-sand	P	P	P	P	P	P	P	P	P	P	P	2	0.140			6000	73	4.53
			<i>Isurus oxyrinchus</i>	Shortfin mako	Pelagic	P	P	P	P	P	P	P	P	P	P	P	2			5	3940	29	4.28
			<i>Lamna nasus</i>	Porbeagle	Pelagic	P	P	P	P	P	P	P	P	P	P	P	<1	0.190			3240	25	4.21
Orectolobiformes (Carpet sharks)																							
			<i>Orectolobus halei</i>	Gulf wobbegong	Shelf-reef	P	P	P	P	P				P	P	P			B	3	2060	27	4.29
			<i>Orectolobus maculatus</i>	Spotted wobbegong	Shelf-reef	P	P	P	P					P	P	P	24	0.890	B	7	1700	22	4.26
			<i>Sutorectus tentaculatus</i>	Cobbler wobbegong	Shelf-reef	P	P	P											B	4	920	–	4.26
Batoidea (Rays)																							
Myliobatiformes (Stinging and manta rays)																							
			<i>Bathytoshia brevicaudata</i>	Smooth stingray	Shelf-sand	P	P	P	P	P	P	P	P	P	P	P	89	0.050				14	3.60
			<i>Bathytoshia lata</i>	Brown stingray	Shelf-sand	P	P	P	P	P	P	P	P	P	P	P	96	0.260				14	3.60
			<i>Myliobatis tenuicaudatus</i>	Southern eagle ray	Shelf-sand	P	P	P	P	P	P	P	P	P	P	P	88	0.550	B	53		32	3.25
			<i>Trygonoptera imitata</i>	Eastern shovelnose stingaree	Shelf-sand									P			1					12	3.50
			<i>Trygonoptera mucosa</i>	Western shovelnose stingaree	Shelf-sand	P	P	P									2			1		17	3.50
			<i>Urolophus bucculentus</i>	Sandyback stingaree	Shelf-sand				P	P	P	P	P	P	P	P	124	0.190		1		17	3.59
			<i>Urolophus cruciatus</i>	Banded stingaree	Shelf-sand				P	P	P	P	P	P	P	P	70			1		10	3.50
			<i>Urolophus expansus</i>	Wide stingaree	Shelf-sand	P	P	P									351					9	3.52
			<i>Urolophus gigas</i>	Spotted stingaree	Shelf-sand				P	P	P				P		3					9	3.71
			<i>Urolophus orarius</i>	Coastal stingaree	Shelf-sand				P	P												11	3.56
			<i>Urolophus paucimaculatus</i>	Sparsely-spotted stingaree	Shelf-sand	P	P	P	P	P	P	P	P	P	P	P	90	0.010		13		10	3.55
			<i>Urolophus viridis</i>	Greenback stingaree	Shelf-sand				P	P	P	P	P	P	P	P	455			5		10	3.52
Rajiformes (Skates)																							
			<i>Spiniraja whiteleyi</i>	Melbourne skate	Shelf-sand		P	P	P	P	P	P	P	P	P	P	176	0.300		3		16	4.02
Rhinopristiformes (Guitar rays)																							
			<i>Aprychotrema vincentiana</i>	Western shovelnose ray	Shelf-sand	P	P	P	P	P							7			1		15	3.78
			<i>Trygonorrhina dumerilii</i>	Southern fiddler ray	Shelf-sand	P	P	P	P	P				P			219	0.260				15	3.66
Holocephali (Chimaeras)																							
Chimaeriformes (Chimaeras)																							
			<i>Callorhynchus milii</i>	Elephant fish	Shelf-sand		P	P	P	P	P	P	P	P	P	P	48	0.940	B	76	1200	23	3.83

Survey of recreational fishers

A survey of recreational fishers was conducted in 2020 (Appendix 3). The aim of the survey was to determine baseline knowledge, techniques, confidence, and behaviour of recreational fishers during capture of chondrichthyans. The survey was mainly distributed through VRFish's mailing list (53,158 email contacts). The survey was initially distributed on 13th Feb 2020 and was closed off to further responses approximately 6 weeks later on 1st April 2020. There were 1,133 responses including 729 fully completed surveys.

Guidelines, communication and extension strategy

We used survey data to incorporate behavioural insights in the design of communication materials and strategies to change the behaviour of recreational fishers. An electronic booklet describing the best-practice capture, handling, and release guidelines was created based on the workshop discussions and previous guidelines for sharks and rays in commercial fisheries (Reina *et al.*, 2015; Reina *et al.*, 2020). A series of six videos was also created to describe best-practice guidelines and were uploaded to YouTube. Volunteer recreational fishers from VRFish extensive network were recruited to assist with production and provision of photographic and video content for the communications strategy and assisted with distribution and promotion of the guidelines in their local communities.

In consultation with marketing and communications strategists a brand name was created: *Shark Mates*. A central website was created to display all information associated with this project (sharkmates.com.au), including informational videos, best-practice guidelines, contact information, and links to all social media accounts. Social media accounts (Instagram, Facebook, Twitter, YouTube) were created and the messaging from the guidelines was shared along with photographic content and informational videos.

A six-page brochure and a double-sided 3-page pamphlet were created to introduce the '*Shark Mates*' project and highlight the more detailed 30-page best-practice capture, handling, and release guidelines booklet outlining key messages of the best-practice guidelines. The materials explain the importance of minimising the impact of capture on sharks, rays, and chimaeras, and provide information on best-practice to humanely euthanise them if retained for eating or handle them to ensure survival following release. The print material provides information directing audiences to learn more about the guidelines and view video content online (e.g. website address, social media accounts). VRFish organised the distribution of 4000 stickers and 5000 flyers to bait & tackle shops within Victoria.

Results

Workshop on chondrichthyans in recreational fisheries

During the workshop, we discussed the development of new, and refinement of existing, best-practice capture, handling, and release guidelines, which can be used as educational resources and enact behavioural change. Workshop attendees highlighted some handling practices that should be used consistently across species, e.g. do not lift shark or ray by the gills or tail, but that other handling recommendations are specific to the general type of animal caught. It was, therefore, suggested to provide different messaging for the following groups of sharks and rays: (1) rays with a dangerous barb; (2) rays without a dangerous barb; (3) sharks under 1.5 m; and (4) sharks over 1.5 m.

A multimedia approach to provide extension and communication was recommended with clear animations, photos, simple videos, print media, a central campaign website or information hub, social media (Instagram and Facebook), and by engaging celebrity ambassadors that resonate with the recreational fishing community to champion the key messaging.

A range of priority species of sharks and rays were also identified for prioritisation for future post-release survival studies (Table 4). When designing post-release survival studies, it was important to assess factors that affect survival that you can test (practically and statistically) such as hook type, hooking location, duration of fight, handling at landing, and resuscitation.

Table 4. List of priority species for development of best-practice capture, handling, and release guidelines for southern Australia (NSW to WA), ordered alphabetically.

Common Name/s	Species name (or genus name if group)
Blue Shark	<i>Prionace glauca</i>
Bronze Whaler #	<i>Carcharhinus brachyurus</i>
Dusky Whaler	<i>Carcharhinus obscurus</i>
Elephantfish	<i>Callorhynchus milii</i>
Fiddler Ray spp.	<i>Trygonorrhina</i> spp.
Grey nurse Shark *	<i>Carcharias taurus</i>
Gummy Shark	<i>Mustelus antarcticus</i>
Hammerhead spp. (only Smooth Hammerhead for SA & VIC) #	<i>Sphyrna</i> spp. (only <i>S. zygaena</i> relevant for SA & VIC)
Port Jackson Shark	<i>Heterodontus portusjacksoni</i>
School shark #	<i>Galeorhinus galeus</i>
Sevengill spp.	<i>Notorynchus cepedianus</i> & <i>Hepttranchias perlo</i>
Shortfin Mako	<i>Isurus oxyrinchus</i>
Smooth Stingray #	<i>Bathytoshia brevicaudata</i>
Southern Eagle Ray #	<i>Myliobatis australis</i>
Stingaree spp.	<i>Urolophidae</i> spp.
Thresher Shark	<i>Alopias vulpinus</i>
Tiger Shark *	<i>Galeocerdo cuvier</i>
Wobbegong spp.	<i>Orectolobidae</i> spp.

* Denotes species that are not relevant for SA and VIC jurisdictions. # Denotes species that should be prioritised for post-release survival studies.

The following fishing practices should be encouraged regardless of species:

- use non-stainless, circle hooks;
- use heavy line or leader;
- remove the hook if possible (unless gut hooked);
- cut the line as short as possible if unable to remove the hook;
- when lifting ensure that you support the body and do not lift the animal by the tail;
- use knot-less nets if using a net to lift;
- reduce fight time; and
- limit time out of water to minimise exposure to the sun and air.

The following handling practices were recommended:

- rays should be lifted by grabbing the snout and/or spiracles if the animal needs to be removed from the water;
- dangerous rays with a barb should be left in the water, if possible, whilst removing the hook or cutting the line as short as possible;
- non-dangerous rays without a barb can be removed from the water to remove the hook;
- sharks should be lifted whilst supporting the body and holding the tail to keep the animal horizontal, if possible, and prevent injury;
- shark caught from shore should not be landed over rocks and should instead be moved to a beach, if possible;
- sharks over 1.5 m should be left in the water to remove the hook or cut the line as short as possible.
- sharks under 1.5 m can be removed from the water to remove the hook.
- if animal is removed from the water, a smooth and wet cloth or towel can be used to cover the eyes, which can calm the animal.

Furthermore, the growing use of social media and photographs of catches result in an increasing need for fishers to use safe photography practices. Photography should not be broadly discouraged, but should promote safe and adequate handling practices.

This is a brief summary of the workshop results and outputs, for an in depth description refer to Reina *et al.* (2020) report to FRDC for Project number 2018-042.

Vulnerability risk analysis

Vulnerability analysis indicates that 13 of the 33 recreationally-fished species (Table 5) are at medium (M) or high (H) risk from anthropogenic stressors for one or more past (2000–06), recent (2018), or future (to 2100) scenario(s). Of these species, five were at medium or high risk during 2000–06 from the effects of fishing, and this number was reduced to four (School Shark, Gummy Shark, Whiskery Shark and Elephantfish) at medium risk by 2018. These species are either target or by-product commercial species and their stocks are closely monitored and managed. The species at highest risk from climate change are three species of wobbegong (*Orectolobus halei*, *O. ornatus*, and *Sutorectus tentaculatus*). All three are assessed at high risk for high emission scenarios and medium risk for medium emission scenarios because of their comparatively high trophic level and dependence on reef substrates, which are predominantly in depths <75 m where water temperatures are rising much more rapidly than in deep water. Another four species of sharks (Broadnose Shark [*Notorynchus cepedianus*], Bronze Whaler, Dusky Whaler, and School Shark) and one species of chimaera (Elephantfish) are at medium risk for high emission scenarios because of their dependence on

inshore habitat for nursery or egg-laying areas. Only one species of ray (Coastal Stingaree [*Urolophus orarius*]) is assessed as at medium risk for high emission scenarios because it appears to be rare. The only recreational species of Victoria and South Australia assessed to be at risk from both fishing and climate change stressors are School Shark and Elephantfish. Risks levels for these five scenarios markedly increase for hypothetical scenarios based on the six possible pairs of the three climate-change and two fishing scenarios (Walker *et al.*, 2021).

Table 5. Risks for each attribute of each resilience component, resilience risk, exposure, and vulnerability for each chondrichthyan species for three climate change emissions and two fishing scenarios.

Z_{MSY}, instantaneous total mortality rate for maximum sustainable yield; LE, low emissions; ME, medium emissions; HE, high emissions climate change scenarios; H, high risk; M, medium risk; blank, low risk.

Taxonomic grouping		Species scientific name	Ecological group	Risk for each attribute and each resilience component										Resilience risk		Exposure for each scenario					Vulnerability for each scenario						
				Sensitivity			Adaptability			Susceptibility				Productivity		Climate change	Fishing & other hazards	Climate change emissions scenarios			Fishing & other hazards		Climate change emissions scenarios			Fishing & other hazards	
				Rarity	Habitat specificity	Total	Distri-butional flex-ibility	Trophic level	Total	Region-ality	Encount-erability	Select-ivity	Post-encounter mortality	Total	1-Z _{MSY}			LE	ME	HE	Period 2000-06	Year 2018	LE	ME	HE	Period 2000-06	Year 2018
Squalomorphii (Squalomorph sharks)																											
Hexanchiformes (Sixgill & sevengill sharks)																											
Hexanchidae (Cowsharks)		<i>Notorynchus cepedianus</i>	Shelf-sand		H	H	M	H	H	H	H	H	H	H	H			M	H	M			M				
Galeomorphii (Galeomorph sharks)																											
Carcharhiniformes (Ground sharks)																											
Carcharhinidae (Whaler sharks)		<i>Carcharhinus brachyurus</i>	Shelf-sand		H	H	M	H	H	H	H	H	H	H	H			M	H	M			M				
		<i>Carcharhinus obscurus</i>	Shelf-sand		H	H		H	H	H	H	H	H	H	H			M	H	M			M				
		<i>Prionace glauca</i>	Pelagic					M	M	H	H	H	H	H	H			M	M								
Scyliorhinidae (Catsharks)		<i>Cephaloscyllium laticeps</i>	Shelf-sand				M	M	H	H	H	H	M	M	H			M	H	M			M				
		<i>Sphyrna zygaena</i>	Shelf-sand		H	H	M	H	H	H	H	H	H	H	H	H			M	H	M			M			
Triakidae (Houndsharks)		<i>Furgaleus macki</i>	Shelf-sand				M	H	H	H	H	H	H	M			M	H	M			M	M				
		<i>Galeorhinus galeus</i>	Shelf-sand		H	H		H	H	H	H	H	H	H	H	H			M	H	M			M			
		<i>Mustelus antarcticus</i>	Shelf-sand					M	M	H	H	H	H	H	H			M	H	M			H	M			
Heterodontiformes (Horn sharks)																											
Heterodontidae (Hornsharks)		<i>Heterodontus portusjacksoni</i>	Shelf-reef		H	H				H	H	H		H				M	H								
Lamniformes (Mackerel sharks)																											
Alopiidae (Thresher sharks)		<i>Alopias vulpinus</i>	Pelagic					H	H	H	H	H	H	H				M	M								
Lamnidae (Mackerel sharks)		<i>Carcharodon carcharias</i>	Shelf-sand					H	H	H	H	H	H	H				M	M			M					
		<i>Isurus paucus</i>	Pelagic					H	H	H	H	H	H	H				M	M								
		<i>Lamna nasus</i>	Pelagic	M			H	H	H	H	H	H	H	M	H			M	M								
Orectolobiformes (Carpet sharks)																											
Orectolobidae (Wobbegongs)		<i>Orectolobus halei</i>	Shelf-reef		H	H	M	H	H	H	H	H	H	H	H	H			M	H			M	H			
		<i>Orectolobus maculatus</i>	Shelf-reef		H	H	M	H	H	H	H	H	H	H	H	H			M	H			M	H			
		<i>Sutorectus tentaculatus</i>	Shelf-reef		H	H	H	H	H	H	H	H	H	H	H	H			M	H			M	H			
Batoidea (Rays)																											
Myliobatiformes (Stinging and manta rays)																											
Dasyatidae (Stingrays)		<i>Bathyraja brevicaudata</i>	Shelf-sand							H	H			M				M	H	M							
		<i>Bathyraja lata</i>	Shelf-sand							H	H			M					M	H	M						
Myliobatidae (Eagle rays)		<i>Myliobatis tenuicaudatus</i>	Shelf-sand						H	H			H					M	H	M							
Urolophidae (Stingarees)		<i>Trygonoptera imitata</i>	Shelf-sand				H		H	H			M					M	H	M							
		<i>Trygonoptera mucosa</i>	Shelf-sand				H		H	H			M						M	H	M						
		<i>Urolophus bucculentus</i>	Shelf-sand				M		H	H			M						M	H	M						
		<i>Urolophus cruciatus</i>	Shelf-sand				H		H	H			M							M	H	M					
		<i>Urolophus expansus</i>	Shelf-sand				H		H	H			M							M	H	M					
		<i>Urolophus gigas</i>	Shelf-sand				H		H	H			M							M	H	M					
		<i>Urolophus orarius</i>	Shelf-sand		H	H		H		H			M			H				M	H	M			M		
		<i>Urolophus paucimaculatus</i>	Shelf-sand				M		M	H	H		M							M	H	M					
<i>Urolophus viridis</i>	Shelf-sand				M		M	H	H		M							M	H	M							
Rajiformes (Skates)																											
Rajidae (Skates)		<i>Spiniraja whiteleyi</i>	Shelf-sand				M	M	H	H			H					M	H	M							
Rhinopristiformes (Guitar rays)																											
Trygonorrhinidae (Banjo rays)		<i>Aprychoctema vincentiana</i>	Shelf-sand				H	M	H	H			H					M	H	M							
		<i>Trygonorrhina dumerilii</i>	Shelf-sand				M		H	H			H						M	H	M						
Holocephali (Chimaeras)																											
Chimaeriformes (Chimaeras)																											
Callorhynchidae (Elephant fishes)		<i>Callorhynchus milii</i>	Shelf-sand		H	H	M	M	H	H	H	H	H	H	H			M	H	M			M	H	M		

Survey of recreational fishers

A total of 1,135 participants completed the survey, but six participants selected 'no' to the statement 'Please indicate that you have read and understood the Explanatory Statement and hereby consent', and did not complete any further questions. Another 400 participants did not answer all questions, leaving 729 surveys fully completed. A summary of survey responses is provided in Appendix 4.

The majority of respondents reported an age between 28 and 62 years of age, with 89% being 'male', 11% being 'female' and less than 1% 'other' or 'prefer not to say'. The vast majority of respondents lived in Victoria (>95%), with 1.5% in both South Australia and New South Wales, and the remaining being spread across other states and territories. The majority of respondents were Australian-born (84%), with 8% being born overseas in an English-speaking country and 8% in a non-English speaking country. Only 17% of respondents said that they had been a member of a fishing club in the last 12 months.

A range of fishing styles was reported, with 35% preferring common tackle and targeting whatever is biting, 25% preferring common tackle and often targeting a particular species, 30% preferring high quality tackle and usually targeting a particular species, and only 10% using high-quality species-specific tackle and always targeting a particular species. The majority (94%) of respondents predominantly fish in Victoria, with only 2% predominately fishing in each South Australia and NSW respectively, and the remaining respondents fishing evenly across the remaining states and territories. Most respondents (96%) had fished within the last 12 months, with 3% having last fished 2–5 years ago, 1% having last fished over 5 years ago, and 2 respondents having never fished before. There was an even amount of variation in reported time spent fishing across the reporting categories, with approximately 10% of respondents stating that they had fished in saltwater for either 1–2 days, 3–4 days, 5–9 days, 10–14 days, 15–19 days, 20–29 days, 30–51 days, or 51+ days over the last 12 months. A large proportion of respondents (45%) stated that all or most of their fishing trips were boat-based in inshore coastal waters (less than 5 km offshore). Beaches, piers, and jetties were also reported to be popular fishing locations, with 48–50% of respondents stating that they completed some of their fishing in those locations over the last 12 months.

Less than a third of respondents (30%) stated that they had targeted and caught chondrichthyes in the last 12 months, with 5% targeting but failing to catch them, and 65% not targeting chondrichthyes. However, about half of those not targeting chondrichthyes (32% of total respondents) caught chondrichthyes in the previous 12 months. The most commonly targeted species was gummy shark, with 23% of respondents targeting them. This was followed by school shark (8%), elephant fish (6%), mako shark (6%), fiddler ray (4%), and bronze whaler (4%). Less than 3% of respondents reported targeting other chondrichthyan species.

The most commonly caught species was gummy shark, with 14% of respondents catching one in the previous 12 months, followed by fiddler ray (13%), Port Jackson shark (10%), eagle ray (7%), elephant fish (6%), school shark (5%), smooth stingray (5%), seven-gill shark (4%), skates (4%), and stingarees (4%). Less than 3% of respondents reported that they caught another chondrichthyan species in the previous 12 months. Respondents predominately reported being very likely to release all species (>50% of all respondents), except for gummy shark which were released by only 21% of respondents. 'Not good eating', 'Not the correct legal size', 'Ethical or environmental reasons', 'Not targeting that species' were the most common reasons to release a shark or ray, with approximately 55% of respondents selecting one of those reasons for release, with 'Not good eating' being the most common response. In contrast, most respondents (63%) that kept sharks did so because they are 'good eating'.

There was a wide range in reported confidence in safely handling different species of shark or ray to reduce the risk of injury to themselves or others. Over 65% of respondents were either 'very

confident' or 'confident' with gummy sharks, fiddler rays, elephant fish, and Port Jackson sharks. Respondents were least confident with mako sharks, thresher sharks, and hammerhead sharks, followed by smooth stingrays and eagle rays. Confidence in ability to safely handle different species was correlated with confidence in ability to handle different species 'in a way that minimises harm to the fish and maximises post-release survival'.

A knife was the mostly commonly reported item that respondents took with them when fishing, with 779 respondents stating so. Pliers (765 respondents selected), measuring pole / sticker (617), gloves (542), and knotless net (418), were reported to be commonly taken on fishing trips. Gaffing pole (339), dark cloth (335), wire leader (299), crimper (192), and bolt / heavy wire cutters (183) were the least reported items bought on fishing trips. In areas where it is possible to catch a shark or ray around half of respondents (49%) reported using circle hooks either 'always' or 'often', with a quarter (27%) reporting 'rarely' or 'never' using circle hooks.

Fishers handling practices and behaviour varied depending on the type of shark or ray caught. For example, less respondents (156) selected that they would 'land / remove ray from water to remove or cut line' if it was a ray with a dangerous barb (stinger) compared to landing the ray if it did not have a barb. Likewise, less respondents (101) selected that they would 'land / remove shark from water to remove or cut line' if it was a shark over 1.5 m compared landing a shark under 1.5 m.

Not many respondents self-reported that they would 'lift a ray by grabbing the snout and / or spiracles', with only 24 respondents selecting this for rays with a barb and 43 selecting it for rays without a barb. Few respondents reported that they would 'lift by grabbing, or gaffing in, the gills or mouth or tail' (11 respondents for rays with a barb and 25 for rays without a barb) or that they would 'cut barb or tail off' (4 respondents for both rays with a barb and for rays without a barb).

Only 54 respondents reported that they would lift a small shark 'by grabbing, or gaffing, the gills or mouth or tail'. Fewer still (23), reported lifting a large shark in such a way. A greater number of respondents selected that they would 'support the body while holding the tail' when lifting small sharks (281 respondents) and large sharks (46 respondents).

In response to the question about what methods respondents thought would maximise post-release survival when releasing a shark or ray, the most popular option selected was 'dehooking by the side of the boat' (572 respondents). 'Removing the hook', 'cutting the line quickly', 'cutting the line as close as possible', and 'reducing exposure to air', were the next most popular responses with approximately 450 respondents selecting each of these responses. 'Using circle hooks' was selected more (306) than 'using J hooks' (89), and 'using non-stainless hooks' was selected more (247) than 'using stainless hooks' (44).

Almost half of the respondents (49%) reported that they had 'witnessed poor practices by other fishers with sharks and rays'. Of those respondents, 45% thought the problem was 'widespread' and 55% thought it was just a 'minor problem'. There was a relatively even range of concern reported about 'other fishers' practices when handling sharks and rays', with 14% being 'very concerned', 34% being 'concerned', 36% being 'slightly concerned', and 16% being 'not concerned'. This pattern was similar for concern about 'other fishers' attitudes towards these species', with 18% being 'very concerned', 37% being 'concerned', 30% being 'slightly concerned', and 15% being 'not concerned'.

In response to the question 'what would be effective methods to assist fishers in adopting best-practice in handling & release of sharks and rays?', the most popular answer selected was 'providing more information on optimal handling practices', with 612 respondents selecting it. 'Changing culture' was the next most selected answer (374 respondents), followed by 'greater enforcement' (258 respondents) and then 'free or subsidised circle hooks' (231 respondents). For the 56

respondents that selected 'other' some provided further information such as 'Facebook, videos, stickers – I save sharks' and 'reinforcing legal limits'.

Guidelines, communication and extension strategy

Best-practice guidelines were created based on the information obtained during the workshop and previous best-practice guidelines (Reina *et al.*, 2015; Reina *et al.*, 2020). The guidelines document is entitled 'Sharks & Rays – Guide to Safe and Responsible Fishing' can be accessed using this [link](#).

The *Shark Mates* brand (Fig. 2) was created with key messaging and associated branding materials were produced.



Figure 2. "Shark Mates" logo and tagline, an example of marketing materials produced.

A series of six educational videos were produced and uploaded to YouTube (Fig. 3) on the same YouTube [channel](#) and can be accessed using the following links:

1. [Preparing yourself for catching sharks or rays](#): This video is an introduction to the *Shark Mate* series on shark and ray recreational fishing. In the video, Mike Burgess from VRFish chats with Mitch McMaster from Fishcare Victoria about useful gear and fishing tools and the importance of having a plan if you catch a shark or ray.
2. [Have a plan for catching sharks and rays](#): Fishers can run into problems if they do not have some sort of plan to follow. In this video, Mike Burgess from VRFish and Elysia Gustafson from Fishcare Victoria chat about what fishers should do once they have hooked a shark or ray. The decision-making framework acts as a guide with basic steps to handle the shark or ray safely and responsibly.
3. [Catching sharks or rays from shores and jetties](#): Catching a shark or ray by accident can be challenging for most fishers. Shores and jetties are very accessible fishing locations for fishers of varying skills and experience. Many inexperienced fishers may end up catching non-target species like sharks and rays without a good understanding of how to handle them. In this video, Mike Burgess from VRFish and Elysia Gustafson from Fishcare Victoria provide fishers with a basic understanding of responsible practices if they catch a shark or ray from a jetty or the shore.

4. [Handling safe rays and sharks less than 1 metre](#): In this video, Ben Scullin and Mike Burgess from VRFish describe how fishers should be handling small and non-dangerous sharks and rays either from a boat or from the shore
5. [Handling and releasing dangerous rays](#): Dangerous rays can pose challenges for fishers and can be very difficult to handle. In this video, Ben Scullin and Mike Burgess from VRFish describe how to best handle and release smooth rays and other dangerous rays that have a barb.
6. [Handling and releasing sharks above 1 metre](#): In this video, Ben Scullin and Mike Burgess from VRFish describe how fishers should be handling large sharks either from a boat or from the shore. We advise that fishers should not try to land the catch. As sharks and rays do not have a ribcage, it is very easy to damage their organs if you take them out of the water. It is also important not to lift them out of the water if pregnant.

The videos were produced by Biomed Pty Ltd in collaboration with VRFish staff Michael Burgess and Ben Scullin, and Fishcare Victoria staff Elysia Gustafson and Mitch McMaster.

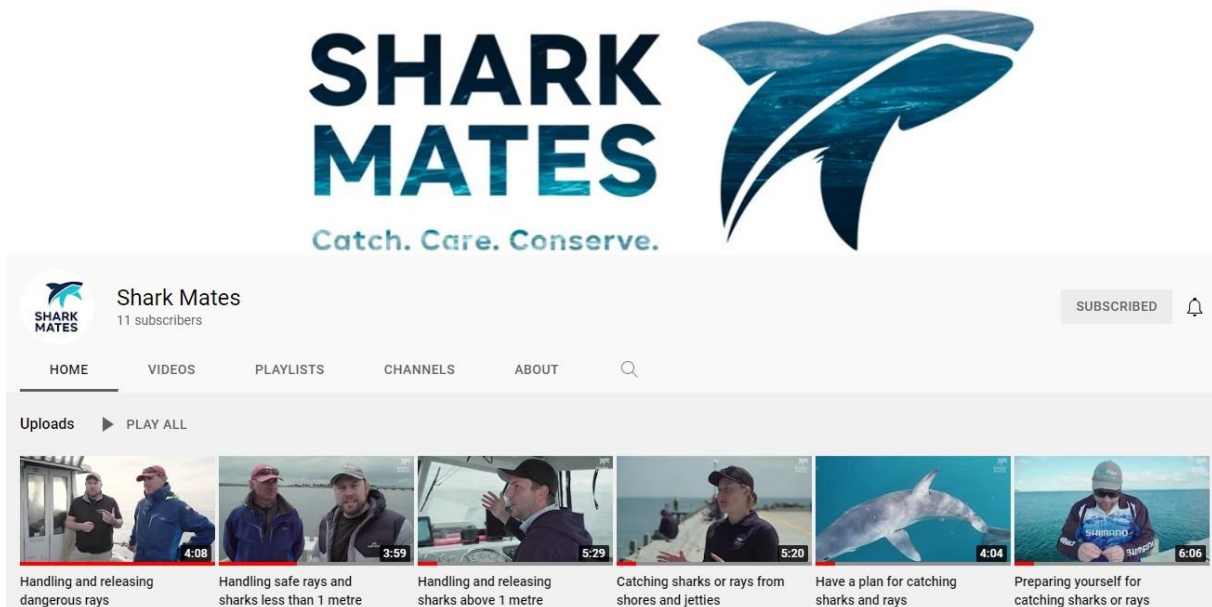


Figure 3. YouTube account created for *Shark Mates* project to disseminate best-practice shark and ray fishing videos to recreational fishing community.

A website was created to house the best-practice guidelines along with imbedded information videos uploaded to YouTube: sharkmates.com.au

Social media accounts were created on [Facebook](#), [Instagram](#), [Twitter](#) and [YouTube](#).

The handles and website link for each account are provided below:

Facebook: @SharkMates facebook.com/SharkMates

Instagram (Fig. 4): @shark_mates instagram.com/shark_mates

Twitter: @SharkMatesAus twitter.com/SharkMatesAus

YouTube: youtube.com/channel/UCBF17Ft5N4F-CuzLYUaNhSA

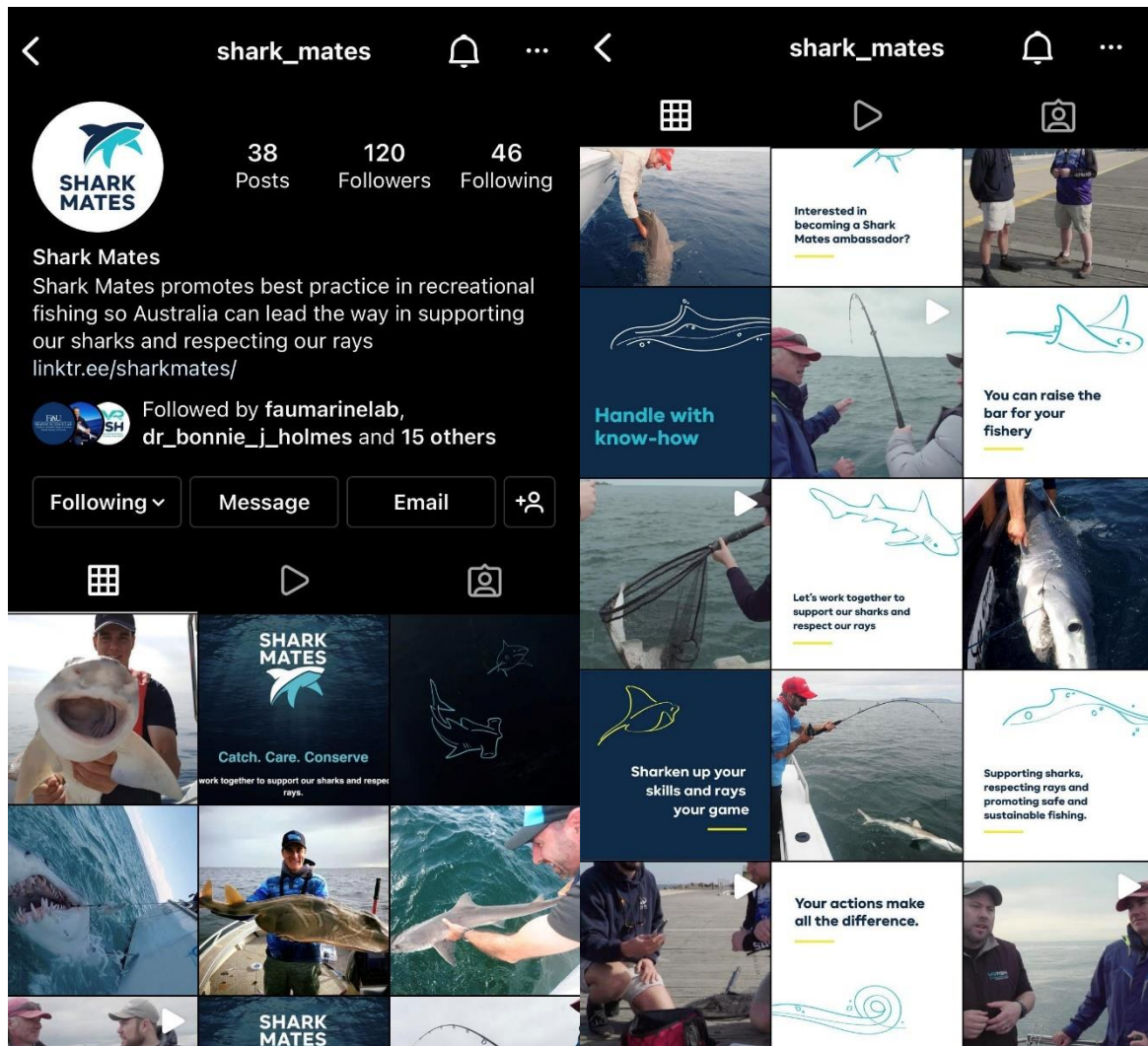


Figure 4. Example of social media account created for *Shark Mates* on Instagram.

A brochure and three stickers advertising the project were also created (Fig. 5, 6).

Discover best practice guidelines for catching, handling and releasing sharks and rays

Australians love spending their weekends catching fish from boats, shores and jetties. That enjoyment can be compromised if you're unsure what to do when you hook a shark or ray. Or you feel that other members of the fishing community can improve their practices.

You asked for best practice guidelines for catching, handling and releasing shark and rays. We've listened and delivered.

Some key takeaways of the guidelines include:

- Choose circle hooks instead of J-hooks to reduce the risk of injury and mortality once you release a shark or ray
- Use non-stainless hooks or corrodible hooks if you plan to release by cutting the line so that the hook will remain in the shark or ray for a shorter time
- If you're targeting sharks and rays, use heavy line to reduce fight time
- If you're fishing from a pier or jetty, use a paternoster rig to lower the chance of hooking sharks and rays as by-catch
- Maintain your tackle box and ensure you have all the required tools including pliers, crimper, de-hooker, gloves, landing net, dispatching tool, gaff, bolt cutters and a measuring pole
- Make sure everyone has an assigned role and is across the Victorian recreational fishing rules or your state's relevant regulations

The Shark Mates guidelines are based on the latest science and targeted research into the most effective handling and release techniques. For more information about the detailed best practice guidelines visit our website and check out our videos and share them with your fishing community. Let's take better care of our sharks and rays and enjoy a better fishing experience as a result.


Sharpen Up Your Skills

Want to find out more about our research, best practice guidelines and surveys?

Or perhaps you're keen to become a Shark Mates ambassador?

Whatever the case, we'd love to hear from you.

DROP US A LINE at www.sharkmates.com.au



SHARK MATES
Catch. Care. Conserve.

sharkmates.com.au

Catch. Care. Conserve.

Let's work together to support our sharks and respect our rays.



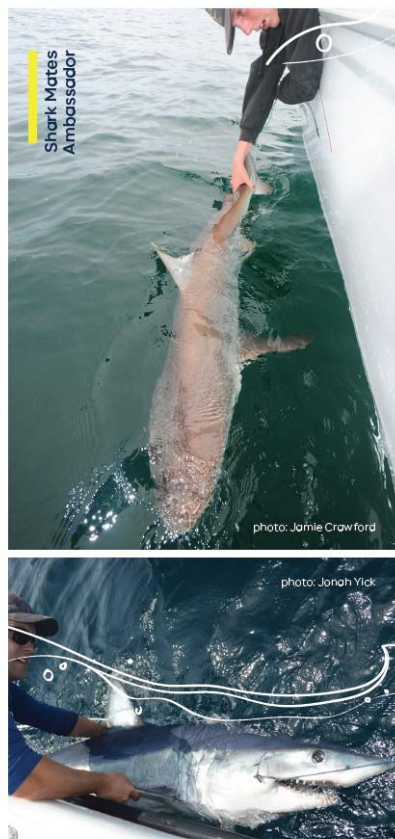


photo: Jamie Crawford



SHARK MATES
Catch. Care. Conserve.

Shark and Ray Introduction



What is a Shark Mate?

Shark Mate:
A skilled recreational fisher who cares for sharks and rays when out fishing

A Shark Mate is a steward of their fishery and someone who:

- Takes the time to learn to identify the different shark and ray species
- Knows how to fish responsibly and cares for the welfare of sharks and rays
- Follows the bag and size limits to fish sustainably
- Follows best practice guidelines <link to skills page> whether keeping or releasing their catch
- Actively shares their knowledge with other recreational fishers
- Understands that healthy populations of sharks and rays help maintain fish stocks and a balanced ecosystem
- Accepts that their actions make all the difference

A better fishing experience for everyone

As a recreational fisher, you play a vital role in maintaining a healthy population of sharks, rays and other fish stocks.

Being able to identify the different species and knowing how to fish responsibly will not only support fish populations, it'll improve your confidence and safety. The result? A more enjoyable fishing experience, now and in the future.

The Shark Mates initiative is about discovering and promoting best practice in recreational fishing guidelines so Australia can lead the way in supporting our sharks and respecting our rays.



Figure 5. Double-sided brochure advertising the *Shark Mates* project and best-practice guidelines.

STICKERS

BOATS, CARS, ESKIES, ETC.

1.



100MM

2.



125X75MM

5.

CAR WINDOWS, T-SHIRTS & HATS, ETC.

100MM



Figure 6. Stickers advertising the *Shark Mates* project.

Discussion

We met all project objectives. An expert steering committee was formed to oversee this project (FRDC Project 2018-042) and FRDC Project 2018-055 (Objective 2). A vulnerability risk analysis for recreationally-caught chondrichthyes was completed (Objective 4). A multi-jurisdictional one-day workshop was convened in Adelaide in 2019 to discuss and develop guidelines for best-practice capture, handling, and release of chondrichthyes, post-release survival, and behavioural change in recreational fisheries (Objective 5) (Reina *et al.*, 2020). A survey of recreational fishers was conducted to assess current practices, behaviours and attitudes related to recreational fishing of chondrichthyes. Based on the survey data and workshop discussions, best-practice guidelines for capture, handling, and release of sharks and rays was produced. The survey also informed a comprehensive extension campaign to share key messages from the best-practice guidelines with the recreational fishing community (Objective 3). These communication and extension activities addressed the overarching objective of this project to cause behavioural change of fishers in their interactions with captured sharks, rays, and chimaeras in Victoria (Objective 1).

Vulnerability risk analysis

The vulnerability analysis highlighted that 13 of the 33 recreationally fished species are at medium or high risk from anthropogenic stressors for one or more past (2000–06), recent (2018), or future (to 2100) scenarios (Walker *et al.*, 2021). However, the only recreationally-fished species of Victoria and South Australia assessed to be at risk from climate change, fishing, and other anthropogenic stressors are School Shark and Elephantfish. Commonly caught species such as Broadnose Shark, Bronze Whaler Sharks, School Shark, Smooth Hammerhead, and Elephantfish, are at a medium risk for high emissions scenarios. Surveys of recreational fishers in southern Australia highlight that whilst most sharks and rays are usually released (~82%), some, such as Gummy Shark, School Shark, Bronze and Dusky Whaler, are often targeted, caught, and retained (Braccini *et al.*, 2021; Henry and Lyle, 2003; Jones, 2009; Ryan *et al.*, 2019). Bronze Whaler Sharks and School Shark are two commonly retained species identified as being at risk from fishing pressure in this vulnerability analysis and harvest rates should be closely monitored (Braccini *et al.*, 2021; Walker *et al.*, 2021). The status of these species may change in the future due to climate change and assessments should be made at regular intervals.

Workshop on chondrichthyes in recreational fisheries

At the workshop completed in collaboration with FRDC Project 2018-055, we were able to identify priority species of Chondrichthyes caught in recreational fisheries for both the development of best-practice capture, handling, and release guidelines and also for future post-release survival studies (Reina *et al.*, 2020). Workshop participants generated a list of 18 species for prioritisation for development of best-practice capture, handling, and release guidelines. It was suggested that species be grouped based on similar handling practices. Workshop participants discussed criteria for grouping species that could have similar handling practices, which were; morphology (body shape & size), respiratory mode (ram vs buccal pumping; related to activity level), feeding behaviour (relates to bait taken), reproductive mode (live bearing vs egg-laying), phylogeny (Rays vs Whalers vs Hammerheads). We recommend best-practice guidelines differentiate species into four groups; sharks < 1.5m, sharks > 1.5m, rays with or without a barb.

Workshop participants identified five species for prioritisation for post-release survival studies in southern Australia, including Smooth Hammerhead (*Sphyrna zygaena*), Southern Eagle Ray (*Myliobatis tenuicaudatus*), School Shark (*Galeorhinus galeus*), Bronze Whaler (*Carcharhinus brachyurus*) and Smooth Stingray (*Dasyatis brevicaudata*).

It was recommended that guidelines should present simple messaging, clear graphics and diagrams. Recommended fishing and handling practices included; use of circle hooks, heavy line and gear, reduce fight time, keep animal in water where possible, no gaffing in the body (lower jaw preferred), no lifting by the tail or squeezing the gills, calm shark by covering the eyes with a smooth, wet and dark cloth. If not possible to remove the hook, cut the leader as short as possible, help recovery if needed by facing fish into the current of the water, release as soon as possible and reduce exposure to sun and air.

Further refinement of the guidelines should be informed by post-release survival studies of priority species within recreational fisheries. It is important to investigate factors that can both be practically and statistically assessed in post-release survival studies. Factors that were identified as being important to assess during post-release survival studies included; hook and gear type, hooking location, duration of fight, handling practices at landing, resuscitation, air exposure and temperature. However, it is important not to test too many variables at once to avoid reductions in statistical power of analyses.

It was highlighted that effective extension of best-practice to the recreational fishing community will enable positive behavioural and cultural change with regard to the capture and release of sharks and rays. Simple and clear messages should be developed for extension activities based off the best-practice guidelines. Extension campaigns could utilise a mixed-media (including face-to-face) approach to providing communication of the key messaging. It is recommended to produce clear animations, photos and simple videos (1-3 minutes) for creating content to extend the key messages to the community. Extension can be achieved through use of print, a central campaign website or information hub, face-to-face communication, social media (Instagram and Facebook), and by engaging celebrity ambassadors that resonate with the recreational fishing community to champion the key messaging.

Recreational fisher surveys were identified as an effective tool to assess the efficacy of extension activities in causing behavioural change. Pre-campaign and post-campaign surveys can be utilised to assess changes in attitudes, beliefs and behaviours of recreational fishers. It is important that surveys are designed properly with representative samples. It may be difficult to influence fringe behaviours, i.e. bad actors who will do the wrong thing regardless of having education about best-practice. However, by creating general behaviour change in recreational fishing towards best-practice behaviours, it is possible that these behaviours will become the 'social norm' which will potentially increase the uptake of these behaviours even by fishers who were previously acting poorly.

Survey of recreational fishers

We received 1135 responses from predominately Victorian fishers from a range of fishing styles and avidity which provided extensive information. Approximately 30% of fishers had targeted and caught chondrichthyans in the last 12 months and a further 32% had unintentionally caught them (62% total). Fiddler ray, Port Jackson shark and various other ray species were often unintentionally captured, with between 4 - 13% of respondents having caught one in the last 12 months despite not targeting them. Confidence levels in handling and release varied depending upon species, with fishers 'having greater confidence with small, non-dangerous species such as Gummy Shark, Fiddler Rays, Elephant fish, and Port Jackson Shark.

Fishers reported varying levels of preparedness for catching sharks and rays. Many respondents (418 - 779) reported using tools recommended for best-practice capture, handling, and release, such as pliers and a knotless net. However, half of the fishers used non-circle hooks which can lead to increased rates of mortality and are increasingly discouraged (French *et al.*, 2015; Reinhardt *et al.*, 2018; Rosa *et al.*, 2020; Serafy *et al.*, 2012). Further emphasis on preparing oneself for fishing by

having the appropriate tools and gear is encouraged in order to improve adoption of best-practice tools such as circle hooks as half the respondents are not always, or often, using them.

The handling practices reported generally adhere with the best-practice guidelines, but some behaviour could be improved. For example, respondents do not report lifting rays by the snout or spiracles, which is the recommended handling method.

The survey highlighted that there is a considerable level of concern amongst the recreational fishing community about practices used by other fishers, with half stating that they had witnessed poor practices by other fishers with sharks and rays. Of the half that stated they had witnessed poor practices by other fishers, a large proportion (45%) thought that the problem was widespread and the rest (55%) thought that it was only a minor problem. Previous surveys have highlighted that positive attitudes and intentions in the handling of sharks does not always translate to using best-practice techniques (Heard *et al.*, 2016). The issue may be widespread if there are fishers unintentionally using practices that are not appropriate. Changing the perceived social norms around what is best-practice for recreational fishing of sharks and rays may have a broad influence on the practices of the recreational fishing community (Heard *et al.*, 2016). Shifting the social norms may also apply more pressure on any individuals that consistently and deliberately use inappropriate techniques. Many of the respondents thought that providing more information on optimal handling practices would be the most effective method to assist fishers in improving behaviour.

Guidelines, communication and extension strategy

Best-practice guidelines were designed based on survey responses and workshop discussions. Simple messaging, clear graphics and diagrams were used for the online document summarising the best-practice guidelines (accessed [here](#)). The techniques are easy to adopt and importantly are easy messages to communicate, such as using circle-hooks, keeping sharks and rays in the water where possible, minimising fight time and exposure to air, supporting the body of the fish if lifting and avoiding lifting by the tail. We created specific recommendations for the handling of groups of species: rays with a barb, rays without a barb, sharks under 1.5 m, and sharks over 1.5 m. It was necessary to provide guidelines for groups of like animals (e.g. large sharks vs small sharks) because best-practice capture and handling techniques are often similar for species within each group.

The delivery of the extension campaign was initially delayed due to the COVID-19 pandemic and the government restrictions on fishing in Victoria, which also prevented in-person extension activities such as presentations at fishing shows or talks at fishing clubs. The strategy shifted to focus almost entirely to a multi-media approach with online dissemination of information along with informational flyers and stickers distributed directly to fishing and tackle shops through VRFish. We created a website (sharkmates.com.au) to host all education material including the best-practice guidelines and a brochure summarising the key recommendations from the best-practice guidelines, and general information about the project. We produced a series of six videos and uploaded them to YouTube and the website to demonstrate best-practice fishing techniques. Social media accounts were created on Instagram, Twitter, and Facebook and advertised on existing social media accounts such as the platforms used by VRFish. To date, there has been limited engagement on social media with 491 views of the videos on YouTube, 131 followers on Instagram and 100 followers on Facebook. Further efforts to promote the campaign and informational resources are warranted.

Resources created by this project and the extension of this information to the recreational fishing community in Australia encourages the recreational fishing community to fish responsibly in an informed way that improves their own safety and post-release survival of captured sharks and rays. It may be difficult to influence the behaviour of fishers within the community who will do the wrong thing regardless of being informed about best-practice. However, by creating general behaviour change in recreational fishing towards best-practice behaviours, it is possible that these behaviours

will become the 'social norm' which will potentially increase the uptake of best practices even by fishers who were previously acting poorly.

Conclusion

Ethical incidents affecting the social licence of recreational fishers to catch chondrichthyes highlighted a need for behavioural change of fishers. An expert steering committee was formed to guide this project and associated SARDI project (FRDC Project 2018-055) to ensure cohesive efforts between both projects and joint development of a workshop focused on chondrichthyes in recreational fisheries (Objective 2 & 5). A vulnerability analysis was completed for chondrichthyans impacted by recreational fishing in the southern waters of Australia and showed that 13 of the 33 recreationally-fished species are at medium or high risk from anthropogenic stressors (Objective 4) (Walker *et al.*, 2021). A multi-jurisdictional workshop was then convened to identify species of importance and develop capture, handling and release protocols for chondrichthyes across states to ensure the safety of fishers, humane and ethical handling and release, and high post-release survival (Reina *et al.*, 2020). A survey of 1135 recreational fishers was conducted to assess current practices and highlighted that ~50% are concerned with treatment of sharks and rays by other recreational fishers. The most supported action to address this issue was to “provide more information on optimal handling practices”. A comprehensive extension campaign (*Shark Mates*) was developed and promoted to the Australian recreational fishing community with the goal of causing behavioural change of fishers in their interactions with captured sharks, rays, and chimaeras in Victoria (Objective 1). Best-practice handling guidelines were developed. The techniques described are simple to adopt and include the use circle-hooks, keeping sharks and rays in the water where possible, minimising fight time and exposure to air, supporting the body of the fish if lifting, and avoiding lifting by the tail. Specific recommendations were created for the handling of the following groups of species: rays with a barb, rays without a barb, sharks under 1.5 m, and sharks over 1.5 m. A suite of informational resources (guidelines, videos, website, brochures) were developed, are available to the public, and are promoted through the peak recreational fishing body in Victoria, VRFish. We recommend that a follow-up survey is conducted in the future (ideally between 2023–2025) to assess whether recreational fisher behaviours has changed as a result of the extension campaign from this project. Whilst the Covid-19 pandemic and associated societal disruptions in Victoria severely impacted the planned activities of this project, the project generated valuable resources for the recreational fishing community to improve outcomes in the capture and release of chondrichthyan species. Further dissemination of this information by VRFish and other fishing groups will further increase behavioural change.

Implications

Our survey data and the data from previous surveys (Heard *et al.*, 2016) highlight that recreational fishers generally hold positive values toward ethical practices to catch sharks and rays. Most fishers surveyed also agree that releasing fish using methods that give the greatest chance of post-release survival is important to them, and ~50% of respondents are concerned with the behaviour of other fishers. Management agencies are likely to optimise outcomes for sharks and rays by focusing on engagement and education activities that provide fishers with the knowledge and tools to implement best-practice, while acknowledging that compliance operations will also be necessary to target the much smaller group of fishers who will continue to behave poorly regardless of the information provided to them (i.e. the shark mutilators). The key messaging for best-practice capture and handling guidelines for sharks and rays discussed within this report serve as an educational resource for informing fishers of best-practice to enable positive outcomes for fishers and released sharks and rays. This project developed a set of best-practice capture and handling guidelines for recreational fishing of sharks and rays in southern Australia and completed an extension campaign to facilitate positive behavioural change of fishers.

Recommendations

We recommend that the best-practice capture, handling and release guidelines are promoted by FRDC and relevant state-based fishing bodies (both government and non-government). VRFish will be monitoring interest and support for the *Shark Mates* brand over the coming year through informal discussions and social media metrics and promoting it amongst their members and networks. Further recruitment of ambassadors from the recreational fishing community could help disseminating the best-practice guidelines and informational videos. Not only can ambassadors provide a critical role as an influential role model within the fishing community, but they can also assist by sharing photographic and video content of their implementation of best-practice techniques. Furthermore, sharing their insights and practical information will assist other fishers' uptake of best-practice techniques. Dependent upon the following of the *Shark Mates* brand, merchandising could be established to help raise funds for social media campaigns, filming of more informational videos, further survey work, and informational workshops or presentations. Finally, any novel information from future post-release survival studies should be used to further refine the existing best-practice guidelines outlined in this report.

Further development

We recommend that a follow-up survey is conducted in the future (ideally between 2023–2025) to assess whether recreational fisher behaviours has changed as a result of the extension campaign from this project. Furthermore, a national survey of current fisher behaviours should be conducted to assess adherence to best-practice and compare it to our results from the Victorian recreational fishing community. Fishing behaviours should be frequently reassessed to identify shifts in fisher behaviour, which could be undertaken through phone apps that incorporate key messaging from the best-practice guidelines.

Extension and Adoption

Unethical handling and release conditions of recreationally-caught sharks and rays across Australia's southern states highlighted a need for better education and behavioural change. Such need was further highlighted by ~50% of respondents to our survey having witnessed poor handling and release practices and that it was a widespread issue. The best-practice capture, handling, and release guidelines developed for this project serve as an informational resource to prepare recreational fishers for shark and ray fishing. This final report submitted to FRDC details the best-practice capture, handling, and release guidelines. This report is accessible to the general public via the FRDC website. The guidelines have also been promoted across VRFish mailing list, social media channels, including YouTube, and are available on the *Shark Mates* website. Various methods for extension of the key messaging were used, including providing informational brochures and promotional stickers to bait and tackle shops, and promotion on Instagram, Facebook, Twitter, and YouTube.

We will present the findings of this project at scientific conferences (such as the World Recreational Fishing Conference in 2023), fishing clubs, fishing conferences (such as the national recreational fishing conference), and publish the survey results in a peer-reviewed article in a scientific journal, such as *Conservation Science and Practice* or *Frontiers in Marine Science*. Members of our project team will provide expert consultations about the project and resulting best-practice guidelines to interested parties. Furthermore, we will ensure ongoing extension via communications from VRFish and VFA about the guidelines. For example, the video and other media generated from the project will continue to be hosted on the *Shark Mates* YouTube and website.

We will use websites and social media networks of all project partners (Flinders University, Monash University, VFA, and VRFish) to highlight the completion of this project and the guidelines to further disseminate information on best-practice capture, handling, and release of Chondrichthyes.

Project coverage

FRDC published a media story that mentions this project: <https://www.frdc.com.au/tuna-champions-looks-beyond-bluefin>

Presentations

Williamson, S. A. (2022) Shark mates: applying physiological research and social science to improve conservation of sharks and rays in Australian recreational fisheries. Florida Atlantic University, Marine Science Seminar.

Publications

Reina, R. D., Rogers, P. and Williamson, S. A. (2020). Shark and rays in recreational fisheries: Priority species, handling guidelines, post-release survival, and extension approaches to support cultural change in fishers. Proceedings of the National Workshop, Adelaide, South Australia, 26th November 2019., pp. 88: Fisheries Research and Development Corporation, South Australian Research and Development Institute, and Monash University.

Project materials developed

The project generated the following products:

1. Vulnerability risk analysis for recreationally caught chondrichthyan species in southern Australia – detailed in this report and adapted from Walker *et al.* (2021)
2. Workshop proceedings – Reina *et al.* (2020)
3. Best-practice capture, handling, and release guidelines – [PDF Document](#)
4. Informational videos – [Shark Mates YouTube Channel](#)
5. Website housing information, guidelines and embed videos – www.sharkmates.com.au
6. Social media account and content – [Instagram](#), [Facebook](#), and [Twitter](#)
7. Informational brochures about Shark Mates project – Figure 5
8. Stickers to promote Shark Mates project – Figure 6

Appendices

Appendix 1: Project Staff

FRDC Project 2018-042:

Dr Richard Reina – Monash University

Dr Sean Williamson – Monash University

Dr Charlie Huveneers - Flinders University

Dr Corey Green – Victorian Fisheries Authority (VFA)

Mr Michael Burgess – VRFish

Mr Ben Scullin – VRFish

Dr Terence Walker – Monash University

Survey Design:

Dr. Carly Cook – Monash University

Dr. Jessica Walsh – Monash University

Film production:

Mr Matt Woods – Biomedica Pty Ltd

Boat Skippers and Charter Companies:

Mr Steve Di Sauro – Bellarine Fishing Charters

Mr Steve Napoli – Able Fishing Charters

Marketing and branding:

Mrs Kris Kelly – Paul Kelly Media

Mr Paul Kelly – Paul Kelly Media

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Appendix 3: Fisher Survey Questions

Shark handling practices survey

Start of Block: Introduction

Q1

This research project is conducted by Monash University and VRFish to better understand safe handling practices for sharks and rays caught by recreational fishers.

Your participation will help us to develop best practice guidelines for the safe handling of sharks and rays. If you would like to go into the draw to win one of three \$100 tackle vouchers for your preferred tackle shop, please tick yes to that question at the end of the survey.

Q2 Please indicate that you have read and understood the [Explanatory Statement](#) and hereby consent to participate in this project. Please be aware that you must be over 18 to participate in this research. All surveys are completed anonymously and all data collected will be presented in an aggregated format to avoid participants from being identified.

I consent to my survey responses being used to develop an understanding of the current ways in which recreational fishers handle and release sharks and rays that they catch, with the goal of improving the outcomes for these fish and fishers' safety.

- Yes (1)
- No (2)

Skip To: End of Survey If Please indicate that you have read and understood the Explanatory Statement and hereby consent = No

End of Block: Introduction

Start of Block: Fisher details

Q3 How would you describe your usual fishing style?

- I prefer common tackle and target whatever is biting. (1)
 - I prefer common tackle and often target a particular species. (2)
 - I prefer high quality tackle and usually target a particular species. (3)
 - I use high-quality species-specific tackle and always target a particular species. (4)
-

Q4 Which state / territory do you predominately fish in?

Select one

– ▼ Australian Capital Territory (1) ... Western Australia (8)

Q5 When did you last go fishing?

- Within the last 12 months (1)
- 2 to 5 years ago (2)
- More than 5 years ago (3)
- Never (4)
- Don't know (5)

Skip To: End of Block If When did you last go fishing? != Within the last 12 months

Page Break

Q6 How often have you fished in the last 12 months at the following locations?

Even if you only fished for an hour that counts as one fishing day.

	Never (1)	1 or 2 days (2)	3-4 days (3)	5-9 days (4)	10-14 days (5)	15-19 days (6)	20-29 days (7)	30-51 days (8)	52+ days (9)
Freshwater Fishing (inland rivers, lakes and dams) (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Estuary Fishing (lakes or rivers that feed into the ocean, where water can be salty) (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Saltwater Fishing (ocean waters or harbours / bays) (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q7 Which locations have you fished at within the last 12 months?

Tick all that apply.

	None of my fishing (1)	Some of my fishing (2)	Most of my fishing trips (4)	All of my fishing trips (3)
Beaches (bays, & coastlines) (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Boat-based - inshore coastal waters (less than 5km offshore) (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Boat-based - offshore waters (more than 5km offshore) (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Boat-based - estuary fishing (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
River bank (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Piers / Jetties (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rocks / Rock platforms (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fishing competitions (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Charter fishing / fishing with a guide (9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
other (please specify) (10)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Page Break

Q8 Have you targeted or caught sharks, rays and/or elephant fish in the last 12 months?

- I targeted and caught (1)
- I targeted but didn't catch (2)
- I did not target but I did catch (3)
- I did not target and did not catch (4)

End of Block: Fisher details

Start of Block: Which species?

Q9 Which of these shark and ray species have you **TARGETED** at any time in the past (NOT just last 12 months)?

Tick all that apply.

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- I have never targeted a shark or ray** (18)
- Shark - not targeting specific species** (22)
- Ray - not targeting specific species** (23)
- Blue Shark** Image: Mark Conlin (1)
- Bronze Whaler** Image: Clinton Duffy (2)
- Draughtboard Shark / Swell Shark / Sleepy Joe** Image: Peter Southwood (21)
- Dusky Shark / Dusky Whaler** Image: John Turnbull (3)
- Eagle Ray** Image - Ken Flan (4)
- Elephant Fish** Image: fir0002 (5)
- Fiddler Ray / Banjo Shark** Image: Mark Norman (6)
- Gummy Shark** Image: Jack Breedon (7)
- Hammerhead Shark** Image: Australian National Fish Collection (8)
- Mako Shark** Image: Patrick Doll (9)
- Port Jackson shark** Image: Mark Norman (10)
- School Shark** Image: Jens Christian Schou (11)
- Seven-gill Shark / Broadnose Shark** Image: Ross Robertson (12)
- Skates** Image: Rick Stuart-Smith (20)
- Smooth Stingray** Image: Sarah Speight (13)
- Stingarees** Image: Andrew Green (14)
- Thresher Shark** Image: Australian National Fish Collection (15)
- Other (please list)** (19) _____

Page Break

Q89 Which of these shark and ray species have you **CAUGHT** at any time in the past (NOT just last 12 months)?

Tick all that apply.

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- I have never caught a shark or ray** (18)
- Ray - not sure of type / species** (23)
- Shark - not sure of type / species** (22)
- Blue Shark** Image: Mark Conlin (1)
- Bronze Whaler** Image: Clinton Duffy (2)
- Draughtboard Shark / Swell Shark / Sleepy Joe** Image: Peter Southwood (21)
- Dusky Shark / Dusky Whaler** Image: John Turnbull (3)
- Eagle Ray** Image - Ken Flan (4)
- Elephant Fish** Image: fir0002 (5)
- Fiddler Ray / Banjo Shark** Image: Mark Norman (6)
- Gummy Shark** Image: Jack Breedon (7)
- Hammerhead Shark** Image: Australian National Fish Collection (8)
- Mako Shark** Image: Patrick Doll (9)
- Port Jackson shark** Image: Mark Norman (10)
- School Shark** Image: Jens Christian Schou (11)
- Seven-gill Shark / Broadnose Shark** Image: Ross Robertson (12)
- Skates** Image: Rick Stuart-Smith (20)
- Smooth Stingray** Image: Sarah Speight (13)
- Stingarees** Image: Andrew Green (14)
- Thresher Shark** Image: Australian National Fish Collection (15)
- Other (please list)** (19) _____

Skip To: End of Block If Which of these shark and ray species have you CAUGHT at any time in the past (NOT just last 12 mo... = I have never caught a shark or ray

Display This Question:

If Have you targeted or caught sharks, rays and/or elephant fish in the last 12 months? = I targeted and caught

Or Have you targeted or caught sharks, rays and/or elephant fish in the last 12 months? = I did not target but I did catch

Q11 In the **LAST 12 MONTHS** how many of each species have you PERSONALLY caught and kept, or caught and released?

Type 'don't know' in the text box if you can't remember. Leave blank if you didn't catch that species in the last 12 months.

	Number caught and kept (1)	Number caught and released (2)
Blue Shark (1)		
Bronze Whaler (2)		
Dusky Shark (3)		
Eagle Ray (4)		
Elephant Fish (5)		
Fiddler Ray / Banjo Shark (6)		
Gummy Shark (7)		
Hammerhead Shark (8)		

Mako Shark (9)		
Port Jackson Shark (10)		
School Shark (11)		
Seven-gill Shark (12)		
Skates (18)		
Smooth Stingray (13)		
Stingarees (14)		
Thresher Shark (15)		
Shark - Not sure of type/ species (16)		
Ray - Not sure of type / species (17)		

Display This Question:

If Have you targeted or caught sharks, rays and/or elephant fish in the last 12 months? = I targeted and caught

Or Have you targeted or caught sharks, rays and/or elephant fish in the last 12 months? = I did not target but I did catch

Q12 For the species of shark or ray listed above that you caught most frequently, what **GEAR** do you usually use?

If you have two species that were equally caught the most frequently, please list species you are referring to at the bottom.

- Hook: (4) _____
- Line & Leader: (5) _____
- Rod & reel: (6) _____
- Other gear: (8) _____
- Species: (7) _____

End of Block: Which species?

Start of Block: Reasons for release

Q13 If you were to catch any of the following species, how likely would you be to try and release it?

By release, we mean to let the fish go alive, rather than keeping it or killing it.

	Very likely (1)	Likely (2)	Unlikely (4)	Very unlikely (5)	Depends on situation (3)	Unsure (6)
Bronze Whaler (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eagle Ray (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Elephant Fish (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fiddler Ray / Banjo Shark (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gummy Shark (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hammerhead Shark (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mako (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Port Jackson Shark (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
School Shark (9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Smooth Stingray (10)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thresher Shark (11)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Page Break

Q14 What are the main reasons why you would **RELEASE** a shark or ray?

Tick all that apply.

- Not good eating (1)
 - I only fish to catch and release (15)
 - Not the correct legal size (too big or too small) (2)
 - Ethical or environmental reasons (3)
 - Unsure of how to handle animal (4)
 - Unsure of catch limits or restrictions for that species (5)
 - Not targeting that species (6)
 - Didn't want to keep a female fish (12)
 - Have enough fillets already (11)
 - Already at bag limit for that species (10)
 - Too big for esky / boat (13)
 - Wanted to scientifically tag the shark (14)
 - I'm not prepared (e.g. fishing in a kayak, or don't have a knife to dispatch fish) (16)
 - Unable to identify the species (17)
 - Other (please specify) (7)
-
- I would never release one (8)

Page Break

Q15 What are the main reasons why you would **KEEP** a shark or ray?

Tick all that apply.

- Good eating (1)
 - Use for bait (2)
 - It's a nuisance species (3)
 - Doesn't look healthy enough for a successful release (7)
 - Trophy (4)
 - To weigh and measure the shark for a fishing competition (8)
 - Other (please specify) (5)
-
- I would never keep one (6)

End of Block: Reasons for release

Start of Block: Confidence

Carry Forward All Choices - Displayed & Hidden from "If you were to catch any of the following species, how likely would you be to try and release it? By release, we mean to let the fish go alive, rather than keeping it or killing it."

X→

Q16 How confident are you in safely handling each species of shark or ray, to reduce the risk of injury to you or others?

	Very confident (1)	Confident (2)	Moderately confident (3)	Slightly confident (4)	Not confident (5)
Bronze Whaler (x1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eagle Ray (x2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Elephant Fish (x3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fiddler Ray / Banjo Shark (x4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gummy Shark (x5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hammerhead Shark (x6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mako (x7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Port Jackson Shark (x8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
School Shark (x9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Smooth Stingray (x10)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thresher Shark (x11)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Page Break



Q17 If releasing the animal, how confident are you in handling each species of shark or ray in a way that **minimises harm to the fish and maximises post-release survival?**

	Very confident (1)	Confident (2)	Moderately confident (3)	Slightly confident (4)	Not confident (5)
Bronze Whaler (xx1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eagle Ray (xx2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Elephant Fish (xx3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fiddler Ray / Banjo Shark (xx4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gummy Shark (xx5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hammerhead Shark (xx6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mako (xx7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Port Jackson Shark (xx8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
School Shark (xx9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Smooth Stingray (xx10)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thresher Shark (xx11)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Page Break

Q18 Are there any shark or ray species that you find particularly **difficult** to handle?

Please list them and state why.

Q19 Are there any shark or ray species that you find particularly **easy** to handle?

Please list them and state why.

Page Break

Display This Question:

If Which of these shark and ray species have you CAUGHT at any time in the past (NOT just last 12 mo... != I have never caught a shark or ray

And And Which of these shark and ray species have you CAUGHT at any time in the past (NOT just last 12 mo... q://QID92/SelectedChoicesCount Is Not Equal to 0

Carry Forward Selected Choices from "Which of these shark and ray species have you CAUGHT at any time in the past (NOT just last 12 months)? Tick all that apply. All images are licensed under Creative Commons by Attribution."



Q20 What proportion of animals that you release do you think will survive? (0 - 100%)

Of these shark or ray species that you have previously caught, think about how many individuals you have released. Of those that you released, please provide a percentage (0-100%) of the number that you think survived. Type "don't know" if unsure, or "NA" if you have never released that species.

- I have never targeted a shark or ray (1)

- Ray - not sure of type / species** (2)

- Shark - not sure of type / species** (3)

- Blue Shark (4) _____
- Bronze Whaler** Image: Clinton Duffy (5)

- Draughtboard Shark / Swell Shark / Sleepy Joe (6)

- Dusky Shark (7) _____
- Eagle Ray** Image - Ken Flan (8)

- Elephant Fish** Image: fir0002 (9)

- Fiddler Ray / Banjo Shark** Image: Mark Norman (10)

- Gummy Shark** Image: Jack Breedon (11)

- Hammerhead Shark (12) _____
- Mako Shark (13) _____
- Port Jackson shark** Image: Mark Norman (14)

- School Shark (15) _____
- Seven-gill Shark (16) _____

- Skates (17) _____
- Smooth Stingray (18) _____
- Stingarees (19) _____
- Thresher Shark (20) _____
- Other (please list)** (21) _____

End of Block: Confidence

Start of Block: Handling methods

Q21 Which of the following items do you usually take with you when fishing?

- Pliers (1)
 - Bolt / heavy wire cutters (2)
 - Knotless net (3)
 - Gaffing pole (4)
 - Measuring pole / measuring sticker (5)
 - Gloves (6)
 - Dark cloth (7)
 - Crimper (8)
 - Knife (9)
 - Wire leader (10)
 - None of the above (13)
 - Other (Please Specify) (11)
-

Page Break

Q22 When you are in an area where you may catch a shark or ray how often do you use **circle hooks**?

image source: http://flseagrant.ifas.ufl.edu/catch_and_release_new/hooking-and-dehooking.html

- Always (1)
 - Often (2)
 - Sometimes (3)
 - Rarely (4)
 - Never (5)
-

Q23 When you are in an area where you may catch a shark or ray how often do you use **J hooks**?

image source: http://flseagrant.ifas.ufl.edu/catch_and_release_new/hooking-and-dehooking.html

- Always (1)
 - Often (2)
 - Sometimes (3)
 - Rarely (4)
 - Never (5)
-

Page Break

Q24 Why do you choose to use or not use circle hooks?

Page Break

Q25 If you catch and intend to release **a ray with a dangerous barb (stinger) on its tail**, which of these practices would you use? (This includes eagle ray, smooth ray, black ray etc).

Tick all that you would use.

- Leave ray in the water and remove hook or cut line as short as possible (3)
 - Land / remove ray from water to remove hook or cut line (4)
 - Remove hook, where possible (6)
 - Cut barb or tail off (18)
 - Lift by grabbing the snout and / or spiracles (openings behind the eyes) (8)
 - Lift by grabbing, or gaffing in, the gills or mouth or tail (9)
 - When lifting, support the body while holding the tail (12)
 - Use a knot-less net to lift ray out of the water (17)
 - Minimise exposure to sun and air (14)
 - Other (please specify) (15)
-

Q26 If you catch and intend to release a **non-dangerous ray without a barb**, which of these practices would you use? (This includes fiddler rays/banjo sharks, skates etc).

Tick all that you would use.

- Leave ray in the water and remove hook or cut line as short as possible (3)
 - Land / remove ray from water to remove hook or cut line (4)
 - Remove hook, where possible (6)
 - Cut barb or tail off (18)
 - Lift by grabbing the snout and / or spiracles (openings behind the eyes) (8)
 - Lift by grabbing, or gaffing in, the gills or mouth or tail (9)
 - When lifting, support the body while holding the tail (12)
 - Use a knot-less net to lift ray out of the water (17)
 - Minimise exposure to sun and air (14)
 - Other (please specify) (15)
-

Page Break

Q27 If you catch and intend to release a **small shark**, which of these practices would you use? (This includes sharks less than 1.5 m long, such as Gummy sharks and Port Jackson sharks).

Tick all that you would use.

- Leave shark in the water and remove hook or cut line as short as possible (3)
 - Land / remove shark from water to remove hook or cut line (4)
 - Remove hook, where possible (6)
 - Lift by grabbing, or gaffing, the gills or mouth or tail (9)
 - When lifting, support the body while holding the tail (12)
 - Use a knot-less net to lift shark out of the water (17)
 - Minimise exposure to sun and air (14)
 - Calm shark by covering eyes with smooth, wet and dark cloth (22)
 - Other (please specify) (15)
-

Q28 If you catch and intend to release a **large shark (greater than 1.5m)**, which of these practices would you use?

Tick all that you would use.

- Leave shark in the water and remove hook or cut line as short as possible (3)
 - Land / remove shark from water to remove hook or cut line (4)
 - Remove hook, where possible (6)
 - Lift by grabbing, or gaffing in, the gills or mouth or tail (9)
 - When lifting, support the body while holding the tail (12)
 - Use a knot-less net to lift shark out of the water (17)
 - Minimise exposure to sun and air (14)
 - Calm shark by covering eyes with smooth, wet and dark cloth (22)
 - Other (please specify) (15)
-

Page Break

Q29 What are the main methods you use to reduce the risk of injury or death to the sharks or rays that you release?

Page Break

Q30 Which of the following methods do you think would minimise the risk of injury/death to the fish and maximise post-release survival when releasing a shark or ray?

Tick all that apply.

- Dehooking by side of boat (1)
- Cutting line quickly (2)
- Holding it in a particular manner (3)
- Remove hook (4)
- Using circle hooks (5)
- Using J hooks (6)
- Cutting line as close as possible (7)
- Reduce exposure to air (8)
- Use heavy fishing line/gear (9)
- Using non-stainless hooks (11)
- Using stainless hooks (13)
- None of the above (12)
- Other (please list) (10) _____

End of Block: Handling methods

Start of Block: Attitudes to sharks and rays

Q31 Have you witnessed poor practices by other fishers with sharks and rays?

By poor practices, we mean practices which have the potential to cause unnecessary harm to the fishers themselves or sharks and rays.

- Yes (1)
 - No (2)
-

Display This Question:

If Have you witnessed poor practices by other fishers with sharks and rays? By poor practices, we... = Yes

Q32 Do you think it's fairly widespread or just a minor problem?

- Widespread (1)
 - Minor problem (2)
-

Q33 How concerned are you about other fishers' **practices when handling** sharks and rays?

- Very concerned (1)
 - Concerned (2)
 - Slightly concerned (3)
 - Not concerned (4)
-

Q34 How concerned are you about other fishers' **attitudes** towards these species?

- Very concerned (1)
 - Concerned (2)
 - Slightly concerned (3)
 - Not concerned (4)
-

Q35 What would be effective methods to assist fishers in adopting best-practice in handling & release of sharks and rays?

Select all that apply.

- Providing more information on optimal handling practices (4)
 - Greater enforcement (5)
 - Free or subsidised circle hooks (6)
 - Changing culture (7)
 - Other (8) _____
-

Q36 What kind of information regarding shark and ray handling would you appreciate / find useful?

End of Block: Attitudes to sharks and rays

Start of Block: Demographics

Q37 How old are you in years?

– ▼ 18 years (1) ... 100 + (165)

Q38 What is your gender?

- Male (1)
 - Female (2)
 - Other e.g. gender non-conforming, gender fluid, inter-gender or don't identify with a gender (3)
 - Prefer not to say (4)
-

Q39 Have you completed any of the following?

Select ALL that apply

- Year 10 of high school or equivalent (1)
- Year 12 of high school or equivalent (2)
- Certificate or Diploma (3)
- University undergraduate degree (4)
- University graduate degree (5)
- None of these (6)

Page Break

Q40 Where do you live? (Primary residence)

We will protect the privacy of survey participants. We ask these questions so we can check for differences in the results of the survey between different regions.

Q41 What state / territory you live in?

- ▼ ACT (1) ... Western Australia (8)

Q42 Postcode you live in:

Page Break

Q43 How would you describe yourself?

- Australian-born (1)
 - Born overseas in an English speaking country e.g. New Zealand, UK (2)
 - Born overseas in a non-English speaking country e.g. Indonesia, France (3)
-

Q44 Are you of Aboriginal or Torres Strait Islander origin?

- No (1)
 - Yes, Aboriginal (2)
 - Yes, Torres Strait Islander (3)
 - Yes, Both Aboriginal and Torres Strait Islander (4)
-

Q45 How would you describe your overall cultural background (e.g. Australian, Chinese, Japanese, English, Zimbabwean)?

Page Break

Q46 Have you been a member of a fishing club in the last 12 months?

- Yes (1)
- No (2)
- Unsure (3)

End of Block: Demographics

Start of Block: Follow up questions

Q47 Would you like to receive more information about safe handling and release practices of sharks and rays?

- Yes (1)
 - No (2)
-

Q48 Would you be willing to participate in a follow-up survey that aims to understand the value of educational material developed to help fishers with safe handling practices?

- Yes (1)
 - No (2)
-

Q49 Would you like to go into the running to win one of three \$100 vouchers at your local tackle store? Only the winners will be contacted.

- Yes (1)
 - No (2)
-

Display This Question:

If Would you like to receive more information about safe handling and release practices of sharks an... = Yes

Or Would you be willing to participate in a follow-up survey that aims to understand the value of ed... = Yes

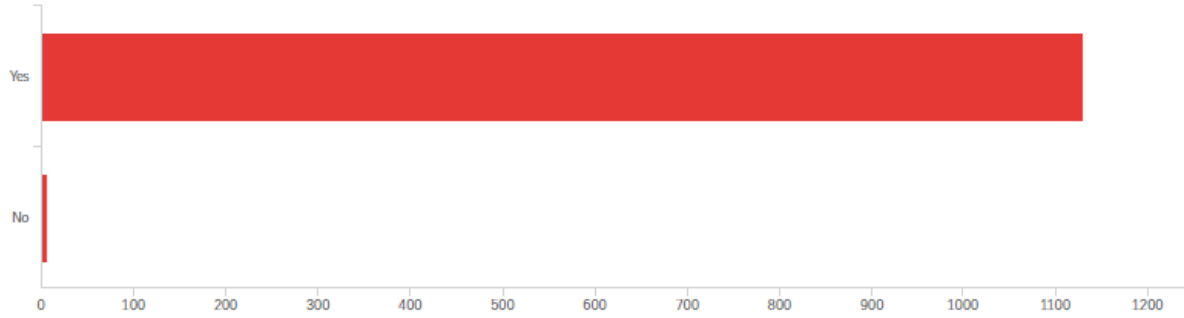
Or Would you like to go into the running to win one of three \$100 vouchers at your local tackle stor... = Yes

Q50 If you said yes to any of these questions, please provide an email address so we can contact you. Your email will only be used for the purpose/s that you indicated above and your responses to other questions will remain anonymous.

Appendix 4: Summary of Survey Response Data

Q2 - Please indicate that you have read and understood the Explanatory Statement and

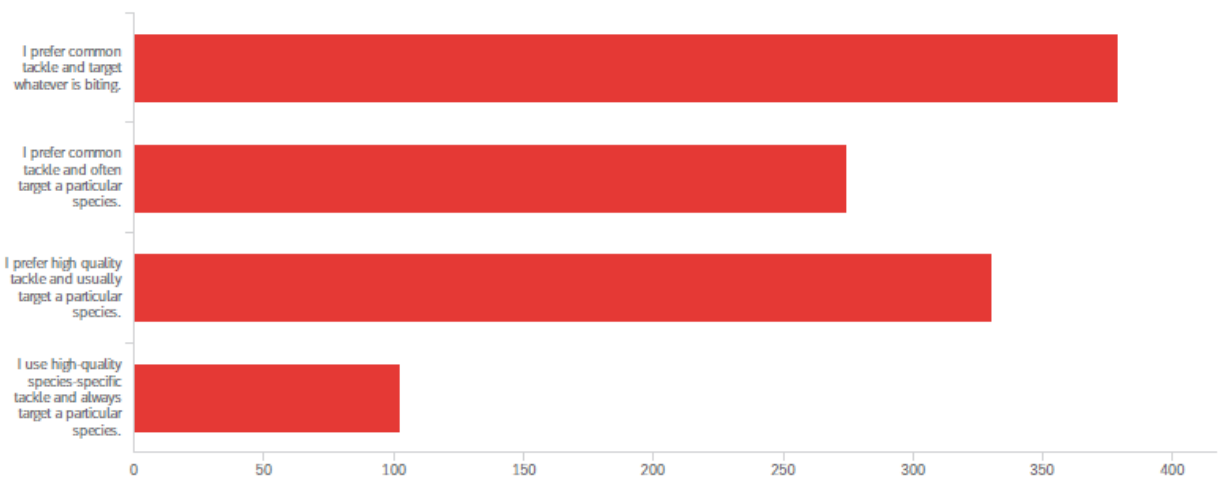
hereby consent



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Please indicate that you have read and understood the Explanatory Statement and hereby consent	1.00	2.00	1.01	0.07	0.01	1,135

#	Field	Choice Count
1	Yes	99.47% 1129
2	No	0.53% 6

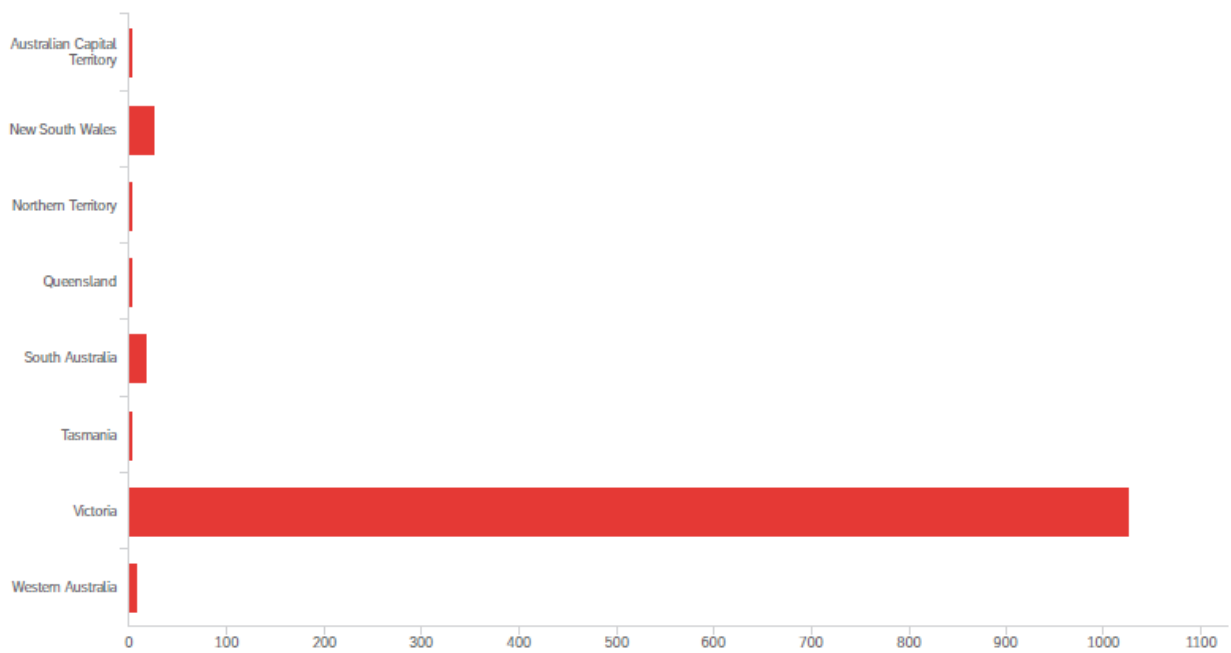
Q3 - How would you describe your usual fishing style?



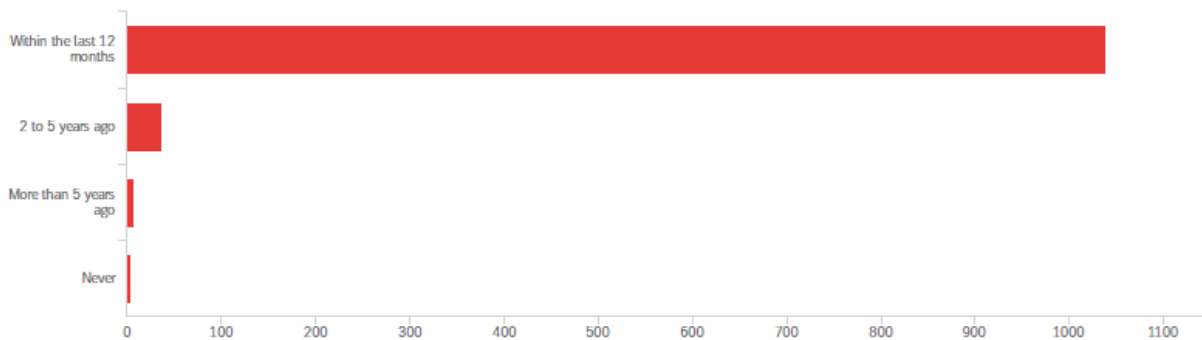
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	How would you describe your usual fishing style?	1.00	4.00	2.14	1.00	1.01	1,085

#	Field	Choice Count
1	I prefer common tackle and target whatever is biting.	34.93% 379
2	I prefer common tackle and often target a particular species.	25.25% 274
3	I prefer high quality tackle and usually target a particular species.	30.41% 330
4	I use high-quality species-specific tackle and always target a particular species.	9.40% 102
		1085

Q4 - Which state / territory do you predominately fish in? Select one



Q5 - When did you last go fishing?



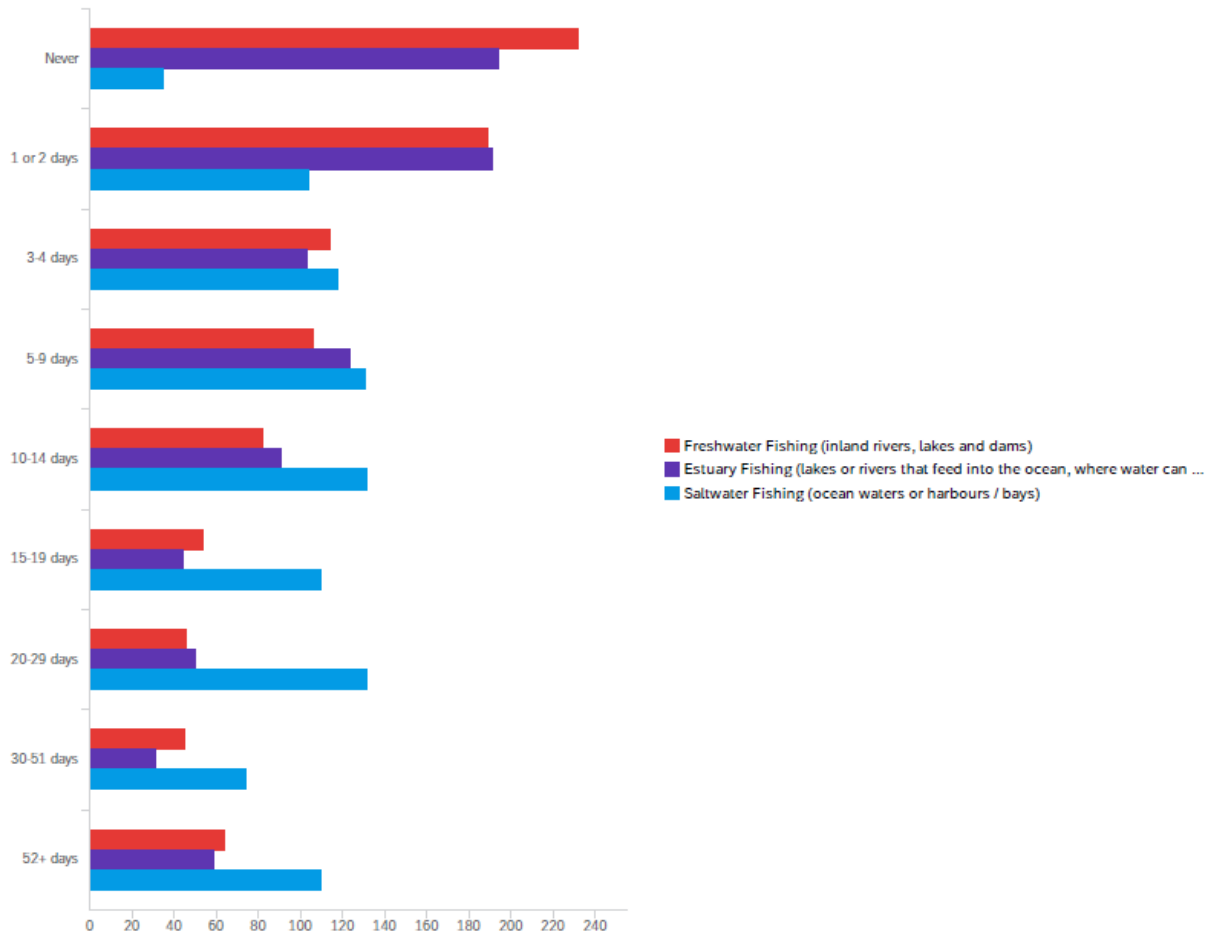
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	When did you last go fishing?	1.00	4.00	1.05	0.26	0.07	1,081

#	Field	Choice Count
1	Within the last 12 months	96.02% 1038
2	2 to 5 years ago	3.24% 35
3	More than 5 years ago	0.56% 6
4	Never	0.19% 2

1081

Q6 - How often have you fished in the last 12 months at the following locations? Even if

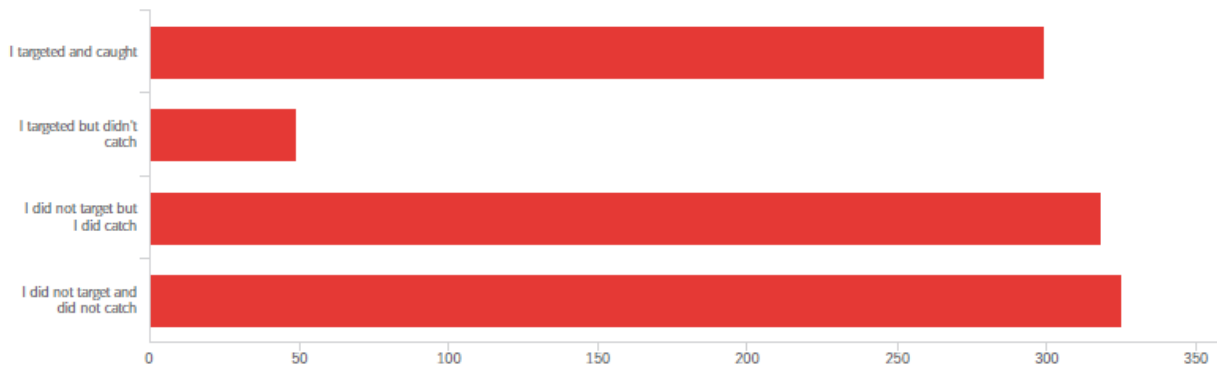
you only fished for an hour that counts as one fishing day.



#	Field	Never	1 or 2 days	3-4 days	5-9 days	10-14 days	15-19 days	20-29 days	30-51
1	Freshwater Fishing (inland rivers, lakes and dams)	24.89% 232	20.28% 189	12.23% 114	11.37% 106	8.80% 82	5.79% 54	4.94% 46	4.83%
2	Estuary Fishing (lakes or rivers that feed into the ocean, where water can be salty)	21.87% 194	21.53% 191	11.61% 103	13.98% 124	10.26% 91	4.96% 44	5.64% 50	3.49%
3	Saltwater Fishing (ocean waters or harbours / bays)	3.70% 35	10.99% 104	12.47% 118	13.85% 131	13.95% 132	11.63% 110	13.95% 132	7.82%

#	Field	None of my fishing	Some of my fishing	All of my fishing trips	Most of my fishing trips	Total
1	Beaches (bays, & coastlines)	21.28% 179	50.06% 421	5.59% 47	23.07% 194	841
2	Boat-based - inshore coastal waters (less than 5km offshore)	20.41% 187	33.95% 311	10.81% 99	34.83% 319	916
3	Boat-based - offshore waters (more than 5km offshore)	54.61% 444	31.86% 259	2.09% 17	11.44% 93	813
4	Boat-based - estuary fishing	45.91% 365	40.38% 321	2.52% 20	11.19% 89	795
5	River bank	29.52% 245	53.61% 445	2.29% 19	14.58% 121	830
6	Piers / Jetties	32.85% 272	48.31% 400	3.02% 25	15.82% 131	828
7	Rocks / Rock platforms	55.14% 429	35.60% 277	1.54% 12	7.71% 60	778
8	Fishing competitions	76.66% 588	18.90% 145	0.65% 5	3.78% 29	767
9	Charter fishing / fishing with a guide	73.87% 571	23.54% 182	0.78% 6	1.81% 14	773
10	other (please specify)	83.06% 304	8.74% 32	3.01% 11	5.19% 19	366

Q8 - Have you targeted or caught sharks, rays and/or elephant fish in the last 12 months?



#	Field	Choice Count
1	I targeted and caught	30.17% 299
2	I targeted but didn't catch	4.94% 49
3	I did not target but I did catch	32.09% 318
4	I did not target and did not catch	32.80% 325
		991

Question 9. Which of these shark and ray species have you TARGETED at any time in the past (NOT just last 12 months)? Tick all that apply.

#	Field	Choice Count
1	Blue Shark Image: Mark Conlin	1.19% 28
2	Bronze Whaler Image: Clinton Duffy	3.84% 90
3	Dusky Shark / Dusky Whaler Image: John Turnbull	0.34% 8
4	Eagle Ray Image - Ken Flan	2.64% 62
5	Elephant Fish Image: fir0002	6.10% 143
6	Fiddler Ray / Banjo Shark Image: Mark Norman	4.43% 104
7	Gummy Shark Image: Jack Breedon	22.85% 536
8	Hammerhead Shark Image: Australian National Fish Collection	1.45% 34
9	Mako Shark Image: Patrick Doll	5.88% 138
10	Port Jackson shark Image: Mark Norman	3.15% 74
11	School Shark Image: Jens Christian Schou	8.23% 193
12	Seven-gill Shark / Broadnose Shark Image: Ross Robertson	3.20% 75
13	Smooth Stingray Image: Sarah Speight	1.07% 25
14	Stingarees Image: Andrew Green	0.81% 19
15	Thresher Shark Image: Australian National Fish Collection	2.56% 60
18	I have never targeted a shark or ray	17.26% 405
19	Other (please list)	0.43% 10
20	Skates Image: Rick Stuart-Smith	1.32% 31
21	Draughtboard Shark / Swell Shark / Sleepy Joe Image: Peter Southwood	0.94% 22
22	Shark - not targeting specific species	9.85% 231
23	Ray - not targeting specific species	2.47% 58

Question 10. Which of these shark and ray species have you TARGETED at any time in the past (NOT just last 12 months)? Tick all that apply.

#	Field	Choice Count
1	Blue Shark Image: Mark Conlin	1.47% 64
2	Bronze Whaler Image: Clinton Duffy	2.89% 126
3	Dusky Shark / Dusky Whaler Image: John Turnbull	0.32% 14
4	Eagle Ray Image - Ken Flan	7.25% 316
5	Elephant Fish Image: fir0002	6.45% 281
6	Fiddler Ray / Banjo Shark Image: Mark Norman	12.98% 566
7	Gummy Shark Image: Jack Breedon	13.65% 595
8	Hammerhead Shark Image: Australian National Fish Collection	2.45% 107
9	Mako Shark Image: Patrick Doll	2.48% 108
10	Port Jackson shark Image: Mark Norman	9.98% 435
11	School Shark Image: Jens Christian Schou	5.28% 230
12	Seven-gill Shark / Broadnose Shark Image: Ross Robertson	4.40% 192
13	Smooth Stingray Image: Sarah Speight	5.02% 219
14	Stingarees Image: Andrew Green	3.62% 158
15	Thresher Shark Image: Australian National Fish Collection	1.26% 55
18	I have never caught a shark or ray	4.27% 186
19	Other (please list)	0.69% 30
20	Skates Image: Rick Stuart-Smith	4.29% 187

Questions 13. If you were to catch any of the following species, how likely would you be to try and release it? By release, we mean let the fish go alive, rather than keeping it or killing it.

#	Field	Very likely	Likely	Depends on situation	Unlikely	Very unlikely	Unsure	Total
1	Bronze Whaler	79.53% 746	7.89% 74	6.29% 59	2.56% 24	2.03% 19	1.71% 16	938
2	Eagle Ray	94.67% 888	2.13% 20	0.43% 4	0.32% 3	1.07% 10	1.39% 13	938
3	Elephant Fish	60.23% 565	13.75% 129	6.40% 60	13.11% 123	3.94% 37	2.56% 24	938
4	Fiddler Ray / Banjo Shark	92.75% 870	2.99% 28	0.96% 9	0.75% 7	1.28% 12	1.28% 12	938
5	Gummy Shark	21.11% 198	9.17% 86	19.08% 179	26.87% 252	22.17% 208	1.60% 15	938
6	Hammerhead Shark	83.80% 786	6.40% 60	2.77% 26	3.30% 31	2.03% 19	1.71% 16	938
7	Mako	65.35% 613	8.85% 83	7.78% 73	9.91% 93	6.18% 58	1.92% 18	938
8	Port Jackson Shark	92.86% 871	3.20% 30	0.96% 9	0.75% 7	0.96% 9	1.28% 12	938
9	School Shark	55.65% 522	8.96% 84	9.28% 87	14.71% 138	9.17% 86	2.24% 21	938
10	Smooth Stingray	94.24% 884	2.67% 25	0.32% 3	0.32% 3	1.28% 12	1.17% 11	938
11	Thresher Shark	80.06% 751	6.50% 61	4.37% 41	4.05% 38	3.20% 30	1.81% 17	938

Question 14. What are the main reasons why you would RELEASE a shark or ray? Tick all that apply.

#	Field	Choice Count
1	Not good eating	14.67% 498
2	Not the correct legal size (too big or too small)	14.47% 491
3	Ethical or environmental reasons	12.61% 428
4	Unsure of how to handle animal	5.48% 186
5	Unsure of catch limits or restrictions for that species	2.89% 98
6	Not targeting that species	12.23% 415
7	Other (please specify)	1.53% 52
8	I would never release one	0.03% 1
10	Already at bag limit for that species	8.07% 274
11	Have enough fillets already	6.13% 208
12	Didn't want to keep a female fish	7.87% 267
13	Too big for esky / boat	4.27% 145
14	Wanted to scientifically tag the shark	0.56% 19
15	I only fish to catch and release	3.15% 107
16	I'm not prepared (e.g. fishing in a kayak, or don't have a knife to dispatch fish)	2.00% 68
17	Unable to identify the species	4.04% 137
		3394

Question 15. What are the main reasons why you would KEEP a shark or ray? Tick all that apply.

#	Field	Choice Count
1	Good eating	62.56% 710
2	Use for bait	1.50% 17
3	It's a nuisance species	0.97% 11
4	Trophy	2.47% 28
5	Other (please specify)	1.67% 19
6	I would never keep one	14.89% 169
7	Doesn't look healthy enough for a successful release	11.54% 131
8	To weigh and measure the shark for a fishing competition	4.41% 50
		1135

Question 16. How confident are you in safely handling each species of shark or ray, to reduce the risk of injury to you or others?

#	Field	Very confident	Confident	Moderately confident	Slightly confident	Not confident	Total
1	Bronze Whaler	20.54% 189	17.28% 159	16.85% 155	11.74% 108	33.59% 309	920
2	Eagle Ray	30.22% 278	20.33% 187	13.04% 120	9.89% 91	26.52% 244	920
3	Elephant Fish	47.28% 435	22.39% 206	8.37% 77	5.98% 55	15.98% 147	920
4	Fiddler Ray / Banjo Shark	53.70% 494	17.83% 164	7.28% 67	6.41% 59	14.78% 136	920
5	Gummy Shark	56.96% 524	19.02% 175	7.93% 73	6.30% 58	9.78% 90	920
6	Hammerhead Shark	20.43% 188	15.65% 144	15.54% 143	11.52% 106	36.85% 339	920
7	Mako	17.50% 161	12.72% 117	15.87% 146	13.80% 127	40.11% 369	920
8	Port Jackson Shark	50.76% 467	14.89% 137	8.59% 79	7.61% 70	18.15% 167	920
9	School Shark	32.17% 296	19.89% 183	14.13% 130	11.09% 102	22.72% 209	920
10	Smooth Stingray	29.57% 272	18.04% 166	14.46% 133	11.09% 102	26.85% 247	920
11	Thresher Shark	18.48% 170	13.59% 125	16.52% 152	13.59% 125	37.83% 348	920

Questions 17. If releasing the animal, how confident are you in handling each species of shark or ray in a way that minimises harm to the fish and maximises post-release survival?

#	Field	Very confident	Confident	Moderately confident	Slightly confident	Not confident	Total
1	Bronze Whaler	27.97% 247	22.99% 203	16.76% 148	10.53% 93	21.74% 192	883
2	Eagle Ray	36.69% 324	22.20% 196	14.84% 131	9.40% 83	16.87% 149	883
3	Elephant Fish	45.75% 404	22.42% 198	11.78% 104	7.13% 63	12.91% 114	883
4	Fiddler Ray / Banjo Shark	49.04% 433	22.20% 196	10.31% 91	6.57% 58	11.89% 105	883
5	Gummy Shark	49.38% 436	23.22% 205	10.76% 95	6.57% 58	10.08% 89	883
6	Hammerhead Shark	28.20% 249	21.06% 186	16.99% 150	10.99% 97	22.76% 201	883
7	Mako	27.29% 241	19.14% 169	17.55% 155	11.10% 98	24.92% 220	883
8	Port Jackson Shark	46.55% 411	20.05% 177	10.99% 97	7.93% 70	14.50% 128	883
9	School Shark	35.67% 315	23.78% 210	15.06% 133	8.49% 75	16.99% 150	883
10	Smooth Stingray	35.56% 314	22.42% 198	14.95% 132	9.40% 83	17.67% 156	883
11	Thresher Shark	26.84% 237	19.93% 176	17.89% 158	12.00% 106	23.33% 206	883

Question 21. Which of the following items do you usually take with you when fishing?

#	Field	Choice Count
1	Pliers	16.87% 765
2	Bolt / heavy wire cutters	4.04% 183
3	Knotless net	9.22% 418
4	Gaffing pole	7.48% 339
5	Measuring pole / measuring sticker	13.61% 617
6	Gloves	11.95% 542
7	Dark cloth	7.39% 335
8	Crimper	4.23% 192
9	Knife	17.18% 779
10	Wire leader	6.59% 299
11	Other (Please Specify)	1.41% 64
13	None of the above	0.02% 1

Question 22. When you are in an area where you may catch a shark or ray how often do you use circle hooks?

#	Field	Choice Count
1	Always	23.11% 187
2	Often	26.33% 213
3	Sometimes	23.36% 189
4	Rarely	9.77% 79
5	Never	17.43% 141
		809

Question 23. When you are in an area where you may catch a shark or ray how often do you use J hooks?

#	Field	Choice Count
1	Always	16.81% 136
2	Often	25.96% 210
3	Sometimes	25.46% 206
4	Rarely	16.44% 133
5	Never	15.33% 124
		809

Question 25. If you catch and intend to release a ray with a dangerous barb (stinger) on it's tail, which of these practices would you use? (This includes eagle ray, smooth ray, black ray etc). Tick all that you would use.

#	Field	Choice Count
3	Leave ray in the water and remove hook or cut line as short as possible	39.74% 631
4	Land / remove ray from water to remove hook or cut line	9.82% 156
6	Remove hook, where possible	25.19% 400
8	Lift by grabbing the snout and / or spiracles (openings behind the eyes)	1.51% 24
9	Lift by grabbing, or gaffing in, the gills or mouth or tail	0.69% 11
12	When lifting, support the body while holding the tail	2.77% 44
14	Minimise exposure to sun and air	11.90% 189
15	Other (please specify)	2.14% 34
17	Use a knot-less net to lift ray out of the water	5.98% 95
18	Cut barb or tail off	0.25% 4

Question 26. If you catch and intend to release a non-dangerous ray without a barb, which of these practices would you use? (This includes fiddler rays/banjo sharks, skates etc). Tick all that you would use.

#	Field	Choice Count
3	Leave ray in the water and remove hook or cut line as short as possible	25.75% 506
4	Land / remove ray from water to remove hook or cut line	17.30% 340
6	Remove hook, where possible	24.27% 477
8	Lift by grabbing the snout and / or spiracles (openings behind the eyes)	2.19% 43
9	Lift by grabbing, or gaffing in, the gills or mouth or tail	1.27% 25
12	When lifting, support the body while holding the tail	8.19% 161
14	Minimise exposure to sun and air	11.81% 232
15	Other (please specify)	1.27% 25
17	Use a knot-less net to lift ray out of the water	7.74% 152
18	Cut barb or tail off	0.20% 4

Question 27. If you catch and intend to release a small shark, which of these practices would you use? (This includes sharks less than 1.5 m long, such as Gummy sharks and Port Jackson sharks). Tick all that you would use.

#	Field	Choice Count
3	Leave shark in the water and remove hook or cut line as short as possible	18.24% 437
4	Land / remove shark from water to remove hook or cut line	17.36% 416
6	Remove hook, where possible	20.95% 502
9	Lift by grabbing, or gaffing, the gills or mouth or tail	2.25% 54
12	When lifting, support the body while holding the tail	11.73% 281
14	Minimise exposure to sun and air	11.19% 268
15	Other (please specify)	1.00% 24
17	Use a knot-less net to lift shark out of the water	9.64% 231
22	Calm shark by covering eyes with smooth, wet and dark cloth	7.64% 183

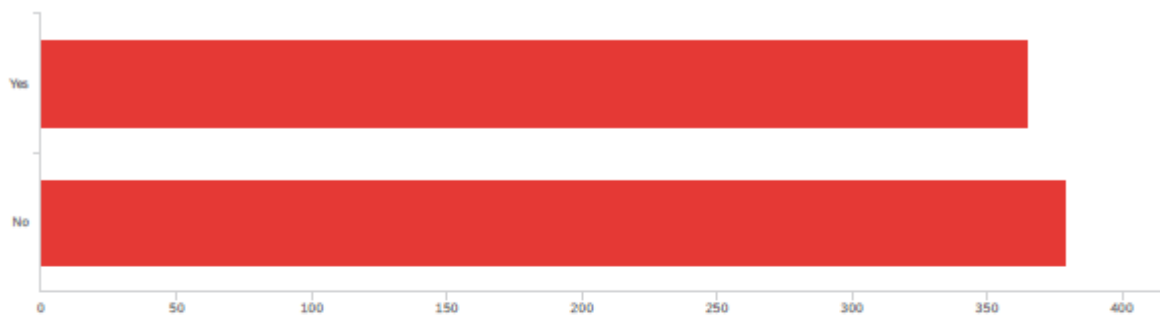
Question 28. If you catch and intend to release a large shark (greater than 1.5m), which of these practices would you use? Tick all that you would use.

Field	Choice Count
Leave shark in the water and remove hook or cut line as short as possible	44.71% 668
Land / remove shark from water to remove hook or cut line	6.76% 101
Remove hook, where possible	23.16% 346
Lift by grabbing, or gaffing in, the gills or mouth or tail	1.54% 23
When lifting, support the body while holding the tail	3.08% 46
Minimise exposure to sun and air	9.64% 144
Other (please specify)	1.54% 23
Use a knot-less net to lift shark out of the water	3.41% 51
Calm shark by covering eyes with smooth, wet and dark cloth	6.16% 92

Question 30. Which of the following methods do you think would minimise the risk of injury/death to the fish and maximise post-release survival when releasing a shark or ray? Tick all that apply.

Field	Choice Count
Dehooking by side of boat	16.69% 572
Cutting line quickly	13.13% 450
Holding it in a particular manner	8.20% 281
Remove hook	13.62% 467
Using circle hooks	8.93% 306
Using J hooks	2.60% 89
Cutting line as close as possible	13.13% 450
Reduce exposure to air	12.72% 436
Use heavy fishing line/gear	2.01% 69
Other (please list)	0.44% 15
Using non-stainless hooks	7.21% 247
None of the above	0.06% 2
Using stainless hooks	1.28% 44

Question 31. Have you witnessed poor practices by other fishers with sharks and rays? By poor practices, we mean practices which have the potential to cause unnecessary harm to the fishers themselves or sharks and rays.

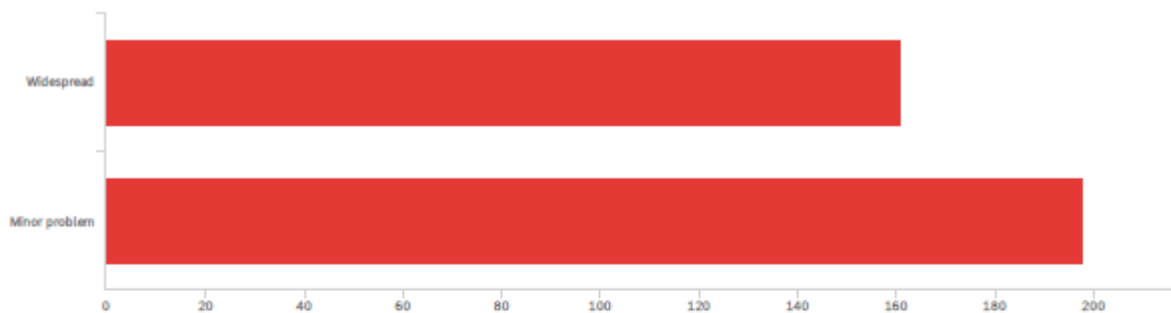


#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Have you witnessed poor practices by other fishers with sharks and rays? By poor practices, we mean practices which have the potential to cause unnecessary harm to the fishers themselves or sharks and rays.	1.00	2.00	1.51	0.50	0.25	744

#	Field	Choice Count
1	Yes	49.06% 365
2	No	50.94% 379

744

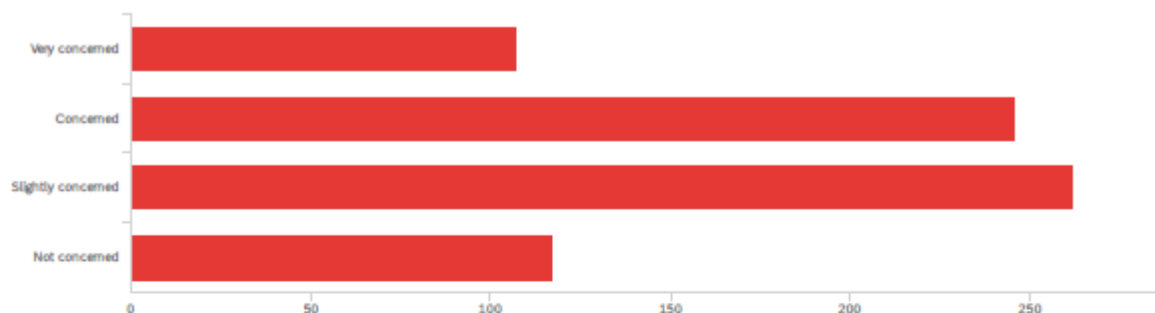
Question 32. Do you think it's a fairly widespread or just a minor problem?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Do you think it's fairly widespread or just a minor problem?	1.00	2.00	1.55	0.50	0.25	359

#	Field	Choice Count
1	Widespread	44.85% 161
2	Minor problem	55.15% 198
		359

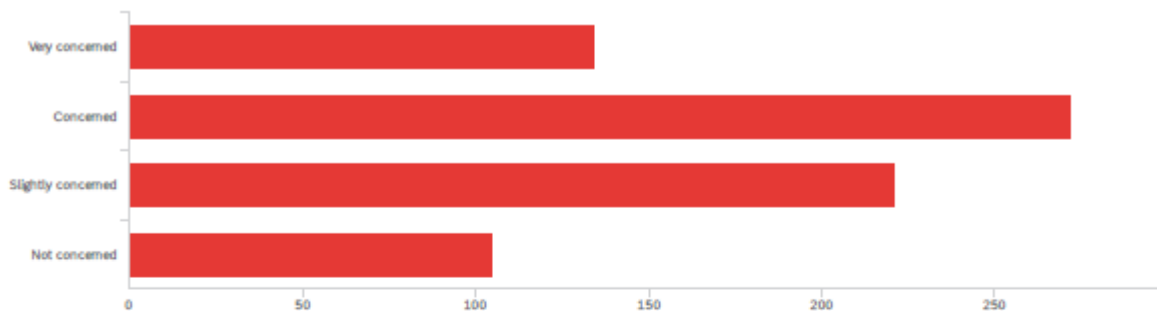
Question 33. How concerned are you about other fishers' practices when handling sharks and rays?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	How concerned are you about other fishers' practices when handling sharks and rays?	1.00	4.00	2.53	0.93	0.86	732

#	Field	Choice Count
1	Very concerned	14.62% 107
2	Concerned	33.61% 246
3	Slightly concerned	35.79% 262
4	Not concerned	15.98% 117
		732

Question 34. How concerned are you about other fishers' attitudes towards these species?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	How concerned are you about other fishers' attitudes towards these species?	1.00	4.00	2.41	0.95	0.89	732

#	Field	Choice Count
1	Very concerned	18.31% 134
2	Concerned	37.16% 272
3	Slightly concerned	30.19% 221
4	Not concerned	14.34% 105
		732

Question 35. What would be effective methods to assist fishers in adopting best-practice in handling & release of sharks and rays? Select all that apply.

Field	Choice Count
Providing more information on optimal handling practices	39.97% 612
Greater enforcement	16.85% 258
Free or subsidised circle hooks	15.09% 231
Changing culture	24.43% 374
Other	3.66% 56