

**RESEARCH REPORT** 

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Marine and coastal threatened species and communities scoping study sub-component: Seabirds and marine mammals (excluding dugongs)

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# **Executive summary**

This project was undertaken across 2022 with the aim of identifying research priorities for threatened species and communities, specifically the taxa groups seabirds and marine mammals (excluding dugongs), that project proposals could be developed in response to and incorporated in the NESP Marine and Coastal Hub 2023 Research Plan. The report from this project contributes to a larger report that brings together similar assessments across a range of other taxa groups to synthesise information more broadly across threatened species and communities.

The project consisted of two components: (i) a literature review covering peer-reviewed publications and reports derived from the Australian region, assessments conducted as part of the 2021 Australia State of the Environment report and recovery plans, conservation management plans, conservation advice and wildlife management plans issued under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) and (ii) stakeholder workshops aimed at capturing Commonwealth, state and territory departmental and expert priorities for filling knowledge gaps and informing decision making processes. The two components were used to identify areas of overlap between priorities articulated and research being conducted and where there are currently research gaps that the NESP could potentially direct efforts to fill.

Clear priorities for research identified by both the literature search and the two taxa specific workshop were associated with:

- ongoing monitoring or establishment of monitoring programs for seabird and marine mammal populations across a range of biological and ecological aspects (e.g. population parameters, foraging ecology, migration and movement ecology), particularly with the view to identifying change over time and being able to quantify impacts of threats on populations.
- (ii) linking at-sea behaviours to population parameters was identified as essential for being able to attribute biological and ecological change to drivers;
- (iii) integrative approaches that allow for the quantification of risk, attribution of the effects of biological and ecological changes on population viability and future projection of population trajectories;
- (iv) identifying and utilising new technologies and novel analytical approaches particularly in expanding and introducing innovation into the monitoring of populations and in reducing and mitigating threats, particularly in relation to fisheries bycatch, entanglement and anthropogenic noise.

An emerging research area for focusing efforts not captured by the literature review, but highlighted in the workshops was understanding the responses to and impacts of offshore renewable energy. This discrepancy is likely due to the rapid development of planning processes associated with this emerging industry within Australian waters and the lag between the identification of emerging threats and their capture in conservation plans and the literature.

Research area needs highlighted by workshops associated with offshore renewable energy included understanding the behaviours of seabirds and marine mammals around offshore installations, understanding the risks from noise generated during the installation, commissioning and decommissioning phases of offshore infrastructure, understanding shifts in habitat use that might be caused by installations and associated supporting infrastructure and the flow on effects of disturbance on population parameters and population viability. For seabirds additional needs included understanding the risks associated with light pollution and collisions with infrastructure.

Future research areas associated with new technologies were those for supporting data and knowledge exchange and delivery, including that associated with best practices and protocols, development of data synthesis products for use by various stakeholders and overall awareness and coordination of research efforts.

Keywords: seabirds, marine mammals, threatening processes, research priorities

Introduction

# 1. Introduction

There are numerous species and ecological communities in Australia's marine and coastal environments that have formal threatened conservation status under the *Environmental Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). There are also additional species listed because of Australia's responsibilities under international conventions and bilateral agreements. Many of these occur in Australia's marine and coastal environments.

The National Environmental Science Program (NESP) Marine and Coastal (MaC) Hub is undertaking a scoping, prioritising and co-design process facilitated through consultation with key stakeholders and end-users. The MaC Hub Research Plan 2021 includes a number of scoping projects aimed at informing future research investment within the MaC Hub's annual research plans, one of which is the 'Marine and coastal threatened and migratory species and communities' project (1.20). This scoping project is being run in parallel with and will contribute to a broader cross-Hub Initiative project 'Threatened and Migratory Species and Threatened Ecological Communities', led by the NESP Resilient Landscapes Hub, thereby contributing to achieving the broader aims of this cross-Hub initiative.

The purpose of the two projects is to identify specific activities that address current needs and gaps relating to marine and coastal threatened species and communities, for supporting policy development, program management and regulatory processes to protect Australia's environmental assets. Through involving a range of end-users in a considered planning, consultation and prioritisation process as part of the two projects, the likelihood of on-ground outcomes and long-term adoption will be increased.

This sub-project sits within an overarching project focused across a range of marine and coastal threatened species and communities. The sub-project is focused specifically on identifying research priorities for the two taxa groups marine mammals (excl. dugongs) and seabirds. Shorebirds are not included here as they are the focus of a separate MaC Hub project (1.21) that is focussing on an updated national trend analysis on key shorebirds species and evaluating the relative contribution of Australian and overseas causes of any decline. Outputs, reported here, from this sub-project along with other taxa group contributions to the overarching project will be incorporated into the 2023 Research Plan and future research plans of the MaC Hub with the aim of maximising the effectiveness of the investments made by the MaC Hub.

# 1.1 Objectives

The objectives of this sub-project are to:

- 1. Undertake a desktop review of knowledge gaps and research needs from past processes and documents, including how previous research is being used.
- 2. Identify potential key end-users including from state and federal governments, community and industry groups and NGO's.
- 3. Hold thematic domain workshops with key end-users to discuss findings of desktop reviews and undertake facilitated discussions to co-identify priority research questions and identify potential collaborators and co-investors.
- 4. Synthesise the outcomes from domain workshops.
- 5. Produce reports that summarise the key issues and next steps on priority issues.

# 2. The scoping exercise: approach

The sub-project consists of two main components:

- 1. A desktop review to identify:
  - relevant Commonwealth recovery plans conservation management plans and conservation advice for seabirds and marine mammals (excl. dugongs);
  - b. Commonwealth policy and guidelines relevant to seabirds and marine mammals (excl. dugongs);
  - c. recent relevant scientific understanding from the Australian region in support of the conservation management of seabirds and marine mammals (excl. dugongs);
  - d. based on the above, key knowledge gaps and research needs.
- 2. Taxa specific workshops with a range of stakeholders to identify key thematic areas or activities that could address the priority research needs of Commonwealth, state and territory conservation managers and industry regulators.

# 2.1 Desktop review

Information on Commonwealth recovery plans, conservation management plans and conservation advice and their current status were derived from the Australian Government Species Profile and Threats Database (see <a href="http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl">http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl</a>). Common threatening processes and research needs across the two taxa groups were then identified from those plans and advice that were current. Expired recovery plans were not included in this assessment as threats and priorities identified in the plans for those species may have changed since the plan had expired.

Relevant literature on seabirds and marine mammals (excl. dugongs) were identified via two approaches:

- i. use of reference lists and direct elicitation as part of assessments conducted for the 2021 State of the Environment report on seabirds, whales, dolphins and porpoises, and pinnipeds (see <u>https://www.dcceew.gov.au/science-research/soe</u>),
- ii. literature searches conducted utilising the platforms Google scholar and Web of Science using the search terms (in various combinations) "seabird", "dolphin", "whale", "cetacean", "sea lion", "seal", and "Australia" conducted in May and June 2022. To ensure that literature reflected contemporary research understanding and was able to be collated within the limits of the sub-project literature searches were limited to the last five years (2017-2022).

The reports of all previous research undertaken on seabirds and marine mammals (excluding dugongs) under the NESP were also collated.

While it is recognised that some literature may not be captured using this approach, it was assumed that it was broad enough to capture relevant conservation and management

concerns, including emerging threats as well as the research needs required to address threats.

Each publication was then qualitatively evaluated to identify:

- The focal species of each publication;
- Threatening processes identified by publications;
- Areas of research included in publications, and;
- Recommendations for specific research needs.

These were then used to identify the most common areas of research focus (threats, biological processes, species) and areas of common research needs articulated by the literature. These were then compared with the threatening processes and research needs identified in Commonwealth recovery plans, conservation management plans and conservation advice. It was noted that many of the species-specific accounts in books published during the period (e.g. Garnett and Baker 2020) utilised the same peer review publications as those identified in the literature search and drew on recovery plans, conservation management plans and conservation advice when identifying threats and research requirements.

# 2.2 Taxa specific workshops

Taxa specific workshops were structured into two parts. The first consisted of a series of presentations that provided:

- Background to the NESP, the MaC Hub and the Threatened and Migratory Species and Threatened Ecological Communities Initiative;
- Priority needs for Commonwealth conservation management;
- Priority needs for Commonwealth offshore energy regulation, and;
- Priority needs for Commonwealth fisheries management and regulation.

The second part of the workshop focused on discussions facilitated through smaller break- out groups guided by the following guiding questions:

- In directly progressing the priorities identified by Commonwealth departments/agencies tasked with conservation management, offshore energy regulation and fisheries management, what might be a thematic/priority area(s) that the NESP MaC Hub can focus on?
- 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?
- 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.)?

Break-out groups then reported back to the workshop with a final discussion of key elements raised by the groups.

Workshop size was purposefully limited to ensure that discussions focused on identifying higher level key priority needs for management and regulatory processes that first, aligned with the objectives of the MaC Hub and second, identified potential areas for cross Hub collaboration. This then ensured that the next stage of consultations

undertaken by the MaC Hub were supported by relevant information that could then be used to co-design specific projects that partners agencies in the Hub could deliver that directly addressed the needs identified.

Workshop attendees were provided with background material relating to the project and the MaC Hub prior to each workshop. This included information that set out the objectives of each workshop, the structure of the workshop and a set of guiding questions for focusing discussions during each workshop. The background material provided for each workshop is provided in Appendix A, the agendas for each workshop are provided in Appendix B.

# 3. Seabirds

# 3.1 Literature review

A summary of all recovery plans, conservation management plans and conservation advice for threatened seabirds is provided in Table 1. There are currently 14 species for which conservation advice is in place, with the conservation advice for one species currently being reviewed and revised (in this case, the previous conservation advice was included in the assessment of threats and research priorities). Nineteen species are included in the recently released National Recovery Plan for Threatened Albatross and Petrels 2022 (DCCEEW 2022). Three species are included in recovery or management plans that are identified as being out of date and required the Australian Government Species Profile and Threats Database. The Wildlife Conservation Plan for Seabirds (DAWE 2020) includes a further 73 species listed as migratory and/or marine under the EPBC Act.

Outputs from the literature search are provided in Appendix C. Publications were predominantly focused on multiple species (45.5% of all publications). Of those publications that focused on a single species, the most common species featured in publications was the short-tailed shearwater (*Ardenna tenuirostris*; 12.1% of publications), little penguin (*Eudyptula minor*; 9.1% of publications) and flesh footed shearwater (*Ardenna carneipes*; 9.1% of publications). While over half of publications featuring multiple species included currently listed threatened species (51.7% of publications), publications that focused on single species predominantly did not. Single species publications that focused on threatened species included the fairy tern (*Sternula nereis nereis*; 3% of single species publications).

No research has been conducted under the NESP on seabirds to date.

# Threatening processes

Threats identified in current conservation advice are listed in Table 2. The most common (i.e. frequently occurring) threatening processes identified in the 16 current recovery plans and conservation advice were those associated with feral/invasive species and associated predation (93.8 %) and habitat loss, disturbance and modification (included in 87.5 % of plans/advice). All other threatening processes identified were listed in less than 40 % of the total number of plans/advice.

It should be noted that this commonality does not necessarily reflect the priority placed on threats at the individual species level, with only the recovery plan for albatross and petrels and the conservation advice for Abbott's booby, *Papasula abbotti* and Christmas Island frigatebird, *Fregata andrewsi* including consideration of threat prioritisation (through a risk matrix and ranking of threats) based on expert advice and consultation. This ranking process identified fisheries interactions and bycatch as having a very high impact on 31 of the albatross and petrel species covered by the recovery plan, and introduced invasive species having a very high impact on eight species. All other threats considered to be very high related to 1 or 2 species. The threat of an introduction of a new disease, was identified as having a major impact on both Abbott's booby and Christmas Island frigatebird with severe storm events considered to also have a major impact on Abbott's booby. Feral/invasive species as either being a primary historical threat, a primary potential threat or a current primary threat to populations.

Table 1: Commonwealth recovery plans, conservation management plans and conservation advice developed for threatened seabird species and their current status. Note: current status is as per listing on the Australian Government Species Profile and Threats Database (<u>http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl</u>).

Species	Common name	EPBC Act listing	Recovery/ Conservation management plan/ Conservation advice	Plan status
Anous tenuirostris melanops	Australian lesser noddy	Vulnerable	Conservation Advice. <i>Anous tenuirostris melanops.</i> Australian lesser noddy	Effective 2015.
Diomedea amsterdamensis	Amsterdam albatross	Endangered, Migratory	National recovery plan for threatened albatrosses and petrels 2022	Effective 2022
Diomedea antipodensis	Antipodes albatross	Vulnerable, Migratory	National recovery plan for threatened albatrosses and petrels 2022	Effective 2022
Diomedea antipodensis gibsoni	Gibson's albatross	Vulnerable	National recovery plan for threatened albatrosses and petrels 2022 (note Gibson's albatross is considered as Antipodean albatross in the plan)	Effective 2022
Diomedea dabbenena	Tristan albatross	Endangered, Migratory	National recovery plan for threatened albatrosses and petrels 2022	Effective 2022

Species	Common name	EPBC Act listing	Recovery/ Conservation management plan/ Conservation advice	Plan status
Diomedea epomophora	Southern royal albatross	Vulnerable, Migratory	National recovery plan for threatened albatrosses and petrels 2022	Effective 2022
Diomedea exulans	Wandering albatross	Vulnerable, Migratory	National recovery plan for threatened albatrosses and petrels 2022	Effective 2022
Diomedea sanfordi	Northern royal albatross	Endangered, Migratory	National recovery plan for threatened albatrosses and petrels 2022	Effective 2022
Fregata andrewsi	Christmas Island frigatebird	Endangered, Migratory	Conservation Advice for the Christmas Island Frigatebird – <i>Fregata andrewsi</i>	Effective 2020
Fregetta grallaria grallaria	White-bellied storm petrel	Vulnerable	Lord Howe Biodiversity Management Plan	Required
Halobaena caerulea	Blue petrel	Vulnerable	Conservation Advice. <i>Halobaena caerulea</i> . Blue petrel	Effective 2015
Leucocarbo atriceps nivalis	Imperial shag (Heard Island)	Vulnerable	Conservation Advice. <i>Leucocarbo atriceps nivalis.</i> Heard shag	Effective 2015

Species	Common name	EPBC Act listing	Recovery/ Conservation management plan/ Conservation advice	Plan status
Leucocarbo atriceps purpurascens	Imperial shag (Macquarie Island)	Vulnerable	Conservation Advice. <i>Leucocarbo atriceps</i> <i>purpurascens</i> . Macquarie shag	Effective 2015
Macronectes giganteus	Southern giant petrel	Endangered, Migratory	National recovery plan for threatened albatrosses and petrels 2022	Effective 2022
Macronectes halli	Northern giant petrel	Vulnerable, Migratory	National recovery plan for threatened albatrosses and petrels 2022	Effective 2022
Pachyptila turtur subantarctica	Fairy prion (southern)	Vulnerable	Conservation Advice. <i>Pachyptila turtur subantarctica</i> . Fairy prion (southern)	Effective 2015
Papasula abbotti	Abbott's booby	Endangered	Conservation advice for Abbott's Booby <i>– Papasula</i> <i>abbotti</i>	Effective 2020
Phaethon lepturus fulvus	Christmas Island white-tailed tropicbird	Endangered, Migratory	Conservation Advice. Phaethon lepturus fulvus. White-tailed tropicbird (Christmas Island)	Effective 2014
Phoebetria fusca	Sooty albatross	Vulnerable, Migratory	National recovery plan for threatened albatrosses and petrels 2022	Effective 2022

Species	Common name	EPBC Act listing	Recovery/ Conservation management plan/ Conservation advice	Plan status
Pterodroma arminjoniana	Round Island petrel	Critically endangered	Conservation Advice <i>Pterodroma arminjoniana</i> Round Island petrel	Effective 2015
Pterodroma heraldica	Herald petrel	Critically endangered	Conservation Advice. <i>Pterodroma heraldica</i> . Herald petrel	Effective 2015
Pterodroma leucoptera leucoptera	Gould's petrel	Endangered	Gould's Petrel ( <i>Pterodroma leucoptera leucoptera</i> ) Recovery Plan	Required
Pterodroma mollis	Soft-plumaged petrel	Vulnerable	Conservation Advice. <i>Pterodroma mollis</i> . Soft- plumaged petrel	Effective 2015
Pterodroma neglecta neglecta	Kermadec petrel (western)	Vulnerable	Lord Howe Biodiversity Management Plan	Required
			Norfolk Island Threatened Species Recovery Plan	Effective 2010
Sterna nereis nereis	Australian fairy tern	Vulnerable	Approved Conservation Advice for <i>Sternula nereis nereis</i> (Fairy Tern)	Effective 2011, new advice currently under development

Species	Common name	EPBC Act listing	Recovery/ Conservation management plan/ Conservation advice	Plan status
Sterna vittata bethunei	New Zealand Antarctic tern	Endangered	Conservation Advice. <i>Sterna</i> <i>vittate bethunei</i> . Antarctic tern (New Zealand)	Effective 2015
Sterna vittata vittata	Antarctic tern (Indian Ocean)	Vulnerable	Conservation Advice. <i>Sterna</i> <i>vittata vittata</i> . Antarctic tern (Indian Ocean)	Effective 2015
Thalassarche bulleri	Buller's albatross	Vulnerable, Migratory	National recovery plan for threatened albatrosses and petrels 2022	Effective 2022
Thalassarche bulleri platei	Northern Buller's albatross	Vulnerable	National recovery plan for threatened albatrosses and petrels 2022 (note northern Buller's albatross is considered as Buller's albatross in plan)	Effective 2022
Thalassarche carteri	Indian yellow-nosed albatross	Vulnerable, Migratory	National recovery plan for threatened albatrosses and petrels 2022	Effective 2022
Thalassarche cauta	Shy albatross	Endangered, Migratory	Conservation Advice. <i>Thalassarche cauta</i> . Shy Albatross	Effective 2020

Species	Common name	EPBC Act listing	Recovery/ Conservation management plan/ Conservation advice	Plan status
Thalassarche cauta steadi	White-capped albatross	Vulnerable, Migratory	National recovery plan for threatened albatrosses and petrels 2022	Effective 2022
Thalassarche chrysostoma	Grey-headed albatross	Endangered, Migratory	National recovery plan for threatened albatrosses and petrels 2022	Effective 2022
Thalassarche eremita	Chatham albatross	Endangered, Migratory	National recovery plan for threatened albatrosses and petrels 2022	Effective 2022
Thalassarche impavida	Campbell albatross	Vulnerable, Migratory	National recovery plan for threatened albatrosses and petrels 2022	Effective 2022
Thalassarche melanophris	Black-browed albatross	Vulnerable, Migratory	National recovery plan for threatened albatrosses and petrels 2022	Effective 2022
Thalassarche salvini	Salvin's albatross	Vulnerable, Migratory	National recovery plan for threatened albatrosses and petrels 2022	Effective 2022

Additional threatening processes (to those listed in Table 2) identified in the Wildlife Conservation Plan for seabirds (Commonwealth of Australia 2022), covering 73 seabirds species listed as migratory or marine under the EPBC Act, included geological processes, native wildlife, resource extraction, renewable energy, aircraft and drones, light pollution and aquaculture.

Table 2: Threats identified in current conservation advice for seabirds. Note some threats have been grouped into broader categories than those specified in conservation advice.

Threat	Number of plans threats are identified in
Climate change	2
Climate variability including storm events	2
Direct anthropogenic disturbance	2
Drowning in artificial water bodies	2
Feral/invasive species/predation	15
Fisheries interactions/bycatch	4
Fisheries prey depletion	2
Habitat loss, disturbance, modification	14
Illegal killing	2
Inter-species interactions	6
Marine debris	1
Oil spill	2
Pathogens/disease	3
Pollution	2
Shipping activity	2

The broader literature identified all of the threats listed in current conservation advice except drowning in artificial water bodies (listed as threat in the Christmas Island frigatebird conservation advice). Additional threats identified in the literature to those listed in conservation advice included threats associated with light pollution, marine renewable energy installations, entanglement and aquaculture operations and reflected the additional threats identified in the Wildlife Conservation Plan for seabirds. This potentially is a result of the more recent publication of literature included in the literature search (2017-2022) and the wildlife conservation plan (2022) in comparison to the conservation advice issued for many species (2014/2015), and in association more recent (and potentially broader) recognition of additional and/or emerging threats. The most common threats that occurred in the broader

literature were pollutants (including light), fisheries interactions/bycatch and marine debris (all of which occurred in 15% of publications), followed by feral/invasive species and predation (10.4%), climate change (9%) and habitat modification/degradation/loss (7.5%). Direct anthropogenic disturbance, fisheries prey depletion, marine renewable energy installations, pathogens/disease, inter-species interactions, entanglement, harvesting/illegal killing and shipping/boating were focused on the least (one publication each).

#### Research priorities

The most common priorities for research identified in the recovery plan and conservation advice were those associated with monitoring of breeding populations to determine demographic data and population dynamics including temporal trends (>90% of plans/advice). All other research priorities identified were listed in less than 40% of the total number of recovery plans/conservation advice issued. These included determining the extent of habitat(s) utilised including overlaps with fisheries, the foraging ecology, movements, general biology, toxicology, pathology, population provenance and structure. Additional priorities for research identified in the Wildlife Conservation Plan for seabirds included investigating the impacts of climate change and renewable energy installations on species and habitats.

In association, the development of tools to support research and access to information was identified as needed. This included the development of monitoring approaches, centralised or national registers or databases, best practices and protocols and evaluation of the applicability of new technologies such as remote/unmanned technologies for monitoring and novel methodologies for determining abundance.

The broader literature detailed studies into foraging ecology (32%), movements/migration (17%), reproductive success (11.5%) and pollutants/toxicology (9.6%), with the application of novel methods featuring in 8% of publications. Publications evaluating reproductive success comprised 11.5% of all publications, and those estimating population abundance comprised 5.8% of all publications. Very few publications (four in total) focused on evaluating population trends or investigating future population trajectories. Publications detailing the application of novel methods included the use of drones for assessing the size of nesting populations and new approaches to ageing species using DNA methylation, while best practices/protocols featured in one publication. The low number of publications detailing best practices/protocols suggests either that methods being used in research are well established, documented in historical publications (those published prior to 2017) and have not subsequently required updating; that best practices/protocols are documented elsewhere in the literature (and therefore not captured in the literature search); or that establishing and documenting best practices/protocols are not priorities for the research community. No additional research topics to those identified in the recovery plan and conservation advice were identified in the broader literature.

Priority areas for further research identified in the literature tended to reflect the focus of publications (e.g. if the focus was on detailing movements, recommendations tended to identify the need for further studies into movements). Priorities identified included further/expanded monitoring (15.4%) and research on foraging ecology (14%), habitat utilisation (8%) and pollutants/toxicology (8%).

### Overlaps and gaps

Overall, the broader literature identified similar threats to those in conservation advice and the Wildlife Management Plan for seabirds, although research priorities identified in the literature were often not directly associated with progressing understanding of the impacts of those threats and quantifying those risks, particularly at the population level. Although much of the literature could be considered as providing foundational information for assessing the responses of species to threats (and in some cases identified that their studies were framed as such), linkages to population viability, future projections and quantitative evaluation of risk was largely lacking. This highlights that knowledge of many aspects of the biology and ecology of many seabird species remains sparce and current capability in moving beyond simple identification of threats to quantification at the individual/population/species level is a key research gap.

Research detailed in the broader literature has predominantly focused on those species that are not currently threatened. This could be a result of a number of reasons such as accessibility to colonies, and in association, broader distributions (and availability) of species or localised identification of threats (i.e., at the colony rather than the species scale; e.g., Colombelli-Négrel and Tomo (2019); Scoleri et al. (2020)). It should also be noted that many of the albatross and petrel species identified as threatened, while utilising Australian waters, breed outside of Australia. This presents challenges for conducting directed research on these species as a result of their dispersed distributions and widespread movements, and in association, on-water access to many species.

In general, both plans/advice and the literature identified that continued monitoring of populations to determine changes in the biology and ecology of species over time was a priority. Linking at sea behaviours, particularly those associated with foraging, with population parameters (e.g. abundance, breeding success and being able to determine drivers of population change through time) was identified by a number of publications, particularly in determining responses to climate change. However, despite being identified as a research priority, few publications detailed such studies, potentially either reflecting the difficulty in achieving such linkages with data currently available or that there are other barriers to undertaking such integrative studies (e.g. access to the required datasets, analytical capability). Divergence in research priorities between those identified in plans/conservation advice and in the literature most likely reflects a management need to respond to immediate and direct threats (e.g. feral species, bycatch), the large number of threats to seabirds identified, and the capacity to respond to research needs associated with threats. It also is likely to be linked to the need to understand aspects of the biology and ecology of seabirds in order to better identify mitigation measures for threats and identify change over the medium to longer term. The lack of prioritisation processes (qualitative or quantitative) provided in conservation advice that can guide the determination of research priorities (the recovery plan for albatross and petrels and conservation advice for only two species incorporated approaches to threat prioritisation) is a gap in itself.

# 3.2 Seabird workshop report

A taxa specific workshop on identifying priority research needs for seabirds was held on Tuesday 12 July 2022. Attendees included representatives from NESP, the Department of Climate Change, Energy, the Environment and Water, the Australian Fisheries Management Authority, the National Offshore Petroleum, Safety and Environmental Management Authority, the Fisheries Research and Development Corporation, relevant State government agencies, universities, non-government organisations and consultants (Table 3).

# 3.2.1 Introduction

The NESP MaC 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 achieve this objective through the delivery of applied and strategic research outputs that are designed to support decision-making and practical management and that respond to identified national and regional research priorities identified through consultation with relevant stakeholders and end-users. Projects funded through the MaC Hub deliver into six thematic areas, one of which is focused on threatened and migratory species and ecological communities.

The MaC Hub Research Plan 2021 includes a number of scoping projects that aim to, through consultation with key stakeholders and end-users, generate shared understanding about research needs, knowledge gaps and priorities. One of these is the 'Marine and coastal threatened and migratory species and communities' project. This scoping project aims to inform future research investment within the MaC Hub's annual research plans. The scoping project will be run in parallel with and contribute to a broader cross-Hub Initiative project 'Threatened and Migratory Species and Threatened Ecological Communities', led by the NESP Resilient Landscapes Hub. This workshop, focused on seabirds, will build on consultations with the Department to further identify and refine focal areas/priorities and activities that can be identified for investment in the NESP MaC Hub 2023 and future research plans.

Table 3: Agencies and organisations invitees and/or represented at the seabird workshop. \*Apologies for the workshop.

Agency/Organisation				
Birdlife International				
Birdlife Tasmania				
Charles Darwin University				
CSIRO				
Department of Agriculture, Fisheries and Forestry				
Australian Fisheries Management Authority				
Fisheries Research and Development Corporation				
Department of Climate Change, Energy, the Environment and Water				
Australian Antarctic Division				
Biodiversity Conservation Division				
Great Barrier Reef Marine Park Authority*				
Latitude 42 Environmental Consultants Pty Ltd				
Monash University				
NESP Marine and Coastal Hub				
NESP Resilient Landscapes Hub				
National Offshore Petroleum, Safety and Environmental Management Authority				
New South Wales Department of Planning, Industry and Environment				
Northern Territory Department of Environment, Parks and Water Security*				
Phillip Island Nature Parks				
Queensland Department of Environment and Science*				
South Australia National Parks and Wildlife Service				
Tasmanian Department of Natural Resources and Environment				
University of Queensland				
University Western Australia*				
Western Australia Department of Biodiversity, Conservation and Attractions*				

# 3.2.2 Priority needs for management and regulation

#### Commonwealth conservation management<sup>1</sup>

The Commonwealth have progressed a broad scale conservation management approach to threatened species and ecological communities through the identification of 20 priority places which aim to provide a balance between diversity of threatened species and ecological communities, importance to First Nations people, and representativeness of species, landscapes and seascapes across Australia. Within the priority places identified under the Threatened Species Action Plan 2022-2032, six islands have been identified as priorities, all of which contain various seabird populations<sup>2</sup>. The same action plan also identifies 110 priority species, none of which are seabird species.

It was noted that a recovery plan for the Australian fairy tern<sup>3</sup> had recently been released and the conservation advice for Antarctic tern (Indian Ocean) and the Australian lesser noddy were being updated. A Wildlife Conservation Plan for 73 species of seabirds<sup>4</sup> had also recently been published by the Australian government.

Priority needs identified include: (i) species population abundances and trends to support assessments; (ii) biological information such as key habitats, breeding and foraging ecology for updating statutory documents; (iii) national coordination of datasets (e.g. breeding site register) to facilitate improved availability of information; and (iv) further documentation of threatening processes, noting that considerable information has informed threat abatement plans. Key emerging threats that required better understanding were offshore renewable energy installations, and in particular wind turbines.

#### Offshore energy infrastructure

It was noted that in areas where existing uses of the marine environment included oil and gas, fishing, tourism shipping etc, emerging industries such as offshore renewable energy were currently being planned, with the likelihood that activities in these areas would develop rapidly in the coming years. This increased use, particularly in regard to offshore wind farms, can bring broader pressures on seabirds and migratory shorebirds, including cumulative effects<sup>5</sup>, given the size of installations and the associated number of structures planned. The

<sup>&</sup>lt;sup>1</sup> After the workshop, the NESP MaC Hub was made aware of an evaluation of the impacts of offshore wind farms on 273 bird species using an ecological risk evaluation approach (Hobday et al. 2011) and conducted on behalf of the Department of Climate Change, Energy, Environment and Water. This report has since been published (Reid et al. 2022) and is available at: https://www.dcceew.gov.au/environment/epbc/publications/impacts-on-birds-from-offshore-wind-farms-australia.

<sup>&</sup>lt;sup>2</sup> <u>www.dcceew.gov.au/environment/biodiversity/threatened/strategy/20-priority-places</u>

<sup>&</sup>lt;sup>3</sup> https://www.dcceew.gov.au/environment/biodiversity/threatened/publications/recovery/fairy-tern-2022

<sup>&</sup>lt;sup>4</sup> https://www.dcceew.gov.au/environment/biodiversity/publications/wildlife-conservation-plan-seabirds-2022

<sup>&</sup>lt;sup>5</sup> It was noted that the term "cumulative effects" was used by workshop participants to reference varying forms of activities without clear definition, including the repeated occurrence of specific activities through time (e.g. pile driving in one location), the occurrence of multiple activities associated with a sector (e.g. pile driving, vessel activity, building of infrastructure associated with offshore infrastructure) and multiple activities by multiple sectors

rapid emergence of the offshore renewable sector was noted, and in association, a pressing need to understand key areas of overlap, associated risks and develop monitoring and management measures to mitigate risks.

It was firstly pointed out that many of the information needs and research priorities for offshore energy regulation were included in the National Offshore Petroleum, Safety and Environmental Management Authority (NOPSEMA) Research Strategy<sup>6</sup>.

It was also noted that there was a clear need for research to be targeted to inform decision making, particularly in informing the mitigation of risks. Two key areas of research were identified: (i) monitoring of seabirds around wind farms including species behaviour and interactions, and (ii) effects of light pollution, including development of best practices associated with monitoring impacts and handling "light trapped" birds, noting that the development of light pollution guidelines<sup>7</sup> had been very helpful in guiding uptake of best practices within industry.

In association with both research areas, it was highlighted that it was important to gather species information at both regional and locality-specific scales, and that there was a significant role for field monitoring to better understand behaviours and responses. This was considered particularly important as much information on interactions between seabirds and offshore energy infrastructure, and in particular offshore wind farms, was derived from Northern Hemisphere species. While this information can be highly useful in guiding best practices, highlighting innovative approaches to monitoring and risk evaluation/mitigation and identifying priority research focal areas uncertainties as to the transferability of findings from studies into the impacts of offshore renewable energy to Australian settings given the biological and behavioural differences between species was raised. It was further highlighted that there was a need to understand the vulnerability of species to pressures at multiple scales (e.g. individuals, colonies, populations) to build understanding of impacts on population viability.

Identifying standardised monitoring approaches based on best practice design that commence at the planning (e.g. to collect pre-development baselines) and continue during operations was also identified. Monitoring programs should be designed to provide information to identify when mitigation measures need to be implemented, allowing the industry to respond to any impacts quickly to minimise any further impacts. This would ensure that species recovery, conservation and management plans can continue to be effective.

<sup>(</sup>fishing, offshore energy, shipping). Further, the terms "cumulative effects" and "cumulative impacts", were used interchangeably without recognition of differences in the terminology and associated measurement of impacts versus effects. These references have been standardised to the term cumulative effects. This is for three reasons: (i) there is as yet no universally accepted definition of cumulative effects and impacts (see Evans et al. 2021); (ii) effects can be defined as a change to the environment, including its human components, while impacts represent the consequences of such change (Johnson 2016) and (iii) as a result, in most cases actual impacts are hypothesized and have either not been directly observed, or attributed (Murray et al. 2015).

<sup>&</sup>lt;sup>6</sup> www.nopsema.gov.au/sites/default/files/documents/NOPSEMA%20Research%20Strategy.pdf

<sup>&</sup>lt;sup>7</sup> https://www.dcceew.gov.au/environment/biodiversity/publications/national-light-pollution-guidelines-wildlife

## Commercial fisheries management

Commonwealth processes include the development of a threat abatement plan for bycatch of seabirds from longline gear and undertaking research focused on mitigation of interactions. It was noted that most of the focus on mitigating interactions had been placed into gear modification, individual vessel management plans and industry education.

Ongoing priority needs identified (noting that research was being conducted in these areas) included: (i) better understanding of impacts of fisheries; (ii) better understanding of the behaviours of seabirds around fishing vessels; (iii) refinement of current mitigation devices, including better understanding of fisher behaviour and influence on the effectiveness of bycatch mitigation devices, and (iv) enhancing approaches to and processing of imagery from electronic monitoring.

# 3.2.3 Breakout group discussions

Break-out groups identified the following priority areas for research:

## Offshore energy infrastructure

There was widespread acknowledgement of the rapid development of the offshore renewable sector but also recognition that there is still a lot of oil and gas infrastructure in the marine environment that shouldn't be ignored. Oil spills, the cumulative impacts of small spills and decommissioning activities (expected to ramp up in the near future across a number of areas) were identified as activities for which risks and impacts should be evaluated. In particular, potential changes to seabird foraging, roosting and migration behaviours were identified as important.

In terms of proposed offshore renewable energy installations, it was recognised that there is currently a small window of opportunity to gather baseline information prior to the beginning of development activities (if the currently proposed projects were to be approved). This window of opportunity could be used to develop key indicators of impacts<sup>8</sup>, methods and technologies for monitoring those indicators and appropriate management/mitigation actions required to avoid impacts identified as unacceptable. Research conducted during this period would facilitate the building of datasets that are currently lacking and inform species recovery, conservation and management plans. One potential first step identified was to undertake a review of new and emerging technologies that could be utilised for building understanding and filling information gaps<sup>9</sup>.

<sup>&</sup>lt;sup>8</sup> This could include trigger points although what might constitute a trigger point was not clearly defined.

One key area of research identified of relevance to offshore wind farm installations was understanding the three-dimensional movements of seabirds, and in particular, how they utilise the air column. Gathering such information was identified relevant for understanding how offshore wind turbines might influence movements and associated effects on energetics. foraging and migration. It would also be important for assessments of the risk of collision with turbine rotors. It was noted that most information on movement had been collected with deolocators to date, which, while suitable for assessing broad scale movements, are not suitable for determining finer scale movements (due to the errors associated with position estimation from light). Movement data collected within study designs that allow for the evaluation of generalised behaviours (that are not biased by individual behaviours) and using technologies that allow for finer scale movements to be collected (e.g. GPS tags, accelerometers) is needed to better evaluate fine scale dynamic horizontal and vertical movements. Further innovation in sensor technologies and approaches to analysing and interpreting the data generated is needed for determining flight patterns across multiple spatio-temporal scales and the full range of weather conditions experienced. It was also noted that work to date had identified that behaviour can vary across colonies of the same species. As a result, the extrapolation of data collected from one colony to others is limited.

It was noted that sustained monitoring programs (that are well designed and implemented in a coordinated and interoperable way) would be beneficial for generating pre-development baselines and evaluating post-development impacts and mitigation effectiveness, including for cumulative effects. It was noted that the implementation of monitoring programs that could determine cumulative effects had been problematic in offshore infrastructure settings to date and therefore innovation would be required in regard to monitoring programs associated with offshore wind farms. Innovation was also identified as needed in mitigation approaches and associated technologies. Information from Australian onshore wind farms demonstrate that a broad range of bird species are affected by such infrastructure, including those previously considered to not be at risk. There is therefore a need for mitigation approaches and technologies to be able to be broadly applied across any potentially affected species, including migratory species.

A key consideration identified for the NESP was that there was a need to understand what the requirements of proponents are during their planning phase (under regulatory requirements), particularly in establishing baselines and evaluating risks and impacts. The MaC Hub should not be taking on that role or duplicating effort, rather it should be adding value. The same should apply to any offset work.

<sup>&</sup>lt;sup>9</sup> Further investigation of the literature undertaken as part of this project identified an internationally publicly accessible tool detailing mitigation technologies currently developed and in implementation: https://tethys.pnnl.gov/wind-energy-monitoring-mitigation-technologies-tool which could be useful for informing such an exercise, particularly as many technologies are focused on mitigating threats to birds.

## Fisheries bycatch

The need for continued evaluation of the performance of threat abatement plans and associated priorities was identified as part of ongoing monitoring of risks and threats to seabirds. Research and innovation in the evaluation of risks and mitigating the associated threats of seabirds from inshore gillnet fishing gears was raised. Advancing this work will require appropriate engagement with state- and territory-based fisheries agencies and industries. It was also highlighted that there was a need to consider existing threat and risk assessments and management actions to address interactions to ensure they were regularly updated and continued to be appropriate for reducing threats.

## Climate change

Key areas highlighted in relation to climate change included a need for basic information on food webs, potential changes to and responses of prey, and how changes to prey populations might then affect seabird species distributions. Evaluation of potential changes should involve the incorporation of regional climate model projections to ensure that risk assessments and potential adaptation responses were based on the most recent scenario outputs available. In noting the potential for changes in species distributions, it was identified that any biologically important areas identified for seabirds would need to be adaptive to be able to account for such changes. Discussions also identified a need to better understand impacts at breeding sites and the need to identify adaptation options in response.

### Marine debris

Marine debris was highlighted to be a continuing issue for seabirds as reflected in recovery and action plans. It was noted that while information on the ingestion and the use of marine debris by seabirds (e.g. for nesting material) had improved, information on impacts on breeding success and survival at the individual, population and species level was lacking. In addition, better understanding of ingestion hotspots was identified as needed for the evaluation of risk. In relation, information on ingestion and use of marine debris being accumulated from Lord Howe Island was noted. It was identified that although considerable information was available, there was currently no suggestion that the population of fleshfooted shearwaters on the island was being impacted, with the species recovering from longer-term historic impacts.

### Other priority areas

Other areas of research that were highlighted included:

- the need for sustained monitoring programs for supporting evaluations of the effectiveness of marine parks in state, territory and Commonwealth waters;
- the need for effective coordination and collaboration nationally, particularly in enhancing data synthesis and delivery. This includes improving accessibility to data

that is not currently in the public domain. This would support improved evaluation of knowledge gaps, support the identification of priority needs and reduce the potential for duplication of efforts.

# 3.3 Priorities identified through the literature review and workshop

Clear priorities for research identified by both the literature search and the workshop were associated with ongoing monitoring or establishment of monitoring programs for seabird populations, particularly in identifying change over time and being able to quantify impacts of threats on populations. In association, linking at-sea behaviours to population parameters was identified as essential for being able to quantify absolute risk to species and populations, attribute changes to drivers, understand the cumulative effects of multiple threats on populations and quantify impacts at the level of populations and species. Integrative approaches that allow for the quantification of risk and attribution of the effects of changes on population viability will be particularly important for evaluating progress against conservation advice and management plans and objectives set under threat abatement plans (e.g. the threat abatement plan for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations<sup>10</sup>) and industry focused management plans (e.g. those set out for Commonwealth fisheries).

With the rapid development of offshore renewable energy, it is not surprising that this was identified as a higher priority for focusing research by workshop participants than was reflected in conservation advice and the literature. Key areas highlighted for research included understanding seabird behaviour around installations and in association risk from strike and impacts of light pollution, understanding shifts in habitat use that might be caused by installations and their flow on effects on population parameters. In association, understanding the requirements and responsibilities of all stakeholders throughout all stages of the development and establishment of this industry along with what research is underway will be essential for guiding any research conducted by the NESP to ensure that it is targeted, creates value and supports knowledge exchange.

A recently published assessment of risks from offshore wind installation on seabirds (Reid et al. 2022) identifies that best practices and emerging approaches for quantifying impacts and identifying mitigation measures from the Northern Hemisphere are likely to be highly useful in Australian research applications. They further identify that research for understanding risks and impacts and identifying mitigative measures will require the application of different approaches to data collection than those used traditionally and will require the use and application of technologies not commonly used in Australia to date, some of which are established and tested, and some of which are emerging and still under development.

Utilising new technologies featured both in the literature and the workshop particularly in expanding and introducing innovation into the monitoring of populations and in also

<sup>&</sup>lt;sup>10</sup> See https://www.dcceew.gov.au/environment/biodiversity/threatened/threat-abatement-plans/approved

developing novel approaches to mitigating threats, particularly fisheries bycatch. New technologies could also be embraced to support data and knowledge exchange and delivery, including that associated with best practices and protocols, development of data synthesis products for use by various stakeholders and overall awareness and coordination of research efforts. This would also serve to support the facilitation of access to widely accepted and the most up-to-date tools such as risk assessment frameworks thereby ensuring standardised approaches to the quantification of risk and threats.

# 4. Marine mammals (excluding dugongs)

# 4.1 Literature review

A summary of all recovery plans, conservation management plans and conservation advice for threatened marine mammals (excluding dugongs) is provided in Table 4. There are currently six species for which recovery plans, conservation management plans and conservation advice are in place, with the conservation management plan for one species currently being reviewed and revised (for the purposes of this report, the previous conservation management plan was included in the assessment of threats and research priorities). Outputs from literature searches are provided in Appendix D. A list of the reports associated with previous research undertaken on marine mammals (excluding dugongs) under the NESP is provided in Table 5.

Publications were predominantly focused on multiple species (32.9% of all publications). Of those publications that focused on a single species, the most common species featured in publications was the Indo-Pacific bottlenose dolphin (*Tursiops aduncus*; 16.4% publications), followed by the Australian fur seal (*Arctocephalus pusillus doriferus*) and humpback whale (*Megaptera novaeangliae*), with both species the focus of 8.6% publications. Of those publications that included multiple species or could be applied to multiple species, 42% included threatened species, and of those publications that included threatened species, 71.4% included Australian sea lions (*Neophoca cinerea*). Single species publications that focused on threatened species included the blue whale (*Balaenoptera musculus spp* 4.6% of publications), Australian sea lion (3.3% publications), southern right whale (*Eubalaena australis*; 3.3% publications) and fin whale (*Balaenoptera physalus*; 0.66% publications).

Research supported previously by the NESP has been focused on southern right whales, the characterisation of multiple marine mammal species in various regions, estimating risks associated with ship strike and characterising anthropogenic noise.

Table 4: Commonwealth recovery plans, conservation management plans and conservation advice developed for threatened marine mammal species (excluding dugongs) and their current status. Note: current status is as per listing on the Australian Government Species (*http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl*).

Species	Common name	EPBC Act listing	Recovery/ Conservation management plan/ Conservation advice	Plan status
Arctocephalus tropicalis	Sub-Antarctic fur seal	Endangered	Conservation Advice. <i>Arctocephalus tropicalis.</i> Subantarctic fur seal	Effective 2016
Balaenoptera borealis	Sei whale	Vulnerable, Migratory	Conservation advice. <i>Balaenoptera borealis</i> . Sei whale	Effective 2015
Balaenoptera musculus	Blue whale	Endangered, Migratory	Conservation Management Plan for the Blue Whale - A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999	Effective 2015-2025
Balaenoptera physalus	Fin whale	Vulnerable, Migratory	Conservation advice. <i>Balaenoptera physalus</i> . Fin whale	Effective 2015
Eubalaena australis	Southern right whale	Endangered, Migratory	Conservation Management Plan for the Southern Right Whale	Effective 2011-2021; new recovery plan under development
Mirounga leonina	Southern elephant seal	Vulnerable	Conservation advice. <i>Mirounga</i> <i>leonina</i> . Southern elephant seal	Effective 2016
Neophoca cinerea	Australian sea lion	Endangered	Conservation Advice. <i>Neophoca</i> cinerea. Australian sea lion.	Effective 2020
			Recovery Plan for the Australian Sea Lion ( <i>Neophoca cinerea</i> )	Effective 2013-2023

Table 5: Reports of research on marine mammals (excluding dugongs) conducted under the NESP. All projects were conducted through the NESP Marine Biodiversity Hub.

Project number	Title	Lead organisation	Link to project and associated reports		
Theme A:	: Threatened and migratory species				
A7	Monitoring population dynamics of 'western' right whales off southern Australia	Western Australian Museum	https://www.nespmarine.edu.au/project/project- a7-monitoring-population-dynamics- %E2%80%98western%E2%80%99-right-whales- southern-australia		
A12	Australia's northern seascape: assessing status of threatened and migratory marine species	Charles Darwin University	https://www.nespmarine.edu.au/project/project- a12-%E2%80%93-australia%E2%80%99s- northern-seascape-assessing-status-threatened- and-migratory-marine		
A13	Estimation of population abundance and mixing of southern right whales in Australian and New Zealand regions	Commonwealth Scientific Research and Industrial Organisation	https://www.nespmarine.edu.au/project/project- a13-estimation-population-abundance-and- mixing-southern-right-whales-australian-and		
A15	Conservation status of tropical inshore dolphins	University of Western Australia	https://www.nespmarine.edu.au/project/project- a15-conservation-status-tropical-inshore-dolphins		
Theme C	Understanding pressures on the marine env	vironment			
C5	Quantification of risk from shipping to large marine fauna across Australia	Commonwealth Scientific Research and Industrial Organisation	https://www.nespmarine.edu.au/project/project- c5-quantification-risk-shipping-large-marine- fauna-across-australia		
Theme E	Theme E: Science for a sustainable Australia				
E2	Characterising anthropogenic underwater noise to better understand and manage impacts to marine life	Commonwealth Scientific Research and Industrial Organisation	https://www.nespmarine.edu.au/project/project- e2-characterising-anthropogenic-underwater- noise-better-understand-and-manage		
Theme E	P: Responding to emerging priorities				
EP2	Surveying marine life in the canyons off Bremer Bay	University of Western Australia	https://www.nespmarine.edu.au/project/ep2- surveying-marine-life-canyons-bremer-bay		

## Threatening processes

Threats identified in current conservation advice are listed in Table 6. All of the current recovery and conservation management plans and conservation advice identified climate change as a threat, with six of the seven (85.7%) identifying climate variability as a threat. Anthropogenic disturbance (including through noise), potential prey depletion by fisheries, pollutants and habitat disturbance, modification and loss were identified in 71.4% of plans/advice, with fisheries interactions (including bycatch and entanglement), vessel disturbance and resumption of whaling identified 51.7% of plans/advice. All other threats were identified in less than 30% of plans/advice. Note that this commonality does not necessarily reflect the priority placed on threats at the individual species level, with the conservation management plans for only two species (blue whale, southern right whale) including consideration of threat prioritisation (through a risk matrix and ranking of threats) based on expert advice and consultation.

The conservation advice for four additional species (fin whale, sei whale *Balaenoptera borealis*, southern elephant seal *Mirounga leonina* and subantarctic fur seal *Arctocephalus tropicalis*) included a consequence rating for risks derived from Woinarski et al. (2014), although no details were provided on how this consequence was determined and the terminology used varied across the conservation advice. The various approaches to ranking threats identified climate change and climate variability as having the highest ranked consequences (possible likelihood and minor-severe consequences), with anthropogenic noise, particularly that associated with seismic surveys highly ranked across the cetacean species, and fisheries bycatch highly ranked across the pinniped species. Predation of pups was identified as a highly ranked threat for subantarctic fur seals also.

Publications in the literature focused on eleven of the 16 threats identified in plans/advice, indicating that research was focused on the collection of generalised information on the biology and ecology of species to a greater extent than on targeted research aimed at estimating/quantifying exposure to threats and associated impacts. The three most common threats publications focused on were anthropogenic disturbance (including noise 6.7%), pathogens/disease (6%), and fishery interactions/bycatch (6%). Targeted research identifying the responses of species to climate variability and the impacts of climate change were detailed in 2.7% of publications. Vessel disturbance was the focus of 2% of publications while no publications focused on prey depletion by fisheries or quantifying changes to habitat quality.

### Research priorities

The most common priorities for research identified in the seven current recovery plans, conservation management plans and conservation advice were those associated with describing the spatial and temporal distributions of species (all plans/advice), determining estimates of population abundance and associated temporal trends (85.7% of plans/advice), identifying and describing habitats of importance, including the extent of their utilisation (71.4% of plans/advice), and in association either continuing to monitor populations or developing monitoring programs where they are currently not in place (71.4% of plans/advice). Understanding the population structure of species, genetic connectivity and gene-flow and sub-speciation was also identified as research priorities in 71.4% of

plans/advice. Other research priorities identified in more than half of plans/advice included understanding the impacts of noise, describing movements, and identifying and assessing new technologies for attaining population data (all occurring in 57.1% of plans advice).

Table 6: Threats identified in current recovery plans, conservation management plans and conservation advice for marine mammals (excluding dugongs). Note some threats have been grouped into broader categories than those specified in plans/advice.

Threat	Number of plans/advice threats are identified in
Anthropogenic disturbance, incl. noise	5
Aquaculture interactions	1
Climate change	7
Climate variability including storm events	6
Entanglement	4
Fisheries interactions/bycatch	4
Fisheries prey depletion	5
Habitat loss, disturbance, modification	5
Illegal killing	1
Marine debris	2
Oil spill	1
Pathogens/disease	1
Pollution	5
Predation	1
Shipping/vessel disturbance activity	4
Whaling	4

In association, 51.7% of plans/advice prioritised the development of protocols or best practices, particularly associated with managing and mitigating bycatch and entanglement, and in association with the collection of samples. In all plans/advice for pinniped species understanding interactions with fisheries, identifying the direct and indirect impacts of fisheries, including cumulative effects and assessing the effectiveness of fisheries management measures were identified as research priorities. Only one plan/advice identified stakeholder engagement as a priority, including exploration of the involvement of citizen science in monitoring efforts.

Publications identified from the literature search focused on all topics identified as research priorities in recovery and conservation management plans and conservation advice and predominantly detailed studies estimating distribution/habitat utilisation (20%), population abundance (11.3%), foraging ecology (6.7%) and pathogens/disease (6%). Very few

publications (six in total) focused on evaluating population trends or investigating future population trajectories. The development of protocols and best practices, including for monitoring aspects of the biology and ecology of species featured in 1.3% of publications, while the application of novel methods, including use of drones for assessing population size featured in 2.7% of publications. The low number of publications detailing best practices suggests that methods being used in research are well established, have been documented in historical publications (i.e. those published prior to 2017) and have not subsequently required updating; that protocols and best practices are documented elsewhere in the literature (and therefore not captured in the literature search); or that establishing and documenting best practices and protocols are not priorities for the research community. Research topics detailed in publications that were not identified in plans/advice included social behaviour/learning, physiology, acoustic signatures, taxonomy, species diversity/assemblages and soundscapes.

Priority areas for further research identified in the literature tended to reflect the focus of publications (e.g. if the focus was on detailing movements, recommendations tended to identify a need for further studies into movements). Priorities identified included further/expanded monitoring, including conducting surveys (18%), estimating population structure/gene flow and better understanding trophic relationships (both 5%).

# Overlaps and gaps

While not directly addressing identified threats to marine mammals, many of the publications identified in the literature search could be considered to be providing foundational information for assessing the responses of species to threats and associated impacts on populations. This highlights that knowledge of many aspects of the biology and ecology of marine mammal species remains sparce and current capability in moving beyond simple identification of threats to quantification of risks and impacts at the individual/population/species level and linkages to population viability, and future projected states are largely lacking and is a key research gap. It also highlights the challenges associated with researching marine mammals, particularly cetaceans due to their cryptic nature, dispersed distributions and the widespread movements of many species (and in association utilisation of multiple habitats).

As a result of these challenges, research has largely focused on inshore cetacean species and pinnipeds given their accessibility, with targeted research on threatened species that are the focus of recovery plans, conservation management plans and conservation advice comprising only 12% of all publications identified by the literature search.

should be noted however that because of the paucity of information on many marine mammal species, very few have been assessed formally under the EPBC Act to determine their conservation status. As a result, formal identification of the threats to most species and quantification of impacts is lacking, as are identification of the research priorities needed to mitigate and reduce those threats. There have been two species nominated for listing under the EPBC Act where data has been regarded as being insufficient to enable any assessment of the species' status against EPBC Act criteria, the Australian snubfin dolphin (*Orcaella heinsohni*) and the Indo-Pacific humpback dolphin (*Sousa chinensis*). In the case of the Australian snubfin dolphin, the Threatened Species Committee has recommended that
development and implementation of a wildlife conservation plan focused on coastal dolphin species could be considered an effective management response<sup>11</sup>.

Previous research conducted under the NESP has primarily focused on determining the population status of species (four projects), with two additional projects focused on identifying the extent of threats associated with vessel strike and noise, and a further project documenting the presence of a cetacean species in a canyon area. Of these projects, only two have directly focused on threatened species identified under the EPBC Act, with the majority focusing more generally across multiple species.

In general, both plans/advice and the literature identified that continued monitoring of populations to determine changes in the biology and ecology of populations over time was a priority, as was determining the population structure and genetic connectivity of populations. While plans/advice identified that determining the responses of species to climate variability and understanding impacts associated with climate change were of high priority, few publications could be identified as responding to this need. This most likely reflects an ongoing need to establish baseline understanding of the biology and ecology of species, key information that is needed for estimating responses and projecting potential future population states under climate change scenarios. The lack of prioritisation processes (qualitative or quantitative) provided in plans/advice that can guide the determination of research prioritisation) is a gap in itself.

# 4.2 Marine mammal (excluding dugongs) workshop report

A taxa specific workshop on identifying priority research needs for marine mammals (excl. dugongs) was held on Friday 8 July 2022. Attendees included representatives from NESP, the Department of Climate Change, Energy, the Environment and Water, the Australian Fisheries Management Authority, the National Offshore Petroleum, Safety and Environmental Management Authority, the Fisheries Research and Development Corporation, relevant State government agencies, and universities (Table 7).

# 4.2.1 Introduction

The NESP MaC 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 achieve this objective through the delivery of applied and strategic research outputs that are designed to support decision-making and practical management and that respond to identified national and regional research priorities identified through consultation with relevant stakeholders and end-users. Projects funded through the MaC Hub deliver into six thematic areas, one of which is focused on threatened and migratory species and ecological communities.

The MaC Hub Research Plan 2021 includes a number of scoping projects that aim to, through consultation with key stakeholders and end-users, generate shared understanding about research needs, knowledge gaps and priorities. One of these is the 'Marine and

<sup>&</sup>lt;sup>11</sup> See https://www.dcceew.gov.au/environment/biodiversity/threatened/nominations/data-deficient-species

coastal threatened and migratory species and communities' project. This scoping project aims to inform future research investment within the MaC Hub's annual research plans. The scoping project will be run in parallel with and contribute to a broader cross-Hub Initiative project 'Threatened and Migratory Species and Threatened Ecological Communities', led by the NESP Resilient Landscapes Hub. This workshop, focused on marine mammals (excluding dugongs), will build on consultations with the Department to further identify and refine focal areas/priorities and activities that can be identified for investment in the NESP MaC Hub 2023 and future research plans.

Table 7: Agencies and organisations invitees and/or represented at the marine mammal (excluding dugong) workshop. \*Apologies for the workshop.

Agency/Organisation		
CSIRO		
Department of Agriculture, Fisheries and Forestry		
Australian Fisheries Management Authority (AFMA)		
Fisheries Research and Development Corporation (FRDC)		
Department of Climate Change, Energy, the Environment and Water		
Australian Antarctic Division		
Biodiversity Conservation Division		
Great Barrier Reef Marine Park Authority*		
Edith Cowan University		
Flinders University*		
Macquarie University		
NESP Marine and Coastal Hub		
NESP Resilient Landscapes Hub		
National Offshore Petroleum, Safety and Environmental Management Authority (NOPSEMA)		
New South Wales Department of Planning, Industry and Environment		
Northern Territory Department of Environment, Parks and Water Security*		
Queensland Department of Environment and Science		
South Australia National Parks and Wildlife Service		
South Australian Research and Development Institute Aquatic Sciences		
Tasmanian Department of Natural Resources and Environment		
Western Australia Department of Biodiversity, Conservation and Attractions		

# 4.2.2 Priority needs for management and regulation

#### Commonwealth conservation management

Priority needs for conservation management were recognised as being based on work that the Department of Climate Change, Energy, the Environment and Water (DCCEEW) is progressing in relation to development of new recovery plans for the southern right whale, blue whale and Australian sea lion, and listing assessments for inshore dolphins. Also underway are a review and update of Biologically Important Areas of regionally significant marine species<sup>12</sup>, and development or review of national guidelines including the EPBC Act Policy statement 2.1 on interactions between offshore seismic exploration and whales<sup>13</sup>. These priorities have also undergone consultation with relevant state and territory government agencies and therefore reflect shared understanding and needs.

Priority needs for Commonwealth conservation management included:

- (i) improving understanding of the conservation status of the two recognised subpopulations of southern right whale and understanding of the influence of climate change on population parameters. In association, improving understanding of the reproductive responses of southern right whales to changes occurring in the marine environment as a result of climate change and ascertaining the connectivity between the foraging and breeding areas;
- (ii) defining foraging areas and biologically important areas for blue whales, including through the use of predictive modelling approaches;
- (iii) improving understanding of the interactions between cetaceans and offshore development projects, and in association, understanding risks from underwater noise for informing noise management and mitigation, including through the use of passive acoustic monitoring and emerging infrared technologies<sup>14</sup> and;
- (iv) understanding the health status of inshore dolphins, including establishing baselines and identifying new and emerging pollutants across marine and estuarine environments subject to varying levels of urbanisation.

Further key needs identified included improved understanding of cetacean species conservation status including distribution, abundance, habitat use and behaviour noting that for many species an evaluation has not been conducted since the 1996 Cetacean Action Plan (Bannister et al. 1996).

Improving understanding of cumulative effects<sup>15</sup> from anthropogenic activities on marine mammals, including enhancing sharing and access to information in suitable formats across

<sup>&</sup>lt;sup>12</sup> https://www.dcceew.gov.au/environment/marine/marine-species/bias

<sup>&</sup>lt;sup>13</sup> https://www.dcceew.gov.au/environment/epbc/publications/epbc-act-policy-statement-21-interaction-between-offshore-seismic-exploration-and-whales

<sup>&</sup>lt;sup>14</sup> Post-workshop consultations highlighted that a potential first step in progressing this priority might be a desktop scoping study to determine the operational and financial feasibility of a national acoustic monitoring network. Given the national scope of such a network, the study would need to involve broader discussions within the context of the National Collaborative Research Infrastructure Strategy and in particular with the Integrated Marine Observing System to determine its long-term sustainability.

<sup>&</sup>lt;sup>15</sup> It was noted that the term "cumulative effects" was used by workshop participants to reference varying forms of activities without clear definition, including the repeated occurrence of specific activities through time (e.g. pile driving in one location), the occurrence of multiple activities associated with a sector (e.g. pile driving, vessel

Commonwealth, state and territory jurisdictions, was highlighted, particularly for developing relevant policy and management at the state and territory and Commonwealth jurisdictional levels.

Understanding the environmental (including climate change) drivers on population parameters and associated pathways was also highlighted as a priority research area for the Australian sea lion, as was improving understanding of the impacts of threats on the species and in particular on pup survival. Threats identified included fishery interactions, parasites and disease, marine debris and habitat and food web modification. This was highlighted as particularly relevant within the context of the revision of the listing of the species to Endangered under the EPBC Act in 2020.

#### Offshore energy infrastructure

Large noise generating projects and activities in the marine environment where there is the potential for interaction between underwater noise and marine mammals during various life stages including foraging, calving and breeding are regulated by NOPSEMA. This includes activities associated with oil and gas, carbon capture and storage and offshore renewable energy. The authority is responsible for making decisions on the environmental assessment and management of noise impacts to ensure that noise generated is acceptable and is kept at a level as low as reasonably practicable. NOPSEMA and the Commonwealth Minister for the Environment (who retains responsibility for decisions in relation to new offshore renewable energy projects assessed under the EPBC Act) cannot not make decisions that are inconsistent with a recovery plan for a listed threatened species and must have regard to relevant EPBC Act guidance and information provided by DCCEEW such as conservation advice, guidelines and policy statements.

Priority research needs for regulation of the offshore energy sector include:

- (i) improved understanding of species distribution (including habitat utilisation) and abundance of marine mammal species (including trends), in particular those that are listed under the EPBC Act and subject to recovery or conservation management plans. This includes understanding use of habitats that overlap with noise generating activities;
- (ii) better understanding of the levels of noise at which important behaviour is disturbed and recovery is compromised (population level impacts);
- (iii) validation of the effectiveness emerging technologies for detecting individuals in real-time for informing mitigation decisions, and;
- (iv) development of underwater noise mitigation/quieting technologies for stationary noise sources such as pile driving, particularly techniques that are applicable to

activity, building of infrastructure associated with offshore infrastructure) and multiple activities by multiple sectors (fishing, offshore energy, shipping). Further, the terms "cumulative effects" and "cumulative impacts", were used interchangeably without recognition of differences in the terminology and associated measurement of impacts versus effects. These references have been standardised to the term cumulative effects. This is for three reasons: (i) there is as yet no universally accepted definition of cumulative effects and impacts (see Evans et al. 2021); (ii) effects can be defined as a change to the environment, including its human components, while impacts represent the consequences of such change (Johnson 2016) and (iii) as a result, in most cases actual impacts are hypothesized and have either not been directly observed, or attributed (Murray et al. 2015).

mitigating noise in the low frequency spectra as this is most relevant to protection of listed threatened baleen whales.

#### Commercial fisheries management

Key drivers influencing research needs include the *Fisheries Management Act 1991* and the EPBC Act, supported through national bycatch policy. Commonwealth processes for identifying and responding to risks include:

- undertaking ecological risk assessments for each fishery to identify those priority species most at risk to fisheries, and;
- developing bycatch mitigation plans, fishery specific mitigation plans, bycatch strategies (including those specific to Australian sea lions and for particular fisheries) and codes of conduct.

External challenges include meeting requirements associated with fishery export licenses to the United States, which require the need to have comparable management plans in place for addressing marine mammal bycatch and harmonising differences in management approaches.

Priority research needs identified for Commonwealth fisheries management (noting that research was being conducted in these areas) include:

- (i) improving knowledge of the cumulative effects of fisheries;
- (ii) understanding climate impacts on non-target species;
- (iii) better understanding of population distributions and abundance particularly in offshore areas, and;
- (iv) improving understanding of marine mammal behaviour around fishing vessels, including depredation by toothed whales.

# 4.2.3 Breakout group discussions

#### Overlap and interactions with offshore industries

With rapid expansion of planned offshore energy installations, there is a need to increase understanding of the distributions and movements of marine mammal species to better evaluate potential overlaps, manage risks and mitigate impacts, particularly in relation to noise and cumulative effects. This includes improving understanding of temporal and spatial variability in distributions and movement.

Outputs from research focused on improving this understanding would also facilitate better understanding of overlaps between mammal species and fisheries, and in particular improve baselines that are needed for applying management rules set as part of overseas export licensing.

It was noted that newly established and emerging technologies and methods that have not been available in the past may have developed to the point that they could be utilised to facilitate the collection of information on distributions, movements and habitat use. It was recognised that there is a role for both government driven and industry led research into technologies that are proven effective for improving understanding and informing risk and impact management and mitigation.

It was also noted that in developing a policy platform for offshore energy, it was the responsibility of government agencies to clarify the research needed to support such policies as part of obligations under relevant environmental legislation. This clarification is particularly important in identifying the role of proponent driven activities that are required under regulatory requirements, particularly in establishing baselines and evaluating risks and impacts, and in doing so where research that might be conducted under the NESP might add value.

#### Risk and impact quantification

A key area of research noted as needed is establishing risks to marine mammal populations by stressors and understanding cumulative effects. Discussions identified that it would be useful to develop an evaluation framework that could be applied across species and regions. This should include consideration of existing threat and risk assessments and management actions and was identified as particularly relevant to progressing fisheries bycatch mitigation measures.

It was noted that regarding entanglement, approaches for estimating cryptic mortality were needed so that all sources of mortality could be accounted in risk evaluations, with recent research conducted overseas identified as a potential example.

In understanding and quantifying risks to species from anthropogenically generated noise, it was noted that further research was needed to better understand overlaps in the spatiotemporal distributions of species and noise being generated. In particular, understanding the overlap of noise with known or potential biologically important areas for marine mammals and the severity, extent and duration of noise footprints associated with pile driving during windfarm construction were raised as important. In addition, understanding exposure levels that have the potential to elicit behavioural and / or physiological response and in turn, have potential to impede the recovery of listed threatened species were highlighted as needed. Having this level of understanding could support the development of a cumulative impact assessment framework that can be applied at varying spatial scales and inform management measures to mitigate such impacts.

Understanding climate change impacts on prey abundance and distribution and in turn how changes in food webs might impact marine mammal population was noted as being needed. To build this understanding, there was a need to utilise regional climate models to a greater extent than is currently done.

#### Method and technology development

With methods and tools development there is opportunity to apply these to better understand distributions, process observations more efficiently and improve data streams. These include using satellite imagery for understanding distributions and associated spatial and temporal variability and use of artificial intelligence and machine learning for processing passive acoustic observations and camera-based observations collected across multiple sectors.

Developments in these approaches could fill knowledge gaps quickly on priority needs, particularly in offshore regions.

In identifying mitigation options related to entanglement, it was noted that a review and consideration of new and emerging technologies was required.

#### Information accessibility

There was a recognition that a lot of information that had been collected on marine mammals across individuals to populations, and relevant threatening processes. Despite these efforts effective coordination and collation of information to make it accessible for decision making was lacking. This lack of coordination and access to information was also identified as currently limiting gap analyses, and in association, setting future priorities. A direct question to the Marine and Coastal Hub asked "what can the Hub do to liberate, coordinate and provide access and delivery to information?".

In discussing priority areas for research, it was noted that there was a need for widespread engagement with stakeholders including Commonwealth, state, territory and local government, industry sectors, Indigenous communities (across appropriate timelines). This was identified as being important for ensuring that research was anticipatory and proactive rather than reactionary, understood industry practices and delivered effective mitigation measures and guidance.

# 4.3 Priorities identified through the literature review and workshop

Clear priorities for research identified by both the literature search and the workshop were associated with ongoing monitoring or establishment of monitoring programs for marine mammal populations, particularly in identifying change over time and being able to quantify impacts of threats on populations. In association, linking at-sea behaviours to population parameters was identified as essential for being able to quantify absolute risk to species and populations, attribute changes to drivers, understand the cumulative effects of multiple threats on populations and quantify impacts at the level of populations and species.

Integrative approaches that allow for the quantification of risk and attribution of the effects of changes on population viability will be particularly important for evaluating progress against conservation advice and management plans. Such approaches will also be important for ensuring that frameworks set out under national strategies (e.g. the National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna<sup>16</sup>) can be effectively implemented and objectives set under threat abatement plans (e.g. the threat abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans), and industry focused management plans, (e.g. those set out for Commonwealth fisheries and shipping) are progressed.

With the rapid development of offshore renewable energy, it is not surprising that this was identified as a greater priority for focusing research by workshop participants than reflected in recovery plans, conservation management plans, conservation advice and the literature. Key

<sup>&</sup>lt;sup>16</sup> https://www.dcceew.gov.au/sites/default/files/documents/vessel-strike-strategy.pdf

areas highlighted for research included understanding the responses of marine mammals and impacts of noise generated during installation, commissioning and decommissioning phases, understanding shifts in habitat use that might be caused by installations and associated supporting infrastructure and flow on effects on population parameters. Understanding the requirements and responsibilities of all stakeholders throughout all stages of the development and establishment of this industry along with what research is underway will be essential for guiding any research conducted by the NESP to ensure that it is targeted, creates value and supports knowledge exchange.

Utilising new technologies and novel analytical approaches featured both in the literature and the workshop, particularly in expanding and introducing innovation into the monitoring of population and reducing and mitigating threats, and in relation to fisheries bycatch, entanglement and anthropogenic noise. New technologies could also be embraced to support data and knowledge exchange and delivery, including that associated with best practices and protocols, development of data synthesis products for use by various stakeholders and overall awareness and coordination of research efforts. This would also serve to support the facilitation of access to widely accepted and the most up-to-date tools such as risk assessment frameworks thereby ensuring standardised approaches to the quantification of risk and threats.

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# Appendix A: Background material provided to each workshop

# Seabirds

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, shorebirds, seabirds, bony fish, invertebrates and endangered ecological communities.

This workshop, focused on seabirds (note shorebirds are the focus of already commissioned research funded through the Hub), will build on consultations with the Department to further identify and refine focal areas/priorities and activities that can be included in the 2023 research plan. 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 discussions in this workshop will build on the efforts placed into identifying risks and actions to address current and emerging threats to a number of seabirds as set out in the Wildlife Conservation Plan for Seabirds and conservation advice provided by the Threatened Species Scientific Committee for Abbott's booby, Antarctic tern (Indian), Australian lesser noddy, blue petrel, Christmas Island frigatebird, fairy prion, fairy tern, Heard Island imperial shag, Macquarie Island imperial shag, New Zealand Antarctic tern, shy albatross, soft- plumaged petrel and white-tailed tropicbird. Workshop attendees will be limited to ensure

engagement is focused and will include state and territory managers, Commonwealth managers and regulators, and researchers engaged broadly across the taxa group.

Outputs from the workshop will be a set of focal areas/priorities/activities that can be included in the 2023 research plan and guide investment in future annual research plans for the Marine and Coastal Hub. The Hub will work with its partners to co-design projects that directly address and deliver into these.

Further information on the Marine and Coastal Hub and the partners involved in the Hub can be found at: https://www.nespmarinecoastal.edu.au/

# Marine mammals (excluding dugongs)

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 DCCEEW 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, shorebirds, seabirds, bony fish, invertebrates and endangered ecological communities.

This workshop, focused on marine mammals (note dugongs are the focus of already commissioned research funded through the Hub and will not be included), will build on consultations with the Department to further identify and refine focal areas/priorities and activities that can be included in the 2023 research plan. 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 discussions in this workshop will build on the efforts placed into identifying risks and actions to address current and emerging threats to a number of marine mammals as set out in the Conservation Management Plans for southern right and blue whales and conservation advice provided by the Threatened Species Scientific Committee for sei, fin and humpback whales, Australian sea lion, southern elephant seal and subantarctic fur seal. Workshop attendees will be limited to ensure engagement is focused and will include state and territory managers, Commonwealth managers and regulators, and researchers engaged broadly across the taxa group.

Outputs from the workshop will be a set of focal areas/priorities/activities that can be included in the 2023 research plan and guide investment in future annual research plans for the Marine and Coastal Hub. The Hub will then work with its partners to co-design projects that directly address and deliver into the focal areas/priorities/activities identified in the research plan.

Further information on the Marine and Coastal Hub and the partners involved in the Hub can be found at: https://www.nespmarinecoastal.edu.au/

# Appendix B: Workshop agendas

# Seabirds

NESP Marine and Coastal Hub Threatened and Migratory Species and Communities scoping study: prioritisation workshop on seabirds Tuesday July 12, 14:00-16:00.

# Context/objectives

This workshop will be focused on identifying a set of priority theme or activity areas relating to seabirds 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.

# This workshop is not focused on identifying specific/individual projects per se.

Outputs from the workshop will be a set of focal areas/priorities/activities that can be included in the 2023 research plan and guide investment in future annual research plans for the Marine and Coastal Hub through to its end of term in 2027. Following the finalisation of the 2023 Research Plan, the Hub will then work with its partners to co-design projects that directly address and deliver into the focal areas/priorities/activities identified.

# Break-out group guiding questions

In directly progressing the priorities identified across conservation management, offshore energy regulation and fisheries management, what might be a thematic/priority area(s) that the NESP MaC Hub can focus on?

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?

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)?

# Agenda

12:00-12:10	Welcome, introduction and overview of objectives of workshop	CSIRO
12:10-12:20	Overview of NESP MaC Hub, objectives, priorities and process for 2023 Research Plan	MaC Hub
12:20-12:30	Q&A	Moderator: CSIRO
12:30-12:40	Commonwealth and state/territory priorities: conservation management perspectives	DCCEEW
12:40-12:50	Commonwealth priorities: offshore energy regulation perspectives	NOPSEMA
12:50-13:00	Commonwealth priorities: fisheries management perspectives	AFMA
13:00-13:05	Break-out groups: recap of tasks and division of attendees	CSIRO
13:05-13:35	Break-out group discussions on priority areas	All
13:35-13:55	Break-out group report to plenary and discussion	All
13:55-14:00	Summary and wrap-up	CSIRO

# Marine mammals (excluding dugongs)

# NESP Marine and Coastal Hub Threatened and Migratory Species and Communities scoping study: prioritisation workshop on marine mammals, Friday July 8, 12:00-14:00, virtual.

# Context/objectives

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.

This workshop is not focused on identifying specific/individual projects per se.

Outputs from the workshop will be a set of focal areas/priorities/activities that can be included in the 2023 research plan and guide investment in future annual research plans for the Marine and Coastal Hub through to its end of term in 2027. Following the finalisation of the 2023 Research Plan, the Hub will then work with its partners to co-design projects that directly address and deliver into the focal areas/priorities/activities identified.

#### Break-out group guiding guestions

In directly progressing the priorities identified across conservation management, offshore energy regulation and fishing management, what might be a thematic/priority area(s) that the NESP MaC Hub can focus on?

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?

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, codesign with particular agencies/groups etc)?

12:00-12:10	Welcome, introduction and overview of	CSIRO
	objectives of workshop	
12:10-12:20	Overview of NESP MaC Hub,	MaC Hub
	objectives, priorities and process for 2023 Research Plan	
12:20-12:30	Q&A	Moderator: CSIRO
12:30-12:40	Commonwealth and state/territory priorities: conservation management perspectives	DCCEEW
12:40-12:50	Commonwealth priorities: offshore energy regulation perspectives	NOPSEMA
12:50-13:00	Commonwealth priorities: fisheries management perspectives	AFMA
13:00-13:05	Break-out groups: recap of tasks and division of attendees	CSIRO
13:05-13:35	Break-out group discussions on priority areas	All
13:35-13:55	Break-out group report to plenary and discussion	All
13:55-14:00	Summary and wrap-up	CSIRO

#### Α

# Appendix C: Literature identified on seabirds

#### Peer review publications

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# Appendix D: Literature identified on marine mammals (excluding dugongs)

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