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## RESEARCH REPORT

Project 1.20

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# Scoping study: marine and coastal threatened species and communities

## Sharks and rays

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## Executive summary

Australia has the single highest shark, ray, and chimaera diversity of any country globally with 328 species comprising 182 sharks, 132 rays, and 14 chimaeras. Twenty-five species are listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act): 1 Critically Endangered species, 1 species with a Critically Endangered status on the east coast and a Vulnerable status on the west coast, 2 Endangered species, 5 Vulnerable species, 4 Conservation Dependent species, and 17 Migratory species (5 also listed as threatened as per categories above; 12 listed only as Migratory). The Action Plan for Australian Sharks and Rays 2021 ('Shark Action Plan') categorises further species as threatened that are not listed under the EPBC Act.

Knowledge gaps have been identified for all of these species with research needs in the fields of resolving taxonomy, clarifying geographic range, monitoring population trend, understating life history, and assessing population connectivity. An online survey of Australian shark and ray researchers, policy-makers, and other practitioners highlighted: (1) that in terms of the top three key issues that they considered Australia's threatened sharks and rays to be facing, nearly all respondents (93.5%) selected 'bycatch in commercial fisheries'; a large majority (82.6%) selected 'lack of information relevant to management and recovery'; and a majority (60.9%) selected 'habitat loss and alteration'; (2) respondents noted a variety of research needs to mitigate the impact of these issues on threatened sharks and rays with responses dominated by (a) population status, size, and trend including long-term monitoring; (b) identification of habitat requirements and critical habitats; (c) bycatch mitigation device innovation and testing; (d) improved data collection and reporting; (e) population structure; and (f) understanding and improving post-release survivorship; (3) that in terms of the key research needs for Australia's threatened sharks and rays, a high proportion of respondents (80.4%) selected 'determine population status through size and trend estimates'; a majority (58.7%) selected 'monitor catch in commercial fisheries'; and just below half of respondents (43.5%) selected 'define distribution and habitat requirements' and 'define movement and migration pathways'; (4) that from an extinction risk perspective, the top five species which they considered to be the highest research priority were Green Sawfish (78.3%), Largetooth Sawfish (73.9%), Maugean Skate (65.2%), Speartooth Shark (45.7%), and Dwarf Sawfish (45.7%); (5) that from a knowledge gap perspective, the top five species which they considered to be the highest research priority were Largetooth Sawfish (52.2%), Green Sawfish (52.2%), Dwarf Sawfish (43.5%), Maugean Skate (41.3%), Narrow Sawfish (34.8%). Respondents noted that extinction and knowledge gaps are only two of many factors that should be considered to prioritize research needs with other key factors including: effectiveness, conservation and management outcomes, stakeholder impact, feasibility, and previous investment and successes.

A workshop held to discuss research needs and priorities converged on four Thematic Areas as priority research and investment areas: (1) Critical Habitats; (2) Population Size and Trends; (3) Mitigation & Bycatch; and (4) Human Dimensions.

Keywords: sharks, rays, threatening processes, research priorities

# 1. Introduction

The Marine and Coastal Hub Research Plan 2021 includes a number of scoping projects that aim to generate shared understanding about research needs, knowledge gaps, and priorities. A key scoping project (1.20) is the 'Marine and coastal threatened and migratory species and ecological communities' project which aims to inform future Hub research investment in priority species and knowledge gaps, principally within the Hub's annual research plans.

The shark and ray component of the scoping project considers issues related to sharks and their relatives, the rays and chimaeras (collectively, the chondrichthyan fishes). The project will focus on species listed as threatened (Critically Endangered, Endangered, Vulnerable), Conservation Dependent, and/or Migratory under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) as well as those assessed as threatened in The Action Plan for Australian Sharks and Rays 2021 ('Shark Action Plan') but not listed under the Act. No chimaera species are threatened or migratory and therefore the project will focus on sharks and rays.

The Shark Action Plan also identifies 26 Data Deficient species which are poorly known with uncertain status. These have been identified as priorities for research in the Shark Action Plan and are summarised in this report. However, the report focuses primarily on EPBC-listed species or Shark Action Plan threatened species.

## 2. Project approach

1. Prepare a situational review including identifying research gaps (Part 1 of this report).
2. Undertake an online survey of shark researchers, managers, policymakers, and end-users to solicit issues, research needs, and priorities (Part 2).
3. Convene a research end-user virtual workshop to discuss issues, research needs, and priorities (Part 3).
4. Prepare and distribute a final report.

Australia has the single highest shark, ray, and chimaera diversity of any country globally with 328 species comprising 182 sharks, 132 rays, and 14 chimaeras (Kyne et al. 2021). Under a recent national extinction risk assessment for The Action Plan for Australian Sharks & Rays 2021 ('Shark Action Plan'), the majority of species are considered secure (70.4% Least Concern) while 11.2% are threatened. This highlights Australia's positive assessment status when compared to the global situation (32% threatened according to observed number of species using the IUCN Red List advanced search tool; IUCN 2023) and other regions e.g., the Mediterranean Sea (53% threatened; IUCN 2016) and the Arabian Seas region (51% threatened; Jabado et al. 2017).

Despite this, the group is of high conservation concern species and abundant knowledge and information gaps persist. Species of conservation concern include species currently listed under Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and

additional species assessed as threatened in the Shark Action Plan but not currently listed under the EPBC Act.

Current (2023) listings under the EPBC Act comprise (Table 1):

- 1 Critically Endangered species: Speartooth Shark *Glyphis glyphis*.
- 1 species with a Critically Endangered status on the east coast and a Vulnerable status on the west coast: Grey Nurse Shark *Carcharias taurus*.
- 2 Endangered species: Northern River Shark *Glyphis garricki*; Maugean Skate *Zearaja maugeana*.
- 5 Vulnerable species: Whale Shark *Rhincodon typus*; White Shark *Carcharodon carcharias*; Dwarf Sawfish *Pristis clavata*; Largetooth Sawfish *Pristis pristis*; Green Sawfish *Pristis zijsron*.
- 4 Conservation Dependent species: Harrison's Dogfish *Centrophorus harrissoni*; Southern Dogfish *Centrophorus zeehaani*; School Shark *Galeorhinus galeus*; Scalloped Hammerhead *Sphyrna lewini*.
- 17 Migratory species (5 also listed as threatened as per categories above; 12 listed only as Migratory): Whale Shark *Rhincodon typus*; Basking Shark *Cetorhinus maximus*; White Shark *Carcharodon carcharias*; Shortfin Mako *Isurus oxyrinchus*; Longfin Mako *Isurus paucus*; Porbeagle *Lamna nasus*; Silky Shark *Carcharhinus falciformis*; Oceanic Whitetip Shark *Carcharhinus longimanus*; Narrow Sawfish *Anoxypristis cuspidata*; Dwarf Sawfish *Pristis clavata*; Largetooth Sawfish *Pristis pristis*; Green Sawfish *Pristis zijsron*; Reef Manta Ray *Mobula alfredi*; Giant Manta Ray *Mobula birostris*; Long-horned Pygmy Devilray *Mobula eregoodoo*; Giant Devilray *Mobula mobular*; Bentfin Devilray *Mobula thurstoni*.

In addition to the 25 EPBC Act listed species, the Shark Action Plan assessed a further (Table 1; Table 2):

- 19 species as threatened according to the Shark Action Plan but that are not listed as threatened under the EPBC Act:
  - 2 Critically Endangered species: Whitefin Swellshark *Cephaloscyllium albiginnum*; Australian Longnose Skate *Dentiraja confusus*.
  - 5 Endangered species: Greeneye Spurdog *Squalus chloroculus*; Pelagic Thresher *Alopias pelagicus*; Great Hammerhead *Sphyrna mokarran*; Grey Skate *Dipturus canutus*; Coastal Stingaree *Urolophus orarius*.
  - 12 Vulnerable species: Eastern Angelshark *Squatina albigunctata*; Colclough's Shark *Brachaelurus colcloughi*; Bigeye Thresher *Alopias superciliosus*; Winghead Shark *Eusphyra blochii*; Spotted Shovelnose Ray *Aptychotrema timorensis*; Sydney Skate *Dentiraja australis*; Melbourne Skate *Spiniraja whitleyi*; Estuary Stingray *Hemitrygon fluviorum*; Sandyback Stingaree *Urolophus bucculentus*; Yellowback Stingaree *Urolophus sufflavus*; Greenback Stingaree *Urolophus viridis*; Purple Eagle Ray *Myliobatis hamlyni*.

- 4 species as threatened according to the Shark Action Plan but that are listed as Conservation Dependent under the EPBC Act:
  - 4 Endangered species: Harrison's Dogfish *Centrophorus harrissoni*; Southern Dogfish *Centrophorus zeehaani*; School Shark *Galeorhinus galeus*; Scalloped Hammerhead *Sphyrna lewini*.
- 8 species as threatened according to the Shark Action Plan that are listed as Migratory but not as threatened under the EPBC Act:
  - 2 Critically Endangered species: Oceanic Whitetip Shark *Carcharhinus longimanus*.
  - 2 Endangered species: Basking Shark *Cetorhinus maximus*; Giant Manta Ray *Mobula birostris*.
  - 4 Vulnerable species: Shortfin Mako *Isurus oxyrinchus*; Longfin Mako *Isurus paucus*; Silky Shark *Carcharhinus falciformis*; Narrow Sawfish *Anoxypristis cuspidata*.

There are an additional 10 species (9 sharks, 1 ray) that are listed on the Convention of Migratory Species Appendix II for which Australia has taken exemptions (Table 3). Without an exemption these species would be listed as Migratory under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).



**Table 1.** Australian chondrichthyan fishes listed under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) and/or as threatened in *The Action Plan for Australian Sharks and Rays* 2021 (Kyne *et al.* 2021). Species are listed in phylogenetic order. CR, Critically Endangered; EN, Endangered; VU, Vulnerable; NT, Near Threatened; LC, Least Concern; CD, Conservation Dependent.

Species	EPBC Act category	EPBC Act Migratory	Shark Action Plan category
<b>Greeneye Spurdog</b> <i>Squalus chloroculus</i>	--	--	EN
<b>Harrisson's Dogfish</b> <i>Centrophorus harrissoni</i>	CD	--	EN
<b>Southern Dogfish</b> <i>Centrophorus zeehaani</i>	CD	--	EN
<b>Eastern Angelshark</b> <i>Squatina albipunctata</i>	--	--	VU
<b>Colclough's Shark</b> <i>Brachaelurus colcloughi</i>	--	--	VU
<b>Whale Shark</b> <i>Rhincodon typus</i>	VU	Migratory	EN
<b>Grey Nurse Shark</b> <i>Carcharias taurus</i>	CR(E);VU(W)	--	VU
<b>Pelagic Thresher</b> <i>Alopias pelagicus</i>	--	--	EN
<b>Bigeye Thresher</b> <i>Alopias superciliosus</i>	--	--	VU
<b>Basking Shark</b> <i>Cetorhinus maximus</i>	--	Migratory	EN
<b>White Shark</b> <i>Carcharodon carcharias</i>	VU	Migratory	VU
<b>Shortfin Mako</b> <i>Isurus oxyrinchus</i>	--	Migratory	VU
<b>Longfin Mako</b> <i>Isurus paucus</i>	--	Migratory	VU
<b>Porbeagle</b> <i>Lamna nasus</i>	--	Migratory	LC
<b>Whitefin Swellshark</b> <i>Cephaloscyllium albipinnum</i>	--	--	CR
<b>School Shark</b> <i>Galeorhinus galeus</i>	CD	--	EN
<b>Silky Shark</b> <i>Carcharhinus falciformis</i>	--	Migratory	VU
<b>Oceanic Whitetip Shark</b> <i>Carcharhinus longimanus</i>	--	Migratory	CR
<b>Northern River Shark</b> <i>Glyphis garricki</i>	EN	--	VU
<b>Speartooth Shark</b> <i>Glyphis glyphis</i>	CR	--	VU
<b>Winghead Shark</b> <i>Eusphyra blochii</i>	--	--	VU
<b>Scalloped Hammerhead</b> <i>Sphyrna lewini</i>	CD	--	EN
<b>Great Hammerhead</b> <i>Sphyrna mokarran</i>	--	--	EN
<b>Narrow Sawfish</b> <i>Anoxypristis cuspidata</i>	--	Migratory	VU
<b>Dwarf Sawfish</b> <i>Pristis clavata</i>	VU	Migratory	EN
<b>Large-tooth Sawfish</b> <i>Pristis pristis</i>	VU	Migratory	CR
<b>Green Sawfish</b> <i>Pristis zijsron</i>	VU	Migratory	CR
<b>Spotted Shovelnose Ray</b> <i>Aptychotrema timorensis</i>	--	--	VU
<b>Sydney Skate</b> <i>Dentiraja australis</i>	--	--	VU
<b>Australian Longnose Skate</b> <i>Dentiraja confusus</i>	--	--	CR
<b>Grey Skate</b> <i>Dipturus canutus</i>	--	--	EN
<b>Melbourne Skate</b> <i>Spiniraja whitleyi</i>	--	--	VU
<b>Maugean Skate</b> <i>Zearaja maugeana</i>	EN	--	EN
<b>Estuary Stingray</b> <i>Hemirhamphys fluviorum</i>	--	--	VU
<b>Sandyback Stingaree</b> <i>Urolophus bucculentus</i>	--	--	VU
<b>Coastal Stingaree</b> <i>Urolophus orarius</i>	--	--	EN
<b>Yellowback Stingaree</b> <i>Urolophus sufflavus</i>	--	--	VU
<b>Greenback Stingaree</b> <i>Urolophus viridis</i>	--	--	VU
<b>Purple Eagle Ray</b> <i>Myliobatis hamlyni</i>	--	--	VU
<b>Reef Manta Ray</b> <i>Mobula alfredi</i>	--	Migratory	LC
<b>Giant Manta Ray</b> <i>Mobula birostris</i>	--	Migratory	EN
<b>Long-horned Pygmy Devilray</b> <i>Mobula eregoodoo</i>	--	Migratory	LC
<b>Giant Devilray</b> <i>Mobula mobular</i>	--	Migratory	NT
<b>Bentfin Devilray</b> <i>Mobula thurstoni</i>	--	Migratory	NT



**Table 2.** Australian chondrichthyan fishes assessed as threatened in *The Action Plan for Australian Sharks and Rays 2021*, but that are not listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Species are listed in phylogenetic order. CR, Critically Endangered; EN, Endangered; VU, Vulnerable.

Species	EPBC Act category	EPBC Act Migratory	Shark Action Plan category
<b>Greeneye Spurdog</b> <i>Squalus chloroculus</i>	--	--	EN
<b>Eastern Angelshark</b> <i>Squatina albipunctata</i>	--	--	VU
<b>Colclough's Shark</b> <i>Brachaelurus colcloughi</i>	--	--	VU
<b>Pelagic Thresher</b> <i>Alopias pelagicus</i>	--	--	EN
<b>Bigeye Thresher</b> <i>Alopias superciliosus</i>	--	--	VU
<b>Whitefin Swellshark</b> <i>Cephaloscyllium albipinnum</i>	--	--	CR
<b>Winghead Shark</b> <i>Eusphyra blochii</i>	--	--	VU
<b>Great Hammerhead</b> <i>Sphyrna mokarran</i>	--	--	EN
<b>Spotted Shovelnose Ray</b> <i>Aptychotrema timorensis</i>	--	--	VU
<b>Sydney Skate</b> <i>Dentiraja australis</i>	--	--	VU
<b>Australian Longnose Skate</b> <i>Dentiraja confusus</i>	--	--	CR
<b>Grey Skate</b> <i>Dipturus canutus</i>	--	--	EN
<b>Melbourne Skate</b> <i>Spiniraja whitleyi</i>	--	--	VU
<b>Estuary Stingray</b> <i>Hemirhamphysa fluviorum</i>	--	--	VU
<b>Sandyback Stingaree</b> <i>Urolophus bucculentus</i>	--	--	VU
<b>Coastal Stingaree</b> <i>Urolophus orarius</i>	--	--	EN
<b>Yellowback Stingaree</b> <i>Urolophus sufflavus</i>	--	--	VU
<b>Greenback Stingaree</b> <i>Urolophus viridis</i>	--	--	VU
<b>Purple Eagle Ray</b> <i>Myliobatis hamlyni</i>	--	--	VU

**Table 3.** Australian chondrichthyan fishes listed on the Convention of Migratory Species Appendix II for which Australia has taken exemptions. Without an exemption these species would be listed as Migratory under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Species	EPBC Act category	EPBC Act Migratory	Shark Action Plan category
<b>Pelagic Thresher</b> <i>Alopias pelagicus</i>	--	Exempt	EN
<b>Bigeye Thresher</b> <i>Alopias superciliosus</i>	--	Exempt	VU
<b>Common Thresher</b> <i>Alopias vulpinus</i>	--	Exempt	NT
<b>School Shark</b> <i>Galeorhinus galeus</i>	--	Exempt	EN
<b>Dusky Shark</b> <i>Carcharhinus obscurus</i>	--	Exempt	NT
<b>Blue Shark</b> <i>Prionace glauca</i>	--	Exempt	NT
<b>Scalloped Hammerhead</b> <i>Sphyrna lewini</i>	--	Exempt	EN
<b>Great Hammerhead</b> <i>Sphyrna mokarran</i>	--	Exempt	EN
<b>Smooth Hammerhead</b> <i>Sphyrna zygaena</i>	--	Exempt	NT
<b>Bottlenose Wedgefish</b> <i>Rhynchobatus australiae</i>	--	Exempt	NT

### 3. Knowledge gaps

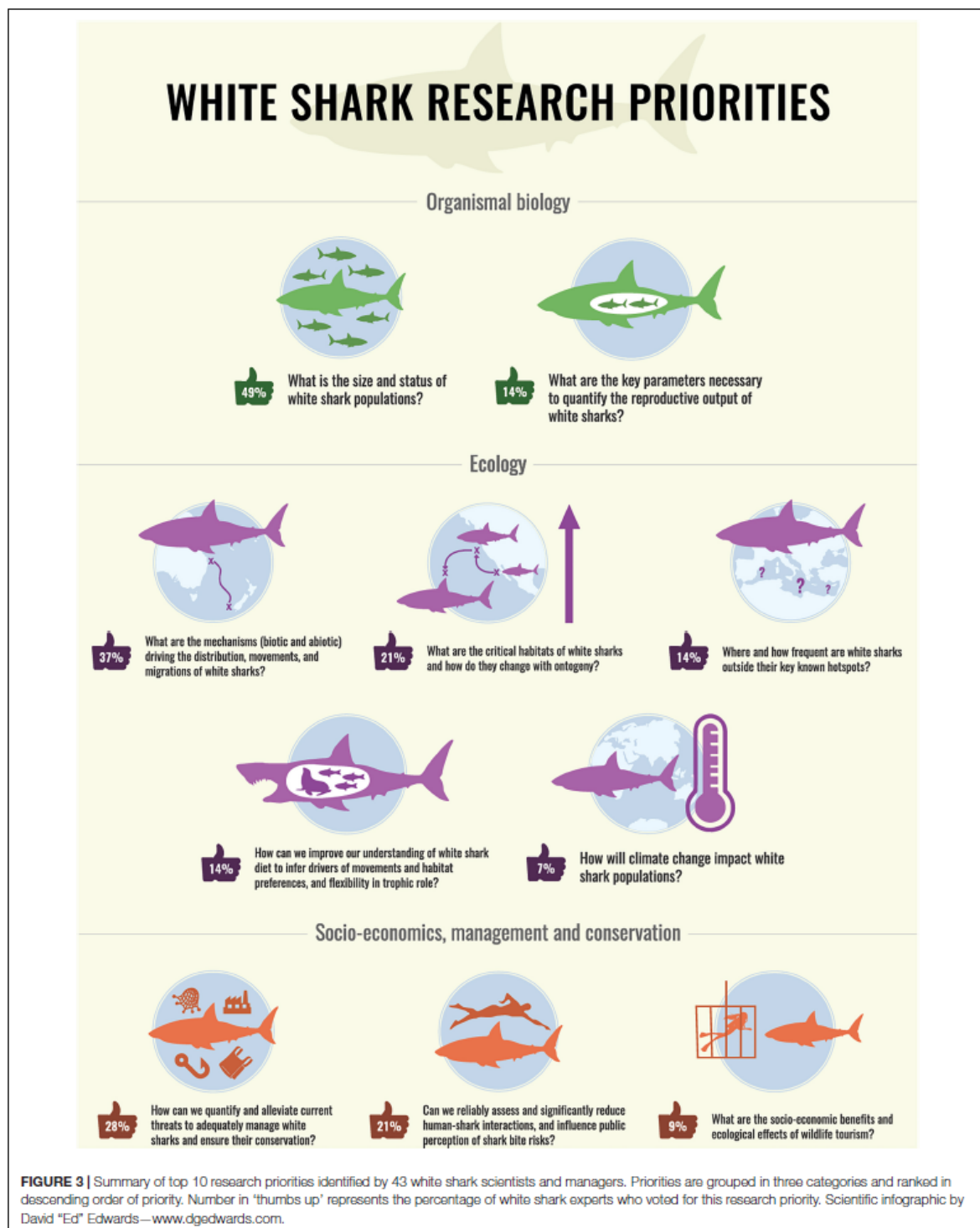
The *Shark Action Plan* outlined knowledge gaps for all Australian sharks, rays, and chimaeras. Gaps were considered across five themes (definitions taken from Kyne et al. 2021):

1. **Taxonomy:** Taxonomy is the very foundation of understanding what species 'unit' needs to be assessed, managed, and conserved.
2. **Distribution:** Clarifying a species distribution (geographic range) is required for species with a limited number of records in Australian waters and those where the range is suspected to be wider than currently recorded. Poorly defined ranges may reflect a lack of fisheries, scientific surveys, or ongoing monitoring in areas where species are likely to occur.
3. **Population trend:** Understanding the trend in population over time is crucial to accurate assessments of extinction risk, particularly given that exploitation by fisheries (either targeted or through bycatch) is the main threat facing most threatened species. Species-specific population trend is available for very few sharks.
4. **Life history:** Information on a species' life history provides an understanding of biological productivity and therefore, a species' ability to sustain exploitation or recover from population depletion. Age and growth (how fast a species grows, when it reaches sexual maturity, and how long it lives for) and reproductive biology (how often it reproduces and how many offspring it has) are critical parameters to understand productivity.
5. **Connectivity:** The status of regionally or globally distributed species can be influenced by threatening processes operating outside of Australian waters. The level of connectivity can have a significant bearing on a species' Australian status even in the absence of local threats.

**Table 4.** Knowledge gaps (green) for all Australian chondrichthyan fishes listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or as threatened in *The Action Plan for Australian Sharks and Rays 2021* (Kyne *et al.* 2021).

Species	Taxonomy	Distribution	Population trend	Life history	Connectivity
Greeneye Spurdog					
Harrison's Dogfish					
Southern Dogfish					
Eastern Angelshark					
Colclough's Shark					
Whale Shark					
Grey Nurse Shark					
Pelagic Thresher					
Bigeye Thresher					
Basking Shark					
White Shark					
Shortfin Mako					
Longfin Mako					
Porbeagle					
Whitefin Swellshark					
School Shark					
Silky Shark					
Oceanic Whitetip Shark					
Northern River Shark					
Speartooth Shark					
Winghead Shark					
Scalloped Hammerhead					
Great Hammerhead					
Narrow Sawfish					
Dwarf Sawfish					
Large-toothed Sawfish					
Green Sawfish					
Spotted Shovelnose Ray					
Sydney Skate					
Australian Longnose Skate					
Grey Skate					
Melbourne Skate					
Maugean Skate					
Estuary Stingray					
Sandyback Stingaree					
Coastal Stingaree					
Yellowback Stingaree					
Greenback Stingaree					
Purple Eagle Ray					
Reef Manta Ray					
Giant Manta Ray					
Long-horned Pygmy Devilray					
Giant Devilray					
Bentfin Devilray					

Global White Shark research priorities were examined by Huveneers *et al.* (2018) and provide a detailed species-specific research prioritization. These global priorities are also priorities within Australia.



## 4. Online surveys

An online survey of Australian shark researchers, managers, policymakers, and end-users was conducted on the platform Google Forms. The survey aimed to solicit issues, research needs, and priorities related to the management of Australia's 25 shark and ray species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as threatened, Conservation Dependent, and/or Migratory (Table 5).

**Table 5.** Australian sharks and rays included in the online survey. Included species are those listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Species are listed in phylogenetic order. \*Denotes a species under consideration in 2023 for listing in a threatened category (or in the case of Largetooth Sawfish, for listing in a higher threatened category).

Species	EPBC Act Threatened	EPBC Act Migratory	EPBC Act Conservation Dependent
<b>Harrisson's Dogfish</b> <i>Centrophorus harrissoni</i>	--	--	CD
<b>Southern Dogfish</b> <i>Centrophorus zeehaani</i>	--	--	CD
<b>Whale Shark</b> <i>Rhincodon typus</i>	VU	Migratory	--
<b>Grey Nurse Shark</b> <i>Carcharias taurus</i>	East: CR; West: VU	--	--
<b>Basking Shark</b> <i>Cetorhinus maximus</i>	--	Migratory	--
<b>White Shark</b> <i>Carcharodon carcharias</i>	VU	Migratory	--
<b>Shortfin Mako</b> <i>Isurus oxyrinchus</i>	--	Migratory	--
<b>Longfin Mako</b> <i>Isurus paucus</i>	--	Migratory	--
<b>Porbeagle</b> <i>Lamna nasus</i>	--	Migratory	--
<b>School Shark</b> <i>Galeorhinus galeus</i>	--	--	CD
<b>Silky Shark</b> <i>Carcharhinus falciformis</i>	--	Migratory	--
<b>Oceanic Whitetip Shark</b> <i>Carcharhinus longimanus</i>	--	Migratory	--
<b>Northern River Shark</b> <i>Glyphis garricki</i>	EN	--	--
<b>Speartooth Shark</b> <i>Glyphis glyphis</i>	CR	--	--
<b>Scalloped Hammerhead</b> <i>Sphyrna lewini</i>	--*	--	CD
<b>Narrow Sawfish</b> <i>Anoxypristis cuspidata</i>	--*	Migratory	--
<b>Dwarf Sawfish</b> <i>Pristis clavata</i>	VU	Migratory	--
<b>Largetooth Sawfish</b> <i>Pristis pristis</i>	VU*	Migratory	--
<b>Green Sawfish</b> <i>Pristis zijsron</i>	VU	Migratory	--
<b>Maugean Skate</b> <i>Zearaja maugeana</i>	EN	--	--
<b>Reef Manta Ray</b> <i>Mobula alfredi</i>	--	Migratory	--
<b>Giant Manta Ray</b> <i>Mobula birostris</i>	--	Migratory	--
<b>Long-horned Pygmy Devilray</b> <i>Mobula eregoodoo</i>	--	Migratory	--
<b>Giant Devilray</b> <i>Mobula mobular</i>	--	Migratory	--
<b>Bentfin Devilray</b> <i>Mobula thurstoni</i>	--	Migratory	--

## 4.1 Survey methods

Survey questions are provided below. A copy of the full Google Forms survey is provided in Annex I.

1. Which sector do you represent? (select one; if you represent more than one, please select the primary sector)
  - a. Research (academic/university)
  - b. Research (state/territory government)
  - c. Research (federal government)
  - d. Research (Industry including environmental consulting)
  - e. Research (other)
  - f. Policy/management (state/territory government)
  - g. Policy/management (federal government)
  - h. Industry (non-research)
  - i. Non-government organisation
  - j. Other (please specify)
2. How many years' experience do you have working on sharks and rays or issues relevant to the management of sharks and rays?
  - a. 1-5 years
  - b. 6-10 years
  - c. 11-15 years
  - d. 16-20 years
  - e. 21+ years
3. What are the key issues facing Australia's threatened sharks and rays collectively (these are likely to vary species by species, but we are looking to solicit big picture items)? Please select **three** key issues.
  - a. Pollution and marine debris
  - b. Habitat loss and alteration
  - c. Targeted commercial exploitation
  - d. Catch in recreational fisheries
  - e. Lack of information relevant to management and recovery
  - f. Climate change
  - g. Bycatch in commercial fisheries
4. Are there any other key issues facing Australia's threatened sharks and rays that are not included in the list above? What is their importance relative to the issues listed in Question 3?
5. For the items you selected as being the most important key issues above, what are some of the research needs to mitigate the impacts of these issues on threatened sharks and rays collectively?

6. What are the key research needs for Australia's threatened sharks and rays collectively (these are likely to vary species by species, but we are looking to solicit big picture items)? Please select **three** key research needs.
  - a. Resolve taxonomic issues
  - b. Define distribution and habitat requirements
  - c. Assess reproductive biology
  - d. Assess age-and-growth
  - e. Assess trophic ecology
  - f. Define movement and migration pathways
  - g. Delineate population structure
  - h. Determine population status through size and trend estimates
  - i. Monitor catch in commercial fisheries
  - j. Monitor catch in recreational fisheries
7. Are there any other key research needs for Australia's threatened sharks and rays that are not included in the list above? What is their importance relative to the research needs listed above?
8. From an **extinction risk perspective**, which **five** species from the list below are the highest research priorities?
  - a. Harrison's Dogfish *Centrophorus harrissoni*
  - b. Southern Dogfish *Centrophorus zeehaani*
  - c. Whale Shark *Rhincodon typus*
  - d. Grey Nurse Shark *Carcharias taurus*
  - e. Basking Shark *Cetorhinus maximus*
  - f. White Shark *Carcharodon carcharias*
  - g. Shortfin Mako *Isurus oxyrinchus*
  - h. Longfin Mako *Isurus paucus*
  - i. Porbeagle *Lamna nasus*
  - j. School Shark *Galeorhinus galeus*
  - k. Silky Shark *Carcharhinus falciformis*
  - l. Oceanic Whitetip Shark *Carcharhinus longimanus*
  - m. Northern River Shark *Glyphis garricki*
  - n. Speartooth Shark *Glyphis glyphis*
  - o. Scalloped Hammerhead *Sphyrna lewini*
  - p. Narrow Sawfish *Anoxypristis cuspidata*
  - q. Dwarf Sawfish *Pristis clavata*
  - r. Largetooth Sawfish *Pristis pristis*
  - s. Green Sawfish *Pristis zijsron*
  - t. Maugean Skate *Zearaja maugeana*
  - u. Reef Manta Ray *Mobula alfredi*
  - v. Giant Manta Ray *Mobula birostris*
  - w. Long-horned Pygmy Devilray *Mobula eregoodoo*



- x. Giant Devilray *Mobula mobular*
  - y. Bentfin Devilray *Mobula thurstoni*
9. What was the basis for selecting this suite of species?
10. From a **knowledge gap perspective**, which **five** species from the list below are the highest research priorities?
- a. Harrison's Dogfish *Centrophorus harrissoni*
  - b. Southern Dogfish *Centrophorus zeehaani*
  - c. Whale Shark *Rhincodon typus*
  - d. Grey Nurse Shark *Carcharias taurus*
  - e. Basking Shark *Cetorhinus maximus*
  - f. White Shark *Carcharodon carcharias*
  - g. Shortfin Mako *Isurus oxyrinchus*
  - h. Longfin Mako *Isurus paucus*
  - i. Porbeagle *Lamna nasus*
  - j. School Shark *Galeorhinus galeus*
  - k. Silky Shark *Carcharhinus falciformis*
  - l. Oceanic Whitetip Shark *Carcharhinus longimanus*
  - m. Northern River Shark *Glyphis garricki*
  - n. Speartooth Shark *Glyphis glyphis*
  - o. Scalloped Hammerhead *Sphyrna lewini*
  - p. Narrow Sawfish *Anoxypristis cuspidata*
  - q. Dwarf Sawfish *Pristis clavata*
  - r. Largetooth Sawfish *Pristis pristis*
  - s. Green Sawfish *Pristis zijsron*
  - t. Maugean Skate *Zearaja maugeana*
  - u. Reef Manta Ray *Mobula alfredi*
  - v. Giant Manta Ray *Mobula birostris*
  - w. Long-horned Pygmy Devilray *Mobula eregoodoo*
  - x. Giant Devilray *Mobula mobular*
  - y. Bentfin Devilray *Mobula thurstoni*
11. What was the basis for selecting this suite of species?
12. Please feel free to add any other points related to issues, research needs, and priorities for species listed above.

## 4.2 Survey results

A total of 46 online surveys were returned. Graphs and results are provided for questions below.

### Question 1

Which sector do you represent? (select one; if you represent more than one, please select the primary sector).

46 responses

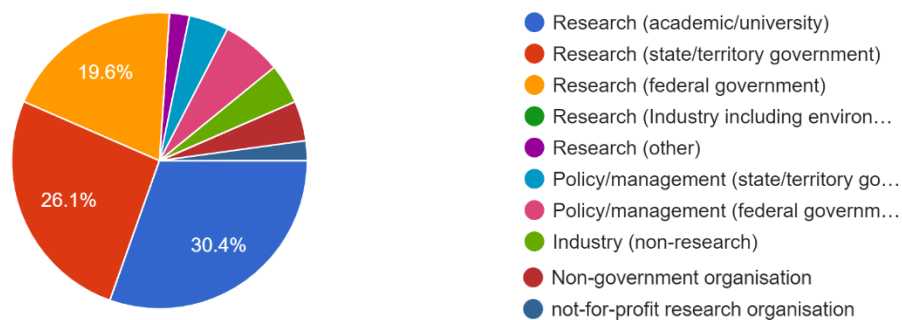


Figure 1. Online survey participant sector representation.

The research sector collectively represented 79% of respondents (across academic/university, state/territory government, federal government, and industry including environmental consultants).

The results of the survey therefore likely reflect priorities and perspectives of that sector with policy, industry, non-government organisations, and not-for-profit research organisations under-represented.

## Question 2

How many years' experience do you have working with sharks and rays or issues relevant to the management of sharks and rays?

46 responses

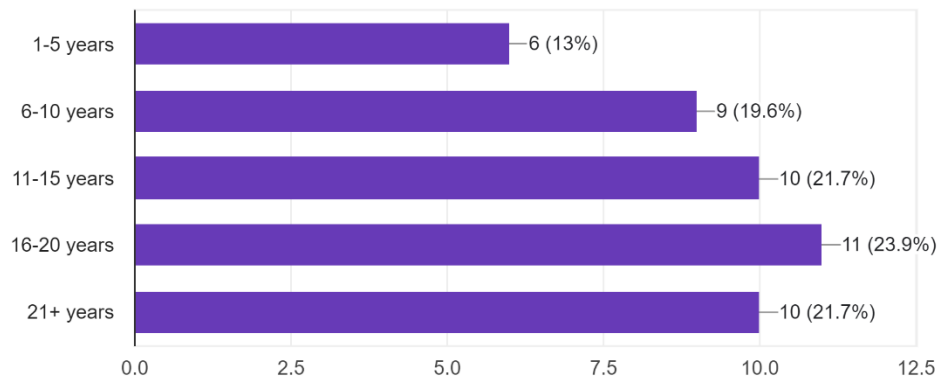


Figure 2. Online survey participant experience.

There was a reasonable spread of years of experience between 6–10 years (19.6%), 11–15 years (21.7%), 16–20 years (23.9%), and 21+ years (21.7%). Combined, 67.3% of respondents had 10+ years of experience working with sharks and rays or on issues relevant to the management of sharks and rays.

## Question 3

What are the key issues facing Australia's threatened sharks and rays collectively (these are likely to vary by species, but we are looking to solicit big picture items)? Please select three key issues.

46 responses

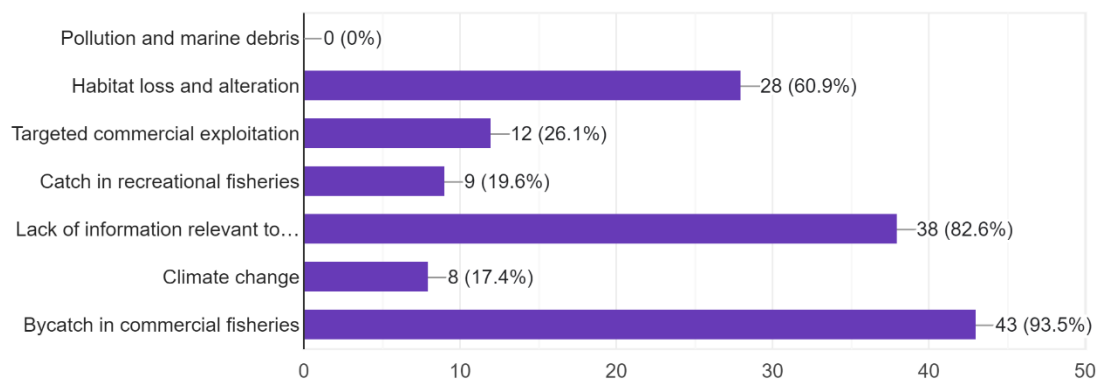


Figure 3. Online survey responses identifying the key issues facing Australia's sharks and rays.

Respondents were asked to select the top three key issues that they considered Australia's threatened sharks and rays to be facing. Nearly all respondents (93.5%) selected 'bycatch in

commercial fisheries'; a large majority (82.6%) selected 'lack of information relevant to management and recovery'; and a majority (60.9%) selected 'habitat loss and alternation'. 'Targeted commercial exploitation' (26.1%); 'catch in recreational fisheries' (19.6%); and 'climate change' (17.4%) were considered key issues by fewer respondents. 'Pollution and marine debris' was not considered a key issue by any respondent.

#### **Question 4**

Are there any other key issues facing Australia's threatened sharks and rays that are not included in the list above? What is their importance relative to the issues listed in Question 3?

Twenty-five respondents (54%) provided additional responses. Of these, five respondents stated that there were no other key issues to add. The remaining respondents noted a variety of issues and additional points relevant to key issues which are provided below in summarized form (no single answer is transcribed here).

Additional identified key issues included:

- Research and management funding limitations.
- A lack of accurate species-specific catch data reporting.
- A lack of regional partnerships to consider status and total mortality beyond Australia.
- Shark control programs.
- Boat strike (although this was noted to be limited to a smaller subset of species, e.g., Whale Shark and devil rays).
- Poor enforcement of, and compliance with, existing management arrangements in fisheries.
- Challenges with field identification (and therefore accurate reporting).
- A lack of coordination in research and the need to build meaningful collaborations for targeted research.
- Misinformation and misunderstanding within the community, media, and politics.

Additional points included:

- The value of facilitating Traditional Owner involvement in fisheries management.
- To better evaluate key issues, more information is required on species-specific catch levels, mortality rates (including post-release), estimates of population sizes, movement ecology, and the identification of critical habitat (including nursery areas).
- A general lack of information on how pollutants and marine debris impact sharks and rays (therefore making it difficult to assess importance of this issue).
- Importance of key issues is spatially dependent – issues differ between tropical and temperate Australia.

#### **Question 5**

For the items you selected as being the most important key issues above, what are some of the research needs to mitigate the impacts of these issues on threatened sharks and rays collectively?

Forty-three respondents (93.5%) provided responses. The respondents noted a variety of **research needs** to mitigate the impact of these issues on threatened sharks and rays which are provided below in summarized form (no single answer is transcribed here). Numbers in parentheses give the number of respondents identifying that research need.

Identified research needs were:

- Population status, size, and trend including long-term monitoring (18)
- Identification of habitat requirements and critical habitats (14)
- Bycatch mitigation device innovation and testing (12)
- Improved data collection and reporting (11)
- Population structure (11)
- Understanding and improving post-release survivorship (10)
- Movement ecology (9)
- Basic life history (e.g., age-and-growth, reproductive biology, demographics) (7)
- Cumulative impact assessments (5)
- Defining geographic ranges (4)
- Defining overlap between geographic ranges and fishing (4)
- Monitoring of recreational catch and mortality (4)
- Assessing and finding solutions for shark depredation (2)
- Distribution and habitat shifts due to climate change (2)
- Traditional ecological knowledge where culturally appropriate (2)
- Habitat restoration (1)
- Monitoring of Indigenous catch (1)
- Physiological responses to climate change (1)
- Education and awareness (1)
- Risk assessments (1)

Challenges identified:

- Weak environmental laws.
- Lack of observer coverage.
- Accuracy of logbook recording.
- Funding limitations.
- Limited effectiveness of marine protected areas.
- Lack of coordination among researchers.
- Building trust between researchers, industry, and regulators.

### Question 6

What are the key research needs for Australia's threatened sharks and rays collectively (these are likely to vary species by species, but we are looking for the items)? Please select three key research needs.

46 responses

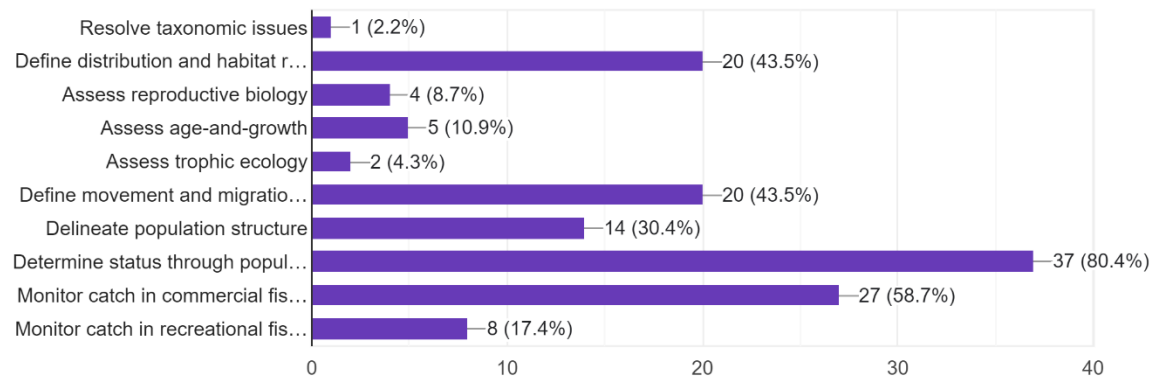


Figure 4. Online survey responses identifying the key research needs for Australia's sharks and rays.

Respondents were asked to select the top three key research needs for Australia's threatened sharks and rays. A high proportion of respondents (80.4%) selected 'determine population status through size and trend estimates'; a majority (58.7%) selected 'monitor catch in commercial fisheries'; just below half of respondents (43.5%) selected 'define distribution and habitat requirements' and 'define movement and migration pathways'; just below a third of respondents (30.4%) selected 'delineate population structure'; and lower numbers of respondents selected 'monitor catch in recreational fisheries' (17.4%), 'assess age-and-growth' (10.9%), 'assess reproductive biology' (8.7%), 'assess trophic ecology' (4.3%), and 'resolve taxonomic issues' (2.2%).

### Question 7

Are there any other key research needs for Australia's threatened sharks and rays that are not included in the list above? What is their importance relative to the research needs listed above?

Twenty-six respondents (56.5%) provided responses. The respondents noted a variety of **research needs** to mitigate the impact of these issues on threatened sharks and rays which are provided below in summarized form (no single answer is transcribed here). Numbers in parentheses give the number of respondents identifying that research need.

Identified research needs were:

- Understanding and improving post-release survivorship (4)
- Human dimensions including understanding values (3)
- Bycatch mitigation device innovation and testing (2)
- Cumulative impact assessments (2)
- Fishing gear selectivity (2)
- Distribution and habitat shifts due to climate change (1)
- Assessing and finding solutions for shark depredation (1)
- Basic research on poorly-known and less-studied species (1)

Additional points included:

- Monitoring should not be considered a research need but a core goal of all fisheries and an essential information need.
- Resolving taxonomic issues is foundational to all other research fields.

### Question 8

From an extinction risk perspective, which five species from the list below are the highest research priorities?

46 responses

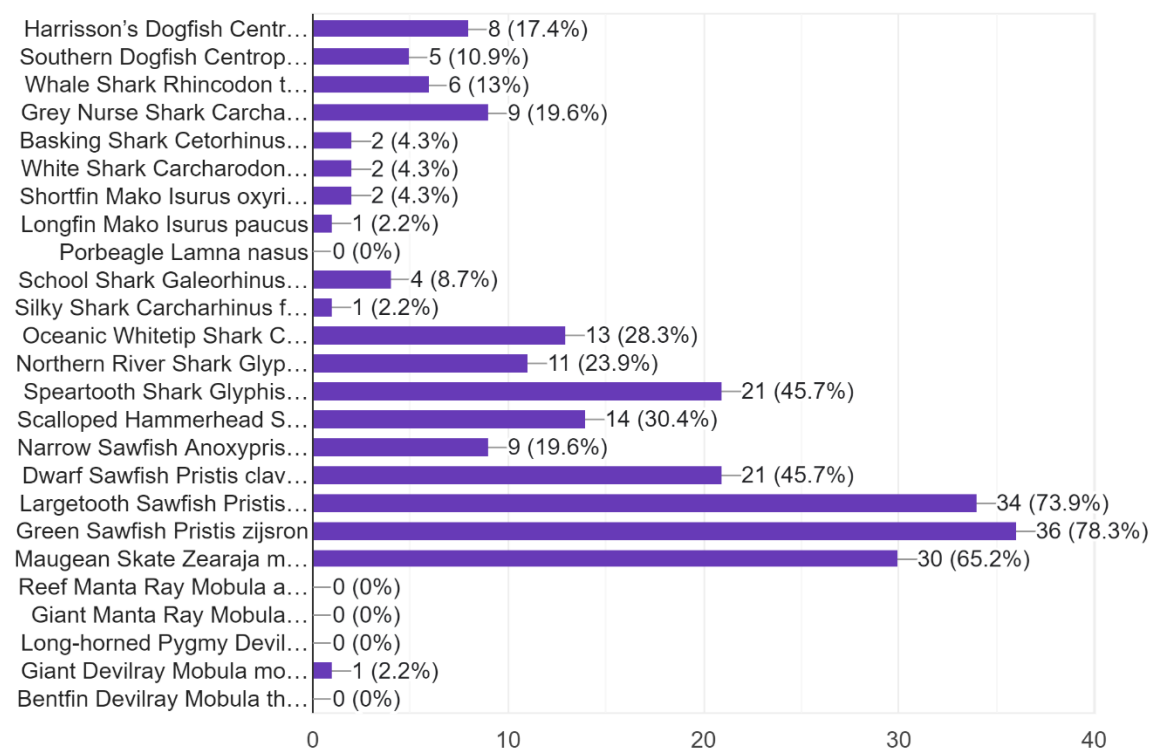


Figure 5. Online survey responses identifying the highest research priorities from an extinction perspective of Australia's sharks and rays.

Respondents were asked to select five species which they considered to be the highest research priority from an **extinction risk perspective**. The top ten species in order of number of respondents selecting these were:

1. Green Sawfish (78.3%)
2. Largetooth Sawfish (73.9%)
3. Maugean Skate (65.2%)
4. Speartooth Shark (45.7%)
5. Dwarf Sawfish (45.7%)
6. Scalloped Hammerhead (30.4%)
7. Oceanic Whitetip Shark (28.3%)



8. Northern River Shark (23.9%)
9. Grey Nurse Shark (19.6%)
10. Narrow Sawfish (19.6%)

### **Question 9**

What was the basis for selecting this suite of species?

Forty-three respondents (93.5%) provided responses.

Key points raised at the species level:

- **Maugean Skate**
  - Severe concern for status of species.
  - Need for immediate action.
  - Good evidence status is higher than current listing of Endangered.
  - Perceived by some respondents to be the Australian shark or ray that is most likely to go extinct.
  - Restricted range.
  - Ongoing threats.
  - Needs include conservation breeding, understanding recruitment failure, and habitat rehabilitation.
- **Sawfishes**
  - Severe declines and extinctions outside of Australia.
  - Higher status in *Shark Action Plan* than *EPBC*.
  - Lack of information to determine status and trend.
  - Ongoing threats.
  - Need better understanding of levels of interactions with commercial fisheries.
  - Movement ecology across the estuarine-marine interface.
  - Cumulative impacts unaccounted for.
  - Reliance on freshwater environments.
  - Susceptibility to developing Northern Australia agenda.
  - No evidence of recovery.
- **Oceanic Whitetip Shark**
  - Severe global declines.
  - Considerable discrepancy between global and *Shark Action Plan* status (Critically Endangered) and *EPBC* (Migratory).
- **Deepwater dogfishes**
  - Low biological productivity.
  - Considerable knowledge gaps remain.
- **Harrison's Dogfish**
  - Movement patterns poorly known which impacts understanding the effectiveness of gulper shark spatial closures.
- **School Shark**
  - Better understanding needed of adult age, movement ecology, population structure.
- **Scalloped Hammerhead**
  - Adult female movement ecology and connectivity with close neighbours (Indonesia, Papua New Guinea).

- Still under exploitation despite status.
- Limited post-release survivability.
- River sharks
  - Restricted range.
  - Reliance on freshwater environments.
  - Susceptibility to developing Northern Australia agenda.
- Whale Shark
  - Ship strikes put species at risk.

Key points raised at the broad level:

- Level of threat, risk, and knowledge gaps help inform selection of species.
- *Shark Action Plan* highlights Critically Endangered and Endangered species which are highest priority. Some of these (e.g., Whitefin Swellshark) are not *EPBC*-listed so not on the list to select from this survey but would have been selected by some respondents due to their status.
- Discrepancies between current *EPBC* listings and those in the *Shark Action Plan*.
- 'Lifeboat Australia' to ensure global persistence (e.g., sawfishes, Scalloped Hammerhead, Oceanic Whitetip Shark).
- Need to understand movement patterns and connectivity for migratory species/shared populations.
- Need for regional management for migratory species/shared populations.
- Capacity to undertake research and act locally are considerations in priority setting.
- Level of knowledge of species was a factor in selecting species from the list (tendency to select species that respondents were more familiar with, while acknowledging that other species may be more at risk).
- Restricted range, small population size, fine-scale population structuring, habitat specialisation, and susceptibility to capture in fisheries increases risk and therefore increases priority.
- Little overlap with protected areas increases risk and therefore increases priority.

## Question 10

From a knowledge gap perspective, which five species from the list below are the highest research priorities?

46 responses

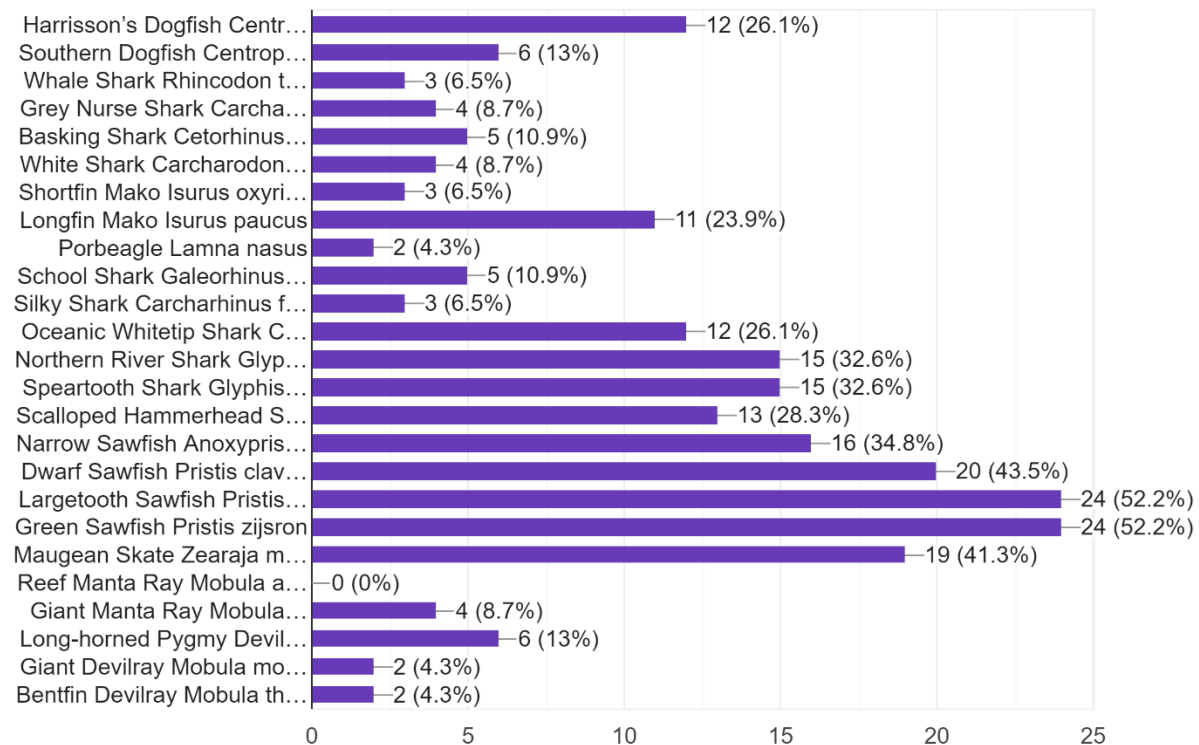


Figure 6. Online survey responses identifying the species with the highest research priorities from a knowledge gaps perspective.

Respondents were asked to select five species which they considered to be the highest research priority from a **knowledge gap perspective**. The top ten species in order of number of respondents selecting these were:

1. Largeetooth Sawfish (52.2%)
2. Green Sawfish (52.2%)
3. Dwarf Sawfish (43.5%)
4. Maugean Skate (41.3%)
5. Narrow Sawfish (34.8%)
6. Northern River Shark (32.6%)
7. Speartooth Shark (32.6%)
8. Scalloped Hammerhead (28.3%)
9. Harrisson's Dogfish (26.1%)
10. Oceanic Whitetip Shark (26.1%)

## Question 11

What was the basis for selecting this suite of species?

Forty-one respondents (89.1%) provided responses.

Key points raised at the species level:

- Maugean Skates
  - Highlighted by some respondents that this is the highest priority of any species by far.
- Sawfishes
  - Cumulative impacts and future threats.
  - Knowledge gaps are diverse including distribution, abundance, movement ecology, habitat use, nursery areas.
  - Information to inform population assessments are still lacking.
- Deepwater dogfishes
  - Population trends poorly known.
- Grey Nurse Shark
  - Much focus on east coast population but west coast population poorly known.
- Speartooth Shark
  - Adults virtually unknown.
  - Confined distribution in Queensland.
- Scalloped Hammerhead
  - Gaps exist on movement ecology and population structure with capture still occurring as target and bycatch.
- Giant Manta Ray
  - Limited information on species in Australia.
- Devil rays
  - Need to resolve taxonomic issues e.g., *Mobula eregoodoo* and *M. kuhlii*.
- Oceanic Whitetip Shark
  - Research priorities should be considered at the ocean basin level.
  - Limited information on species in Australia.

Key points raised at the broad level:

- There was considerable overlap in reasoning for species selection with Questions 8/9.
- Lack of data/knowledge drove species selection.
- Future threats also informed responses.
- For some more well studied species, there is sufficient information to inform management; it is the will to act that is lacking.
- Global status and threats causing local declines in migratory species/connected populations.
- Many species still have knowledge gaps for life history and population structure; even well-studied species have significant gaps (e.g., White Shark).
- Filling knowledge gaps can inform recovery planning.
- Survey did not allow consideration of priorities at subpopulation level (e.g., Grey Nurse Shark on west coast).
- Acknowledgement that some species are difficult to study.

### Question 12

Please feel free to add any other points related to issues, research needs, and priorities for species listed above.

This was an open-ended question allowing respondents to offer any further information or comments. Eighteen respondents (39.1%) offered additional comments.

Key points raised:

- Extinction risk and knowledge gaps are not the only factors to consider when prioritising research; the survey would have benefited from also including:
  - (1) effectiveness ('bang for buck'),
  - (2) conservation and management outcomes,
  - (3) stakeholder impact,
  - (4) feasibility,
  - (5) previous investment and successes.
- Threatened species in the *Shark Action Plan* that are not *EPBC*-listed were highlighted by respondents; some of these require data collection to facilitate assessment under *EPBC* while others have sufficient information for nomination.
- Shark and ray science and management is hampered by a lack of long-term monitoring; there is a need to redirect funding to large-scale collaborative monitoring programs.
- Importance of basic life history data (e.g., age-and-growth, reproductive biology), and population structure for determining population status and trend.
- Some respondents highlighted endemic species (e.g., threatened southeast Australian endemics) as research priorities, particularly to obtain data needed for evidentiary requirements of *EPBC* listing.
- The research and management community should be vigilant to new and emerging threats, e.g., ship strike for Whale Shark, climate change, de-risking depredation.
- Interest, capacity, and capability all exist locally to work to fill knowledge gaps, but limited funding opportunities are a continued impediment.
- Working alongside industry is key to conservation and management success.
- Some species are poorly known because they are difficult to research due to factors such as rarity, remoteness, cryptic nature.
- Utilization of existing datasets and samples can be cost-effective.

## 5. Workshop

### 5.1 Introduction and approach

The Marine and Coastal Hub has the primary objective of delivering high-quality research that improves environmental, cultural, social, and economic outcomes across Australia's marine and coastal regions. It will do this (over its lifetime 2020/21-2026/27) through the development of tools and methods that can be applied for supporting decision-making and practical management in response to Australia's national and international laws and obligations. Projects funded through the Hub deliver into six thematic areas, one of which is focused on threatened and migratory species.

To ensure that the Hub, with its partners, develops projects that deliver into conservation management and regulatory priorities and address current needs and gaps, the Marine and Coastal Hub is carrying out a scoping exercise as part of the development of its 2023 and future research plans. To date, this has involved a series of meetings with DAWE managers to discuss key needs and potential practical solutions that might be the focus of Hub and partner funding and activities across the taxa/species/community groups of marine mammals, dugongs, marine reptiles, sharks, rays, seabirds, bony fish, invertebrates and threatened ecological communities.

A short workshop will focus on sharks and rays, to build on consultations with the Department to further identify and refine focal areas/priorities and activities that can be included in future research plans. Specifically, this workshop will be focused on identifying a set of priority theme or activity areas that:

- Have the potential to create a step change in information provision to processes.
- Deliver into priorities/needs across multiple jurisdictions (e.g. State/Territory and Commonwealth).
- Meet/align with or deliver to actions within current management advice/plans.
- Align with the objectives of NESP.
- Are (i) likely to be funded by NESP, with matching co-investment by Hub partners and (ii) delivered within the lifetime of NESP.
- Can be delivered through provision of a staged delivery of outputs that enables regular review and feedback provision to ensure delivery of outputs that are tangible and directed for application in conservation management and by regulatory agencies.
- Build on efforts already underway and provide opportunities for integration of efforts.

The workshop will focus on species listed as threatened, conservation dependent, and/or migratory under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (see table below). No chimaera species are threatened or migratory and therefore the project will focus on sharks and rays. Workshop invitees include State and Territory managers, Commonwealth managers and regulators, and researchers engaged broadly across the taxa group.

This workshop was not focused on identifying specific/individual projects per se. Outputs from the workshop will be a set of focal areas and priorities that can be included in guidance for the Hubs future research plans and inform investment in future annual research plans.

The workshop agenda is provided below:

### Break-out group guiding questions

The workshop participants split into two break-out groups which aimed to workshop focal areas and priorities. A set of three guiding questions were asked of participants:

1. In directly progressing the priorities identified across research-users, what might be a thematic/priority area(s) that the NESP MaC Hub can focus on?
2. Given the scope of the NESP MaC Hub and the funding potentially available, what of the key priority/thematic areas identified above are the most feasible for the NESP MaC partners to focus on and what might be practically achievable within the lifetime of the NESP MaC Hub?
3. Are there specific elements that would need to be considered by NESP partners in developing projects around these thematic/priority areas (e.g. consultation processes, co-design with particular agencies/groups etc)?

### Workshop Agenda

<b>10:00-10:10</b>	Welcome, introduction and overview of objectives of workshop	Peter Kyne
<b>10:10-10:20</b>	Overview of NESP MaC Hub, objectives, priorities, and process for 2023 Research Plan	Alan Jordan
<b>10:20-10:40</b>	Results from on-line sharks and ray survey	Moderator: Peter Kyne
<b>10:40-10:50</b>	Q&A	Moderator: Peter Kyne
<b>10:50-11:20</b>	Commonwealth and state/territory priorities: management perspectives	Research-user reps
<b>11:20-11:25</b>	Break-out groups: recap of tasks and division of attendees	Peter Kyne
<b>11:25-12:05</b>	Break-out group discussions on priority areas	All
<b>12:05-12:25</b>	Break-out group report to plenary and discussion	All
<b>12:25-12:30</b>	Summary and wrap-up	Peter Kyne



## Workshop focal species

The workshop focused on Australian sharks and rays listed under the *EPBC Act*. Species are listed in phylogenetic order. \*Denotes a species currently under consideration for listing in a threatened category (or in the case of Largetooth Sawfish, for listing in a higher threatened category).

Species	<i>EPBC Act</i> Threatened	<i>EPBC Act</i> Migratory	<i>EPBC Act</i> Conservation Dependent
<b>Harrisson's Dogfish</b> <i>Centrophorus harrissoni</i>	--	--	CD
<b>Southern Dogfish</b> <i>Centrophorus zeehaani</i>	--	--	CD
<b>Whale Shark</b> <i>Rhincodon typus</i>	VU	Migratory	--
<b>Grey Nurse Shark</b> <i>Carcharias taurus</i>	East: CR; West: VU	--	--
<b>Basking Shark</b> <i>Cetorhinus maximus</i>	--	Migratory	--
<b>White Shark</b> <i>Carcharodon carcharias</i>	VU	Migratory	--
<b>Shortfin Mako</b> <i>Isurus oxyrinchus</i>	--	Migratory	--
<b>Longfin Mako</b> <i>Isurus paucus</i>	--	Migratory	--
<b>Porbeagle</b> <i>Lamna nasus</i>	--	Migratory	--
<b>School Shark</b> <i>Galeorhinus galeus</i>	--	--	CD
<b>Silky Shark</b> <i>Carcharhinus falciformis</i>	--	Migratory	--
<b>Oceanic Whitetip Shark</b> <i>Carcharhinus longimanus</i>	--	Migratory	--
<b>Northern River Shark</b> <i>Glyphis garricki</i>	EN	--	--
<b>Speartooth Shark</b> <i>Glyphis glyphis</i>	CR	--	--
<b>Scalloped Hammerhead</b> <i>Sphyrna lewini</i>	--*	--	CD
<b>Great Hammerhead</b> <i>Sphyrna mokarran</i>	--	--	--
<b>Narrow Sawfish</b> <i>Anoxypristis cuspidata</i>	--*	Migratory	--
<b>Dwarf Sawfish</b> <i>Pristis clavata</i>	VU	Migratory	--
<b>Largetooth Sawfish</b> <i>Pristis pristis</i>	VU*	Migratory	--
<b>Green Sawfish</b> <i>Pristis zijsron</i>	VU	Migratory	--
<b>Maugean Skate</b> <i>Zearaja maugeana</i>	EN	--	--
<b>Reef Manta Ray</b> <i>Mobula alfredi</i>	--	Migratory	--
<b>Giant Manta Ray</b> <i>Mobula birostris</i>	--	Migratory	--
<b>Long-horned Pygmy Devilray</b> <i>Mobula eregoodoo</i>	--	Migratory	--
<b>Giant Devilray</b> <i>Mobula mobular</i>	--	Migratory	--
<b>Bentfin Devilray</b> <i>Mobula thurstoni</i>	--	Migratory	--

## Workshop attendees

Workshop attendees/agencies are listed in the following table.

Alan Jordan	Charlie Huveneers	David Morgan
Peter Kyne	Fabrice Jaïne	Thor Saunders
Matias Braccini	Grant Johnson	Mark Meekan
Russ Bradford	Yvette Williams	Adam Stow
Matthew Campbell	Steve Auld	Michael Usher
Christine Dudgeon	Adrian Gleiss	Al Harry
Michael Drew	Fisheries Research and Development Corporation	Department of Climate Change, Energy, the Environment and Water
Threatened Species Scientific Committee	Australian Fisheries Management Authority	

## Workshop discussions

### Background and scene-setting

#### *Online survey discussion*

- Tractability is an important component of priority setting (ensuring investment delivers outcomes).
- Knowledge varies widely across species; many unknowns persist, including those vital for achieving conservation outcomes e.g., long-term monitoring.
- There is no fixed formula for monitoring vs. research in the NESP Marine and Coastal Hub framework; if end-users require and value monitoring then this can be supported within the Hub.
- Post-release survivorship is considered an important topic to address.
- Movement ecology has had considerable focus in Australia but ranking in survey suggests there are still many unknowns in this space.
- Human dimensions questions were lacking from online survey but are an important consideration.

#### *Threatened Species Scientific Committee (TSSC) perspectives*

- Priorities informed by:
  - Species status (as assessed under Act).
  - Understanding progress to recovery for currently listed species.
  - Species that are under assessment for possible listing on the Act.
  - Species that might need assessment under the Act in the future.
  - Threats and threat mitigation.
  - Actions from Recovery Plans and Conservation Advice.

#### *Fisheries Research and Development Corporation (FRDC) perspectives*

- Key areas include:
  - Understanding the intersection between species and fisheries.
  - Population estimates.
  - Bycatch mitigation.
  - Depredation.

- Taking a risk assessment approach to identifying priorities (to understand what can be mitigated).
- Movement and spatial ecology can inform closures.
- Data and information on CITES listed species.

***Department of Climate Change, Energy, the Environment and Water (DCCEEW) perspectives***

- Support for TSSC priorities.
- Reviewing Recovery Plans (White Shark, sawfish and river sharks multi-species, Gery Nurse Shark) and Conservation Advice (Maugean Skate) can be informative for priority setting.
- Commonwealth priorities guided by Threatened Species Strategy and Action Plan.
- Sharks and rays in the Strategy are limited to Grey Nurse Shark, Largetooth Sawfish, Maugean Skate. Priorities for these species are:
  - Grey Nurse Shark
    - Identification of new aggregation sites.
    - Population abundance and trend.
  - Largetooth Sawfish
    - Population abundance.
    - Bycatch mitigation.
    - Identification of critical habitats.
    - Post-release mortality.
  - Maugean Skate
    - Population trend.
    - Population structure.

***Australian Fisheries Management Authority (AFMA) perspectives***

- Good overlap with results of online survey.
- Fisheries-specific bycatch mitigation.
- Post-release survivorship.
- Understanding species behaviour (to understand how species can avoid gear).
- Population size and status.
- Understanding habitats to avoid.
- Life history data to inform ecological risk assessments.
- Monitoring methods.

***Perspectives from states/territories (open floor – perspectives provided by WA and NT)***

***Northern Territory (NT) perspectives***

- Important to understand status of shared stocks.
- Applicability of monitoring methods may vary between species (e.g., close-kin mark-recapture may not be suitable for all species).

***Western Australian (WA) perspectives***

- Most focus being placed on fisheries, but habitat loss may be a 'blindspot' which may not have immediate direct mortality affect.

- Impacts of water extraction particularly relevant for northern Australia.

### **Break-out group outcomes**

Break-out group converged on four **Thematic Areas** as priority research and investment areas:

1. **Critical Habitats**
2. **Population Size and Trends**
3. **Mitigation & Bycatch**
4. **Human Dimensions**

Each theme is outlined below.

#### ***Theme 1. Critical Habitats***

- Critical habitat is highly species-specific and varies with life history.
- Critical habitat can be relatively small areas (e.g., nurse areas) or very large areas (e.g., migration corridors).
- There is a need to assess emerging threats e.g., habitat alteration due to developing Northern Australian agenda including water extraction.
- Seagrass a critical habitat under loss. How will loss impact species?
- Aggregation sites for Grey Nurse Shark; well known on east coast, poorly known on west coast.
- Need to understand overlap between threatening processes and critical habitat.
- Understanding critical habitat requires rich data on how the animal's environment is being used.
- Thematic Area has a natural 'poster child' in Maugean Skate.

#### ***Theme 2. Population Size and Trends***

- Long-term monitoring to assess trend is required for all threatened species.
- Monitoring can raise the alarm (declines) and highlight successes (recovery)
- Long-term species-specific monitoring is severely lacking in Australia.
- Capacity to curate and nationally coordinate large-scale datasets.
- Collaborative approach to data-sharing.
- Monitor emerging/re-emerging threats that can impact population trend (e.g., increasing illegal fishing in Northern Australia).
- Conservation genetics will have an increasing role in understanding population structure and connectivity.
- Utilise existing datasets and tissue sampling (need for national collaborative tissue bank).
- Build capacity in close-kin mark-recapture outside of CSIRO.

#### ***Theme 3. Mitigation & Bycatch***

- Assessment of post-release survivorship is a need across fisheries.
- Assessing post-release survivorship needs a collaborative approach (NESP, FRDC, AFMA, Industry).
- Innovation to mitigate bycatch.
- Understand technological advances in mitigating bycatch.

- Spatial element of where Critical Habitats are to plan spatial management to mitigate impact (link to Critical Habitats Thematic Area)
- Clear links to Human Dimensions Thematic Area.

#### **Theme 4. Human Dimensions**

- Human dimensions are an element of all Thematic Areas.
- Early engagement is essential to bringing in human dimensions across life of Hub (invest time to build trust).
- Understanding drivers of fishing practices can help inform Theme 3 (Mitigation & Bycatch).
- Build trust with industry through collaborations.
- Incorporating Traditional Owners is key across all Thematic Areas.
- Understanding public perception (including around shark bites and depredation) can inform shaping of research and conservation actions.

## **6. References**

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IUCN. 2016. *The Conservation Status of Sharks, Rays, and Chimaeras in the Mediterranean Sea*. IUCN Centre for Mediterranean Cooperation, Málaga, Spain.

Jabado RW, Kyne PM, Pollom RA, Ebert DA, Simpfendorfer CA, Ralph GM, Dulvy NK, eds. 2017. *The Conservation Status of Sharks, Rays, and Chimaeras in the Arabian Sea and Adjacent Waters*. Environment Agency – Abu Dhabi, UAE and IUCN Species Survival Commission Shark Specialist Group, Vancouver, Canada.

Kyne PM, Heupel MR, White WT, Simpfendorfer CA 2021. *The Action Plan for Australian Sharks and Rays 2021*. National Environmental Science Program, Marine Biodiversity Hub, Hobart.

## Appendix A: Survey details provided for the workshop

8/17/22, 4:08 PM

NESP Marine and Coastal Hub Threatened and Migratory Species Scoping Project Online Survey - Sharks & Rays

### **NESP Marine and Coastal Hub Threatened and Migratory Species Scoping Project Online Survey - Sharks & Rays**

*Dear Australian shark and ray researchers, managers, policy-makers, and end-users,*

*You have been selected for a survey given your knowledge and experience with Australian sharks and rays.*

The NESP Marine and Coastal Hub Research Plan 2021 includes a number of scoping projects that aim to generate shared understanding about research needs, knowledge gaps, and priorities. A key scoping project (1.20) is the 'Marine and coastal threatened and migratory species and ecological communities' project which aims to inform future Hub research investment in priority species and knowledge gaps, principally within the Hub's annual research plans over the multiple years of the program.

The shark and ray component of the scoping project will consider issues related to sharks and rays. The project will focus on species currently listed as threatened, conservation dependent, and/or migratory under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

It is also noted here that a number of sharks and rays have been assessed as threatened in *The Action Plan for Australian Sharks and Rays 2021* ('Shark Action Plan') but are not listed under the EPBC Act. The Shark Action Plan also recommends some species currently listed under the EPBC Act be up-listed (moved to a higher threatened category) or down-listed (moved to a lower threatened category). Lastly, the Shark Action Plan identifies a group of Data Deficient species which are poorly-known with uncertain status. While these have been identified as priorities, they are not considered in this online survey but will be outlined in the final report of the project.

**Online survey scope:** This survey relates to Australia's 25 species of sharks and rays listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as threatened, conservation dependent, and/or migratory. A species list is provided below.

**Online survey aim:** This survey aims to solicit issues, research needs, and priorities related to the management of these species. This survey will help understand shark and ray expert and practitioner priorities and represents one of several steps to gather information for this scoping study (other steps include desktop reviews and workshops).

*Please feel free to request access to this survey for others in your organisation if they have relevant expertise.*

*The survey will close on Monday 22nd August at midnight ACST.*

*Thank you for your participation,*

[https://docs.google.com/forms/d/1miqRgnXwvI8DkWEzcnPx6Qx-33ycVTNDbk8J7b5hITY/edit?ts=62ef57c8&edit\\_requested=true](https://docs.google.com/forms/d/1miqRgnXwvI8DkWEzcnPx6Qx-33ycVTNDbk8J7b5hITY/edit?ts=62ef57c8&edit_requested=true)

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**Dr Alan Jordan & Dr Peter Kyne, NESP Marine and Coastal Hub**

**Annex.** Australian sharks and rays currently listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Species are listed in phylogenetic order.

\*Denotes a species currently under consideration for listing in a threatened category (or in the case of Largetooth Sawfish, for listing in a higher threatened category).

**Harrisson's Dogfish *Centrophorus harrissoni*** Conservation Dependent

**Southern Dogfish *Centrophorus zeehaani*** Conservation Dependent

**Whale Shark *Rhincodon typus*** Vulnerable; Migratory

**Grey Nurse Shark *Carcharias taurus*** East: Critically Endangered; West: Vulnerable

**Basking Shark *Cetorhinus maximus*** Migratory

**White Shark *Carcharodon carcharias*** Vulnerable; Migratory

**Shortfin Mako *Isurus oxyrinchus*** Migratory

**Longfin Mako *Isurus paucus*** Migratory

**Porbeagle *Lamna nasus*** Migratory

**School Shark *Galeorhinus galeus*** Conservation Dependent

**Silky Shark *Carcharhinus falciformis*** Migratory

**Oceanic Whitetip Shark *Carcharhinus longimanus*** Migratory

**Northern River Shark *Glyphis garricki*** Endangered

**Speartooth Shark *Glyphis glyphis*** Critically Endangered

**Scalloped Hammerhead *Sphyrna lewini*\*** Conservation Dependent

**Narrow Sawfish *Anoxypristis cuspidata*\*** Migratory

**Dwarf Sawfish *Pristis clavata*** Vulnerable; Migratory

**Largetooth Sawfish *Pristis pristis*** Vulnerable\*; Migratory

**Green Sawfish *Pristis zijsron*** Vulnerable; Migratory

**Maugean Skate *Zearaja maugeana*** Endangered

**Reef Manta Ray *Mobula alfredi*** Migratory

**Giant Manta Ray *Mobula birostris*** Migratory

**Long-horned Pygmy Devilray *Mobula eregoodoo*** Migratory

**Giant Devilray *Mobula mobular*** Migratory

**Bentfin Devilray *Mobula thurstoni*** Migratory



\* Required

1. Which sector do you represent? (select one; if you represent more than one, please select the primary sector). \*

*Mark only one oval.*

- ☐ Research (academic/university)
- ☐ Research (state/territory government)
- ☐ Research (federal government)
- ☐ Research (Industry including environmental consulting)
- ☐ Research (other)
- ☐ Policy/management (state/territory government)
- ☐ Policy/management (federal government)
- ☐ Industry (non-research)
- ☐ Non-government organisation
- ☐ Other: \_\_\_\_\_

2. How many years' experience do you have working with sharks and rays or issues relevant to the management of sharks and rays? \*

*Check all that apply.*

- ☐ 1-5 years
- ☐ 6-10 years
- ☐ 11-15 years
- ☐ 16-20 years
- ☐ 21+ years

3. What are the key issues facing Australia's threatened sharks and rays collectively (these are likely to vary by species, but we are looking to solicit big picture items)? Please select **three** key issues. \*

*Check all that apply.*

- ☐ Pollution and marine debris
- ☐ Habitat loss and alteration
- ☐ Targeted commercial exploitation
- ☐ Catch in recreational fisheries
- ☐ Lack of information relevant to management and recovery
- ☐ Climate change
- ☐ Bycatch in commercial fisheries

4. Are there any other key issues facing Australia's threatened sharks and rays that are not included in the list above? What is their importance relative to the issues listed above?

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5. For the items you selected as being the most important key issues above, what are some of the research needs to mitigate the impacts of these issues on threatened sharks and rays collectively?

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6. What are the key research needs for Australia's threatened sharks and rays collectively (these are likely to vary species by species, but we are looking to solicit big picture items)? Please select **three** key research needs. \*

*Check all that apply.*

- ☐ Resolve taxonomic issues
- ☐ Define distribution and habitat requirements
- ☐ Assess reproductive biology
- ☐ Assess age-and-growth
- ☐ Assess trophic ecology
- ☐ Define movement and migration pathways
- ☐ Delineate population structure
- ☐ Determine status through population size and trend estimates
- ☐ Monitor catch in commercial fisheries
- ☐ Monitor catch in recreational fisheries

7. Are there any other key research needs for Australia's threatened sharks and rays that are not included in the list above? What is their importance relative to the research needs listed above?

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8. From an **extinction risk perspective**, which **five** species from the list below are the highest research priorities? \*

*Check all that apply.*

- ☐ Harrison's Dogfish *Centrophorus harrissoni*
- ☐ Southern Dogfish *Centrophorus zeehaani*
- ☐ Whale Shark *Rhincodon typus*
- ☐ Grey Nurse Shark *Carcharias taurus*
- ☐ Basking Shark *Cetorhinus maximus*
- ☐ White Shark *Carcharodon carcharias*
- ☐ Shortfin Mako *Isurus oxyrinchus*
- ☐ Longfin Mako *Isurus paucus*
- ☐ Porbeagle *Lamna nasus*
- ☐ School Shark *Galeorhinus galeus*
- ☐ Silky Shark *Carcharhinus falciformis*
- ☐ Oceanic Whitetip Shark *Carcharhinus longimanus*
- ☐ Northern River Shark *Glyphis garricki*
- ☐ Speartooth Shark *Glyphis glyphis*
- ☐ Scalloped Hammerhead *Sphyrna lewini*
- ☐ Narrow Sawfish *Anoxypristis cuspidata*
- ☐ Dwarf Sawfish *Pristis clavata*
- ☐ Largetooth Sawfish *Pristis pristis*
- ☐ Green Sawfish *Pristis zijsron*
- ☐ Maugean Skate *Zearaja maugeana*
- ☐ Reef Manta Ray *Mobula alfredi*
- ☐ Giant Manta Ray *Mobula birostris*
- ☐ Long-horned Pygmy Devilray *Mobula eregoodoo*
- ☐ Giant Devilray *Mobula mobular*
- ☐ Bentfin Devilray *Mobula thurstoni*

9. What was the basis for selecting this suite of species?

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10. From a **knowledge gap perspective**, which **five** species from the list below are the highest research priorities? \*

*Check all that apply.*

- ☐ Harrison's Dogfish *Centrophorus harrissoni*
- ☐ Southern Dogfish *Centrophorus zeehaani*
- ☐ Whale Shark *Rhincodon typus*
- ☐ Grey Nurse Shark *Carcharias taurus*
- ☐ Basking Shark *Cetorhinus maximus*
- ☐ White Shark *Carcharodon carcharias*
- ☐ Shortfin Mako *Isurus oxyrinchus*
- ☐ Longfin Mako *Isurus paucus*
- ☐ Porbeagle *Lamna nasus*
- ☐ School Shark *Galeorhinus galeus*
- ☐ Silky Shark *Carcharhinus falciformis*
- ☐ Oceanic Whitetip Shark *Carcharhinus longimanus*
- ☐ Northern River Shark *Glyphis garricki*
- ☐ Speartooth Shark *Glyphis glyphis*
- ☐ Scalloped Hammerhead *Sphyrna lewini*
- ☐ Narrow Sawfish *Anoxypristis cuspidata*
- ☐ Dwarf Sawfish *Pristis clavata*
- ☐ Largetooth Sawfish *Pristis pristis*
- ☐ Green Sawfish *Pristis zijsron*
- ☐ Maugean Skate *Zearaja maugeana*
- ☐ Reef Manta Ray *Mobula alfredi*
- ☐ Giant Manta Ray *Mobula birostris*
- ☐ Long-horned Pygmy Devilray *Mobula eregoodoo*
- ☐ Giant Devilray *Mobula mobular*
- ☐ Bentfin Devilray *Mobula thurstoni*

11. What was the basis for selecting this suite of species?

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12. Please feel free to add any other points related to issues, research needs, and priorities for species listed above.

Thank you for your participation in this survey.

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