Conservation Significant Marine Fauna Desktop Study

Eramurra Solar Salt Project

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Marine fauna sighting records provided by DBCA are interpreted with caution, as they represent a presence-only dataset. The Threatened and Priority Fauna Database contains data from a combination of sources (e.g. surveys, monitoring programs, translocations, opportunistic sightings, evidence/secondary signs, museum specimens or historical documents). Locational accuracy varies across records. Not all records are verified and may include repeated sightings of the same individual. The completeness of records varies by species depending on the remoteness of their distribution and the survey effort within that area.

Data sourced from DCCEEW has been informed by a variety of sources including broad species ranges, bioclimatic modelling, and subject matter expert advice. As such, resolution is coarse.

Maps are created in WGS 84 - Pseudo-Mercator (EPSG:3857) coordinate reference system and are not to be used for navigational purposes. Positional accuracy should be considered as approximate.

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O2 Marine acknowledges Aboriginal and Torres Strait Islander people as this land's first storytellers and holders of scientific knowledge through their ongoing and continued connection to land, sea and community. We pay our respect to Elders past and present for their custodianship of the land and sea over millennia, which inspires us daily in our collective responsibility to sustain the land and sea country which we live by, work in and dream about.

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Transmission Register

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ENVIRONMENT
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Executive Summary

Leichhardt Salt Pty Ltd (LS) propose to construct and operate the Eramurra Solar Salt Project (ESSP), a solar salt project to extract up to 4.2 million tonnes per annum (Mtpa) of high-grade salt (sodium chloride (NaCl)) from seawater, using a series of concentration and crystalliser ponds and processing plant, transport corridor, stockpiling and export from the Cape Preston East Port (the Proposal). The concentration and crystalliser ponds will be located on Mining Leases.

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Cth) and Western Australian *Environmental Protection Act 1986* (EP Act) govern the environmental approval process. They aim to support environmentally sustainable development while protecting environmental values, including biodiversity. 'Marine Fauna' are a key environmental factor to be considered during environmental impact assessment (EIA) under the EP Act (WA). They are defined as 'Animals that live in the ocean or rely on the ocean for all or part of their lives' (EPA 2016). The EPA's objective for marine fauna is: 'To protect marine fauna so that biological diversity and ecological integrity are maintained'.

This report presents the outcomes of a marine fauna desktop study that will be used to inform EIA and formulation of related management measures. The objectives were to:

- Identify key species based on their conservation status and their likelihood of occurrence in Proposal-impacted areas
- Summarise key species' ecological characteristics (i.e. population, distribution, habitat use, life history characteristics and ecological windows)
- Identify EPBC Act related policies pertaining to the management of these species.

Bird species have been precluded from this desktop study because they have been addressed elsewhere. Commercially and recreationally important fish and fisheries have also been discussed in complementary reports.

Identification of 'key' species as those with the highest conservation significance and which could be impacted by the Proposal, ensures that the correct level of attention is paid to those at greatest potential risk from the Proposal. The key conservation significant species were identified based on their status and likelihood of occurrence in the Proposal area. These are:

- Humpback whale (*Megaptera novaeangliae*)
- Dugong (*Dugong dugon*)
- Australian humpback dolphin (*Sousa sahulensis*)
- Indo-Pacific bottlenose dolphin (*Tursiops aduncus*)
- Green turtle (*Chelonia mydas)*
- Flatback turtle (*Natator depressus*)
- Hawksbill turtle (*Eretmochelys imbricata*)
- Short-nosed sea snake (*Aipysurus apraefrontalis*)
- Leaf-scaled sea snake (*Aipysurus foliosquama*)
- Green sawfish (*Pristis zijsron*)

- Reef manta ray (*Mobula alfredi*).

Ecological windows for these species have been presented, including for humpback whales and turtles, which have a high likelihood of occurrence on a seasonal basis.

There are no conservation significant marine fauna populations or habitats that are restricted to the Proposal development envelopes (DEs), which are predominantly bare sand with occasional areas of limestone pavement. The habitats surrounding the Proposal are widespread and well represented throughout the region.

The full EIA and associated management plans will need to ensure that Proposal activities consider the objectives of relevant species' Recovery Plans or Conservation Advice.

Acronyms and Abbreviations

Term	Full term
ALA	Atlas of Living Australia
AMSIS	Australian Marine Spatial Information System
BC Act	*Biodiversity Conservation Act 2016*
BCH	Benthic Communities and Habitats
BIA	Biologically Important Areas
CALM Act	*Conservation and Land Management Act 1984*
C	Concern
CC	Closed Canopy
CD	Conservation Dependent
CI	Confidence Interval
CITES	Convention on International Trade in Endangered Species
cm	Centimetres
CR	Critically Endangered
CSMF	Conservation significant marine fauna
CV	Coefficient of variation
DAWE	Department of Agriculture, Water and the Environment
DBCA	Department of Biodiversity, Conservation and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DD	Data deficient
DE	Development Envelope
DEWHA	Department of the Environment, Water, Heritage and the Arts
DoE	Department of Environment
DoEE	Department of Environment and Energy
DPIRD	Department of Primary Industries and Regional Development
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
DTAG	Digital Acoustic Recording Tag
DW	Disc width
DWER	Department of Water and Environmental Regulation
EGMPF	Exmouth Gulf Prawn Managed Fishery

Term	Full term
EIA	Environmental Impact Assessment
EN	Endangered
EP Act	*Environmental Protection Act 1986*
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESD	Environmental Scoping Document
ESSP	Eramurra Solar Salt Project
EX	Extinct
FRM Act	*Fish Resources Management Act 2016*
GLpa	Gigalitres per annum
ha	Hectare
HBI	Harry Butler Institute
IMCRA	Interim Marine and Coastal Regionalisation for Australia
IMMA	Important marine mammal areas
IMP	Introduced Marine Pests
IMS	Invasive Marine Species
IN	Intertidal
IUCN	International Union for Conservation of Nature
kg	Kilograms
km	Kilometre
LAT	Lowest astronomical tide
LAU	Local Assessment Unit
LC	Least Concern
m	Metre
mm	Millimetre
MI	Migratory
MNES	Matters of National Environmental Significance
MPA	Marine Protected Areas
MS	Ministerial Statement
NBMPF	Nickol Bay Managed Prawn Fishery
NC	Not of Concern

Term	Full term
NS	Nearshore
NSW	New South Wales
NT	Northern Territory
NWC	North West Cape
NWS	North West Shelf
OF	Offshore
OMPF	Onslow Managed Prawn Fishery
OS	Other Species Protected (BC Act)
P3	Priority 3: Poorly-known species
P4	Priority 4: Rare, Near Threatened and other species in need of monitoring
PC	Potential Concern
PER	Public Environmental Review
PFTIMF	Pilbara Fish Trawl Interim Managed Fishery
PIN	Pilbara (Inshore)
PMST	Protected Matters Search Tool
PON	Pilbara (Offshore)
ppt	parts per thousand
PSMT	Protected Matters Search Tool
QLD	Queensland
RPAS	Remotely piloted aerial system
SD	Standard deviation
TAP	Threat Abatement Plan
TL	Total length
TSSC	Threatened Species Scientific Committee
UAV	Unmanned Aerial Vehicle
VU	Vulnerable
WA	Western Australia

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1. Introduction

Leichhardt Salt Pty Ltd (Leichhardt) is seeking to develop the Eramurra Solar Salt Project (ESSP), a solar salt project east of Cape Preston, approximately 55 km west-south-west of Karratha in the Pilbara region of WA (Figure 1). The Proposal will be implemented (with necessary connecting infrastructure) within three Development Envelopes (DEs) shown in Figure 2. The Proposal will utilise seawater and natural solar evaporation processes to produce a concentrated salt product. An average production rate of 5.2 Million tonnes per annum (Mtpa) is being targeted with up to 6.8 Mt of salt deposited in a low rainfall year. A short summary of the Proposal is presented in Table 1 and includes the following infrastructure will be developed:

- Seawater intake, pump station and pipeline
- Concentration ponds totalling approximately 10,060 hectares (ha) (6,930 ha West ponds and 2,110 ha East ponds)
- Crystallisers, totalling approximately 1,840 ha
- Drainage channels and bunds
- Process plant and product dewatering facilities
- Water supply (desalination plant)
- Bitterns disposal pipeline and outfall
- Power supply and power lines
- Pumps, pipelines, roads, and support buildings including offices and communications facilities
- Workshops and laydown areas
- Landfill
- Other associated infrastructure.

Table 1: Short summary of the Proposal

Project Title	Eramurra Solar Salt Project
Proponent Name	Leichhardt Salt Pty Ltd
Short Description	Leichhardt Salt Pty Ltd (Leichhardt) is seeking to develop a solar salt project in the Cape Preston East area, approximately 55 kilometres (km) west-southwest of Karratha in Western Australia (WA) (the Proposal). The Proposal will utilise seawater and evaporation to produce a concentrated salt product for export. The Proposal includes the development of a series of concentration ponds, crystallisers and processing plant. Supporting infrastructure includes bitterns outfall, drainage channels, product dewatering facilities, desalination plant, pumps, pipelines, power supply, access roads, administration buildings, workshops, laydown areas, landfill facility, communications facilities and other associated infrastructure. The Proposal also includes dredging at the Cape Preston East Port and both offshore and onshore disposal of dredge spoil material.

The export of salt is proposed to be via a trestle jetty. The jetty and associated stockpiles will be located at the Cape Preston East Port approved by Ministerial Statement (MS) 949. Dredging will be undertaken as part of this Proposal to remove high points at the Cape Preston East Port. Dredged material will either be disposed of at an offshore disposal location, or onshore within the Ponds and Infrastructure DE. The Cape Preston East Port jetty and associated stockpiles are excluded from the ESSP. The ESSP will produce a salt concentrate according to the following processes:

- Seawater will be pumped into the first concentration pond and commence progressive concentration by solar evaporation as it flows through successive concentration ponds
- Salt is deposited onto a pre-formed base of salt in the crystallisers
- Salt will be removed from the drained crystallisers by mechanical harvesters and stockpiled adjacent to the processing facilities
- Salt concentrate will be trucked to the trestle jetty approved by Ministerial Statement (MS) 949 for export, and
- A maximum of 5.4 GL of bitterns (at 360 ppt salinity) will be generated in any given year and up to 0.59 GL (at 360 ppt salinity) in a peak summer month. The bitterns will be diluted 1:1 mass ratio with local seawater prior to discharge via ocean outfall diffuser within the Marine DE.

The Proposal may be developed in its entirety, or the East concentration ponds may be developed at a later stage.

O2 Marine was engaged by the proponent to undertake marine environmental investigations to help identify environmental risks of the ESSP, establish baseline conditions, help facilitate the environmental approvals process, and guide appropriate monitoring and management to minimise potential impacts to the marine environment during construction and operations. Table 2 outlines the extent of the physical and operational elements of ESSP.

Table 2: Location and proposed extent of physical and operational elements

Element	Location	Proposed extent
Physical element		
Pond and Infrastructure Development Envelope – Concentration ponds and crystallisers. Process plant, desalination plant, administration, water supply, intake, associated works (access roads, laydown, water supply and other services).	Figure 2	Disturbance of no more than 12,201 ha within the 20,160 ha Ponds DE.
Marine Development Envelope – Seawater intake and pipeline, dredge channel, bitterns pipeline, outfall diffuser and mixing zone.	Figure 2	Disturbance of no more than 53 ha within the 703 ha DE.
Dredge Spoil Disposal Development Envelope – Disposal location for dredge spoil.	Figure 2	Disturbance of no more than 100 ha within the 285 ha Dredge Spoil Disposal DE.
Operational elements		
Bitterns discharge	Figure 2	Discharge of up to 5.9 Gigalitres per annum (GL pa) of bitterns within a dedicated offshore mixing zone within the Marine Development Envelope
Dredge Volume	Figure 2	Approximately 400,000 m^3

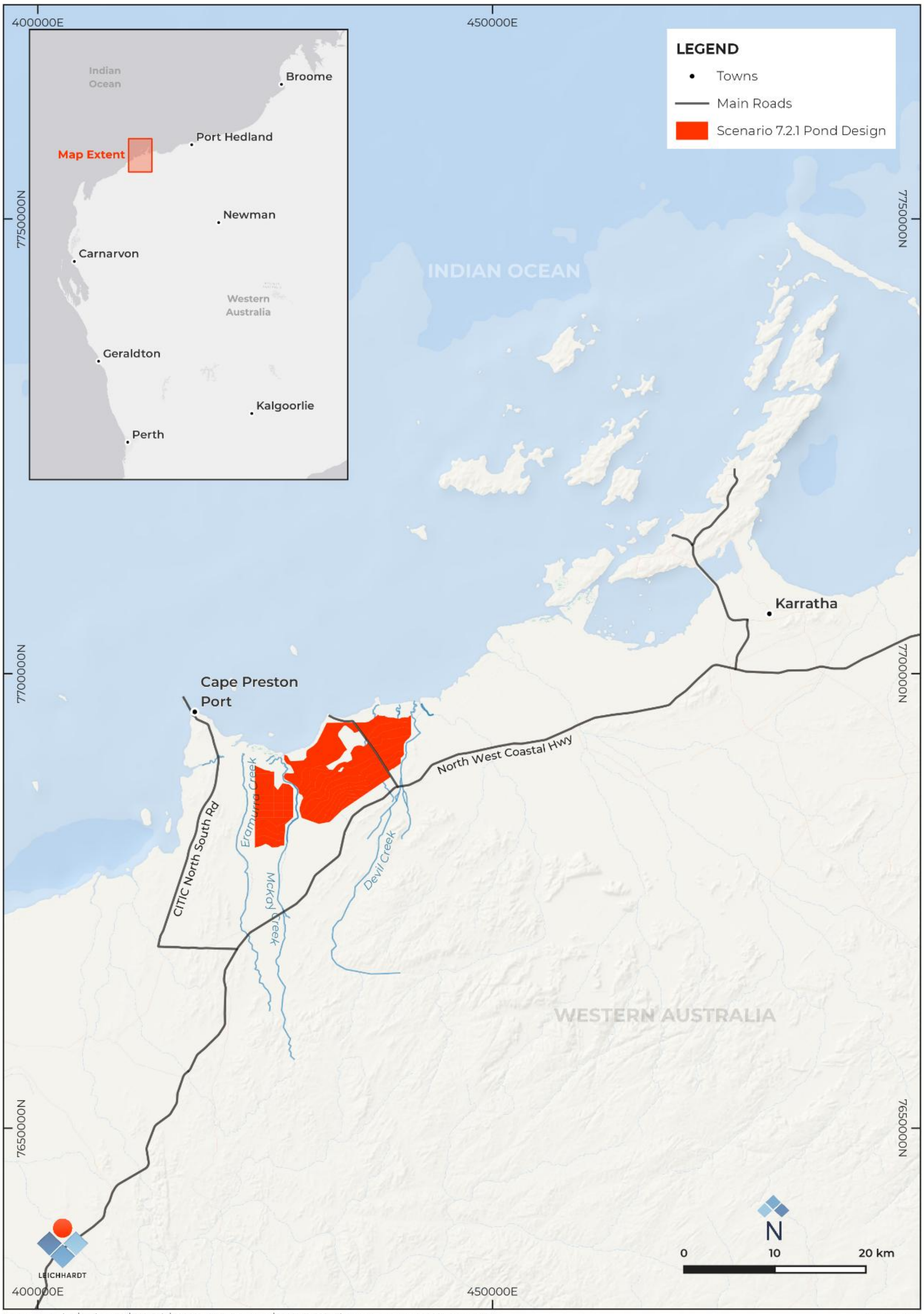

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Figure 1: Regional location of the Proposal

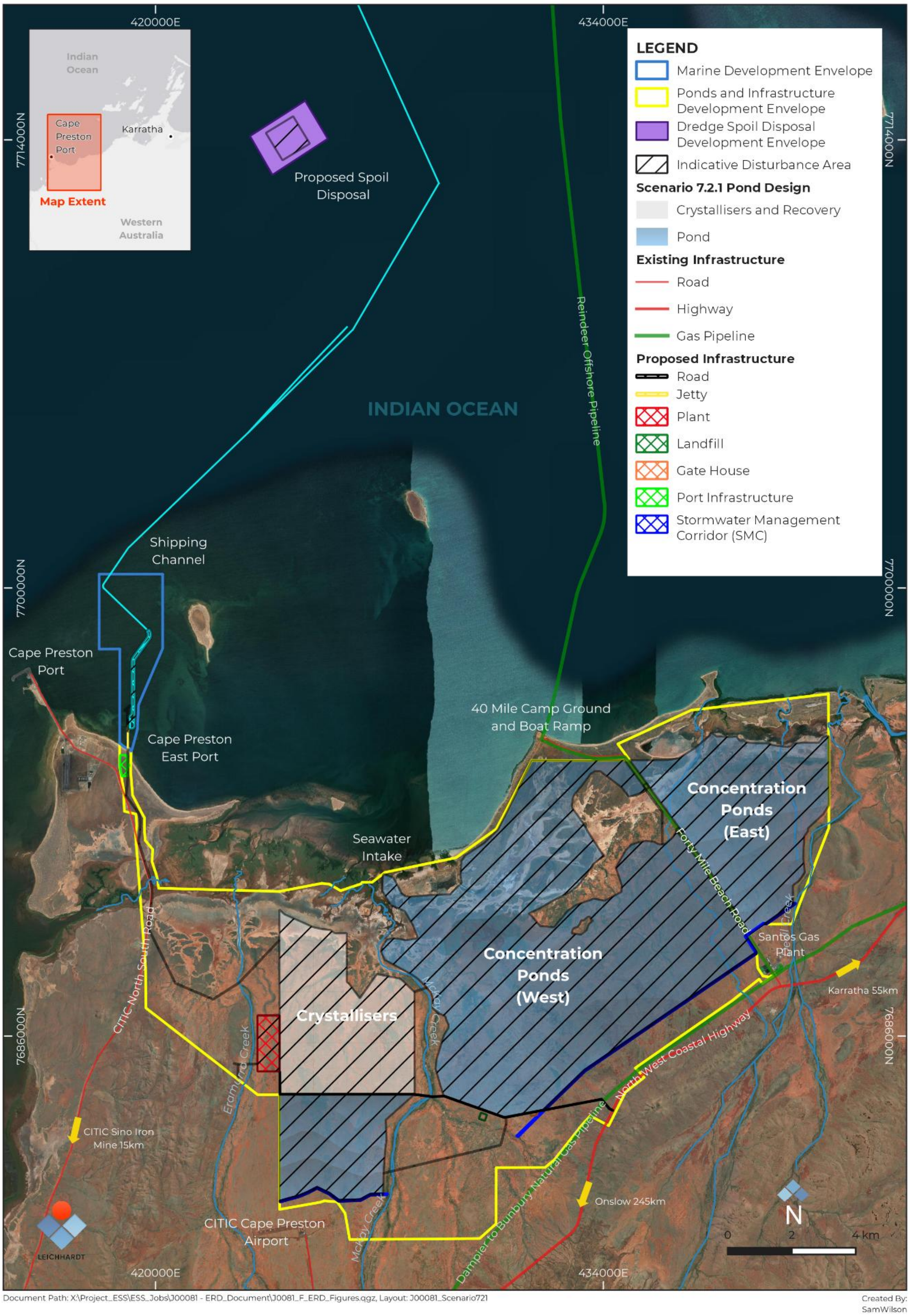

Figure 2: Development Envelopes

1.1. Objectives

The report presents the outcomes of a marine fauna desktop study that will be used to inform environmental impact assessment (EIA) and formulation of related management measures.

The objectives were to

- Identify key species based on their conservation status and their likelihood of occurrence in Proposal-impacted areas
- Summarise key species' ecological characteristics (i.e. population, distribution, habitat use, life history characteristics and ecological windows)
- Identify EPBC Act related policies pertaining to the management of these species.

In doing so, this report addresses Environmental Scoping Document (ESD) items 60 and 70 outlined by Preston Consulting (2022) (Table 3). The report contributes to ESD items 69 and 71. It incorporates key findings from the Turtle Nesting Study Report (O2 Marine 2022c), Marine Turtle Monitoring 2022/23 Report and Marine Turtle Monitoring 2023/24 (Pendoley Environmental 2023; 2024) and Sawfish Study Report (O2 Marine and Harry Butler Institute 2023; HBI 2023). Commercially and recreationally important fish species noted in item 69 are discussed in the Fish and Fisheries Report (O2 Marine 2023). Items 71e and 71f are included in the Environmental Review Document which contains the full impact assessment for the Proposal.

Table 3: ESD Items and Requirements (Preston Consulting 2022)

ESD item	Requirement
60	Undertake a desktop review to identify what marine fauna species would be expected to utilise marine waters surrounding the Proposal including those protected under the EPBC Act.
69	Identify any significant marine fauna (as well as ecological 'keystone' species and species important to commercial and recreational fishers) likely to be found in the area of influence of the Proposal, including commercially important species and migratory species;
70	Identify any known critical periods for key environmental/life cycle events for marine fauna (e.g. turtle nesting, southern whale migrations, sawfish pupping);
71	Identify likelihood of significant marine fauna species (excluding sea and shore bird) occurring near the Development Envelopes, including: a) Information on the abundance, distribution, ecology and habitat preferences of any listed species; b) Information on the conservation value of each habitat type from a local and regional perspective; c) If a population of a listed species is present, its size and the importance of that population from a local and regional perspective; d) Baseline mapping of local occurrences; e) Discuss and determine significance of, potential direct, indirect (including downstream) residual and cumulative impacts to conservation significant marine fauna as a result of the Proposal at a local and regional level; and f) Describe the application of the mitigation hierarchy in the proposal design, construction, operation, and closure. Detail actions undertaken to avoid, minimise and mitigate proposal impacts. Include management and/or monitoring plans to be implemented pre- and post-construction to demonstrate that residual impacts (direct and indirect) are not greater than predicted. Management and/or monitoring plans are to be presented in accordance with Environmental Protection Authority (EPA) instructions. If management and/or monitoring plans for Introduced Marine Pests (IMP) are deemed to be required, they must align with the Marine Pest Plan 2018-2023: The national strategic plan for marine pest biosecurity and comply with Environmental Management Plan Guidelines.

2. Relevant marine fauna legislation

Key legislation governing the protection of conservation significant marine fauna and their habitats in WA are summarised in Table 4. The EPBC Act and EP Act govern the environmental approval process. They aim to support environmentally sustainable development while protecting environmental values, including biodiversity. Proposals referred under the EPBC Act are assessed by the Department of Climate Change, Energy, the Environment and Water (DCCEEW). Proposals referred under the EP Act are assessed by the WA EPA. The EPA may undertake assessments on behalf of DCCEEW on Public Environmental Review (PER) and Assessment on Referral Information - Category A (API-A) levels of assessment under a Bilateral agreement made under section 45 of the EPBC Act relating to environmental assessment.

The Department of Water, Environment and Regulation (DWER) will support the EPA in conducting environmental impact assessments and developing policies to protect the environment.

Table 4: Summary of relevant Marine Fauna legislation

Legislation	Relevance
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	Protects 'nationally significant' animals, plants, habitats, and places as Matters of National Environmental Significance (MNES) and aims to ensure that potential negative impacts are carefully considered before changes in land use or new developments are approved. In relation to marine fauna it protection and impact assessments focus on listed Threatened and Migratory species. The Act also recognizes Recovery Plans for threatened species, guiding research and management for their survival. It helps Australia meet international conservation commitments, including those under the International Union's Conservation of Nature (IUCN) Red List, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and conventions for migratory species. The Act protects Marine and Cetaceans listed species, with the Australian Whale Sanctuary protecting cetaceans from harm within Commonwealth waters (out to 200 nautical miles (nm)).
Environmental Protection Act 1986 (EP Act)	The aim is to protect WA's environment, with a focus on five key environmental principles. The third principle, related to the conservation of biological diversity and ecological integrity, directly applies to Marine Fauna, which are defined as 'Animals that live in the ocean or rely on the ocean for all or part of their lives' (EPA 2016). The EPA's objective for Marine Fauna is: 'To protect marine fauna so that biological diversity and ecological integrity are maintained'. The EPA pays special attention in EIA to marine fauna species that are of social, cultural, economic, or ecological significance. The mangroves in the vicinity of the Proposal area are of very high conservation value and designated as 'regionally significant mangroves that occur inside areas that have been designated as industrial areas, associated ports or related development' under Guideline 3 of the *Protection of Tropical Arid Zone Mangroves Along the Pilbara Coastline* (EPA 2001). This advice is in accordance with section 16(j) of the EP Act. The EPA's operational objective for Guideline 3 is: *'That no development should take place that would significantly reduce the mangrove habitat or ecological function of the mangroves in these areas.'*
Biodiversity Conservation Act 2016 (BC Act)	The aim is to conserve and protect WA's biodiversity and support the sustainable use of its species, habitats, ecosystems, and ecological processes. It also includes measures to prevent the harassment or disturbance of fauna. Native species are classified as Specially Protected, Threatened (Critically Endangered, Endangered, Vulnerable), or Extinct. Species that may be threatened but lack sufficient data are ranked with Priority 1, 2, or 3 for survey and evaluation, while Priority 4 species are rare but not threatened and require regular monitoring.

Legislation	Relevance
Conservation and Land Management Act 1984 (CALM Act)	Defines the role of the Department of Biodiversity, Conservation and Attractions (DBCA) as the management agency for WA's conservation estate. In doing so, it facilitates the protection of some marine fauna habitats through the gazettal and management of marine protected areas (MPA). The Proposal DEs do not spatially overlap with any Marine Parks. The Proposal is, however, located in close proximity to the Great Sandy Island Reserve, which encompasses 29 islands off the Pilbara coast within an area extending generally from about 15 km east of Cape Preston to the mouth of the Robe River, and ranging from approximately 10 to 35 km offshore. It does not, however, include the surrounding marine waters. The nearest Islands to the Proposal Area include North-East Regnard Island, only ~7.5 km to the north, and the islands within the Great Sandy Island Reserve, which are all considered breeding and resting places for migratory and resident shorebirds and seabirds, and marine turtles. The islands are recognised as Nature Reserves, which are protected and managed by DBCA.
Fish Resources Management Act 1994 (FRM Act)	Is the principal act that regulates the management, utilisation, and conservation of fish (i.e. all aquatic organisms except reptiles, birds, mammals, amphibians) and their habitat in WA, including addressing biosecurity risks from invasive marine species (IMS). Administered by the Department of Primary Industries and Regional Development (DPIRD), the Act provides advice to the EPA and DCCEEW on potential impacts of proposed actions on fish or fish habitats. Proposals with significant impacts on fish or fish habitats in WA State waters must be assessed by the EPA, and by the DCCEEW for those in Commonwealth waters.
Biosecurity Act 2015 (Biosecurity Act)	Under the BC Act, DCCEEW are responsible for managing biosecurity risks of IMP from ballast water and biofouling from vessels operating in Australian seas. The BAM Act (WA) aims to prevent new pests from entering WA (including marine waters) and restrict the spread of those that are present. It is designed to facilitate cooperation between government agencies, as well as with interested groups ranging from primary producers to the public and has been extended to protect State aquaculture interests. A detailed introduced marine pest risk assessment has been undertaken for the Proposal (MScience 2022).

3. Existing environment

The Proposal is situated on the Pilbara coastline and is located ~55 km west south-west of Karratha within the North-west Bioregion. The marine elements of the Proposal and DEs are located on the coast and within the relatively flat and shallow waters of the Pilbara (Inshore) WA (PIN) Interim Marine and Coastal Regionalisation for Australia (IMCRA) meso-scale region (IMCRA 1998), within the broader North-west Marine Region (DSEWPaC 2012a). Habitats within the Proposal area are widespread and typical of the broader region (IMCRA 1998).

The PIN meso-scale region has a high diversity of infauna from intertidal mudflats and sandflats associated with fringing mangals in bays and lagoons (IMCRA 1998). The waters are highly turbid, especially during periods of spring tides, and associated with a large tidal range up to 6 m (IMCRA 1998). Fringing coral reefs exist around some of the islands (IMCRA 1998). The sea floor is gently sloping, and the 10 m bathymetric contour is generally between 1 and 2 nautical miles offshore (IMCRA 1998). Along the mainland, barrier islands and associated lagoons, embayments and deltas, predominate, and the coast is either open or partly protected by chains and clusters of small, nearshore, shelly limestone islands (IMCRA 1998).

The waters of the Pilbara (offshore) (PON) IMCRA meso-scale region are generally clear but may become turbid during periods of spring tide (IMCRA 1998). The continental shelf is wide in the Proposal area, with a change to a steeper slope at ~20 m bathymetric contour (IMCRA 1998). Just inside this contour there is a series of limestone islands and fringing coral reefs are well developed on the seaward sides of most of these islands (IMCRA 1998). Wide intertidal sandflats occur on the leeward sides of most of these islands, often with the sand forming thin sheets over a rock pavement (IMCRA 1998). The seabed substrate is mainly terrigenous mud but there is sand and gravel in tidal scours of some areas (IMCRA 1998).

The Pilbara coastline is characterised by mangrove communities, supratidal flats behind the mangroves, intertidal creeks and mudflats and sandy flat habitats (IMCRA 1998). Climatic conditions and oceanographic features influence marine faunas ranges, and seasonal and interannual distribution. Additionally nearshore and coastal environments provide habitat for a range of fauna species and may be utilised year-round or seasonally, depending on the species. There are no Proposal elements that overlap with Key Ecological Features (KEFs) (Figure 3). Some bathymetric features may attract aggregations of pelagic species offshore. Regionally significant mangrove areas are found within the Proposal and surrounding environments.

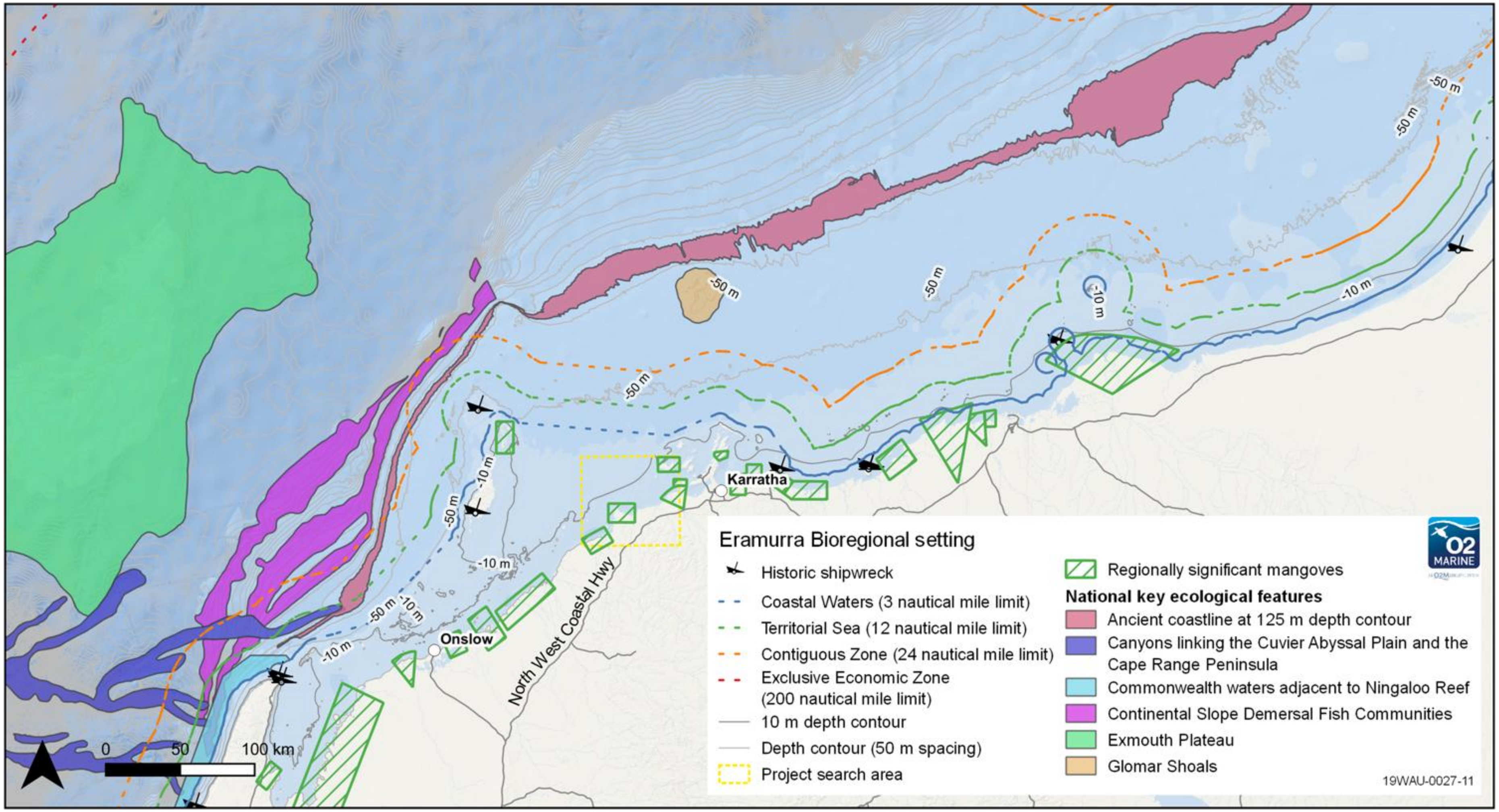

Figure 3: Bioregional setting

3.1. Climate and oceanography

The Pilbara is characterised as an arid region, with pronounced wet (November to April) and dry (May to October) seasons and experiences an average annual rainfall of only 315 mm (which is dominated by wet season tropical storms). Daily temperatures at nearby Mardie reached a maximum monthly average of 37.9°C in January, falling to 28.3°C in July (O2 Marine 2022a). Winds directions are easterly to south-easterly in the dry season, and west and south-westerly in the wet season. During the wet season the regions is exposed to intense tropical storms and cyclones (with an average of one cyclone landfall every 2-years). Sea temperature varies from 18°C in the cooler months to a maximum of 31.5°C during the wet season, and inshore salinities may reach levels around 37 ppt (CALM 2005).

Wave energy in the area is typically relatively low, except during cyclones, with typical wave directions of west to south-west from May to July, and east to north-east between September to February (O2 Marine 2022a). Various currents operate in the vicinity of the study area and are typically dominated by tides on the inner shelf. At the Proposal site, tides are semidiurnal, with a mean spring tidal range of approximately 3 m and a maximum range of 4.5 m.

3.2. Geomorphology

The Pilbara comprises a very broad and shallow continental shelf, which ranges from around 100 km wide in the west to 300 km wide in the east (Heap and Harris 2008). According to James et al. (2004), shallower (continental shelf) deposits comprise of mixed sediments, including modern terrigenous (river derived) and carbonate (biogenic) materials, and often contain the preserved remains of ancient sediments (relict intraclasts).

Between North-West Cape and the Dampier Archipelago, numerous small bedrock islands lie in shallow water and introduce heterogeneity in the ambient hydrodynamic conditions along the coastline promoting heterogeneity in marine habitats (O2 Marine 2022a). The Pilbara continental shelf is strongly influenced by limestone features deposited during lower stages of sea level and remain on the modern seabed as partially buried (reef veneer) or completely exposed rocky reef systems (LeBrec et al. 2022). These often-complex features vary greatly in morphology, state of weathering and bathymetric profile. LeBrec et al. (2022) identified that the seabed near the Regnard Islands to the 20 m isobath features a series of submerged ancient strandplains. The authors do not characterise the inner bay itself, though the satellite derived bathymetry product of LeBrec et al. (2021) indicates several distinct systems of ridges within the bay.

The oceanography of the region, including cyclone events, internal tides, and ocean currents, plays an important role in regulating sediment transport, deposition, and erosion (James et al. 2004). Marine sediments are mobilised and deposited through the action of waves and tides, whereas terrigenous sediments are delivered to the coast episodically through flood plains and river deltas, the largest river within Regnard Bay being the Maitland River to the east of the proposed site.

3.3. Local habitats

The Proposal is located in the western part of Regnard Bay, extending offshore between Cape Preston and South West Regnard Island. Benthic communities and habitats (BCH) mapping for the Proposal area found the area predominantly comprises of large expanses of bare sediment, interspersed with areas of coral, macroalgae, seagrass, and filter feeders, and the intertidal region mangroves, algal mats, tidal creeks, mudflats and samphire. Bare sediment, primarily composed of coarse sand with shell fragments, dominates in mid-shelf and offshore regions, while vegetated and reef-associated habitats are more localised and influenced by substrate availability and geomorphic complexity (O2 Marine 2025a; b).

3.3.1. Intertidal benthic communities and habitats

The intertidal zone studied by O2 Marine primarily focused on the coastal zone extending from the existing Sino Iron causeway in the west and extending east along the northern shore to the Strelley River West in the east. The Proposals intertidal area has been assessed through four local assessment units (LAUs), and the intertidal zone typically extends ~5 km north to south within each LAU. An assessment of intertidal BCH mapping for the Proposal (Figure 4; O2 Marine 2025a) used the following habitat classes:

- Bare intertidal habitat
- Cyanobacterial mat
- Samphire
- *Avicennia marina mangrove*
- *Rhizophora stylosa mangrove*
- Terrestrial
- Tidal creek
- Mixed intertidal habitat.

A summary of each habitat class is presented below.

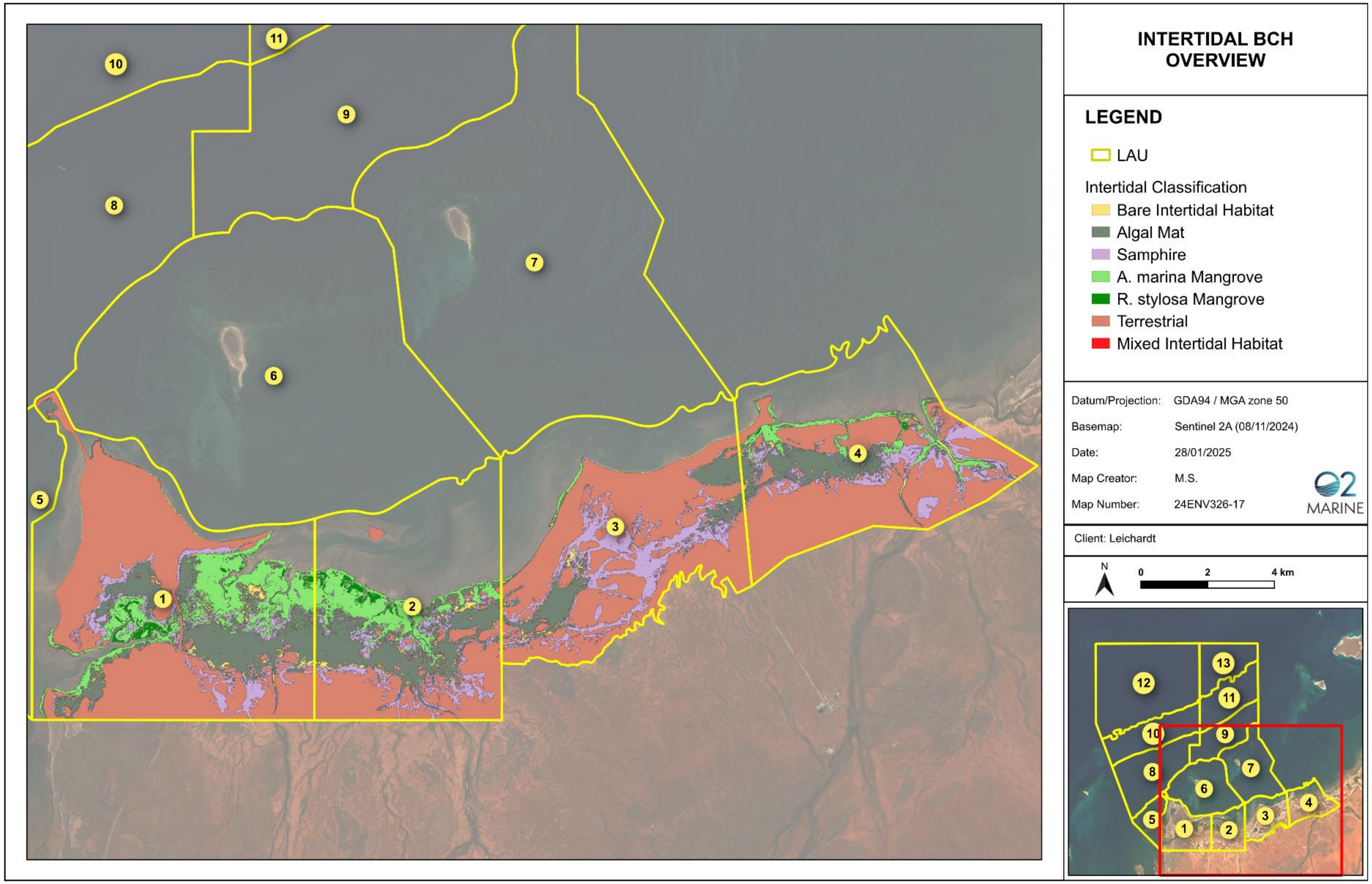

Figure 4: Intertidal BCH classification within Proposed LAUs (O2 Marine 2025a)

Mangroves

The Proposal located within the EPA designated regionally significant mangrove management Area 9: Cape Preston Area. The EPA's operational objective for Guideline 3 areas is that no development should take place that would significantly reduce the mangrove habitat or ecological function of the mangroves in these areas.

Mangroves represented 7.7% (1,381 ha) of the intertidal BCH study area. Mangrove habitat was generally associated with tidal creeks, and distribution was consistent with the mapped extent of tidal creeks. The most dense and extensive mangrove communities were in LAU 1 and LAU 2, accounting for 85% of the mangroves in the study area. In these LAUs, the creeks are more common and typically larger. Whereas, more sparse and fragmented mangrove communities are present in LAU 4, where the creeks are less common and generally smaller (O2 Marine 2025a). Mangroves in LAU 1 and 2 form an almost continuous forest that extends out across the tidal flats between creeks and interspersed by samphire and mudflat communities.

Seven mangrove species are known to occur in the Pilbara region (EPA 2001). Of these, three species representing two families have been identified within the Proposals intertidal BCH study area:

- *A. marina* (Acanthaceae)
- *C. australis* (Rhizophoraceae)
- *R. stylosa* (Rhizophoraceae).

The species richness recorded in the Proposal area is low when compared with other regional project assessments where species richness recorded a maximum of six of the seven species known to occur in the Pilbara. *A. marina* communities are the dominant in the Proposal area, representing over 84% of the total mapped area. This dominance by *A. marina* is typical of mangrove communities within this local Pilbara region and the wider Pilbara and Canning coasts of north-western Australia (LeProvost Environmental 1991; Semeniuk 1993).

Mangroves (in particular, the Closed Canopy (CC) functional group) are deemed the most ecologically significant intertidal BCH within the Proposals intertidal BCH study area. These CC groups are considered to be in good health with relatively no anthropogenic impacts observed (O2 Marine 2025a).

Mudflats

Revised mapping completed by O2 Marine (2025a) found that mudflats were the most dominant intertidal BCH across the four LAUs, with a total of 2,419 ha identified, making up 19.1% of the intertidal study area. The LAUs were calculated over two BCH categories (bare intertidal habitat including high intertidal salt flats and algal mat). Mudflats across the study area ranged from the spring low tide mark landward to the spring high tide mark. Mudflats were typically located immediately adjacent (both seaward and landward) of mangal communities and generally have 'Terrestrial Vegetation' as the landward limit.

The most continuous and extensive mudflat areas within the study area are located seaward of mangrove or beach/foredunes, extending out towards the intertidal macroalgae/seagrass/rock platform communities. LAU 1 contains the largest area of mudflat, with 919 ha. Mudflat areas were notably lower in LAU 3 and LAU 4, with areas of 399 ha and 416 ha, respectively. Large sections of the seaward mudflat areas have a regular exposed/inundated cycle due to daily tidal movement. These areas were generally classified as flat and fine sand with shells and were predominantly devoid of biotic cover except for the occasional macroalgae and crab burrows. Mudflats on the landward side of the mangal were found to contain less sand and have more clay properties, with shells, and organic debris commonly interspersed on the surface.

Tidal creeks

Revised BCH mapping found that tidal creek systems were identified in LAUs 1, 2 and 4. Tidal creeks were found to be adjacent to mudflats and mangrove communities. Tidal creeks are considered critical feeding and reproduction habitats for marine species such as fish, crustaceans, turtles, rays, and sawfish (DBCA 2020). Tidal Creeks form the base environment for mangrove communities and all the associated fauna that utilise this vegetated habitat (insects, birds etc).

Algal mats

Mudflat/algal mat habitat accounted for ~17% (2,157 ha) of the BCH across the intertidal BCH study area. Algal mats are also included in the samphire shrubland/algal mats, comprising 1,197 ha (9.4%) of the intertidal BCH study area. Algal mats are most abundant by area within LAU 1 (1128 ha), making up 8.9% of the total intertidal study area. LAU 2 and LAU 3 recorded comparable algal mat areas with 844 ha and 738 ha, respectively. LAU 4 recorded less algal mat area of only 651 ha.

Algal mat microscopic examination identified six taxa across the study area, dominated by filamentous cyanobacteria *Lyngbya sp*., followed by *Coleofasciculus chthonoplastes* and *Schizothrix spp*. Algal mats present in the Proposal are representative of other algal mat habitats within the Pilbara region, including the Mardie coastline (O2 Marine 2020), Exmouth Gulf (Biota Environmental Sciences 2005), and south of Onslow (Paling 1990; URS 2010). Algal mats are known to play an important role in nutrient and carbon cycling, however their overall significance on the surrounding intertidal BCH is not well documented (O2 Marine 2025a).

Samphire

Samphire was present in all the coastal intertidal LAUs. Samphire, including algal mat, are associated with the greatest spatial area across the study area, covering over 1,197.3 ha or 66.0% of the mapped samphire area. Samphire shrublands occupy 34.0% of the total area of all samphire mapped (O2 Marine 2025a). Samphire shrublands provide essential ecosystem services, including coastal protection by stabilizing intertidal zones and reducing erosion, habitat for migratory shorebirds and small invertebrates, and contributions to blue carbon storage, particularly in dense samphire-algal mat complexes (O2 Marine 2025a).

3.3.2. Nearshore subtidal benthic communities and habitats

A subtidal BCH assessment conducted by O2 Marine (2025b) identified seven benthic habitat classes within the subtidal zone of the Proposal area surveyed (Figure 5):

- Unvegetated soft sediment
- Hard coral habitat
- Filter feeder dominated habitat
- Macroalgae dominated habitat

- Habitat with seagrass present
- Mixed subtidal habitat.

The subtidal zone for the BCH assessment primarily focused on the nearshore coastal zone including and adjacent to the Proposal DE. The assessment draws on relevant information collected for wider regional nearby projects (within 100 km) and from site specific field studies undertaken from 2017 to 2024. For the BCH assessment, the subtidal nearshore coastal zone was defined as extending from the lowest astronomical tide (LAT) of the Cape Preston East coast to the 20 m bathymetric contour and includes several small coastal islands (O2 Marine 2025b).

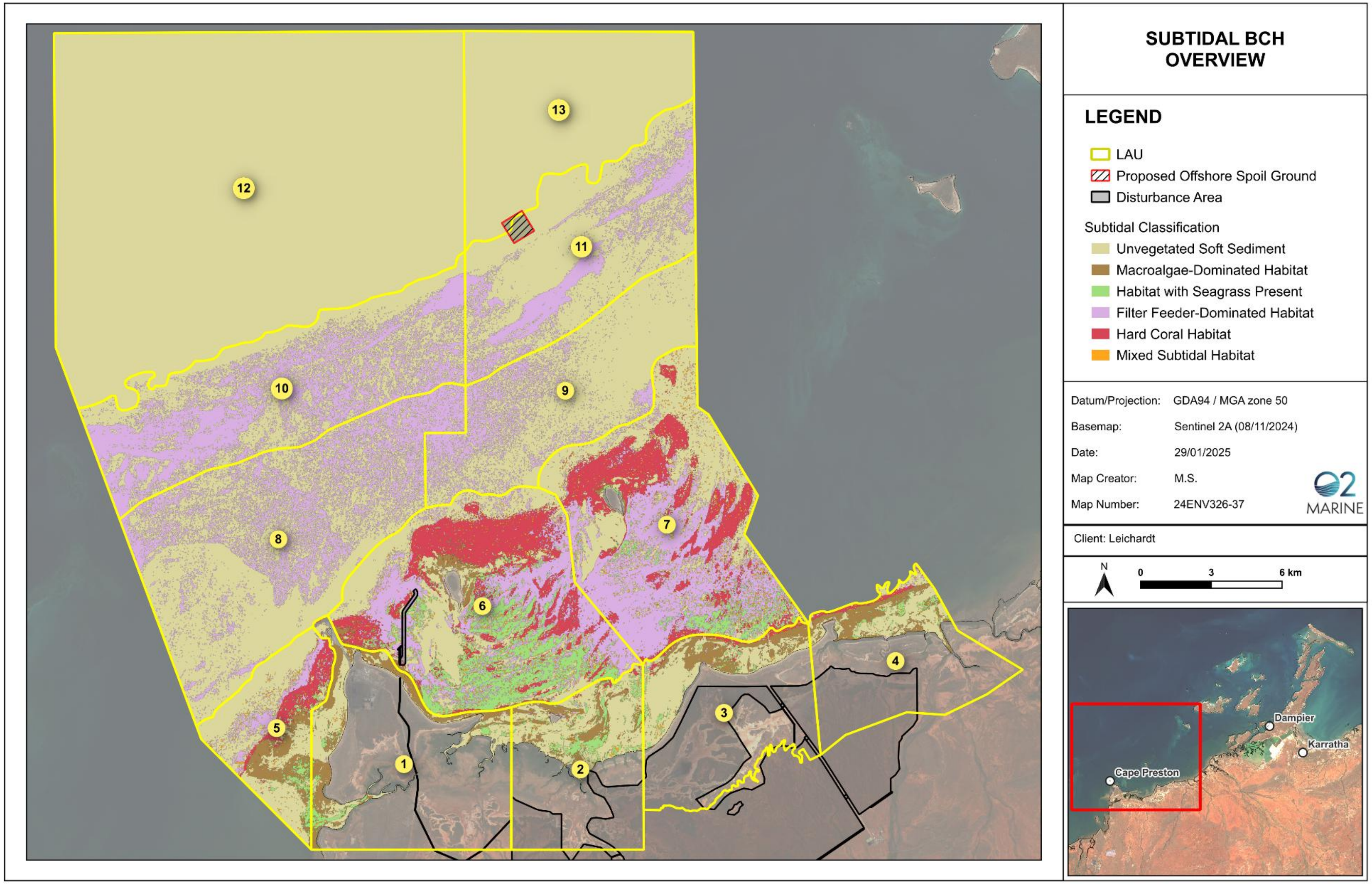

Figure 5: Subtidal BCH within the proposed LAUs (O2 Marine 2025b)

Unvegetated soft sediment

Unvegetated soft sediment was the dominant BCH class in the revised BCH mapping, accounting for 69.9% of the area. The updated mapping of the subtidal habitats identified three key sub-classifications of sediment types that are present within the Proposal area:

- Intertidal sandy muds found in nearshore areas subject to tidal influences, which supports microphytobenthic algae and contributes to local productivity.
- Muddy sand, bare, predominantly in the eastern parts of the Proposal area, is associated with tidal sediment deposition and reduced hydrodynamic energy.
- Coarse sand and shell fragments, which dominates the mid-shelf and offshore zones, with minimal colonisation by sessile organisms due to high levels of sediment movement.

Unvegetated habitats can support microphytobenthic alga communities and sometimes diverse benthic infauna, depending on depth and other environmental variables (PHPA 2010; O2 Marine 2025b)

Habitat with seagrass present

Habitat with seagrass present accounted for 3% of the subtidal survey area but was widespread (O2 Marine 2025b). Seagrasses, predominantly in low densities, were the most common benthic primary producer present over unconsolidated sediments. High-density seagrass areas were the most common classification (51.6%) and were restricted to shallow sheltered areas >2 m (mean sea level). LAU 6 recorded the highest area of seagrass, 1,446 ha, smaller patches of seagrass are present in LAUs 3 (70 ha, 5%), 4 (66 ha, 7%), and 1 (110 ha, 8%), providing additional connectivity between vegetated habitats across the Proposal area (O2 Marine 2025b). No significant areas of seagrass were observed further offshore.

Seagrass present in the Protected inshore regions of Regnard Bay were entirely comprised of small ephemeral species. There were three distinct subcategories based on density and associated biotic communities:

- Sand with dense ephemeral seagrass, and sparse filter feeders, predominantly found in LAUs 1, 2, 5, and 6.
- Sand with dense mixed macroalgae and sparse seagrass, observed in LAUs 1, 2, and 5.
- Sand with sparse ephemeral seagrass and mixed macroalgae, distributed more broadly across LAUs 1 to 6.

The densities of seagrasses identified in the Subtidal BCH report (O2 Marine 2025b) were consistent with densities observed across the Pilbara, where coverage rarely exceeds 5% and dense seagrass meadows are less common compared to southern Australian waters (Vanderklift et al. 2017).

Macroalgae dominated habitat

Macroalgae dominated habitats are widely distributed across the Proposal area and appear to be associated with outcropping low-relief reefs (O2 Marine 2025b). Macroalgae habitats were identified in the nearshore LAUs (1 to 7), with largest areas recorded in LAU 1 and 4. The macroalgae present across the Proposal area was characterised by coarse branching macroalgae, such as *Sargassum sp*., and were typically located closer to shorelines, particularly in LAUs 1, 4, and 5 (O2 Marine 2025b). The updated mapping indicates that macroalgal habitats occur in distinct bands, particularly in shallow waters adjacent to 40 Mile Beach and between South West and North East Regnard Islands.

Macroalgae are critical to marine ecosystems' productivity because they provide habitat for invertebrates, fish, and birds. They also serve as both a food source and a contributor to decomposition processes. Some species, such as *Halimeda*, act as sediment producers, while other forms of macroalgae, like Rhodophyta, contribute to the cementation and binding of materials with calcium carbonate, creating functional habitats for other organisms (Jones and Desrochers 1992; O2 Marine 2025b).

Hard coral habitat

In the Proposal area, hard corals are primarily found near limestone reef features and areas with higher topographic complexity (e.g. shoals or isolated reef patches) (O2 Marine 2025b). Hard coral habitats were generally located in water depths ranging from -5 m to -15 m. The highest density of coral was observed around South West Regnard Island (LAU 6 and 7) (O2 Marine 2025b; Figure 5). Corals were not found in muddier areas of the inner bay, except for a narrow band of low-cover, inshore corals identified within LAU 7.

Filter feeder dominated habitats

Filter feeder habitats were identified by O2 Marine (2025b) in the revised mapping. Filter feeder habitats consist of sparse to dense coverage, include bivalves, sponges, ascidians, bryozoans, and soft corals. Filter feeder communities are present across various depths and are often associated with sediments and reef structures partially covered by sand veneers. LAUs 7, 8 and 10 had the greatest filter feeder dominated habitat present, with lower amounts recorded in LAUs 1, 2 ,3, 4, 5, and 6.

Filter Feeders are key contributors to ecosystem services, including enhancing biodiversity and stabilising substrates. Filter feeders cover significant tracts of marine habitats, particularly in deeper waters and areas with sand veneers over hard substrates (O2 Marine 2025b).

Mixed subtidal habitat

In the revised O2 Marine subtidal habitat mapping, mixed subtidal habitat was the least common habitat class in the Proposal area (1.1%). This habitat class represents area where no clear majority occurred for a particular data collection point. These areas are often transitional habitats and generally include a combination of macroalgae (brown and other macroalgae), filter feeders (sponges, hydroids, and sea whips) and/or hard and soft corals. (O2 Marine 2025b).

3.4. Marine fauna habitat

BCH, such as seagrasses, macroalgae, coral reefs and filter feeders, support a high level of biodiversity, and these habitats are likely to attract higher order predators for foraging, such as coastal dolphins, turtles and sea snakes. A summary of the spatial overlap of Proposal elements and operations with local habitats is presented in Table 5, and an overview of marine fauna habitat in relation to associated BCH is presented in Table 6.

Table 5: Spatial overlap between marine Proposal elements and operations, and habitats

Proposal Element / Aspect	Intertidal	Nearshore	Offshore	Islands
Seawater intake	Yes	Yes	No	No
Trestle jetty[1]	Yes	Yes	No	No
Shipping channel	No	Yes	No	No
Bitterns	No	Yes	No	No
Spoil disposal ground	No	Yes	No	No

Table 6: Important marine fauna habitat associations

Habitat type	Marine fauna
Seagrass beds	Dugongs and turtles are known to forage on seagrass beds. *Halodule* dominated seagrass meadows are known to support lactating female dugongs and their neonatal calves in the summer months (EPA 2016).
Macroalgae	Macroalgae beds are an important component of the tropical subtidal ecosystem, contributing to the productivity of a system, and provides foraging and nursery habitat for commercially and ecologically important species. Macroalgae is consumed by herbivorous fishes, crabs, sea urchins, zooplankton and turtles. Juvenile bluespotted emperor are directly associated with inshore (<10 m) macroalgae beds, along with seagrass, in the western Pilbara (Wakefield et al. 2024).
Tidal creeks and shallow intertidal zone	Sawfish and other elasmobranchs are known to forage in inshore marine waters, river mouths, embankments, and along sandy and muddy beaches. Further, creeks are known to provide pupping and nursery habitat for elasmobranchs. Shallow creeks and intertidal areas are known to provide refuge and foraging habitat for neonate and young juvenile green sawfish, the species almost exclusively uses shallow areas <1 m, often <20 cm (HBI 2023; Morgan et al. 2023). The Proposals intake Creek appears to have high elasmobranch abundance. It is likely that this abundance is due to the high abundance of prey species (small teleosts) present within the creek.
Mangroves	Mangrove lined creeks are known to provide nursery habitat for juvenile green sawfish and juvenile green turtles. Green sawfish have a strong association with mangroves, providing shelter and foraging habitat. Juvenile green turtles are known to forage on mangroves and within mangrove lined creeks. The mangrove communities in this area are of significant ecological and economic importance, supporting a large number of organisms such as snails, crabs, shrimps, oysters, barnacles, fish, and birds, and are highly productive nursery areas for many species,

[1] Noting that the trestle jetty is not part of this Proposal as it has a separate approval. Habitat in this area to be considered within the cumulative impact assessment

Habitat type	Marine fauna
	including fish, sawfish, marine turtles, and crustaceans (DSEWPaC 2012a; DBCA 2020). An assemblage of fishes and invertebrates utilise the food resources of mangals on a temporary basis. There are also some fish and invertebrate taxa whose adult populations are restricted to mangrove habitats, referred to as 'mangal obligates'. These mangrove habitats play a major role in supporting coastal food webs and nutrient cycles in the coastal zone and they are often an efficient sink for nitrogen, phosphorus, and silicon (O2 Marine 2025a).
Coral habitats	Short-nosed sea snakes primarily inhabit reef flats and shallow waters (<10 m depth) and leaf-scaled sea snakes are also a coral associated species. Coral trout are indirectly dependent on healthy, stable coral reef habitats. The Australian humpback dolphin is thought to predominantly occur within shallower coastal waters likely associated with foraging opportunities at coral reefs and shoals (Hanf et al. 2022).
Sandy beaches	Sandy beaches, on the mainland and islands, in the Pilbara are known to provide nesting habitat for marine turtles.
Islands	In the waters surrounding the Proposal support a number of different islands, notably the Dampier Archipelago is located ~35 km from the Proposal. These islands are known to support a large diversity of marine fauna, including marine mammals, reptiles and elasmobranchs.
Nearshore waters	The Proposal is located within shallow nearshore waters, nearshore coastal waters are known to provide habitat for many coastal marine fauna species such as coastal dolphins, marine turtles, dugongs, elasmobranchs, sea snakes, and variety of fish, crustaceans, and invertebrates.
Offshore waters	The Proposal is located within shallow nearshore waters. There are no physical elements of the Proposal that overlap with the offshore subtidal environment. However, marine fauna species can be highly mobile and likely to move between offshore and nearshore subtidal environments, where operational vessels could potentially interact with mobile marine fauna. Adjacent to the Proposal the offshore waters are known to provide migration habitat for marine megafauna, namely the humpback whale, and the pygmy blue whale

3.5. Islands

Nearshore coral-fringed islands include North-East Regnard Island, Eaglehawk Island, Enderby Island, Steamboat Island, and Fortescue Island. Many Pilbara Islands are important nesting sites for turtles and seabirds (IMCRA 1998). There are no Proposal elements that overlap with islands. However, light spill from Proposal activities have the potential to impact marine fauna species such as turtles and seabirds.

3.6. Existing threats and pressures

3.6.1. North-west marine bioregion

Within the North-west Bioregional Plan, key pressures and threats have been identified and assessed on selected key ecological features and species (DSEWPaC 2012a). Generally, the human pressures on the North-west Marine Region are, by global standards, low (DSEWPaC 2012a). Nevertheless, several pressures exist within the region, and the North-west Bioregional Plan identifies the main drivers and sources of anthropogenic pressure on conservation values in the region as follows:

- Climate change and associated large-scale effects, including shifts in major currents, rising sea levels, ocean acidification, and changes in the variability and extremes of climatic features (e.g. sea temperature, winds, storm frequency and intensity)
- Domestic and international harvesting of living resources
- Increasing petroleum and mineral exploration and development
- Rapid industrial development in areas adjacent to the region
- Increases in shipping activities and development of port infrastructure.

The threats and pressures within the North-west bioregional plan have been assessed in terms of their relative importance/concern which allows for the pressures to inform conservation priorities and the development of regional advice. The pressures have been assessed as concern (C), potential concern (PC), least concern (LC), not of concern (NC), and data deficient (DD). A summary of the assessed pressures and threats in relation to marine fauna species are presented in Section 5.5 and Appendix A.1

3.6.2. Commercial fisheries

Globally, bycatch is thought to be the leading cause of death for cetaceans (whales and dolphins) (WWF Australia n.d.). The Pilbara region waters support many commercial fisheries, with operational areas overlapping the Proposal (See O2 Marine 2023). Bycatch from commercial fisheries is a known threat to many marine fauna species in WA (Appendix A.2), and air-breathing marine fauna species are most susceptible to death from bycatch. Bycatch from the Pilbara Fish Trawl Interim Managed Fishery, which is offshore from the Proposal is presented in Appendix A.2. The Pilbara Trap Managed Fishery reported 173 sea snakes (63 alive, 110 unknown), and the Northern Prawn fisheries only reported nine sea snakes. The Exmouth Gulf Prawn Managed Fishery (EGMPF) does not report the number of alive or deceased, but in 2023, the fishery caught 10 sawfish, 973 sea snakes, 18 turtles, five Syngnathids, and one dolphin (Newman et al. 2024).

4. Methods

This desktop marine fauna review was informed by a literature review, database searches, and surveyed sightings. The methods employed in this report are consistent with the background information requirements of the National Guidelines for the Survey of Cetaceans, Marine Turtles, and the Dugong (DCCEEW 2024a). This requires the Proponent to identify species that may occur in the proposed area of interest and obtain as much historical and contemporary information (<5 years) as possible about presence, distribution, abundance, and function importance of the area (i.e. function use of habitat and biological importance of the area) for each species. Information was obtained from Commonwealth, State and Territory governments, industry, and the research community (including citizen science). For these species, basic information about the species biology, ecology, abundance, distribution, habitat use, and population status must be obtained as an absolute minimum requirement (DCCEEW 2024a). The aim is to obtain enough information to determine what significant impacts may occur (DCCEEW 2024a). The methods outlined in the sections below detail how this report satisfies the background search requirements of the National Guidelines for the Survey of Cetaceans, Marine Turtles, and the Dugong (DCCEEW 2024a).

4.1. Database searches

This desktop study was informed by four databases (Table 7) using the search area shown in Figure 6 ('Project search area'). This broad area included all marine Proposal elements and extended across islands and mainland shoreline that are within 20 km of the Proposal elements and activities, which is in line with DCCEEW's National Light Pollution Guidelines for Wildlife (DCCEEW 2023), further the area was extended for the DBCA search to capture potential regional sightings. It also included varying water depths that represents the bathymetry of the surrounding area, as that has the potential to influence the occurrence of highly mobile marine fauna species.

Table 7: Database searches

Target	Database	Methods	Organisation	Citation
Conservation significant species*	Commonwealth Protected Matters Search Tool (PMST)	Section 4.1.1	DCCEEW	DAWE (2021a) DCCEEW (2024b)
Conservation significant species**	DBCA Threatened Species Database	Section 4.1.2	DBCA	DBCA (2024) DBCA (2021a, b)
Biologically Important Areas (BIAs) and Critical Habitats	PMST and Conservation Values Atlas[2]	Section 4.1.3	DCCEEW	DAWE (2021b) DCCEEW (2024c)
EPBC Legal Status and Documents	Species Profile and Threats Database	Section 4.1.4	DCCEEW	DCCEEW (2024d)

[2]The conservation atlas was replaced with the Australian Marine Spatial Information System (AMSIS) in 2024

Target	Database	Methods	Organisation	Citation
Global context	International Union for Conservation of Nature (IUCN) Red List	Section 4.1.5	IUCN	IUCN (2024)
Species occurrence	Atlas of living Australia (ALA)	Section 4.1.6	ALA	ALA (2024)

**Species listed as Threatened or Migratory, or other MNES under the EPBC Act (Cth)*

***Species listed as Threatened or Priority under the BC Act (WA)*

In addition to the data outlined in Table 7, raw sightings data of coastal dolphins and dugongs were requested from DBCA for two monitoring programs that targeted Indo-pacific bottlenose dolphins and Australian humpback dolphins:

- Boat-based surveys in Dampier Archipelago, conducted annually from 2015 to 2019 (DBCA 2021a)
- Regional-scale aerial surveys, conducted annually from 2015 to 2017 (DBCA 2021b).

As observers focused on recording dolphins, with dugongs as a second priority, dugong numbers may be under-represented.

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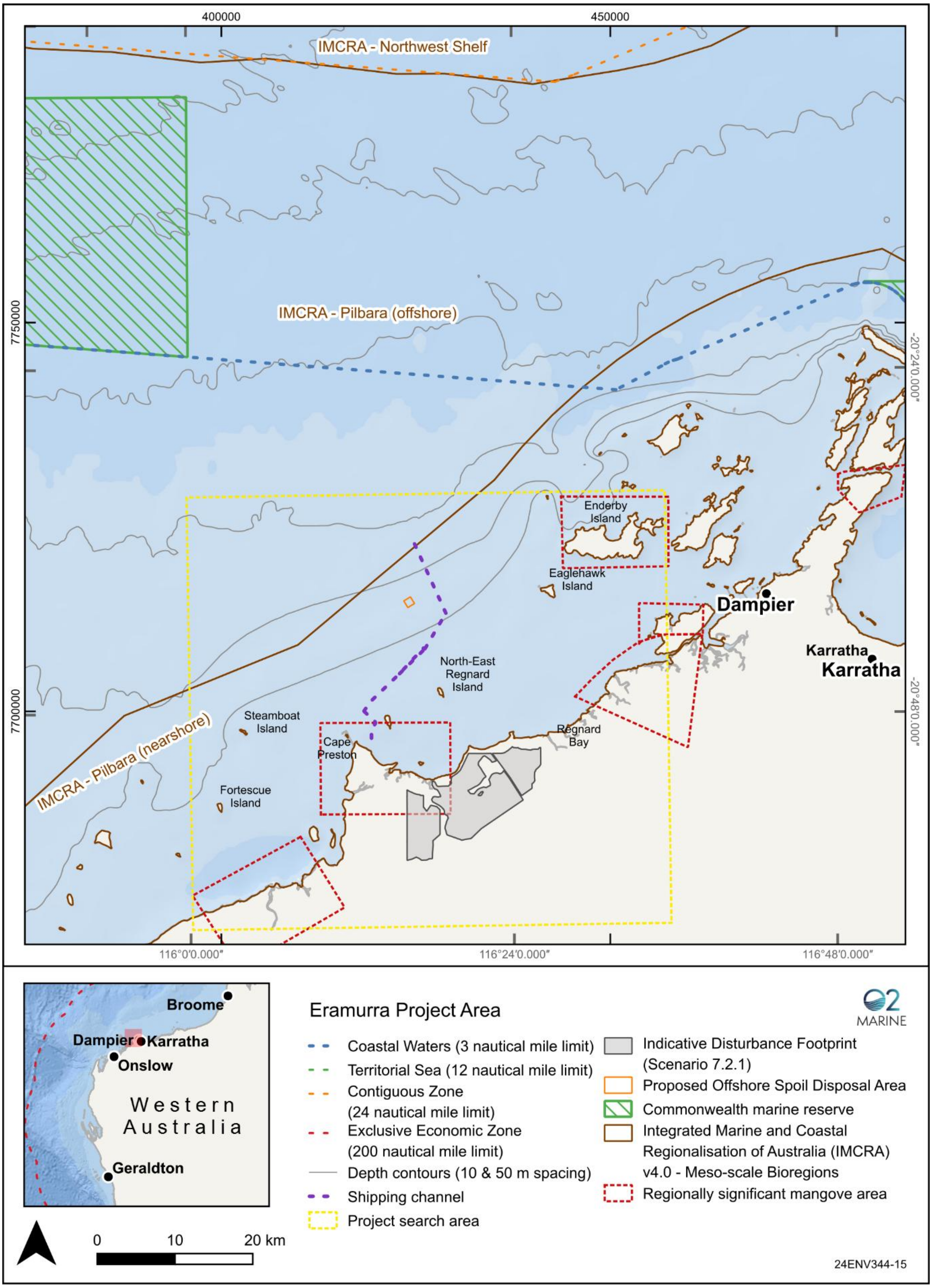

Figure 6: Marine fauna search area

4.1.1. Protected matters search tool (PMST)

The PMST provided by the DCCEEW was used to identify MNES within the search area. MNES are defined as 'nationally significant' animals, plants, habitats, and places listed under the EPBC Act. The PMST identifies listed species and communities that have a 'moderate potential to occur' based on broad species ranges, bioclimatic modelling and scientific expert advice. The database search results include the species, listing categories and probability of species presence, including a ranked order (DCCEEW 2024b).

Threatened species from the PMST search are reported using the following categories:

- EX: extinct
- EW: extinct in the wild
- CE: critically endangered
- EN: endangered
- VU: vulnerable
- CD: conservation dependent.

Other protected species are reported with the following categories:

- MI: Migratory
- CT: Cetacean
- MA: Marine.

4.1.2. DBCA threatened species database

The DBCA provides a database search service (an email needs to be sent to DBCA requesting the information) for the sighting and identification of threatened and priority plants, animals and ecological communities at or near an area of interest, made and reported to the DBCA. The database search results include coordinates and available information relevant to all sightings from this search area.

Threatened species are reported with the following categories:

- CR: critically endangered
- EN: endangered
- VU: vulnerable.

Specially protected species are reported with the following categories:

- MI: Migratory
- OS: other specially protected
- CD: conservation dependent.

Priority species (Priority is not a listing category under the BC Act) are reported with the following categories:

- Priority 1: P1 poorly-known species
- Priority 2: P2 poorly-known species
- Priority 3: P3 poorly-known species
- Priority 4: P4 rare, near threatened and other species in need of monitoring.

Priority species classifications also exist for species that may possibly be threatened species that do not meet the criteria for listing under the BC Act because of insufficient survey or are otherwise data deficient. Priorities 1,2, 3 are ranked in order of prioritisation for survey and evaluation of conservation status so that consideration can be given to potential listing as threatened. Species that are adequately known, meet criteria for near threatened, or are rare but not threatened, or that have been recently removed from the threatened species list or conservation dependent or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring (DBCA 2024).

These records are to be interpreted with caution, as they represent a presence-only dataset. The Threatened and Priority Fauna Database contains data from a combination of sources (e.g. surveys, monitoring programs, translocations, opportunistic sightings, evidence/secondary signs, museum specimens or historical documents). Locational accuracy varies across records. Not all records are verified and may include repeated sightings of the same individual. The completeness of records varies by species depending on the remoteness of their distribution and the survey effort within that area.

4.1.3. Conservation values atlas/Australian marine spatial information system (AMSIS)

Biologically Important Areas (BIAs) and “habitat critical” areas for conservation significant species were identified from the PMST results and a search on the Conservation Values Atlas (DAWE 2021b) and a revised search of AMSIS (DCCEEW 2024c; which has replaced the Conservation Values Atlas).

BIAs are spatially defined zones where aggregations of individuals of a particular species are known to display biologically important behaviours such as breeding, foraging, resting or migration (DAWE 2021b). BIAs were first identified on a regional basis as they were developed as part of the Commonwealth Marine Bioregional Plans and have been identified using expert scientific knowledge about species’ distribution, abundance, and behaviour in the region, to inform decisions made under the EPBC Act. BIAs and areas identified as critical habitats are important components of Species’ Recovery Plans, where those plans exist.

4.1.4. Species Profile and Threats Database

DCCEEW’s Species Profile and Threats Database was consulted to confirm the current status of Threatened and Migratory species and identify relevant documents relating to the EPBC Act for protection of those species.

4.1.5. International Union for Conservation of Nature

Species global (non-statutory) listing by the IUCN Red list status was compiled during the likelihood of occurrence assessment.

4.1.6. Atlas of Living Australia

The Atlas of Living Australia (ALA) is a collaborative tool that collates Australian biodiversity information from multiple sources. The ALA was consulted to note the dated last sighting of a species and an estimated count.

4.2. Publications and studies

To support this desktop assessment, O2 Marine completed a review of relevant literature from peer-review papers, field studies, baseline assessments, and published literature relevant to the Proposal DE and surrounding environment. The purpose of the literature review was to compile relevant, contemporary information of conservation significant species as outlined in Table 8.

Table 8: Literature review parameter for key conservation significant species

Topic	Parameters
Population	• Abundance • Trends
Distribution	• Range and area of occupancy (State, regional and local) • Local patterns • Animal movement • Temporal occurrence
Habitat use and life history	• Longevity and fecundity • Breeding • Foraging • Ecological windows • Critical habitat • Biologically important areas • Habitat availability
Relevant guidance and policies (including threats and pressures)	• Recovery plans and conservation actions • Threat abatement plans • Relevant pressures and threats (direct and indirect) as outlined in the North-west Marine Bioregional Plan (DSEWPaC 2012a) • Conservation status (State, Federal, and International).

4.3. Project specific surveys

4.3.1. Turtle

To support with the assessment phase of the Proposal, turtle surveys were completed by O2 Marine in December 2020 to March 2021 over 3 days each month and January 2022 (see O2 Marine 2022c). In response to comments received from the EPA, Leichhardt engaged Pendoley Environmental to undertake marine turtle benchmark nesting survey in the vicinity of the Proposal. The aim was to determine the species and abundance of marine turtles nesting and hatching on nearby (within 20 km of the Proposal) beaches, including mainland and islands offshore. Turtle surveys have been completed during the 2022/23 and 2023/24 nesting periods (Pendoley Environmental 2023; 2024). Surveys were conducted by personnel walking the survey beaches and recorded turtle tracks *in-situ*. The surveys focus on four routine monitoring locations and two opportunistic monitoring locations (Figure 7). Routine locations include:

- North East Regnard Island
- South West Regnard Island
- Steamboat Island
- Cape Preston East beach.

Opportunistic locations include:

- Cape Preston West
- Forty Mile Beach.

For additional information on the Marine Turtle Monitoring see Pendoley Environmental 2023 and 2024.

Figure 7: Field survey locations for the Eramurra Solar Salt Project WA (Pendoley Environmental 2024)

4.3.2. Sawfish

Initial surveys into the fish fauna of the tidal creeks surrounding the proposed Eramurra Solar Salt Project were conducted for Leichhardt Salt Pty Ltd by Murdoch University and O2 Marine in August 2022 (O2 Marine and HBI 2023). Additional studies were completed by Harry Butler Institute (HBI) in October 2023 (HBI 2023) and August 2024 (HBI 2025).

Surveys involved:

- Traditional sawfish targeted surveys were conducted using a large mesh 60 m gill net, of 150 mm stretched monofilament mesh, set perpendicular to the bank in sites that were considered to be habitat suitable for sawfish, particularly shallow banks adjacent to tidal creek entrances
- Visual surveys for sawfish were also conducted using an Unmanned Aerial Vehicle (UAV) (drone) at approximately the gill net locations within the study area
- Acoustic array of nine InnovaSea VR2W-69 kHz, single-channel receivers (deployed during the 2022 sampling campaign (O2 Marine and HBI 2023)) and tagging green sawfish with Innovasea V13TP acoustic tags.

The most recent netting sampling locations are presented in Figure 8. For additional information on sampling methods and surveys see O2 Marine and HBI 2023, HBI 2023 and HBI 2025.

Figure 8: Locations of seine netting (SN) and gill netting (GN) in August 2022, October 2023, and August 2024. Included are the locations of two VR2W acoustic receivers situated within the study area (HBI 2025)

4.4. Likelihood of occurrence assessment

The PMST results were filtered to species with high conservation status (i.e. Threatened or Migratory) and ranked as 'known' or 'likely' within the search area. The likelihood of each of these species to occur within the Proposal DEs was assessed using the definitions presented in Table 9.

The likelihood of occurrence assessment was informed by sighting records sourced from DBCA, BIA presence and a literature review. The literature review considered parameters aligned to the EPBC Act Significant Impact Criteria for Threatened and Migratory species (DoE 2013), and the EPA's Environmental Factor Guideline for Marine Fauna (EPA 2016). For sawfish species, the likelihood of occurrence was informed by the sawfish risk assessment workshop (O2 Marine 2022b), which involved subject matter experts.

Table 9: Species likelihood of occurrence definitions

Likelihood	Definition
High	Individuals of the species have been repeatedly recorded in the DEs and/or surrounding habitat. The DEs are within the species' known range and the surrounding habitat is expected to support populations of the species.
Medium	Individuals of the species have been infrequently recorded in the DEs and/or surrounding habitat. The high likelihood of occurrence criteria has not been met, however suitable (not necessarily preferred) habitat may occur within the DE, or nearby. The surrounding habitat may support individuals or populations of the species.
Low	The DEs are well outside of the species' range, or the species has not been recorded there. Suitable habitat is not likely to be present.

4.5. Key species

Key species were identified to ensure that species with the greatest potential of being impacted by the Proposal will be given the greatest attention during EIA and management planning. Key species were identified to ensure that the most accurate characterisation of the marine fauna within the environment. Identified key species are effectively 'umbrella' species – when they are protected, others will also be indirectly protected.

Key species were defined as those with:

- A high conservation status under the EPBC Act as MNES or the BC Act as threatened or migratory species, and a high or medium likelihood of occurrence within the Proposal DE determined through the process described above in Section 4.4.
- Important species for industry or iconic species, such as charismatic marine megafauna.

5. Results

5.1. Marine fauna database search results

5.1.1. Protected matters search tool

Conservation significant marine fauna (CSMF) are fauna species listed as Threatened or Migratory under the EPBC Act, or the BC Act as Threatened or Priority Species. The full PMST search results are provided in Appendix A. A summary of conservation significant marine fauna species derived from database searches is presented in Table 10.

Table 10: Summary of Conservation Significant marine species listed by database searches

Fauna group	BC Act	EPBC Act			
	Threatened, Priority or 'other'	Threatened	Migratory	Marine	Cetacean
Mammals	6	2	8	1	13
Reptiles	7	7	5	23	N/A

Fauna group	BC Act	EPBC Act			
Fish	5	8	9	31	N/A

The PMST results, the species of highest conservation significance that are ‘known’ or ‘likely’ to be in the search area are as follows.

Mammals:

‘Known’

- Humpback whale (*Megaptera novaeangliae*) – Migratory
- Dugong (*Dugong dugon*) – Migratory
- Australian humpback dolphin (*Sousa sahulensis*) – Vulnerable and Migratory[3]

‘Likely’

- Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) – Migratory
- Blue whale (*Balaenoptera musculus* and *Balaenoptera musculus brevicauda*) – Endangered and Migratory
- Snubfin dolphin (*Orcaella heinsohni*) – Vulnerable and Migratory[4]

Reptiles:

‘Known’

- Green turtle (*Chelonia mydas*) – Vulnerable and Migratory
- Flatback turtle (*Natator depressus*) – Vulnerable and Migratory
- Hawksbill turtle (*Eretmochelys imbricata*) – Vulnerable and Migratory
- Loggerhead turtle (*Caretta caretta*) – Endangered and Migratory
- Leaf-scaled sea snake (*Aipysurus foliosquama*) – Critically endangered

‘Likely’

- Leatherback turtle (*Dermochelys coriacea*) – Endangered and Migratory
- Short-nosed sea snake (*Aipysurus apraefrontalis*) – Critically endangered

Fish:

‘Known’

- Green sawfish (*Pristis zijsron*) – Vulnerable and Migratory.
- Reef manta ray (*Mobula alfredi*) – Migratory
- Dwarf sawfish (*Pristis clavata*)- Vulnerable and Migratory[5]

‘Likely’

---

[3] Previous PSMT search was identified as likely, revised PMST search was ranked as known (search 2024) and currently undergoing threatened listing assessment

[4] Was not identified as likely in the pervious PMST search

[5] Was not identified within previous PMST search, but was identified in the revised PMST search 2024

- Southern bluefin tuna (*Thunnus thynnus*) – Conservation Dependant[6]
- Giant manta ray (*Mobula birostris*) – Migratory
- Grey nurse shark (*Carcharias taurus*) – Vulnerable
- Narrow sawfish (*Anoxypristis cuspidata*) –Migratory
- Scalloped hammerhead (*Sphyrna lewini*) – Conservation Dependant

'*May'* and BIA is within the region

- Whale shark (*Rhincodon typus*) – Vulnerable and Migratory.

5.1.2. DBCA Threatened species database

Marine fauna sighting records provided by DBCA represent historical sightings spanning over multiple years and accounts throughout WA. Sightings within the Proposal search area are presented in Figure 9 to Figure 15. These figures only represent sightings for marine fauna that have a listing status under the BC Act. Therefore, some species that have an EPBC Act threatened status will not appear in these figures (e.g. scalloped hammerhead).

Marine fauna species, especially marine mammals, are highly mobile, and the figures presented below represent a point in time for these highly mobile species. These maps were used to inform known occurrence of a species in the region and the number of sightings within a certain area often reflects the survey effort and/or survey area. This dataset provides sightings in relation to the Proposal DE. However, exact locational accuracy varies across records as some are unverified and may include repeated sightings of the same individual.

[6] Was removed from conservation listing in July 2024 – no longer listed under the EPBC Act

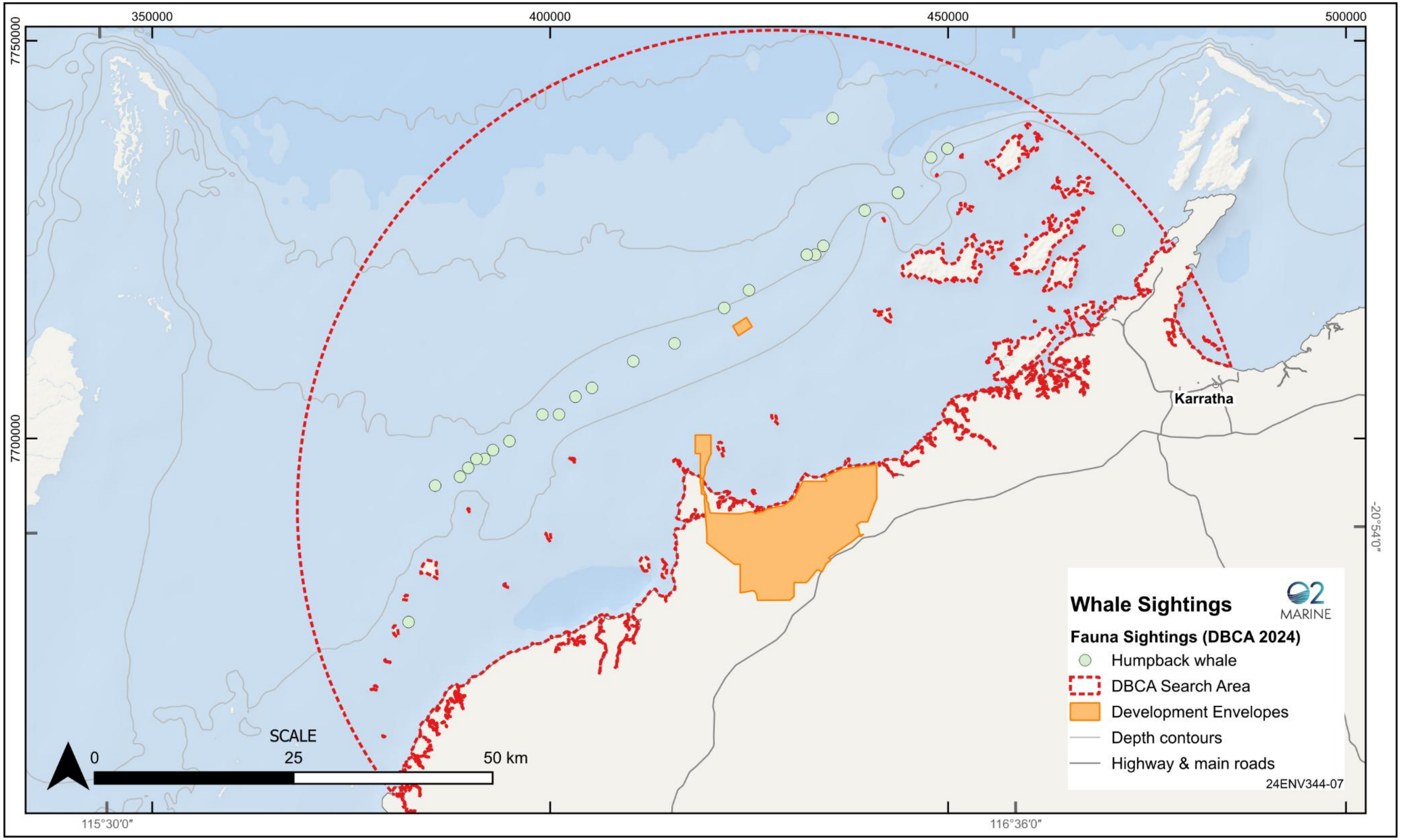

Figure 9: Whale sightings in proximity to the Proposal area

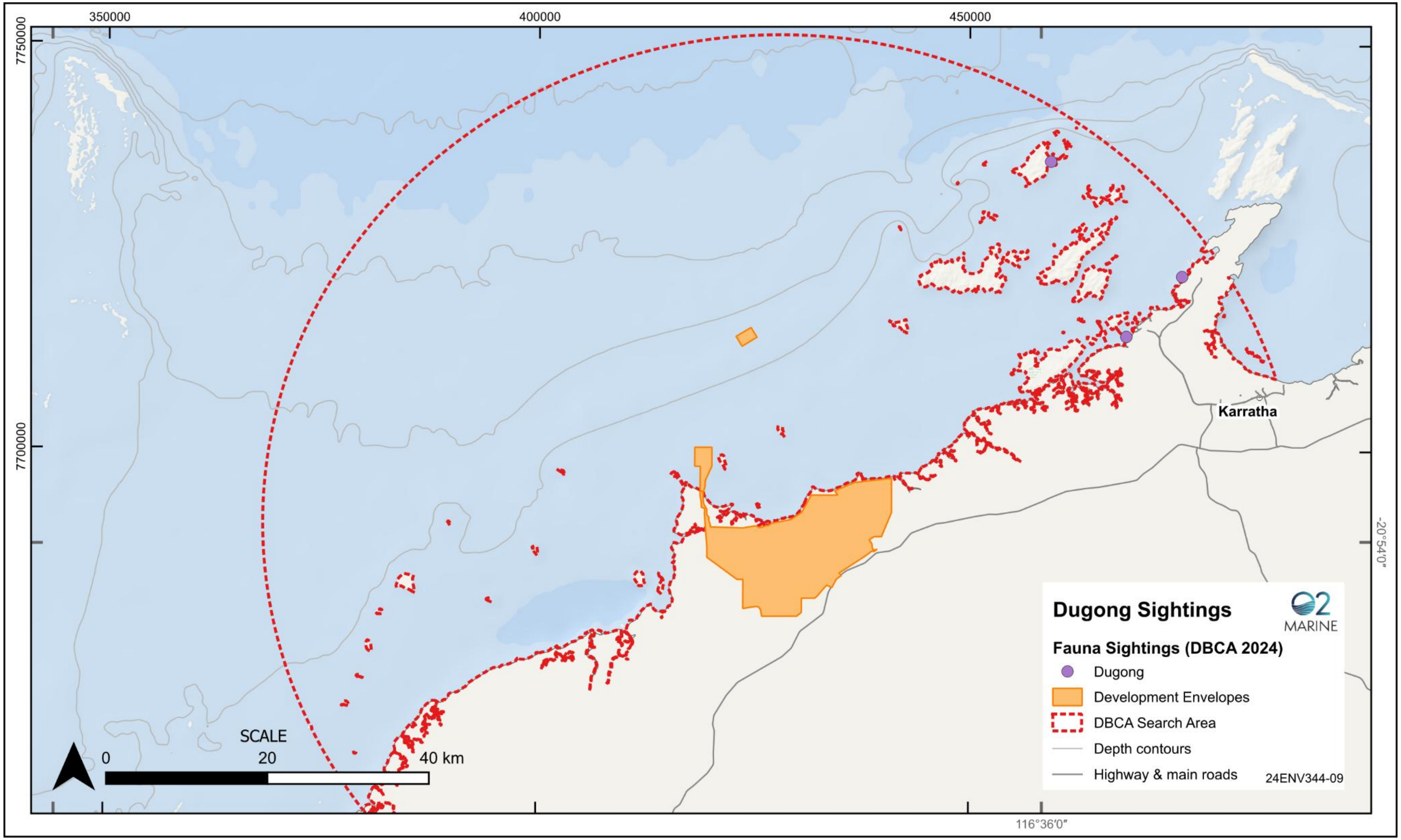

Figure 10: Dugong sightings in proximity to the Proposal area

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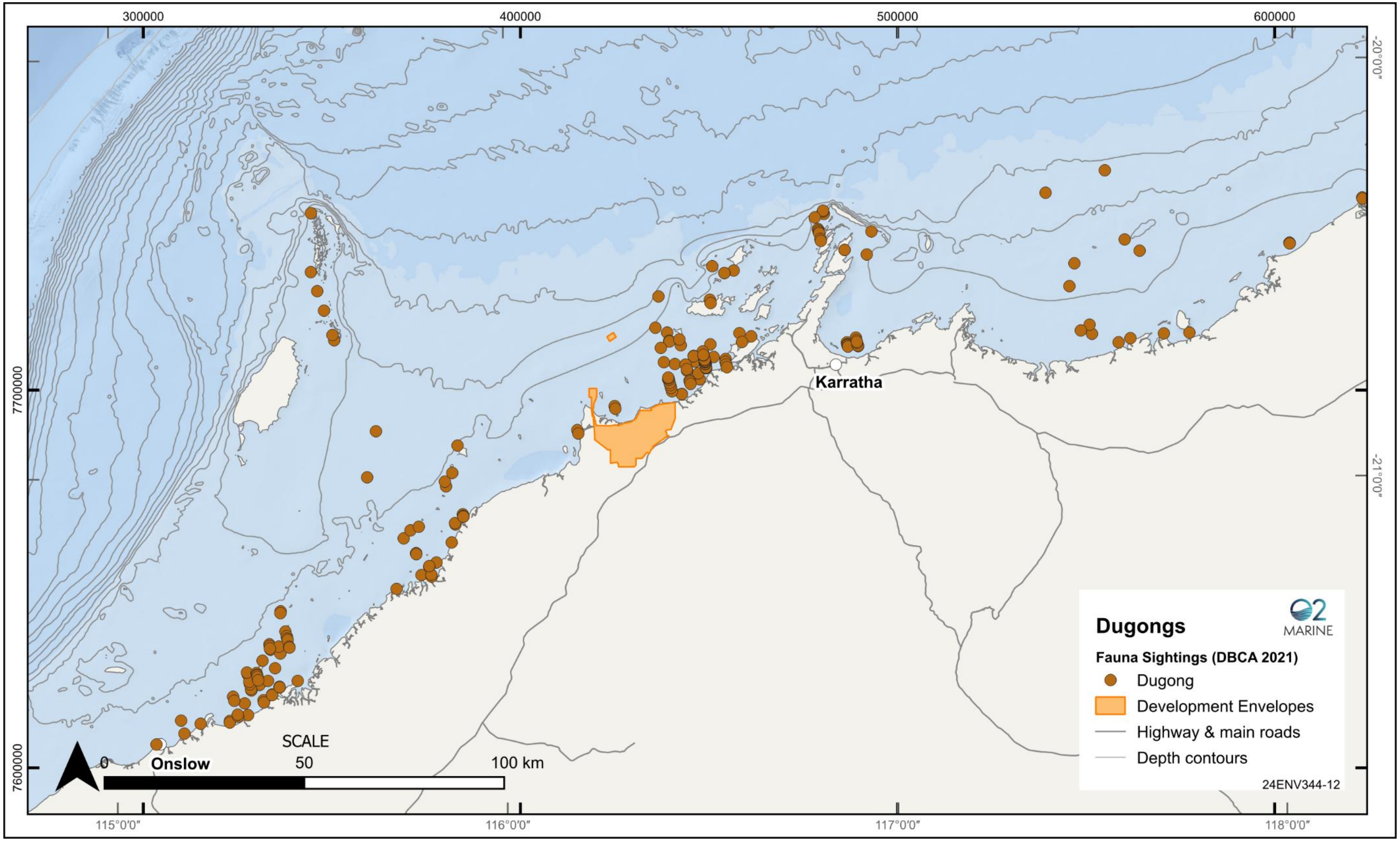


Figure 11: Opportunistic dugong sightings from broadscale dolphin aerial surveys conducted by DBCA (2021b), in proximity to the Proposal area

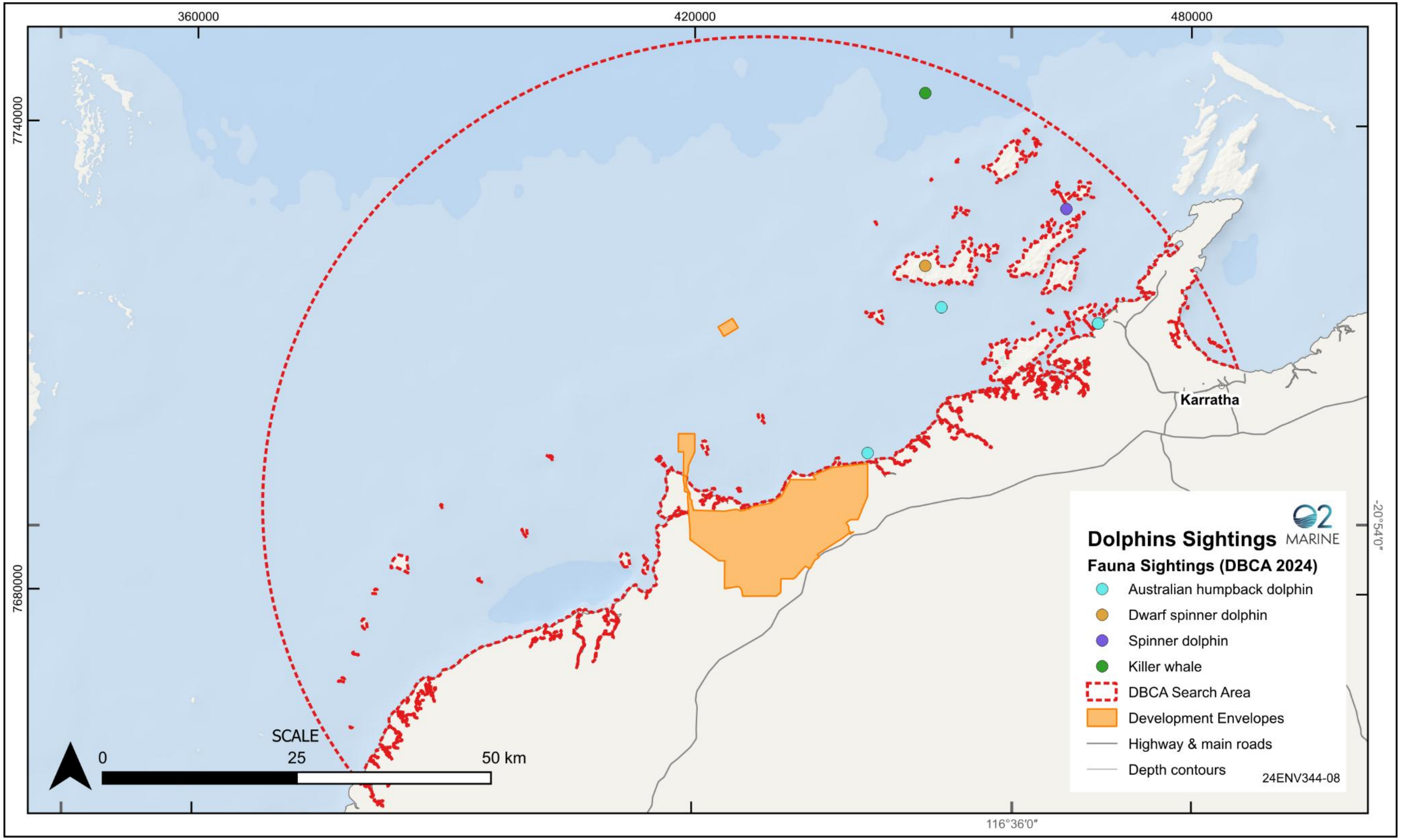


Figure 12: Dolphin sightings from the DBCA Fauna and Threatened Species Search (DBCA 2024), in proximity to the Proposal area

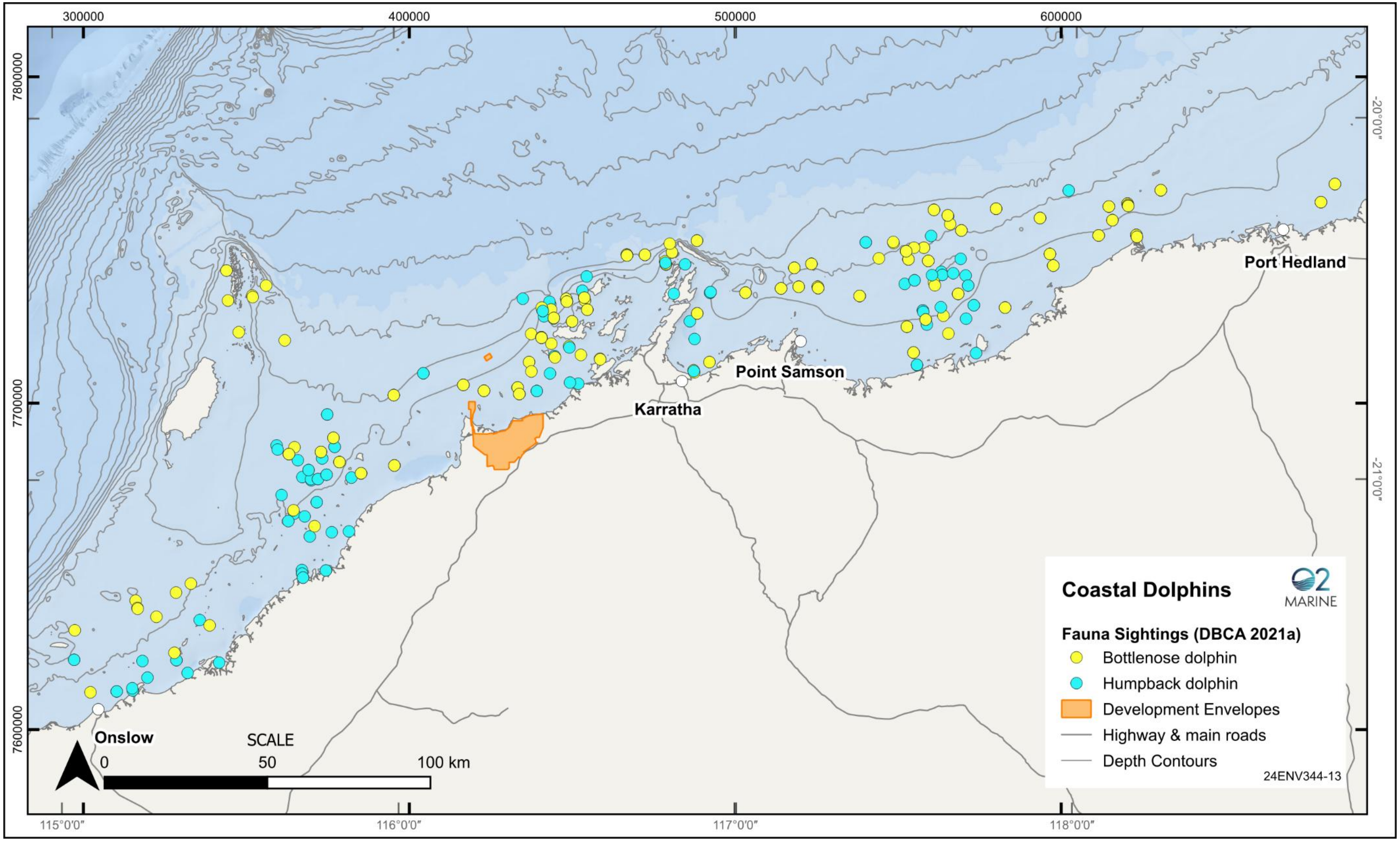


Figure 13: Dolphin sightings from broadscale aerial surveys conducted by DBCA (2021a), in proximity to the Proposal area

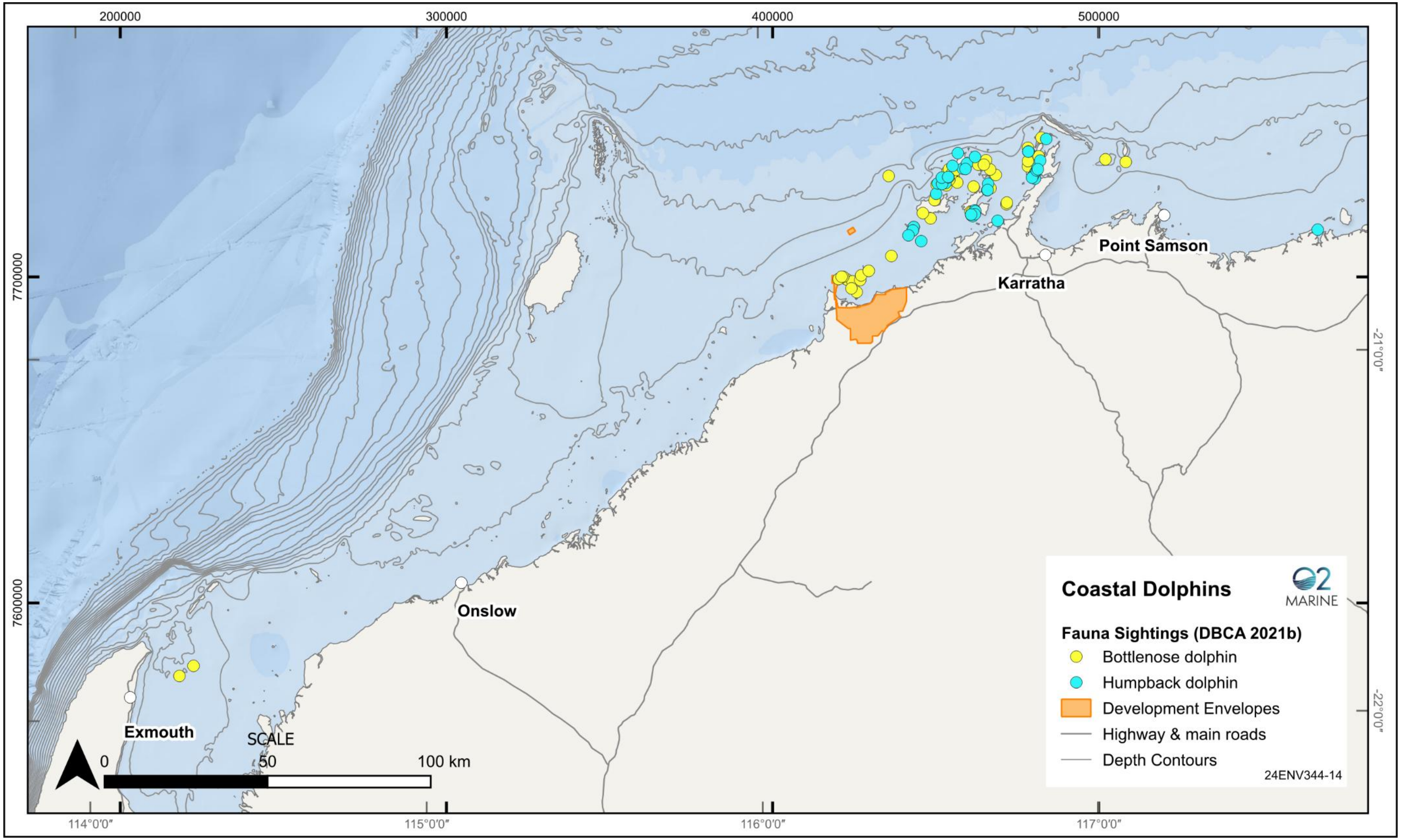


Figure 14: Coastal dolphin sightings from boat surveys conducted by DBCA (2021b), in proximity to the Proposal area

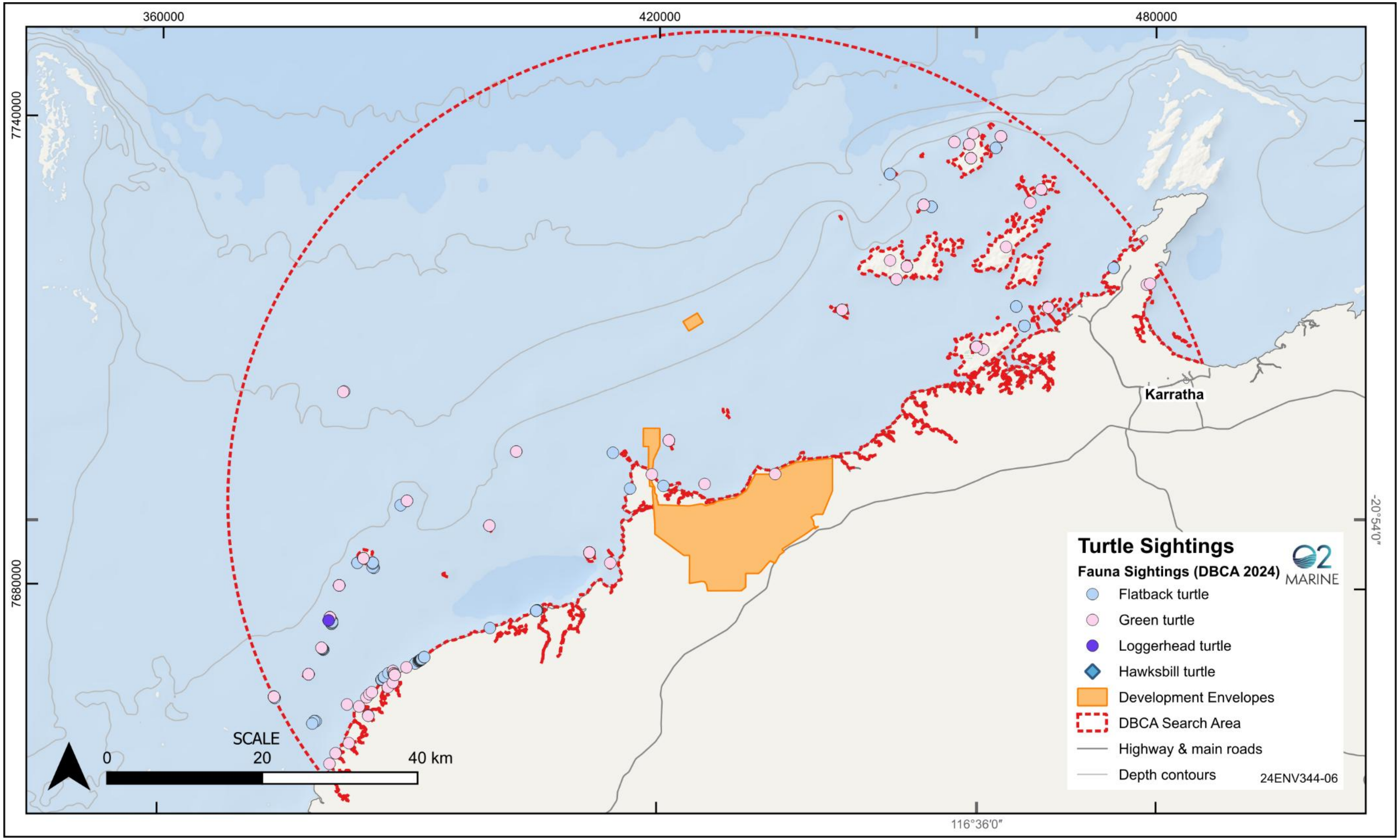


Figure 15: Turtle sightings from the DBCA Fauna and Threatened Species Search (DBCA 2024), in proximity to the Proposal area

5.1.3. Biologically important areas

Five species were found to have BIAs that overlap with marine elements of the Proposal (Table 11; Figure 16-Figure 18). Whale shark BIAs were identified in the region, but they do not overlap with the Proposal area (Figure 19).

Table 11: BIAs that spatially overlap with the marine elements of the Proposal

Species	Type	Marine component
Humpback whale	Migration	Nearshore and Offshore DEs
Blue whale	Migration	Offshore from Proposal
Flatback turtle	Reproduction Foraging Migration	Nearshore and Offshore DEs Proposal search area Proposal search area
Green turtle	Reproduction Foraging Migration	Proposal search area Proposal search area Proposal search area
Loggerhead turtle	Reproduction	Proposal search area
Hawksbill turtle	Reproduction Foraging Migration	Proposal search area Proposal search area Proposal search area
Whale shark	Foraging	Proposal search area

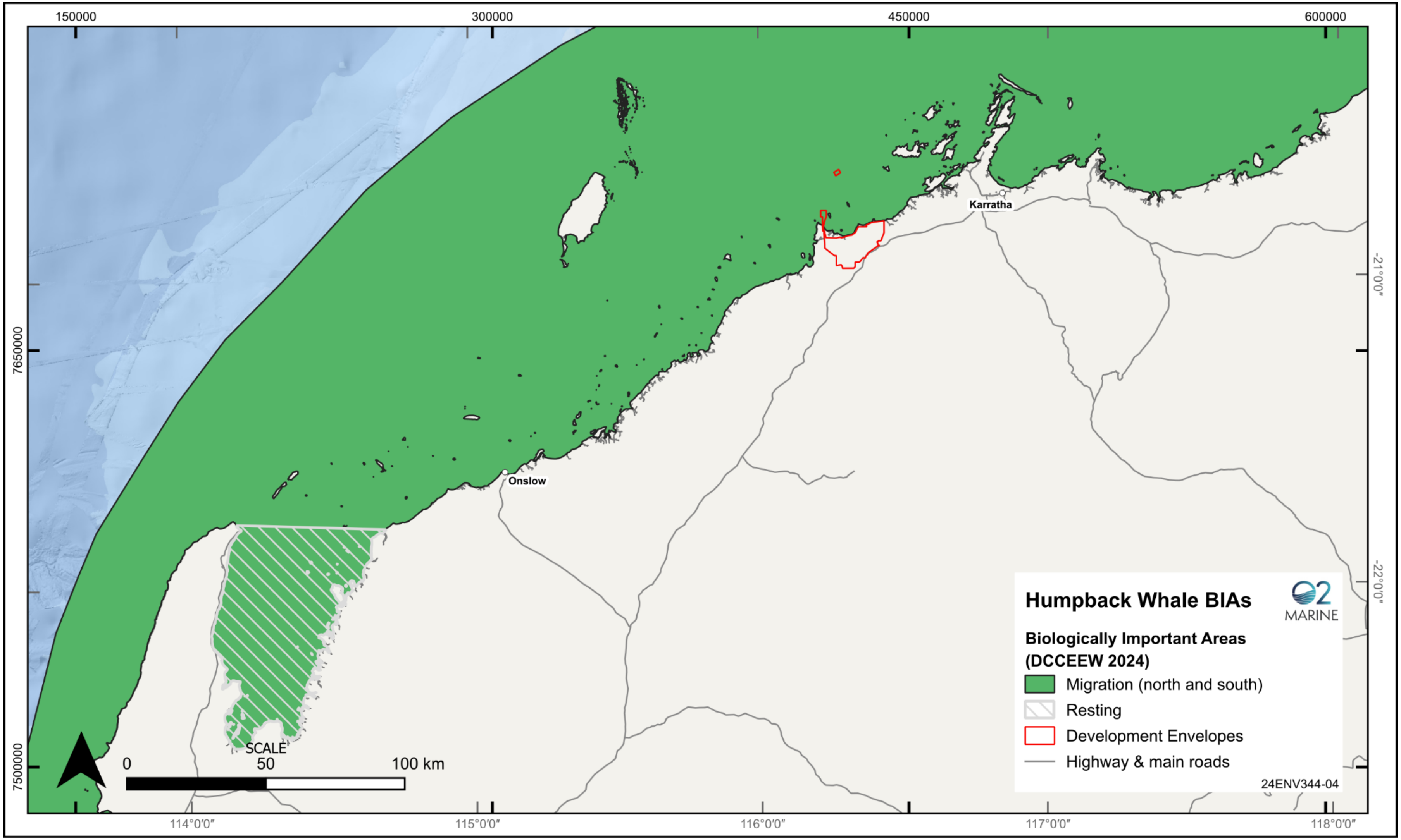


Figure 16: Humpback whale BIA in relation to the Proposal

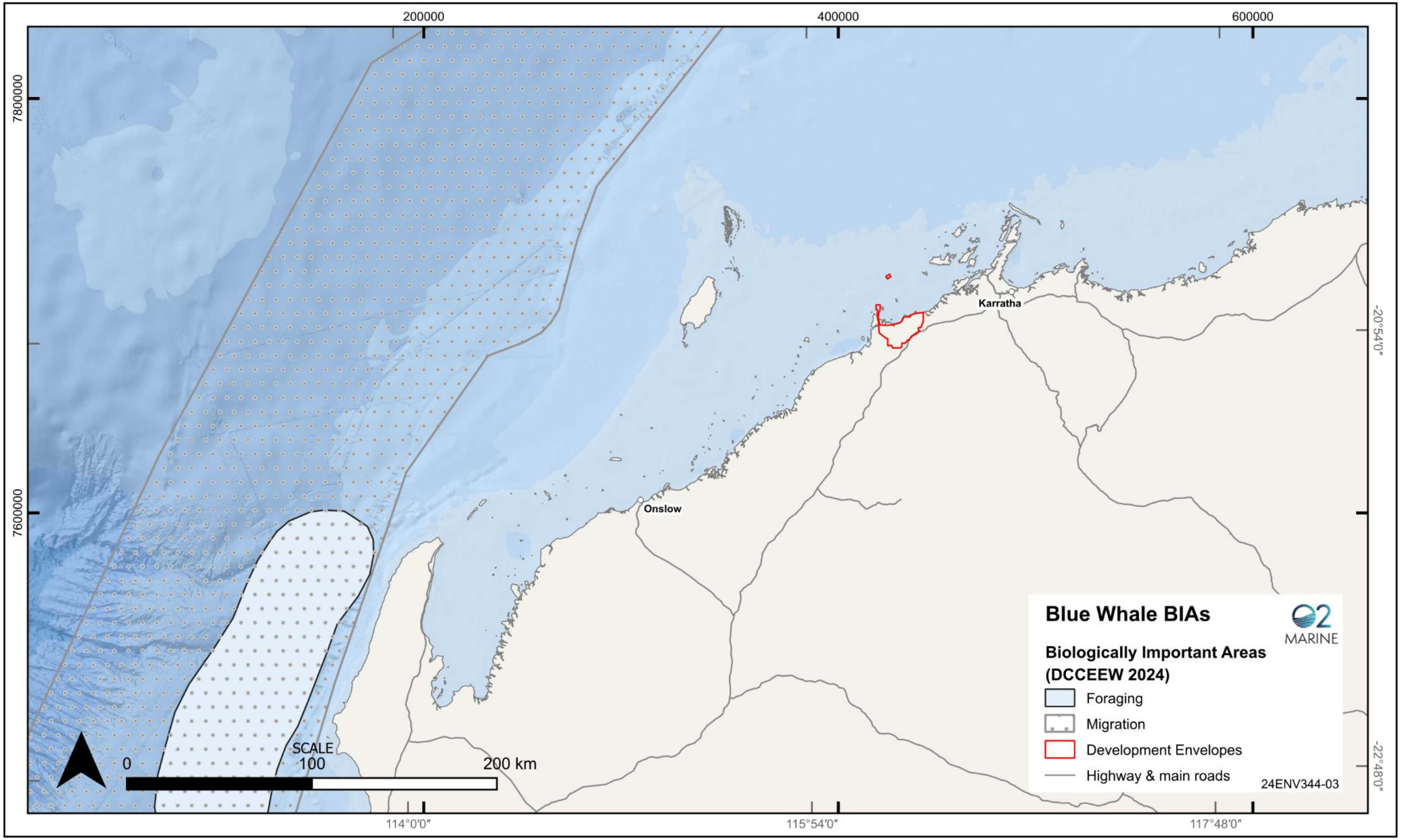


Figure 17: Blue whale BIA in relation to the Proposal area

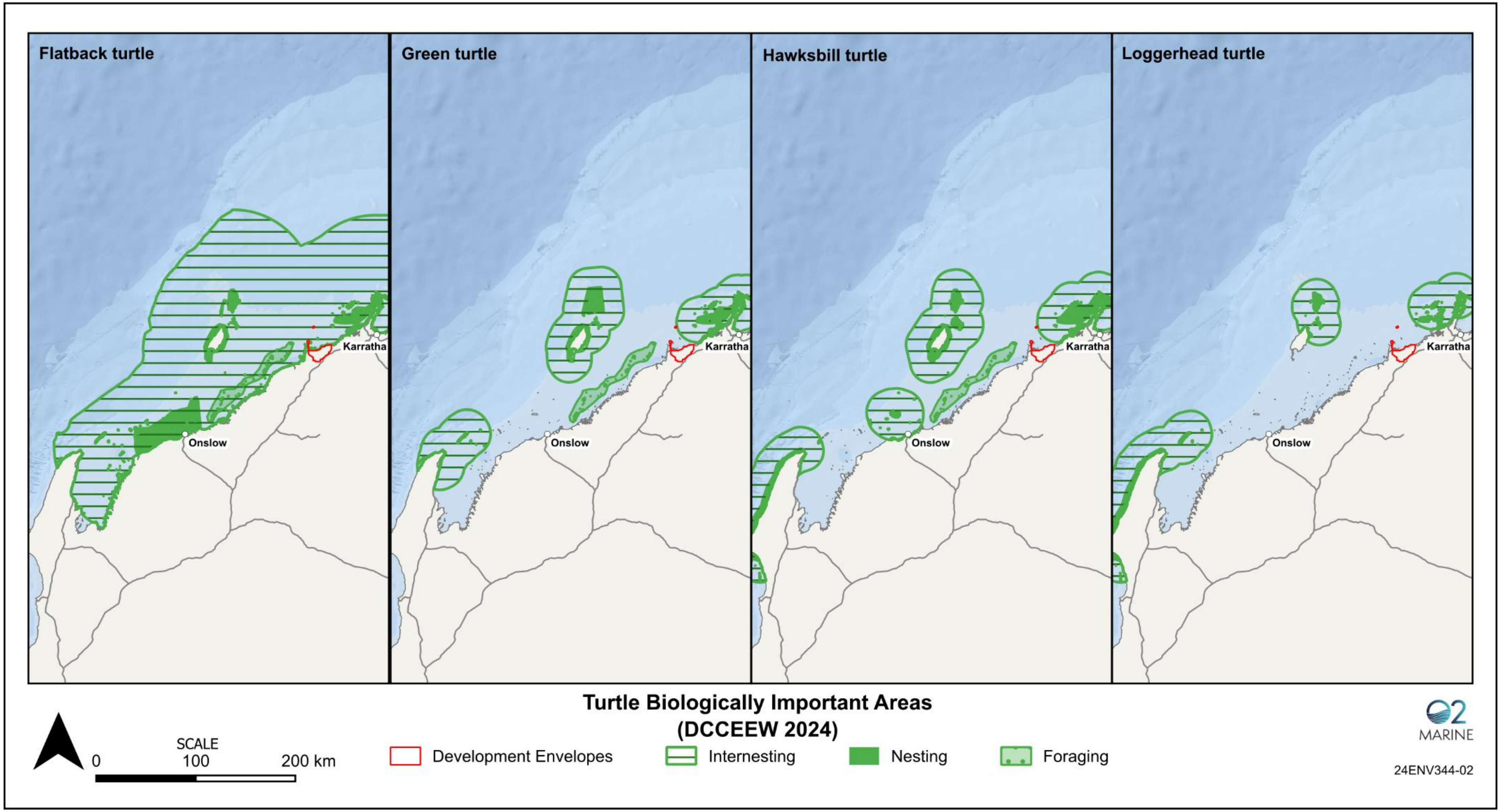


Figure 18: Turtle BIAs in relation to the Proposal

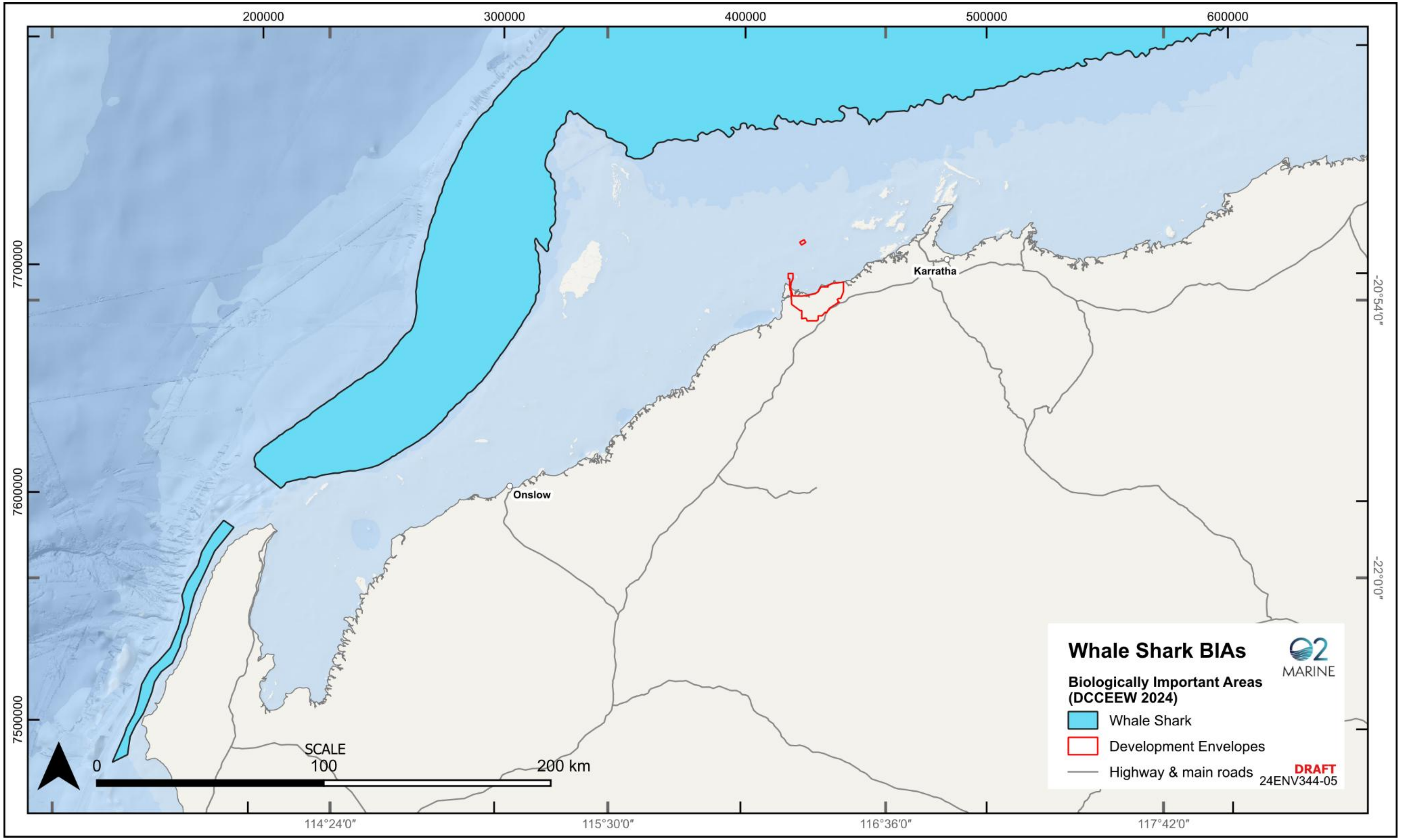


Figure 19: Whale shark BIA in relation to the Proposal

5.1.4. Critical habitat for the survival of a species

Nesting and inter-nesting areas identified as habitat critical to the survival of marine turtles are listed for each stock within the Recovery Plan for Marine Turtles in Australia (DoEE 2017a). The areas have been identified by a consensus panel of subject matter experts and include buffered areas around nesting sites. The following radii around important nesting sites are given (Figure 20; Table 12):

- North West Shelf (NWS) green turtle stock: 20 km
- Pilbara flatback turtle stock: 60 km
- WA hawksbill turtle: 20 km
- Loggerhead turtle: 20 km.

These areas should be considered when assessing the significance of potential impacts, but they are not 'Critical Habitat' as defined under Section 207A of the EPBC Act (Register of Critical Habitat). No registered 'Critical Habitat' overlaps with the Proposal.

Table 12: Areas identified as Habitat Critical to the Survival of Marine Turtles that spatially overlap with the Proposal area

Species	Type	Proposal area
Flatback turtle	Inter-nesting	• Inter-nesting buffer BIA overlaps with the Proposal site • Dampier Archipelago and coastal island inter-nesting buffers overlaps with the Proposal area, which is critical habitat for the species survival.
Green turtle	Inter-nesting	• Inter-nesting buffer BIA overlaps with the spoil disposal sites • Dampier Archipelago inter-nesting buffer overlaps with the Proposal area, which is critical habitat for the species survival.
Hawksbill turtle	Inter-nesting	• Inter-nesting buffer BIA overlaps with the spoil disposal sites • Dampier Archipelago inter-nesting buffer overlaps with the Proposal area, which is critical habitat for the species survival.

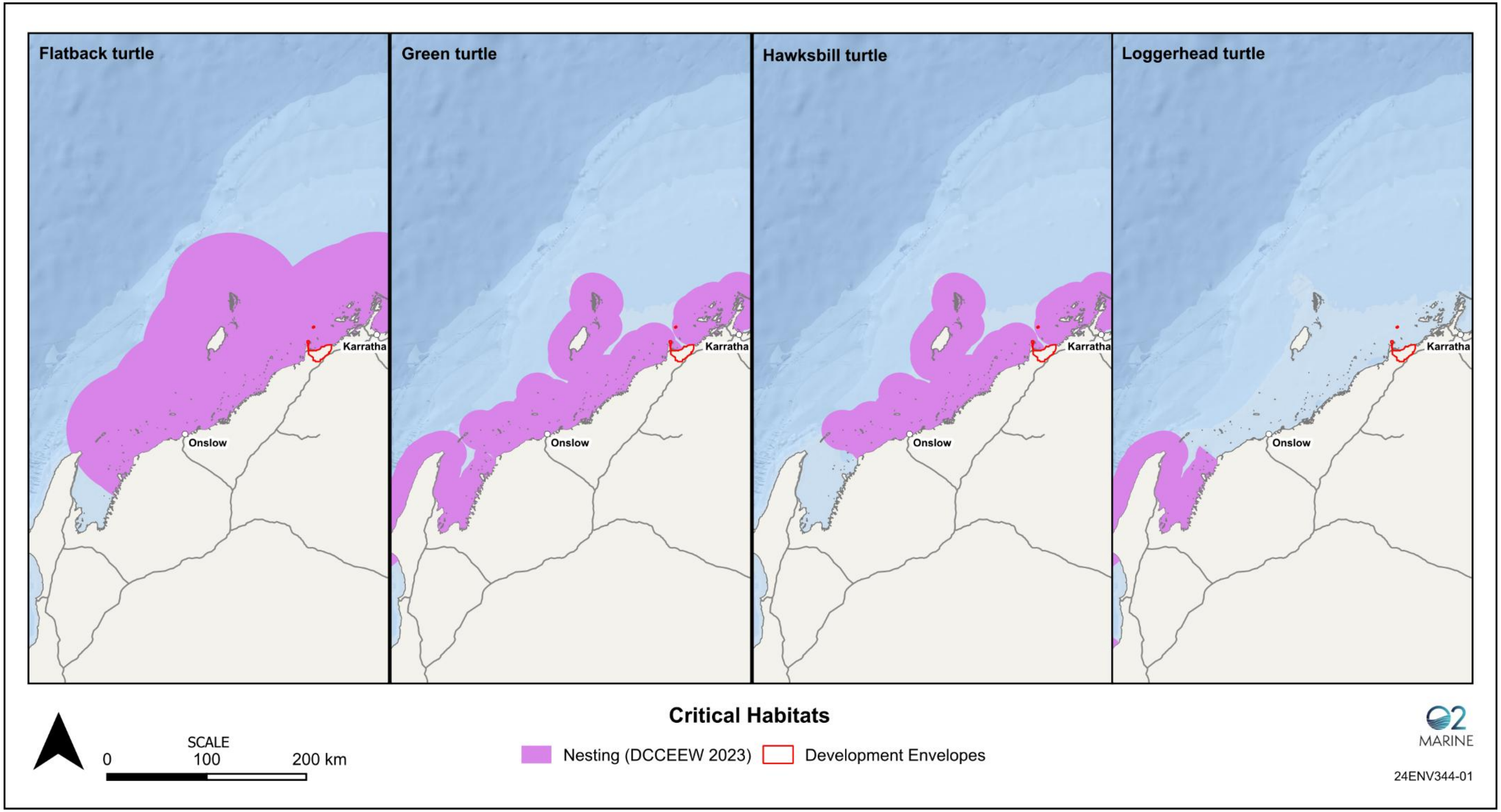


Figure 20: Turtle critical habitat for the survival of a species in relation to the Proposal area

5.1.5. Important marine mammal areas

Important marine mammal areas (IMMAs) are defined areas where discrete portions of habitat important to marine mammal species have the potential to be delineated and managed for conservation. IMMAs are defined to provide a cost-effective approach to conservation. The rationale for developing IMMAs includes identifying qualifying species as umbrella species to help ensure that a properly designed conservation plan will be beneficial to the broader ecosystem. Therefore, for each IMMA, marine mammal diversity is included, listing other species that utilise the area or have habitat present but do not specifically utilise the area the same way as the qualifying species.

Although they are non-statutory, these areas have been developed by the IUCN Joint SSC/WCPA Marine Mammal Protection Areas Task Force. One IMMA overlaps with the Proposal area, and another two are located within the 20 km search area (Figure 21). These IMMAs are summarised in Table 13.

Table 13: IMMAs relevant to the Proposal

Name	Qualifying species and criteria	Marine mammal diversity
Western Australian Humpback Whale Migration Route IMMA	Humpback whale: C1 and C3	*Dugong dugon, Orcaella heinsohni, Sousa sahulensis, Stenella longirostris, Tursiops aduncus, Tursiops truncatus, Orcinus orca, Pseudorca crassidens, Balaenoptera musculus, brevicauda, Eubalaena australis, Balaenoptera physalus, Physeter macrocephalus, Balaenoptera eden.*
Dampier Archipelago IMMA	Dugong, Australian humpback dolphin, Indo-pacific bottlenose dolphin, humpback whale: A, B1, B2, C1, C2, D1	*Orcaella heinsohni, Pseudorca crassidens.*
Ningaloo Reef to Montebello Islands IMMA	Australian humpback dolphin, dugong, and humpback whale: A, B1, C1, C2	*Tursiops aduncus, Balaenoptera musculus, Orcaella heinsohni, Balaenoptera acutorostrata, Orcinus orca, Eubalaena australis, Balaenoptera omurai, Balaenoptera physalus, Pseudorca crassidens.*

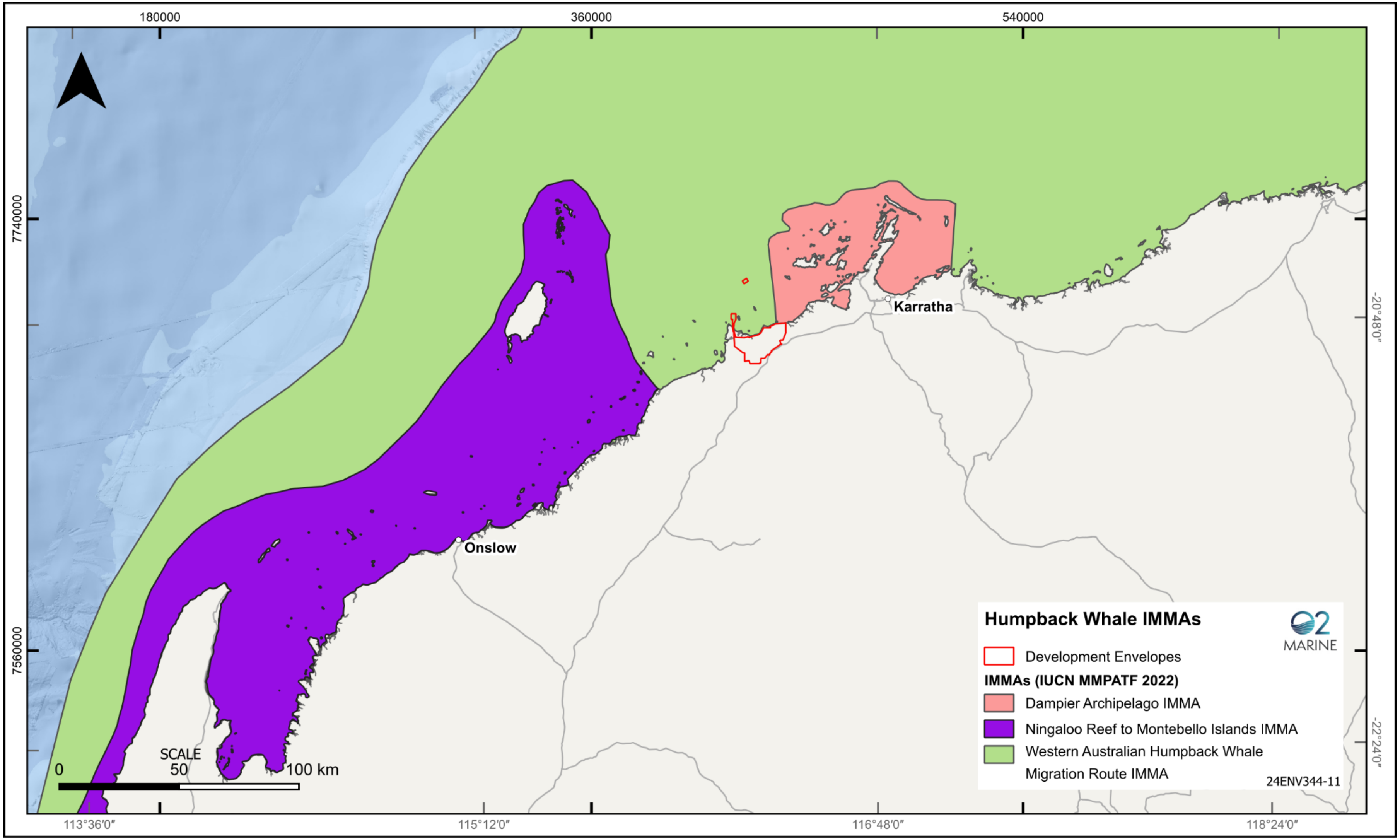


Figure 21: IMMAs in relation to the Proposal (IUCN MMPATF 2022)

5.2. Publications and Studies

The Proposal area and the surrounding Pilbara region have a few studies on marine fauna presence and habitat use. A summary of the key research papers that relate to the Proposal location and the surrounding environment are summarised in Appendix C.

5.3. Project specific surveys

5.3.1. Turtle surveys

O2 Marine drone survey results are presented in Figure 22, Figure 23, and Figure 24. Pendoley Environmental additional track census surveys were undertaken around the Proposal area in 2022/23 and 2023/24 during the turtle nesting season (October to February) results are presented in Figure 25 to Figure 32 (see Pendoley Environmental 2023).

Both surveys found that the number of marine turtles using the beaches of Cape Preston was considered low, and previous surveys found that in some years, no nesting occurred (Imbricata Environmental 2013). The eastern beach of Cape Preston, however, provides a suitable nesting habitat for marine turtles (Imbricata Environmental 2013).

Pendoley Environmental (2023; 2024) detected nesting activity across south-west Regnard Island (Figure 25; Figure 26), north-east Regnard Island (Figure 27; Figure 28), Steamboat Island (Figure 29; Figure 30), and Cape Preston East beach (Figure 31; Figure 32). Hawksbill turtles were the most abundant of the three turtle species. Flatback and green turtle nesting was marginal. Pendoley Environmental (2023) found evidence of hawksbill turtle nesting at Cape Preston East beach(Figure 31), which was consistent with the O2 Marine drone survey where nesting was recorded at Cape Preston East beach but the species was unable to be determined (Figure 22; Figure 24). Hawksbill turtles had the highest activity detected at south-west Regnard Island (Figure 25). Hatchlings fans were recorded on south-west Regnard Island, north-east Regnard Island, Cape Preston East beach, and Steamboat Island (Pendoley Environmental 2023).

Opportunistic surveys found no nesting activity on Unnamed Island or Potter Island in October 2022 and January 2023. Opportunistic surveys in October 2023 identified one turtle nesting attempt track on Forty Mile Beach and in January 2024 one flatback false crawl was identified on Cape Preston West (Pendoley Environmental 2023; 2024).

Results from the benchmark turtle surveys determined that the beaches around the Proposal have low nesting abundance, and the cumulative contribution of nesting females to the genetic stock for each species is <1% and is not thought to represent an important nesting population (Pendoley Environmental 2024). The surveys found low nesting success for hawksbill and flatback turtles, indicating that it is unlikely that the area provides an important contribution to the genetic stock (Pendoley Environmental 2024).

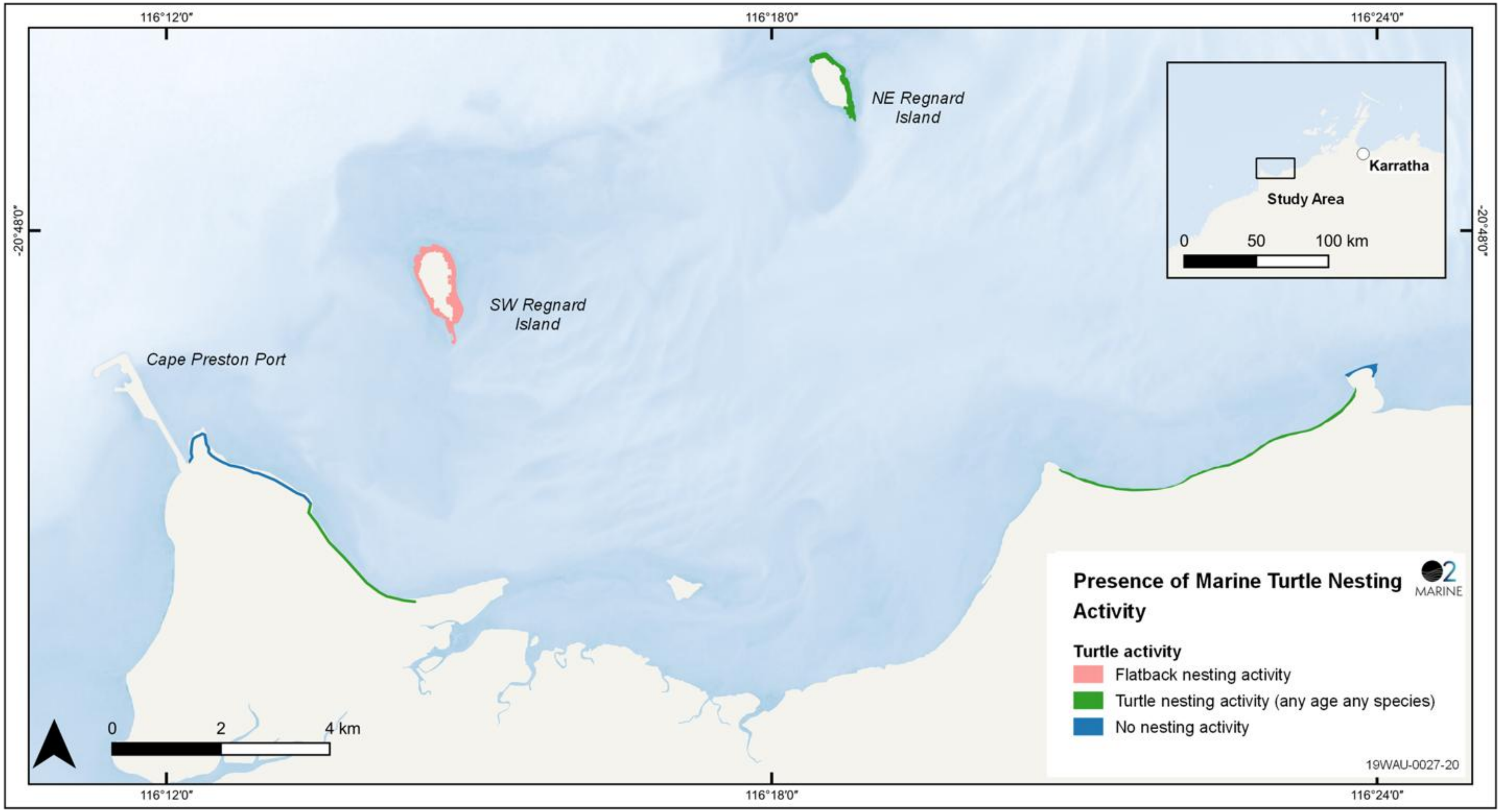


Figure 22: Presence of marine turtle nesting activity (O2 Marine 2022c)

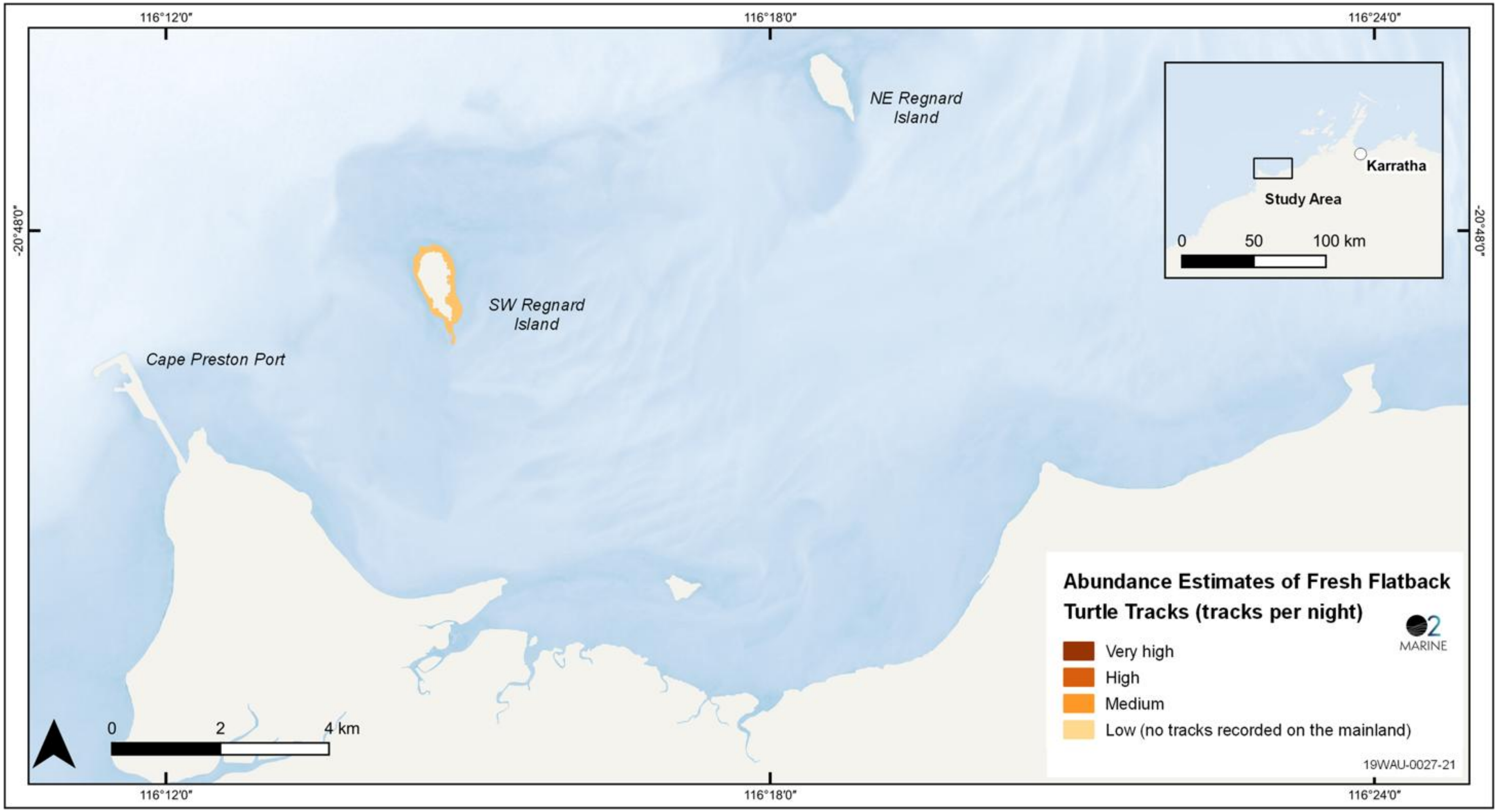


Figure 23: Abundance estimates of fresh flatback turtles tracks (Fossette et al. 2021a in O2 Marine 2022c)

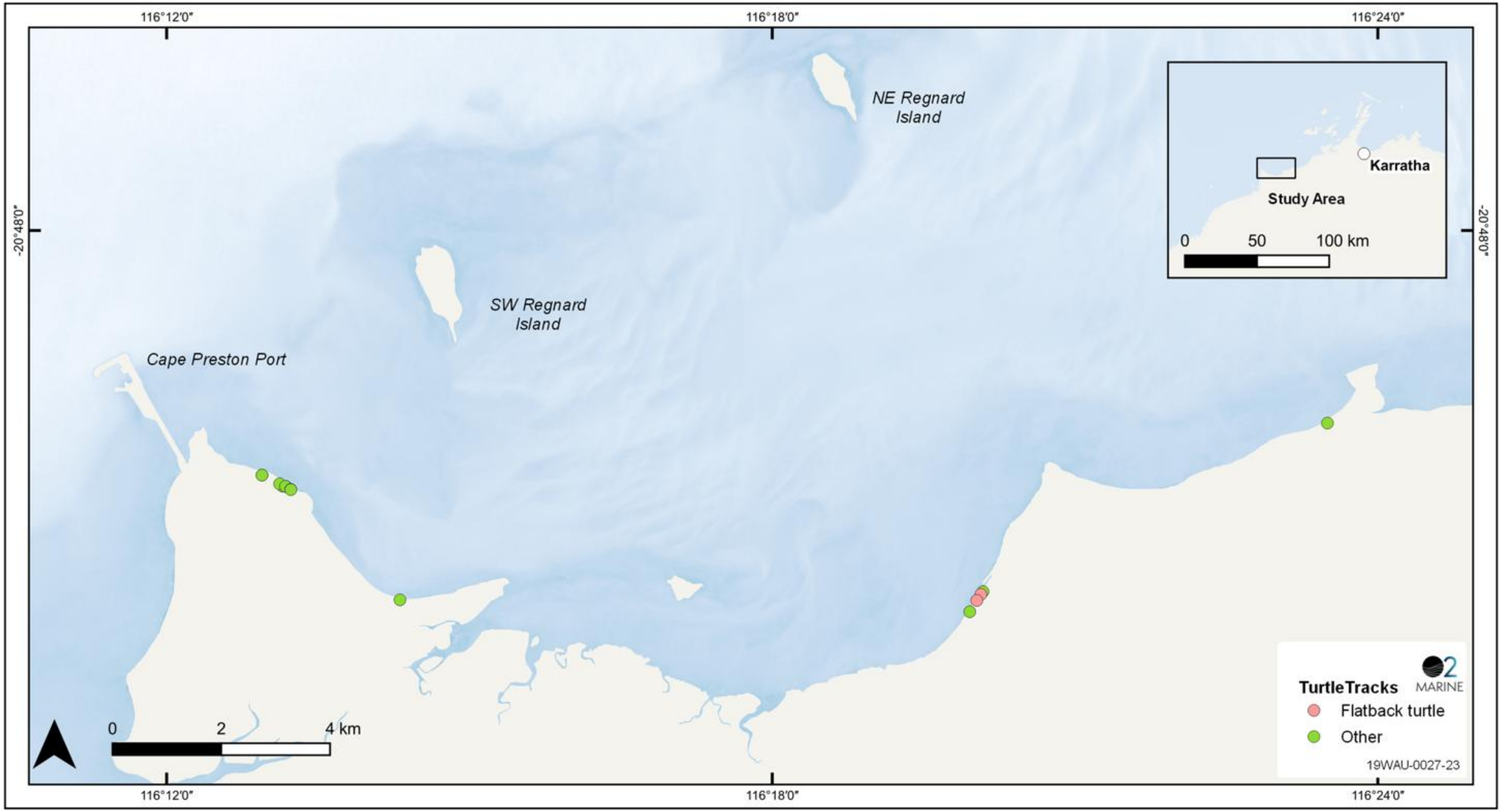


Figure 24: Turtle tracks identified in Remotely piloted aerial system (RPAS) imagery (O2 Marine 2022c)

Figure 25: South West Regnard Island combined track census results for FS1 (14 days, October 2022) and FS2 (15 days, January 2023) (Pendoley Environmental 2023)

Figure 26: South West Regnard Island combined track census results for FS1 (14 days, October 2023) and FS2 (15 days, January 2024) (Pendoley Environmental 2024)

Figure 27: North East Regnard Island combined track census results for FS1 (14 days, October 2023) and FS2 (15 days, January 2024) (Pendoley Environmental 2024)

Figure 28: North East Regnard Island combined track census results for FS1 (14 days, October 2022) and FS2 (15 days, January 2023) (Pendoley Environmental 2023)

Figure 29: Steamboat Island combined track census results for FS1 (2 days opportunistic, October 2022) and FS2 (15 days, January 2023) (Pendoley Environmental 2023)

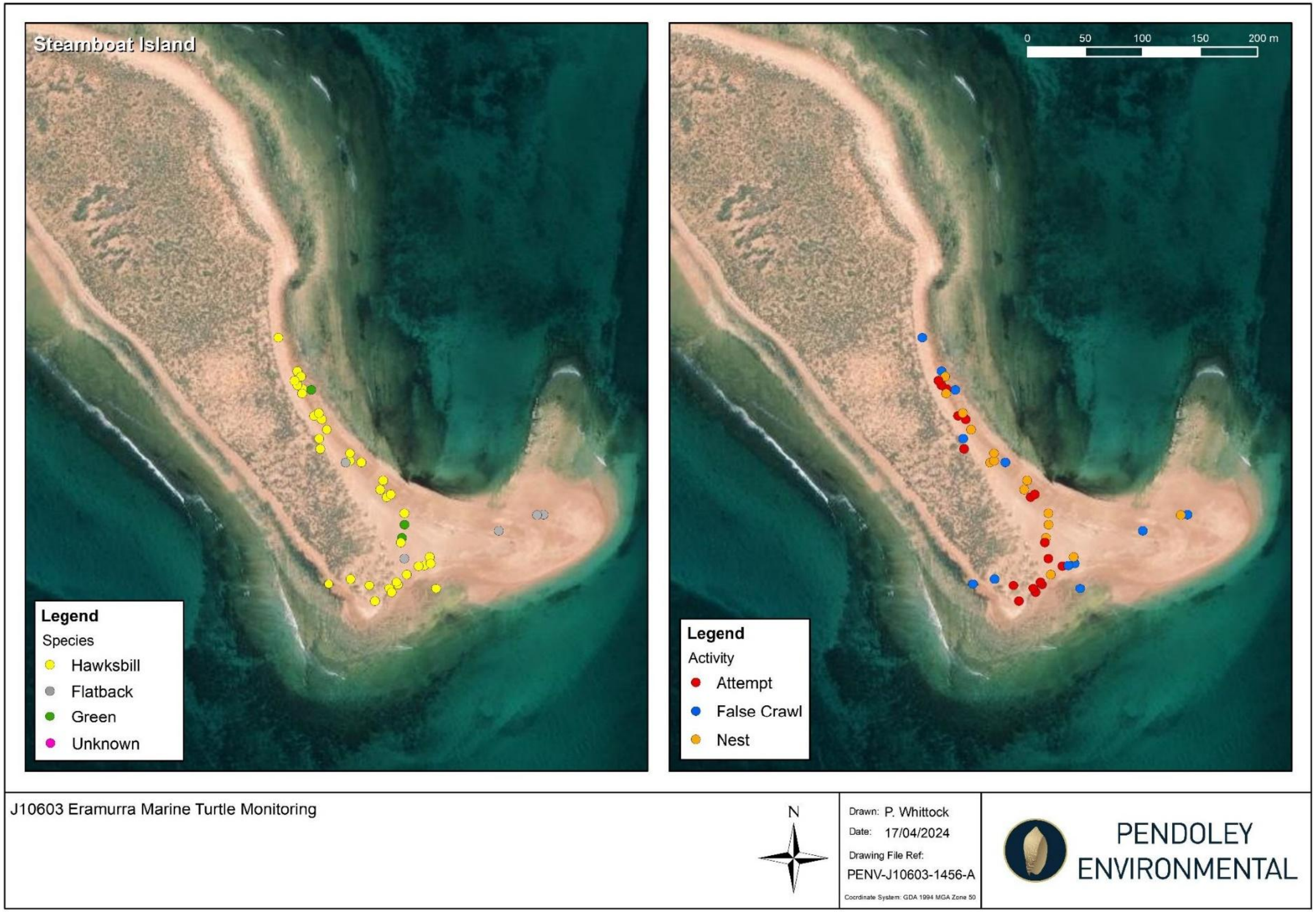


Figure 30: Steamboat Island combined track census results for FS1 (14 days, October 2023) and FS2 (15 days, January 2024) (Pendoley Environmental 2024)

Figure 31: Cape Preston East combined track census results for FS1 (14 days, October 2022) and FS2 (15 days, January 2023) (Pendoley Environmental 2023)

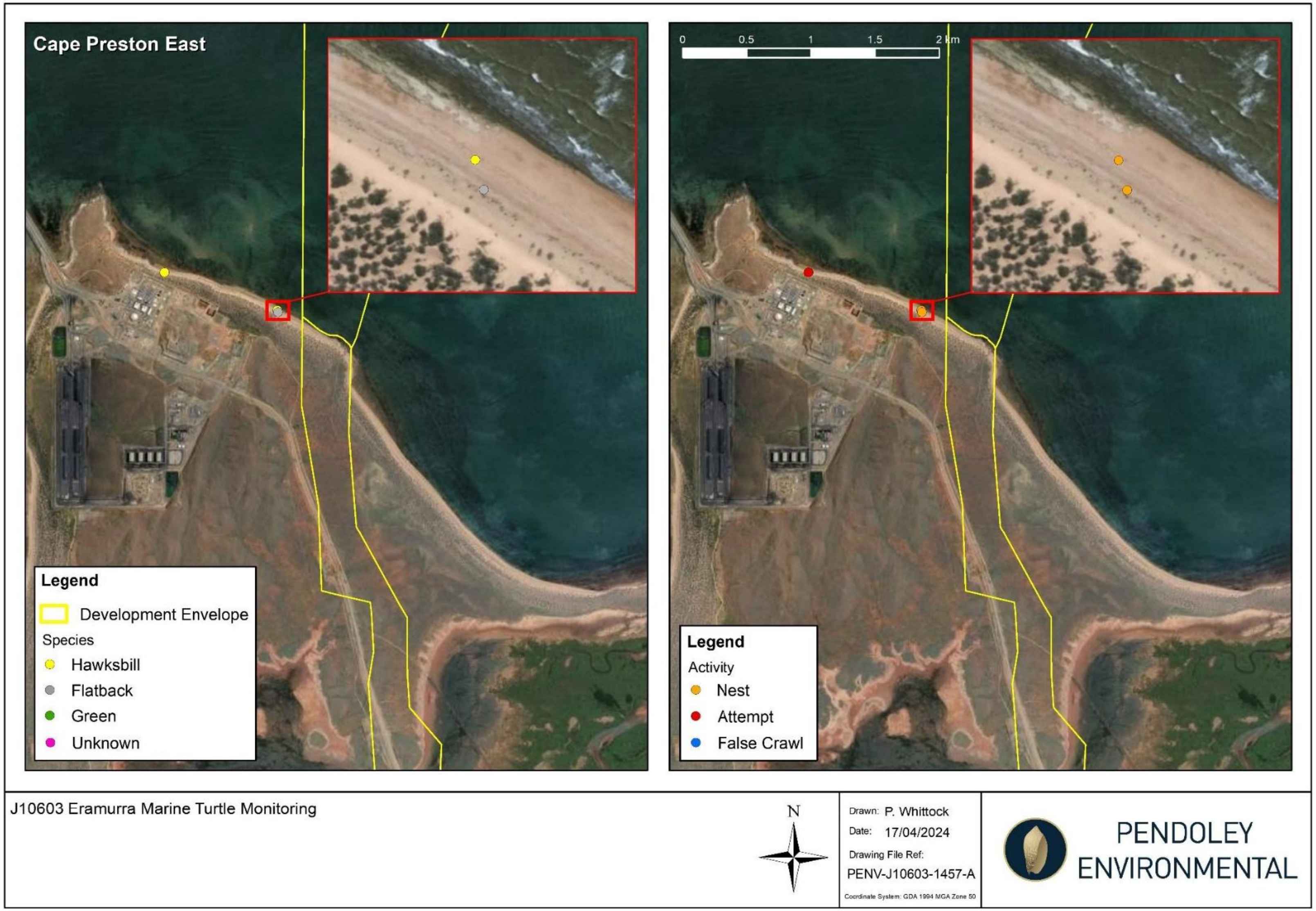


Figure 32: Cape Preston East combined track census results for FS1 (14 days, October 2023) and FS2 (15 days, January 2024) (Pendoley Environmental 2024)

5.3.2. Sawfish surveys

A summary of the sawfish survey results are presented in Table 14, Table 15, and Table 16. No green sawfish were caught in the seine or gill net surveys (August 2022, October 2023 or August 2024); however, one large green sawfish was sighted during drone flight (no. 14) near the mouth of the Intake Creek on the 10/10/2023. No green sawfish were observed during the drone surveys in 2024 (HBI 2025). Notably in the 2024 drone surveys green turtles (>66 individuals) and a sea snake were observed (HBI 2025).

In 2024 (28/08/2024) at south-east of E4 receiver, during low tide, seven Australian whiprays, eight nervous sharks, one giant shovelnose ray, one great hammerhead (*Sphyrna mokarran*), two blue swimmer crabs (*Portunus pelagicus*), two sea snakes, and over 70 green turtles were sighted from 10:10am to 10:28 am (HBI 2025).

The acoustic receiver arrays had not sawfish detected (sawfish that were acoustically tagged). Noting that all batteries failed between July and September 2023. No tagged green sawfish were detected on five Eramurra receivers surrounding Cape Preston and the Eramurra site. Site SN137851 to the west of Cape Preston had one single detection of an adult lemon shark (originally tagged at Ningaloo) (Morgan et al. 2023; HBI 2023). MacKay Creek did not have any sawfish detections (HBI 2025).

The acoustic receiver located at the mouth of the Fortescue River had >13,000 detections from two different sawfish, which were tagged in August 2022. One of these sawfish (Pz02), showed near constant residency to the Fortescue River mouth, while the other sawfish (Pz03), showed more sporadic residency but continued to return to the Fortescue River mouth up to the point of receiver download.

Surveys of the Intake Creek found that the area had extremely high abundance of elasmobranchs, many of which are globally (non-statutory) listed under the IUCN; giant shovelnose rays, Australian whipray, broad cowtail ray, and bottlenose wedgefish.

Table 14: Total number of each fish species (T), percentage contribution (%C) and total length range in mm (LR) of each species captured during gill net surveys in August 2024. Lengths of green turtles correspond with carapace lengths. Net sets correspond with GN 2024-1 to 5 on Figure 8 (HBI 2025)

Common name	Scientific name	Listing			T	%C	LR (mm)
		EPBC Act	BC Act	IUCN			
Sicklefin lemon shark	*Negaprion acutidens*	-	-	Vulnerable	1	2.27	1121
Spinner shark	*Carcharhinus brevipinna*	-	-	Vulnerable	6	13.64	695-938
Nervous shark	*Carcharhinus cautus*	-	-	Least Concern	13	29.55	579-1,064
Giant shovelnose ray	*Glaucostegus typus*	-	-	Critically Endangered	18	40.91	611-2,000
Trevally	*Caranx sp.*	-	-	NA	1	2.27	461

Common name	Scientific name	Listing			T	%C	LR (mm)
		EPBC Act	BC Act	IUCN			
Green turtle	*Chelonia mydas*	VU MI	VU	Endangered	5	11.36	420-513

Table 15: Total number marine fauna (excluding fish species[7]) recorded in the seine and gill nets in October 2023 at the study site Sites correspond to SN 2023-1 to 12 and GN 2023-1 to 8 (Figure 8) (HBI 2023)

Common name	Scientific name	Listing			Total number (seine net)	Total number (gill net)	Total
		EPBC Act	BC Act	IUCN			
Lemon shark	*Negaprion acutidens*	-	-	Vulnerable	1	-	1
Spinner shark	*Carcharhinus brevipinna*	-	-	Vulnerable	-	2	2
Nervous shark	*Carcharhinus cautus*	-	-	Least Concern	2	18	20
Bull shark	*Carchahinus leucas*	-	-	Vulnerable	-	1	1
Giant shovelnose ray	*Glaucostegus typus*	-	-	Critically Endangered	1	8	9
Australian whipray	*Himantura sp.*	-	-	Least Concern	2	3	5
Snubnose Garfish	*Arrhamphus sclerolepis*	-	-	Least Concern	1	-	1

Table 16: Total number of each fish species each species recorded in the seine and gill nets in August 2022 at the study site (Second Creek and Great Sandy Island and channel)

Common name	Scientific name	Listing			Total number (seine net)	Total number (gill net)	Total
		EPBC Act	BC Act	IUCN			
Lemon shark	*Negaprion acutidens*	-	-	Vulnerable	-	3	1
Spinner shark	*Carcharhinus brevipinna*	-	-	Vulnerable	-	1	1

[7] Fish species are presented in the Fish and Fisheries Desktop Review (O2 Marine 2023)

Common name	Scientific name	Listing			Total number (seine net)	Total number (gill net)	Total
		EPBC Act	BC Act	IUCN			
Nervous shark	*Carcharhinus cautus*	-	-	Least Concern	-	2	2
Bull shark	*Carchahinus leucas*	-	-	Vulnerable	-	1	1
Giant shovelnose ray	*Glaucostegus typus*	-	-	Critically Endangered	-	1	1
Broad cowtail ray	*Pastinachuas ater*	-	-	Vulernable	5	-	5
Snubnose Garfish	*Arrhamphus sclerolepis*	-	-	Least Concern	1	-	1

5.4. Likelihood of occurrence

Key marine fauna species for the Proposal were identified as the species most likely to be impacted by the Proposal through the likelihood of occurrence within the Proposal area based on the desktop assessment. The results are presented in Table 17, Table 18, and Table 19.

Table 17: Summary of mammal PMST results and listing status (EPBC Act, BC Act and IUCN listing) for the Proposal search area and likelihood of occurrence ranking

Species		Listing status			PMST Rank	Likelihood of occurrence
Common Name	Scientific Name	BC Act	EPBC Act	IUCN (non-statutory)		
Australian humpback dolphin	*Sousa sahulensis*	P4 & MI	Vulnerable Migratory Cetacean	Vulnerable	Likely	High (NS)
Indo-Pacific bottlenose dolphin	*Tursiops aduncus*	MI	Migratory Cetacean	Near threatened	Likely	High (NS, OF)
Dugong	*Dugong dugon*	MI	Migratory Marine	Vulnerable	Known	High (NS)
Humpback whale	*Megaptera novaeangliae*	CD & MI	Migratory Cetacean	Least Concern	Known	High (NS, OF)
Blue whale Pygmy Blue Whale	*Balaenoptera musculus* *B.m. brevicauda*	EN	Endangered Migratory Cetacean	Endangered	Likely	Low
Australian snubfin dolphin	*Orcaella heinsohni*	P4 & MI	Vulnerable Migratory Cetacean	Vulnerable	Likely	Low

Table 18: Summary of reptiles PMST results and listing status (EPBC Act, BC Act and IUCN listing) for the Proposal search area and likelihood of occurrence ranking

Species		Listing status			PMST Rank	Likelihood of occurrence
Common Name	Scientific Name	BC Act	EPBC Act	IUCN (non-statutory)		
Green turtle	*Chelonia mydas*	VU	Vulnerable Migratory	Endangered	Known	High (NS, OF)
Hawksbill turtle	*Eretmochelys imbricata*	VU	Vulnerable Migratory	Critically Endangered	Known	High (NS, OF)
Loggerhead turtle	*Caretta caretta*	EN	Endangered Migratory	Vulnerable	Known	Low
Leatherback turtle	*Dermochelys coriacea*	VU	Endangered Migratory	Vulnerable	Likely	Low
Flatback turtle	*Natator depressus*	VU	Vulnerable Migratory	Data deficient	Known	High (NS, OF)
Short-nosed sea snake	*Aipysurus apraefrontalis*	CR	Critically Endangered Marine	Data deficient	Likely	Medium
Leaf-scaled sea snake	*Aipysurus foliosquama*	CR	Critically Endangered Marine	Data deficient	Known	Medium

*A precautionary approach has been implemented for the species given its high conservation value and deficiency of sightings (which could be a result of the species being difficult to detect and/or there being a lack of adequate survey effort) across northern WA. Both sea snake species have been included as 'medium' likelihood as the niche model (Udyawer et al. 2020) indicates a 50% or greater possibility of habitat suitability in the Proposal area. Further, sea snakes (not identified to a species level) were identified in the August 2024 surveys for the Proposal by HBI (2025).

Table 19: Summary of shark and rays PMST results and listing status (EPBC Act, BC Act and IUCN listing) for the Proposal search area and likelihood of occurrence ranking

Species		Listing status			PMST Rank	Likelihood of occurrence
Common Name	Scientific Name	BC Act	EPBC Act	IUCN (non-statutory)		
Reef manta ray	*Mobula alfredi*	MI	Migratory	Vulnerable	Known	Medium (NS, OF)
Giant manta ray	*Mobula birostris*	MI	Migratory	Endangered	Likely	Low
Whale shark	*Rhincodon typus*	MI	Vulnerable Migratory	Endangered	May	Low
Green sawfish	*Pristis zijsron*	VU	Vulnerable Migratory	Critically endangered	Known	High (IN, NS)
Dwarf sawfish	*Pristis clavata*	P1 & MI	Vulnerable Migratory	Critically endangered	Known	Low
Narrow sawfish	*Anoxypristis cuspidata*	MI	Migratory*	Critically endangered	Likely	Low
Grey nurse shark (west coast population)	*Carcharias taurus*	VU	Vulenerable	Critically endangered	Likely	Low
Scalloped hammerhead	*Sphyrna lewini*	-	Conservation dependent	Critically endangered	Likely	Low
Southern bluefin tuna	*Thunnus thynnus*	-	Conservation dependent**		Likely	Low

**Species under threatened listing assessment – due 30 April 2025*

***Species removed from threatened listing status July 2024.*

5.5. Key species

Key marine fauna species for the Proposal identified as having a high and medium likelihood of occurrence within the Proposal search area were:

- Mammals
  - Dugong (Migratory and Marine)
  - Australian humpback dolphin (Vulnerable, Migratory and Cetacean)
  - Indo-pacific bottlenose dolphin (Migratory and Cetacean)
  - Humpback whale (Migratory and Cetacean).
- Reptiles
  - Green turtle (Vulnerable, Migratory and Marine)
  - Hawksbill turtle (Vulnerable, Migratory and Marine)
  - Flatback turtle (Vulnerable, Migratory and Marine)
  - Short-nosed sea snake (Critically Endangered)
  - Leaf-scaled sea snake (Critically Endangered).
- Sharks and rays
  - Green sawfish (Vulnerable, Migratory and Marine)
  - Reef manta ray (Migratory and Marine).

6. Key species discussion

Key species identified to have a high and medium likelihood of occurrence, are described in further detail in this Section. Other species that were identified as having a low likelihood of occurrence within the Proposal area are described in more detail in Appendix D.

6.1. Mammals

6.1.1. Dugong

Population

The dugong is the only species of its genus and family, Dugongidae (monospecific). Dugongs are of high cultural and conservation significance in Australia and many other coastal regions globally. Globally, dugong populations are significantly differentiated from each other, and overall, the global population is experiencing a decreasing trend (Marsh and Sobtzick 2019; Furness et al. 2024). Dugongs in Australia are an interconnected stock with a high level of gene flow but with separate populations in Australia's west and east coasts. In WA, specific areas supporting dugongs include Shark Bay, Ningaloo and Exmouth Gulf, the Pilbara coast and Kimberley coast. The largest dugong population in WA is in Shark Bay, followed by the Exmouth Gulf, both south of the Proposal Area.

Distribution

Dugongs' global distribution extends from east Africa to the western Pacific (Groom et al. 2017). In Australia, dugong distribution and abundance varies along the northern coastline from Shark Bay, WA, into the Northern Territory (NT) and to Moreton Bay near Brisbane, Queensland (QLD) (Holley and

Prince 2008; DSEWPaC 2012d; Groom et al. 2017). In WA, dugongs are present in Shark Bay, Ningaloo, Exmouth Gulf, and the Pilbara and Kimberley coasts, and this distribution represents a significant proportion of the Australian dugongs (Bayliss et al. 2019). Historical surveys along the Pilbara and Kimberley coastlines show dugong abundance varies across the coastline, and high abundance of dugongs has been recorded either side of the Proposal (Figure 33).

The Proposal is adjacent to the Dampier Archipelago IMMA, where dugongs are the key qualifying species for the classification of the IMMA. In the Dampier Archipelago/Cape Preston region, a small number of dugongs have been sighted in the shallow, warm waters in bays and between islands, including at East Lewis Island, Cape Preston, Regnard Bay, Nickol Bay and west of Keast Island (IMMA 2022). More recently, May and November 2018, drone surveys conducted around Regnard Island (~30 km^2) identified dugongs in the area during each survey event (Said et al. 2025).

From satellite tracking of individuals and aerial surveys, it appears that dugongs, like many other marine mammals, can move long distances, but the timing and length of movements vary individually. Gales et al. (2004) found a regional shift of dugongs from Exmouth Gulf and Ningaloo Reef to Shark Bay in response to large scale damage to seagrass meadows from a tropical cyclone.

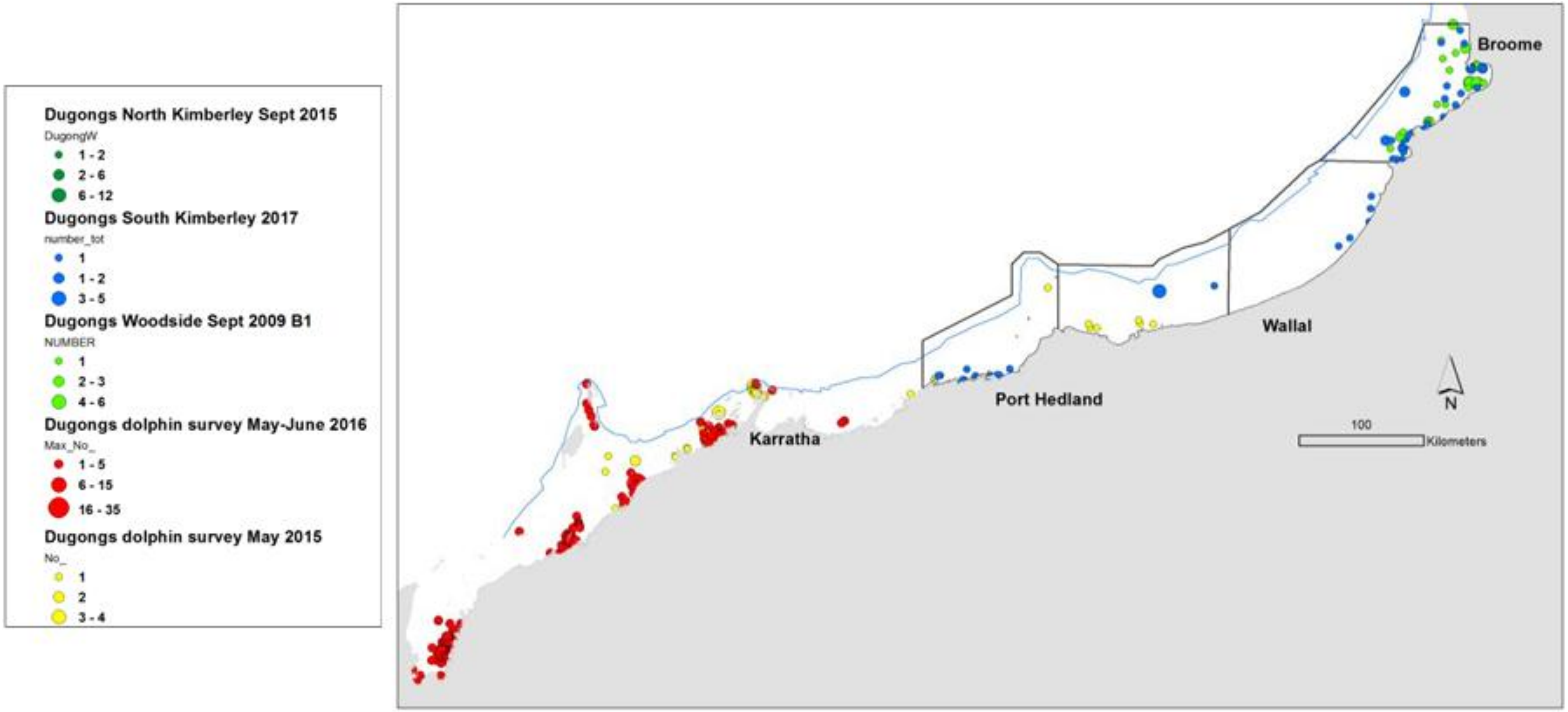


Figure 33: Distribution and relative abundance of dugong sightings in the Kimberley and Pilbara (Bayliss and Hutton 2017)

Habitat use and life history

Dugongs are herbivores, feeding extensively on seagrass with a preference for sparse seagrass beds as it may be easier to graze on ephemeral species when the canopies are less dense (Bayliss et al. 2019). Dugongs are known to forage on ephemeral species, such as *Halophila ovalis*. Surveys along the Pilbara coastline found that dugong abundance is driven by low cover (2-10%) of colonising seagrass (*H. ovalis* and *H. uninervis*). When both species of seagrass are present a recent study has found that the presence of dugongs increased by >60%, and the presence of *H. uninervis* alone was predicted to increase the abundance of dugongs by 1.4 times (Said et al. 2025). Therefore, these results indicate that low cover seagrass and potential seagrass habitats are important habitat foraging habitat for dugongs (Said et al. 2025). These core foraging habitats are generally small. Core foraging area and habitat utilisation is dependent on the quality and abundance of seagrass habitat, which often has patchy distribution and can varying seasonally (Holley 2006; Sheppard et al. 2009). Dugongs are known to undertake large migrations in search for suitable seagrass habitats.

Dugongs are long-lived, living to over 70 years of age, with a very slow and highly variable reproductive rate of one calf produced every 3 to 6 years (DCCEEW 2024d). Males reach sexual maturity between the ages of 4 and 13 years old with a body length range from 220 to 250 cm. Female dugongs reach sexual maturity and can bear their first calf from the ages of 6 to 17 years (DCCEEW 2024d). Reproduction of dugongs is highly seasonal and competitive, during which reproductive females are pursued by a group of mounting males (generally four to five) (DCCEEW 2024d). Calves remain with their mothers for at least a year (up to 18 months) where the calves rely on their mothers to nurse. Population simulations indicate that even with the most optimistic combinations of life-history parameters (e.g. low natural mortality and no human-induced mortality) a dugong population is unlikely to increase by more than 5% per year (Marsh 1999).

Relevant policy and guidance

Dugongs are listed as Migratory and Marine under the EPBC Act and as Other Protected Fauna under the BC Act (WA). Their global (non-statutory) listing by the IUCN is 'Vulnerable'. There is no adopted or made Recovery Plan for this species. Other relevant EPBC Act documents are:

- Threat Abatement Plan for the Impacts of Marine Debris on the Vertebrate Wildlife of Australia's Coasts and Oceans (DoEE 2018)
- National Guidelines for the Survey of Cetaceans, Marine turtles and the Dugong (DCCEEW 2024a)
- Marine bioregional plan for the North-west Marine Region (DSEWPaC 2012a).

Threats and pressures

The dugong's life history traits render the species vulnerable to potential impacts (Marsh et al. 2012). Historical loss of seagrass habitat has resulted in the collapse of breeding recruitment. Reduced food availability can result in abortions, calf mortality, delayed sexual maturity or suppressed ovulation (Bayliss et al. 2019). Dugong populations recorded significant reduced juvenile recruitment following the 2010/11 heat wave (Bayliss et al. 2019) and similar effects observed after extensive seagrass dieback (Preen and Marsh 1995).

Habitat degradation including coastal development, port expansion and aquaculture, resulting in loss of critical food resources, i.e. seagrass habitat, has been identified as a moderate to severe threat to dugongs (Woinarski et al. 2014). Pollution, entanglement, indigenous hunting, underwater noise, and climate variability have also been identified as additional known threats by DCCEEW (2024d).

Based on the North-west Marine Bioregional Plan (Appendix A.1; DSEWPaC 2012a) the following existing threats have identified that may be relevant to consider when assessing impacts of the Proposal, habitat modification, vessel strike, marine debris, invasive species, hydrocarbon spills, and of a lesser concern underwater noise, human presence and chemical spills.

Relevance to the Proposal area

Likelihood of occurrence: High

Dugongs are known to occur in the nearshore waters of and adjacent to the Proposal (Figure 10 and Figure 11) and herds have been identified in the shallow waters of Dampier, Cape Preston, and Regnard Islands (DPaW 2016). The Proposal does not overlap with the species BIA. The Dampier Archipelago is recognised as an IMMA with dugongs being the qualifying species, with the species known to occur in the shallow, warm waters in bays and between islands, including at East Lewis Island, Cape Preston, Regnard Bay, Nickol Bay and west of Keast Island (IMMA 2022). Dugong calves have been sighted either side of the Proposal (Bayliss and Hutton 2017), with no ecological windows for the species having been identified calves could be present.

The presences of suitable seagrass habitat (Figure 5) and occurrence of dugongs around Regnard Island (Said et al. 2025), indicates that the area supports dugongs. It is likely that dugongs will be present in and adjacent to the Proposal, especially in areas where foraging habitat is present (Figure 5; seagrass habitat) or travelling through the area. Dugongs may be present in the Proposal area at any time of year, with no ecological windows for the species having been identified.

6.1.2. Australian humpback dolphin

Population

There is no range-wide population estimate for the Australian humpback dolphin (herein 'humpback dolphin'), however, it is estimated to be <10,000 mature individual and is declining (Parra et al. 2017; DCCEEW 2025a) It is thought that in the Pilbara region of WA that the Australian humpback dolphin is declining in numbers (Raudino et al. 2023). In 2013 estimating the total number of mature individuals of Australian humpback dolphins in Australia was ranked as a high priority for research in *National Research Framework to Inform the Conservation and Management of Australia's Tropical Inshore Dolphins* (DoE 2013), however no results are available (Allen 2021).

Available data suggests that humpback dolphins form metapopulations of small and relatively isolated populations with limited gene flow among them (Brown et al. 2014, 2017; Parra et al. 2018). The average estimated subpopulation size for the humpback dolphin is ~134 individuals (DCCEEW 2025a).

In WA, humpback dolphins exhibit low genetic connectivity between Exmouth and Dampier region, however there is some evidence of movement between the two regions (Brown et al. 2014; Raudino et al. 2018). There is no population trend data for the species in WA (DCCEEW 2025a). Sparse data available in WA suggests humpback dolphins occur as localised populations in low numbers within a range of inshore habitats, including both clear and turbid coastal waters (Brown et al. 2014; Hunt et al. 2017 Raudino et al. 2018; Hanf et al. 2022). This is consistent with findings in northern QLD, where humpback dolphins' populations are fragmented, have limited gene flow and low genetic diversity. A high population estimate from North West Cape (NWC) suggests that this area may be a stronghold toward the south-west extent of the species' range (Hunt et al. 2017). Australian humpback dolphins are generally found in small populations of 50 – 150 individuals (Parra, Hunt, and Hanf 2016).

Australian humpback dolphin abundance has been estimated for 2016 and 2017, noting that in 2015 too few Australian humpback dolphins were identified to model abundance, across the Pilbara study area study area (Figure 34) (Raudino et al. 2023). The estimated abundance of humpback dolphins in 2016 and 2017 across the study area was 1,546 (95% confidence interval (CI) = 942–2,537; coefficient of variation (CV) = 0.26) and 2,690 (95% CI: 1,792–4,038; CV = 0.24), respectively. Which corresponds to an average density of 0.097 (± 0.03 standard deviation (SD)) humpback dolphins per km^2 in 2016 and 0.169 (± 0.064 SD) in 2017 (Raudino et al. 2023; Figure 35). Raudino et al. (2023) found that at a broad scale across the Pilbara dolphin abundance varied both spatially and temporally and confirmed the non-homogonous nature of dolphin distribution.

An important population for the humpback dolphin for a species' long-term survival and recovery includes, as defined within the species conservation advice; key source populations either for breeding or dispersal, populations that are necessary for maintaining genetic diversity, and/or populations that are near the limit of the species range (DCCEEW 2025a). Important population in WA have been identified at NWC and Cygnet Bay (DCCEEW 2025a).

Distribution

Humpback dolphins are found in tropical waters of southern Papua New Guinea and northern Australia to ~22 to 23°S latitude (Parra et al. 2004) The area of occupancy for the species is estimated to be >20,000 km^2 (DCCEEW 2025a). In The Pilbara, humpback dolphins have been recorded up to 50 km from the mainland, in areas associated with offshore islands (Hanf et al. 2022). Humpback dolphins do not appear to undergo large-scale seasonal migrations, although seasonal shifts in abundance have been observed (Parra and Cagnazzi 2016). Along the Pilbara coastline the highest densities of individuals have been recorded off Onslow and in the waters between the northern end of Exmouth Gulf and Dampier Archipelago (DCCEEW 2025a). Humpback dolphins have been observed in the nearshore waters, with hotspots in Exmouth Gulf, the Dampier Archipelago, and Great Sandy Islands (Raudino et al. 2023; Figure 35).

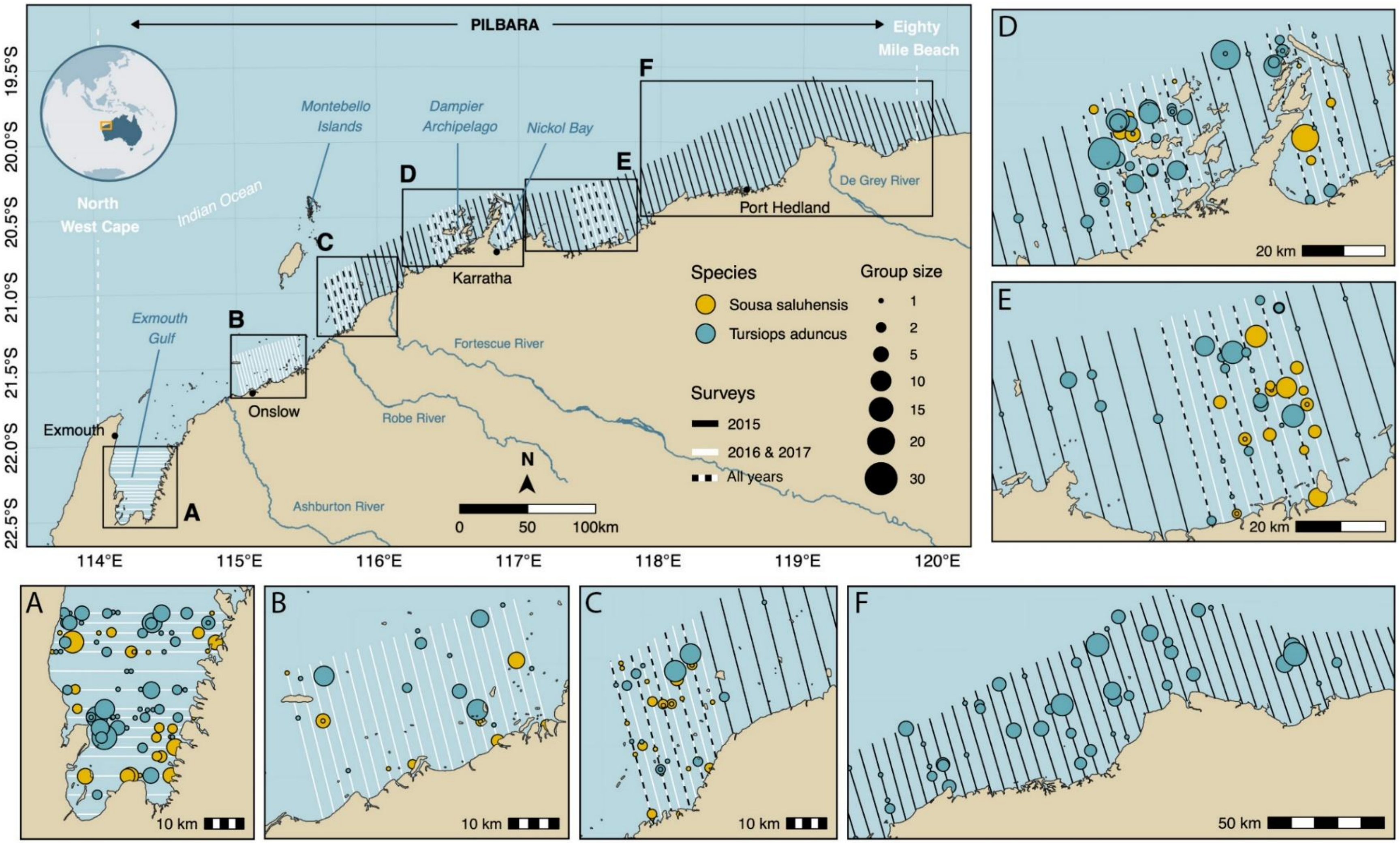


Figure 34: Map of the study area showing the location of transect lines for each survey time period. Detections of Australian humpback dolphins (*S. saluhensis*) and Indo-Pacific bottlenose dolphins (*T. aduncus*) appear as filled circles in the map insets. (A) Exmouth Gulf, (B) Onslow and Thevenard Island, (C) Great Sandy Islands, (D) Karratha and Dampier Archipelago, (E) Balla Balla and (F) Port Hedland (Raudino et al. 2023).

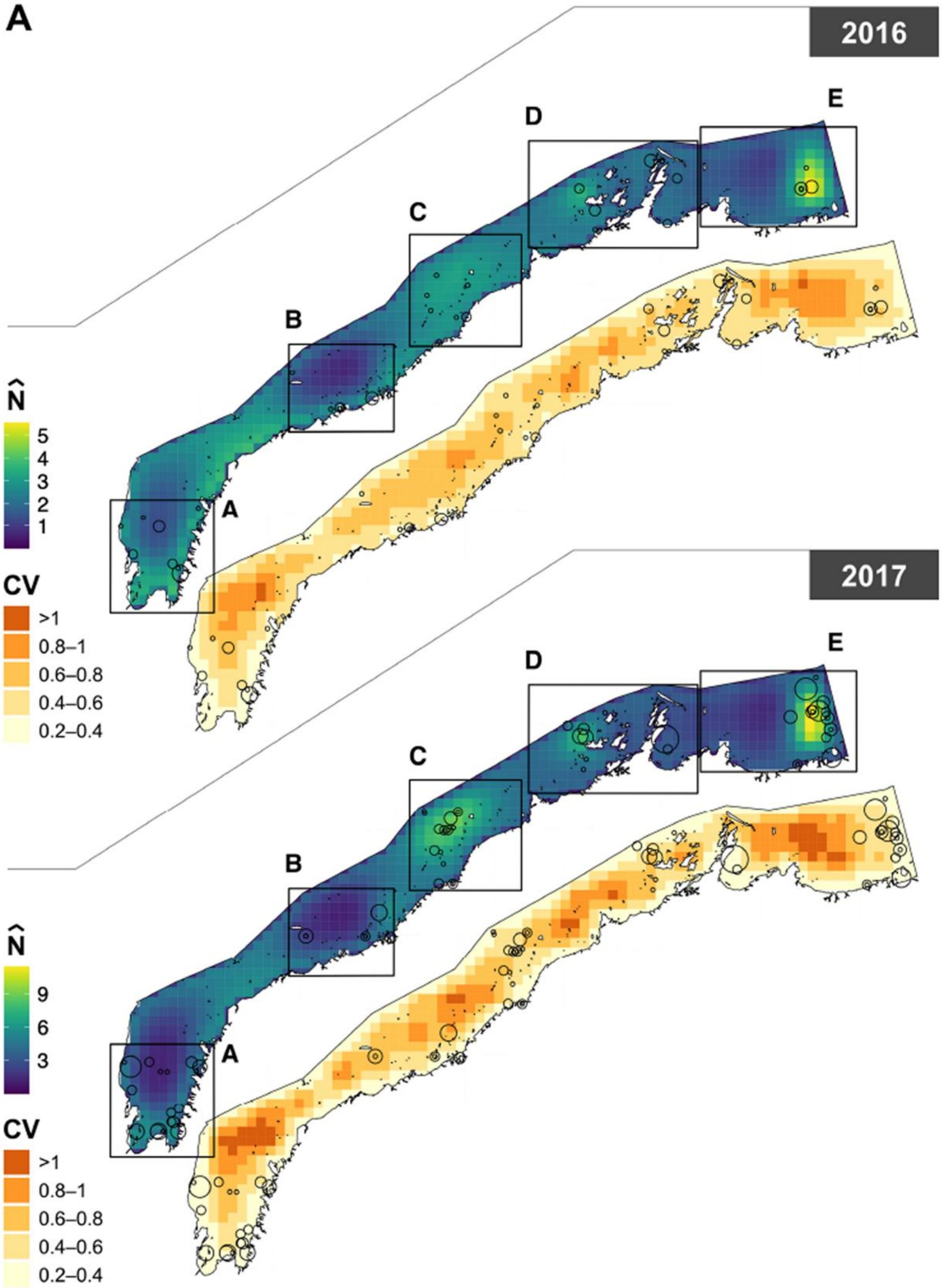


Figure 35: Maps of predicted abundance (N) for the humpback (*S. saluhensis*) dolphin, with associated uncertainty (represented as the coefficient of variation, CV). Circles represent sightings of dolphin groups; their size is proportional to group size (Raudino et al. 2023)

Habitat and life history

Humpback dolphins are opportunistic, generalist feeders. They prey on a wide variety of both schooling, bottom dwelling and pelagic fish and cephalopods, that are generally associated with mangroves, seagrass, sandy bottom or rocky coral reefs in shallow coastal waters and estuaries of tropical regions (Parra and Jedensjö 2013). Mangrove and seagrass habitats are known to support fish species which humpback dolphins prey on, and therefore are considered important foraging habitat for the species (DCCEEW 2025a).

Humpback dolphins inhabit shallow, coastal waters; typically, within 20 km of land and in water depths of less than 30 m (Parra and Jedensjö 2013; Hanf 2015; Hunt et al. 2017; Hanf et al. 2022). Research on Australian humpback dolphins at North West Cape, WA, found that water depth and distance to coast were the most important variables influencing presence, with the dolphins showing a preference for shallow waters (5–15 m) less than 2 km from the coast (Hunt et al. 2020). In QLD they have found to be associated with estuaries and river mouths (Parra et al. 2016); whereas in WA they have been associated with coral reefs, with higher habitat suitability within intertidal areas (Hunt et al. 2017; Hanf et al. 2022). In the Pilbara humpback dolphins have been observed foraging in rivers, which could be an indication that rivers are an important habitat at a local scale and possibly used intermittently (Hanf et al. 2022).

Life history traits for the humpback dolphin are not well understood, but likely to be similar to the Indo-pacific humpback dolphin. With a gestation period between 10 to 12-months and a lactation period >2 years. Female sexual maturity is reached at 9 to 10 years of age and males mature at 12 to 14 years. The generation length is estimated at between 20 and 25 years and an estimated longevity of >40 years (Parra and Cagnazzi 2016; Allen 2021).

As defined in the species conservation advice, habitat critical to the survival is shallow (≤15 m depth) inshore coastal waters and estuarine habitats within sub-tropical and tropical zones of Australia up to 20 km from a coastline or land body, such as an island group, with sand banks, mud flats, seagrass, rock and/or reef substrate. Within this range, site with a high density of teleost fish, cephalopods and bivalves are considered potential important foraging habitat (DCCEEW 2025a).

Relevant policy and guidance

The humpback dolphins are listed as Vulnerable, Migratory, and Cetacean under the EPBC Act, the species listing status was effective as of 5 March 2025. In WA, the humpback dolphin is listed as Priority (P4), which mean the species lack evidence for Threatened status listing. The P4 listing is for species that are rare, near threatened and other species in need of monitoring. Their global (non-statutory) listing by the IUCN is Vulnerable. Other relevant EPBC Act documents are:

- Marine bioregional plan for the North-west Marine Region (DSEWPaC 2012a)
- Conservation Advice for *Sousa sahulensis* (Australian humpback dolphin) (DCCEEW 2025)
- National Guidelines for the Survey of Cetaceans, Marine turtles and the Dugong (DCCEEW 2024a).

Threats and pressures

In the Pilbara region of WA habitat loss and degradation from construction of processing facilities and export infrastructure for petroleum and mineral industries are likely to be the major threat to coastal dolphins. Additionally, increased vessel traffic and noise from works and operations in the Pilbara could disturb and displace dolphins in the area and increase the risk of vessel strike (Raudino et al. 2023). Humpback dolphins can be directly impacted by vessel strike but also indirectly from vessel presence, including high risk from sub-lethal effects of habitat disturbance due to their high site fidelity and small, discrete populations that spatially overlap with human activity (i.e. coastal development, petroleum exploration, commercial fishing, recreational boating) (Allen et al. 2012; Smith et al. 2016; Hanf et al. 2016). The humpback dolphin is thought to be at an increased risk of extinction due the population structure, with individuals found in small and relatively isolated populations, however currently the population is not considered to be severely fragmented (DCCEEW 2025a)

Based on the North-west Marine Bioregional Plan (Appendix A.1; DSEWPaC 2012a) and the species conservation advice (DCCEEW 2025a) the following existing threats have identified that may be relevant to consider when assessing impacts of the Proposal:

- Chemical spills
- Vessel strike
- Marine debris
- Nutrient pollution
- Hydrology changes
- Human presences
- Coastal development
- Habitat modification and degradation
- Underwater noise.

Relevance to the Proposal area

Likelihood of occurrence: High

Humpback dolphins are known to occur in the waters surrounding the Proposal (Figure 12; Figure 13; Figure 14). No BIAs have been recognised in the Pilbara for humpback dolphins, however, humpback dolphins are likely to move through the nearshore waters of the Proposal at some time. Australian humpback dolphins are one of the qualifying species for the nearby Dampier Archipelago IMMA and the Ningaloo Reef to Montebello Islands IMMA (Figure 21) due to the likelihood of small resident populations being present with varying degree of site fidelity to the area (IMMA 2022). While site specific surveys have not been completed for the Proposal area, surveys completed nearby at the Dampier Archipelago identified that the region is a hotspot (Figure 34), along with Exmouth Gulf and Sandy Islands for the humpback dolphin. Therefore, it is likely that Australian humpback dolphins would be present in the Proposal area and surrounding waters at any time of the year, with no ecological windows for the species having been identified. It is likely that the dolphins could be foraging, travelling or socialising in the waters of the Proposal and habitat suitability suggests that shallow intertidal waters could be important habitat for the species (Hanf et al. 2022).

6.1.3. Indo-pacific bottlenose dolphin

Population

There are no population estimates for the Indo-pacific bottlenose dolphin globally and in Australia, and no reliable national trend data are available (Allen 2021). However, it is thought that in the Pilbara region of WA that the Indo-pacific bottlenose dolphin is declining in numbers (Raudino et al. 2023). Indo-pacific bottlenose dolphins in WA form three distinct genetic clusters, which correspond to the three provincial bioregions; northern, central, and southern covering the tropical, subtropical and temperate water bioregions respectively. Dolphins present in the waters of and adjacent to the Proposal would be part of the northern genetic cluster, which includes dolphins from Exmouth through to Cygnet Bay (Marfurt et al. 2024).

Aerial surveys along the Pilbara coastline, 2015-2017, found the Indo-pacific bottlenose dolphins had an average density of 0.189 (± 0.046 SD) dolphins per km^2. In 2016 and 2017 were 2,638 (95% CI = 1,670–4,168; CV = 0.24) and 1,635 (95% CI: 1,031–2,593; CV = 0.24), respectively, in a study area of (19,943 km^2), and during this time period the Indo-pacific bottlenose were more abundant around the Dampier Archipelago and in Exmouth Gulf (Raudino et al. 2023; Figure 36).

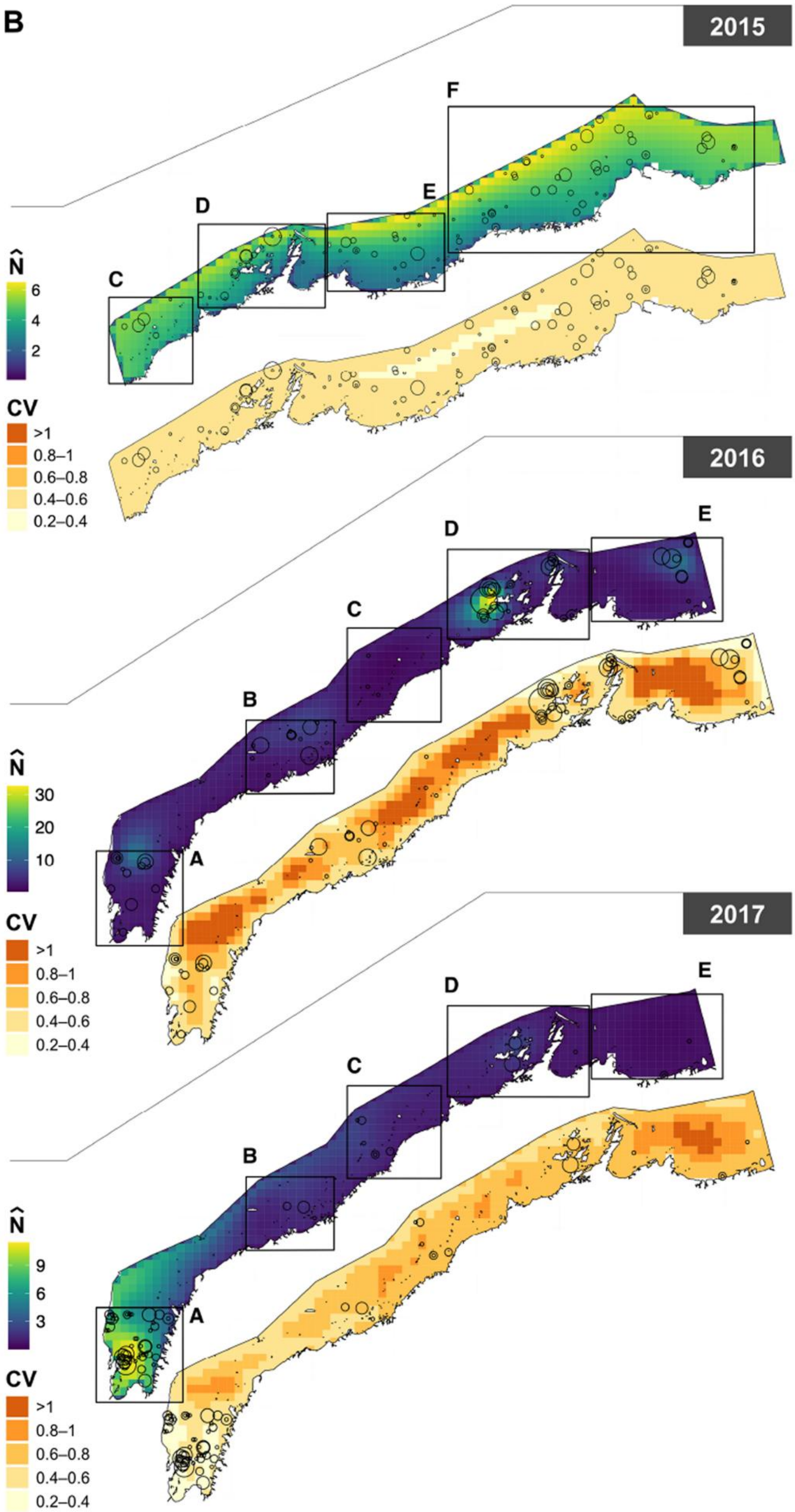


Figure 36: Maps of predicted abundance (N) for the bottlenose (*T. aduncus*) dolphin, with associated uncertainty (represented as the coefficient of variation, CV). Circles represent sightings of dolphin groups; their size is proportional to group size (Raudino et al. 2023)

Distribution

Indo-Pacific bottlenose dolphins occur in tropical and sub-tropical, shallow waters from South Africa to the Red Sea and eastwards to the Arabian Gulf, India, China and Japan, southwards to Indonesia and New Guinea, and New Caledonia. In Australia, Indo-pacific bottlenose dolphins are distributed through the northern tropical and subtropical waters in inshore and nearshore waters (Allen 2021). Further, in Australia the species is restricted to inshore areas such as bays and estuaries, nearshore waters, open coast environments, and shallow offshore waters, around the whole Australian coast (Allen et al. 2012). Preliminary distribution models suggest that there could be habitat partitioning between Indo-Pacific bottlenose and humpback dolphins (Hanf et al. 2022). Indo-pacific bottlenose dolphins have a wider distribution and are more abundant than the Australian humpback dolphin (Raudino et al. 2023).

Habitat and life history

The Indo-Pacific bottlenose dolphins share similar behavioural activities with the Australian humpback dolphin, with some degree of spatial overlap. At a regional scale, there may be some partitioning between the species with bottlenose dolphins preferring deeper waters close to sloping bathymetry (Hanf et al. 2022). Finer scale studies support this, with significant differences in habitat use and fine-scale habitat selection (e.g. Hunt et al. 2017). Habitat suitability modelling has been undertaken for the species between the NWC and east of Barrow Island (Hanf et al 2022), although this does not overlap with the Proposal area it is likely that these habitat preferences are observed across the species Pilbara range. Habitat suitability modelling results indicate that deeper water and generally further offshore provided more suitable habitat for the species, when compared to the humpback dolphin (Hanf et al 2022). The area between Barrow Island and the mainland represents potential suitable habitat for Indo-Pacific bottlenose dolphins.

Indo-pacific bottlenose dolphins form open social networks, and the social system features a fission-fusion grouping pattern which has stronger associations between adult males than adult females (Frère et al. 2010; Connor et al. 2019). Indo-pacific bottlenose dolphins are opportunistic generalist forages, feeding on a variety of fish; schooling, demersal and reef, and estuary-associated fish and cephalopods (Allen 2021; Sprogis and Parra 2022).

Female Indo-Pacific bottlenose dolphins reach sexual maturity between the ages of 10 and 11 and males between the ages of 14 and 15 years. Females have a gestation period of 12 months, and the average inter-birth interval is ~4 years. The weaning age of calves is variable and can be between the ages of 3 and 8 years of age, and mothers' last-born calves appear to be weaned later than earlier-born calves, suggesting terminal investment. The species life expectancy is thought to be >40 years (Allen 2021).

Relevant policy and guidance

Indo-pacific bottlenose dolphin has no threatened listing status under the EPBC Act or the BC Act. Under the EPBC Act the species is listed as Migratory, Marine, and Cetacean, and Migratory under the BC Act. Globally (non-statutory, Indo-Pacific bottlenose dolphins are listed as Near Threatened. Relevant EPBC Act documents are:

- Threat Abatement Plan for the Impacts of Marine Debris on the Vertebrate Wildlife of Australia's Coasts and Oceans (DoEE 2018)

- National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (DoEE 2017b)
- National Guideline for the Survey of Cetaceans, Marine Turtles and the Dugong (DCCEEW 2024a)
- Australian National Guidelines for Whale and Dolphin Watching 2017 (DoEE 2017c)
- Marine bioregional plan for the North-west Marine Region (DSEWPaC 2012a).

Threats and pressures

Indo-pacific bottlenose dolphins preference for shallow coastal habitats overlap with human activity and coastal development which exposes them to repeated and cumulative stressors that have potential to disrupt and displace individuals (Bejder et al. 2006; Smith et al. 2016). Indo-pacific bottlenose dolphins in the Pilbara are facing increasing pressures from combined impacts of environmental change and industrial activities (Raudino et al. 2023).

Based on the North-west Marine Bioregional Plan (Appendix A.1; DSEWPaC 2012a) the following existing threats have identified that may be relevant to consider when assessing impacts of the Proposal:

- Chemical spills
- Vessel strike
- Marine debris
- Nutrient pollution
- Hydrology changes
- Human presences
- Habitat modification and degradation
- Underwater noise.

Relevance to the Proposal area

Likelihood of occurrence: High

Indo-pacific bottlenose dolphins are known to occur in the waters of and around the Proposal (Figure 12; Figure 13; Figure 14; Figure 34). The Indo-Pacific bottlenose dolphin is a qualifying species for the nearby Dampier Archipelago IMMA (Figure 21), this area is thought to support small resident populations of Indo-Pacific bottlenose dolphins (IMMA 2022). Habitat suitability modelling suggests more suitable habitat to be present offshore (Hanf et al. 2022), however have been sighted inshore and offshore throughout the Pilbara. Given the species is highly mobile it is highly like that Indo-Pacific bottlenose dolphins will be present foraging, socialising or travelling in all areas of the Proposal, at any time of year, but are not restricted to the area.

6.1.4. Humpback whale

Population

Humpback whales have a global distribution consisting of 16 distinct populations currently recognised (Jackson et al. 2015). The whales present in the waters off WA represent Population IV, or Breeding Stock D, which are humpback whales that annually migrate from their feeding grounds in Antarctica to their breeding grounds in northern WA (Jenner et al. 2001; Salgado Kent et al. 2012). Breeding Stock D is the largest population of humpback whales worldwide and is estimated at ~20,000 to 30,000 animals

(Salgado Kent et al. 2012). Humpback whales were targeted by commercial whaling industry in WA until it was shut down in 1978. When the population was last assessed in 2008, they were the fastest recovering population, with annual recovery rates estimated at between 9.7 to 13% (Hedley et al. 2008; Hedley et al. 2011; Salgado Kent et al. 2012). Humpback whales were delisted from its previous threatened species status in 2022 though it is still a species considered a MNES under the EPBC Act as a listed Migratory species and remains listed as a Cetacean under EPBC Act Division 3 where it is an offence to kill, injure, take, trade, keep, move or interfere with a cetacean (TSSC 2022).

Distribution

Globally, humpback whales have a fragmented distribution. In Australia, humpback whales are found on both the east and west coast but represent different populations. The humpback whale migration route is generally within 200 km from shore (Jenner et al. 2010a). Important resting areas have been identified during the southern migration and include (TSSC 2022):

- Augusta
- Geographe Bay
- Shark Bay
- Exmouth Gulf
- The southern Kimberley region.

Humpback whales have been recorded in high numbers throughout the area and surrounds (Jenner et al. 2010a). During their northern migration, the whales tend to remain further offshore (around 50 km offshore), than on their southern migration (around 35 km offshore) (Jenner et al. 2010a). Humpback whale numbers during their northern migration peak offshore of the Dampier Archipelago, from the end of July to the beginning of August (Jenner et al. 2001; Jenner et al 2010a). Peak southern migration numbers occur from the end of August and the beginning of September (Jenner et al. 2001; Jenner et al 2010a). Data collected from satellite tagged whales found that median distances from shore was less than 25 km and in shallow waters (<40 m water depth) (Jenner et al. 2010a). During their southern migration, humpback whale cow-calf pairs travel close to the shore in shallow water depths (<30 m), likely to avoid attacks by sharks, killer whales, and threats from male humpback whales (Jenner et al. 2010b; Thums et al. 2018). Studies for the Wheatstone Proposal by the Centre for Whale Research recorded a substantial number of humpback whales further south of the Proposal area with highest numbers from mid-June onwards, the peak abundance being in August (Jenner at al. 2010a).

Habitat and life history

Humpback whales live to around 48 years old, with a mean sexual maturity age of five years. They undergo seasonal migrations between summer foraging grounds in cold productive waters to winter breeding grounds in warm waters of low latitudes. Breeding Stock D whales migrate annually from the southern Antarctic feeding grounds to the north, entering the North-west Marine Region waters around June, to breed and give birth to their calves, until later returning to the southern waters of the Antarctic around October (DSEWPaC 2012c; Comrie–Greig and Abdo 2014).

Humpback whale calves remain with their mothers for the first year of their lives, with mothers providing food, protection, and help their development (Seeary et al. 2022). Female humpback whales calve every 2 to 3 years, allowing time for the previous year calf to be weaned. This mother-calf association is thought to increase the calves' reproductive success due to the mother teaching essential skills, therefore making this mother-calf association a pivotal movement in the species' life cycle. Occasionally mother-calf pairs will be escorted along their migratory route by male humpback whales (Seeary et al. 2022). The humpback whale migration BIA overlaps the Proposal area. Recent studies have revealed that humpback whale calving grounds extend south from Camden Sound in the Kimberley to at least North-West Cape (Irvine et al. 2018). Approximately 20% of humpback whale calves are born near, or south of, North-West Cape. Using humpback whale borne Digital Acoustic Recording Tags (DTAG), in the Exmouth Gulf, Bejder et al. (2019) demonstrated that:

- Lactating whales save their energy by devoting a significant amount of time to rest
- Lactating females mainly rest while stationary at shallow depths within reach of the hull of commercial ships, thus increasing the potential for ship strike collisions
- Even moderate increases of noise from vessels will decrease the communication range of humpback whales.

Relevant policy and guidance

Humpback whales have been removed from their Vulnerable status under the EPBC Act as of the 26 February 2022. Humpback whales are listed as Migratory and Cetacean under the EPBC Act. They are classified as Conservation Dependant fauna under the BC Act. Their global (non-statutory) listing by the IUCN is Least Concern. Relevant EPBC Act documents are:

- Listing Advice *Megaptera novaeangliae* Humpback Whale (TSSC 2022)
- Threat Abatement Plan for the Impacts of Marine Debris on the Vertebrate Wildlife of Australia's Coasts and Oceans (DoEE 2018)
- National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (DoEE 2017d)
- Australian National Guidelines for Whale and Dolphin Watching 2017 (DoEE 2017c)
- National Guidelines for the Survey of Cetaceans, Marine Turtles and the Dugong (DCCEEW 2024a)
- Marine bioregional plan for the North-west Marine Region (DSEWPaC 2012a).

Threats and pressures

The greatest threats to humpback whales in WA are from human-made underwater noise (resulting in hearing impairment, organ damage, communication interference, elevated stress levels and/or avoidance of important habitat), vessel strike, entanglement in lobster pot lines and marine debris (TSSC 2022). Lactating female humpback whales save their energy by devoting a significant amount of time to rest, and during this time they mainly rest while stationary at shallow depths within reach of the hull of commercial ships, thus increasing the potential for ship strike collisions (Bejder et al. 2019).

Based on the North-west Marine Bioregional Plan (Appendix A.1; DSEWPaC 2012a) the following existing threats have been identified that may be relevant to consider when assessing impacts of the Proposal:

- Underwater noise
- Vessel strike.

Of lesser concern are chemical and hydrocarbon spills.

Relevance to the Proposal area

Likelihood of occurrence: High

Humpback whales are likely to occur within both the nearshore and offshore waters of the Proposal. Humpback whales have been recorded in high numbers throughout the area (Figure 9; Figure 37; HappyWhale 2025) and the humpback whale migration BIA overlaps with the Proposal area (Figure 16). The resting behaviour of the mother-calf whales observed in the Exmouth Gulf (Bejder et al. 2019), only represents a portion of the humpback whale behaviours during southern migration along the WA coastline. With humpback whales displaying resting behaviour across their southern migration (Jenner et al. 2010a). Irvine et al. (2018) research indicates that humpback whale calving grounds extends to include the waters from the Camden Sound in the Kimberley to at least North-West Cape (Irvine et al. 2018) Given the uncertainty of the behaviour of the mother-calves at the Proposal area, the assumption is that mother-calf behaviour would display the same behaviour across their calving area, including the waters adjacent the Proposal.

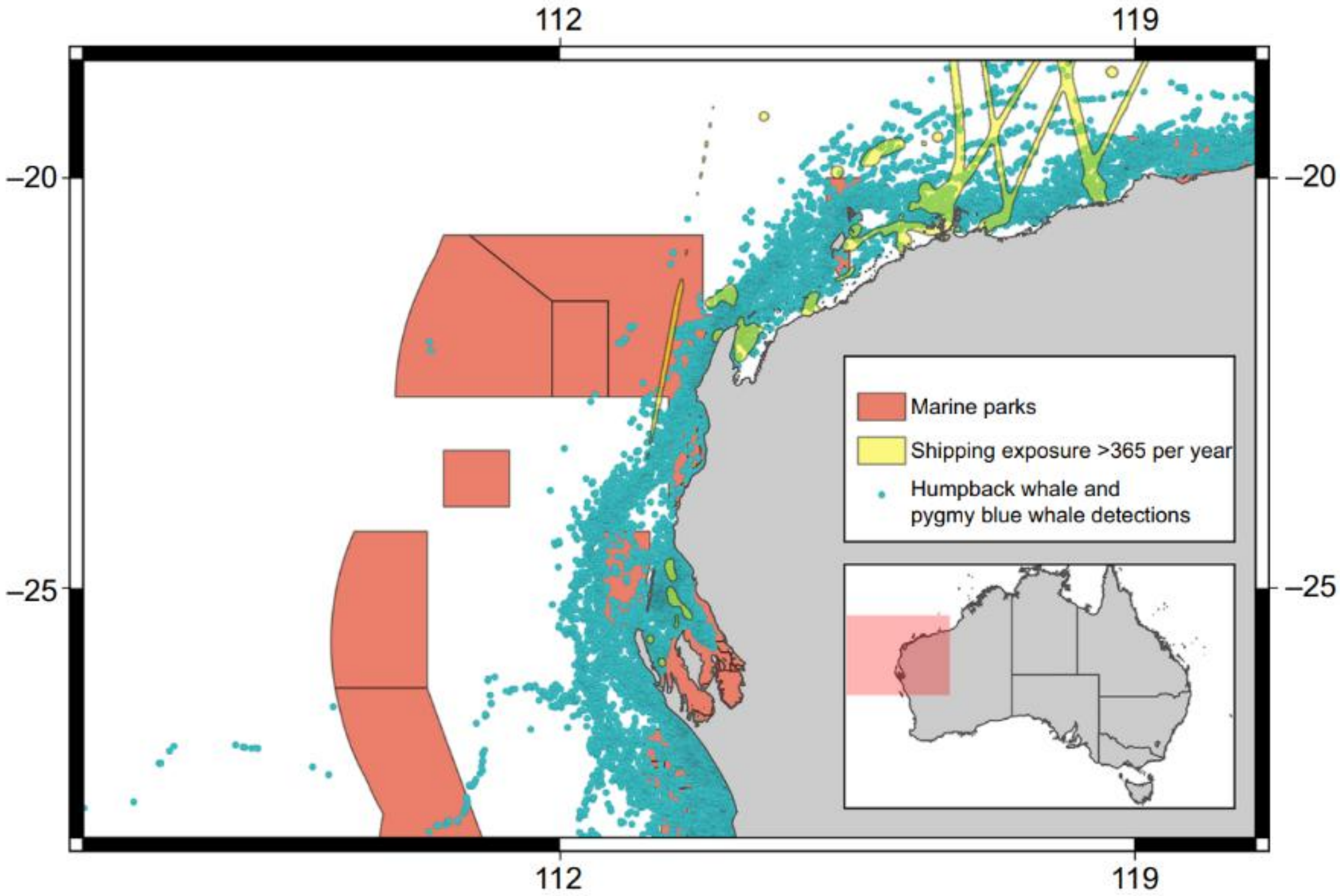


Figure 37: Areas exposed to >365 vessels per year per 10-km radius (yellow) in relation to baleen whale movements (teal), with a focus on the Ningaloo Marine Park (in the centre) and other marine parks (red zones). Satellite-tag record locations of pygmy blue and humpback whales (n = 155, teal circles). State and national marine parks of Australia are overlayed in red (Raoult et al. 2022)

6.2. Reptiles

6.2.1. Turtles

There are three turtles that have been identified as key species in the Proposal area; green, flatback, and hawksbill turtles. These are discussed in the sections below.

Population

Marine turtles return to the region where they hatched to breed, meaning through evolution discrete genetic stocks have formed for each species which are defined by the presence of regional breeding aggregations. A summary of the turtles global, regional and local populations are presented in Table 20.

Table 20: Summary of turtle population estimates, trends, and status (DoEE 2017a; IUCN 2025)

Species	Global	Australian	Stock relevant to the Proposal
Green turtle	Estimate: Unknown Trend: decreasing.	In Australia there are nine genetically distinct stocks.	Stock: NWS stock/Scott Browse stock' Status: stable and is one of the largest in the world and the largest in the Indian Ocean
Flatback turtle	Estimate: Unknown Trend: Unknown.	In Australia there are five genetically distinct flatback turtle stocks.	Stock: 'Pilbara' coast stock Status: unknown
Hawksbill turtle	Estimate: Unknown Trend: Decreasing.	Three genetically distinct stocks of hawksbill turtle in Australia.	Stock: WA Status: unknown, but is one of the largest in the world and the largest in the Indian Ocean.

Distribution

Turtles are found in the nearshore environment, turtles habitat overlaps with the Proposal elements seawater intake, trestle jetty, shipping channel, bitterns, spoil disposal ground, underwater noise, and dredge plume. A summary of the relevant species distribution is presented in Table 21.

Table 21: Summary of turtle species distribution

Species	Global distribution	Australian distribution
Green turtle	Green turtles have a circumglobal distribution, found in tropical and subtropical waters.	In Australia green turtles are distributed across tropical northern waters of the country. NWS stock The NWS stocks nesting distribution Adele Island, Maret Island, Cassini Island, Lacepede Islands, Barrow Island, Montebello Islands (all with sandy beaches), Serrurier Island, Dampier Archipelago, Thevenard Island, North-West Cape, and the Ningaloo coast (DoEE 2017a).
Flatback turtle	Flatback turtles are distributed through tropical waters of northern Australia,	Flatback turtles have a restricted distribution and are endemic to Australia. Tagging studies completed on flatback turtles in WA identified two key areas of importance based upon occupancy index;

Species	Global distribution	Australian distribution
	Papua New Guinea, and Irian Jaya.	Barrow Island and Roebuck Bay (Figure 38), and the waters adjacent to the Proposal area recorded lower levels of occupancy and percentage of turtles' present (Peel et al. 2024). Further, a clear corridor connecting the western-most NWS stocks and the eastern Kimberely was present in the tagging studies with a high percentage of turtles (Figure 38; Peel et al. 2024). Pilbara stock Flatback turtles that nest on the Pilbara coast disperse to feeding areas extending from the Exmouth Gulf to the Tiwi islands in the NT (DSEWPaC 2012e). Nesting distribution of the Pilbara stock has been identified at the Montebello Islands, Mundabullangana Station, Barrow Island, Cemetery Beach, Dampier Archipelago (including Delambre Island and Huay Island), and coastal islands from Cape Preston to Locker Island.
Hawksbill turtle	Hawksbill turtles are distributed globally in tropical, subtropical, and temperate waters.	In Australia they are found in QLD, the NT, and WA. WA is one of the largest remaining hotspots of hawksbill turtles (Fossette et al. 2021a). WA stock The nesting distribution of the WA stock has been identified at the Dampier Archipelago (Including Rosemary Island and Delambre Island), Montebello Islands (including Ah Chong Island, Southeast Island and Trimouille Island), Lowendal Islands (including Varanus Island, Beacon Island and Bridled Island) and Sholl Island

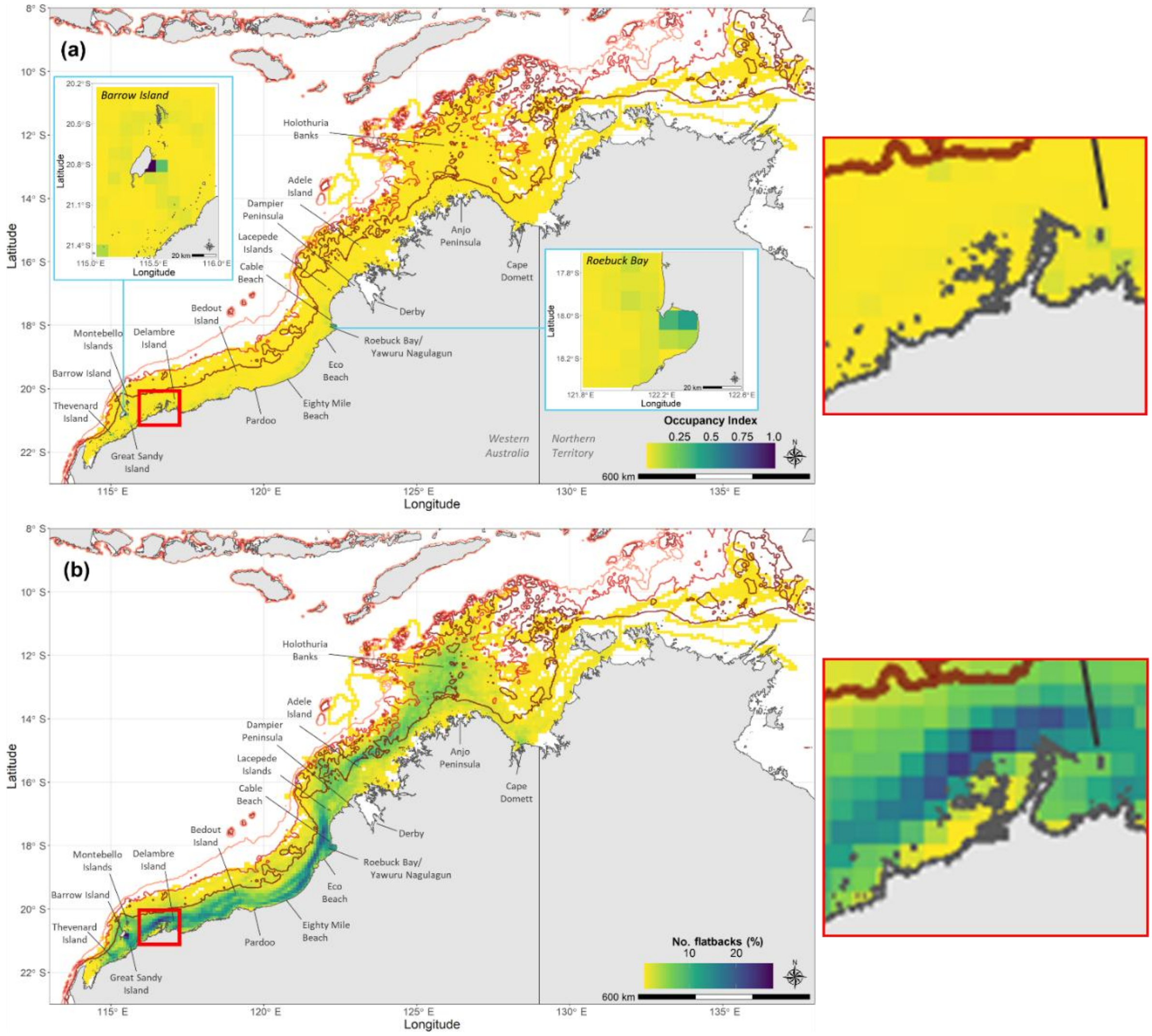


Figure 38: Space use for flatback turtles (n = 280) tracked with satellite tags in northern WA (years 2005–2019) as measured by occupancy index (i.e. relative amount of time spent per 10 × 10 km grid cell (Peel et al. 2024)

a) The number of tagged flatbacks moving through each 10x10 km grid cell (percentage of total), b) colour ramp scales from low (yellow to high (purple) occupancy indices and numbers of flatbacks (max=27.9%). Orange lines represent bathymetric contours at 50, 100, and 200 m (dark, medium, and light lines, respectively). Blue inset boxes in (a) indicate peaks in occupancy index offshore of Barrow Island (left) and at Roebuck Bay (right).

Habitat and life history

The biology and ecology of turtles renders the survival of their population susceptible to changes in their environment. Turtle growth is slow, although it varies among species, habitats, sex, and maturity. Depending on species, turtles require 20 to 50 years to reach sexual maturity and female reproductive activity may vary from one to eight years depending on food availability to assist in fat storage for egg production and breeding migration (Pendoley 2005; Fossette et al. 2021a). Marine turtles return to the region where they hatched to breed, meaning through evolution discrete genetic stocks have formed for each species which are defined by the presence of regional breeding aggregations. Turtles utilise different foraging habitats based on their respective diets, a summary of the diets is presented in Table 22, and description of foraging habitats and behaviours are presented in the sections below.

Table 22: Summary of turtles' diets

Species	Generalised diet
Green turtle	Primarily herbivorous, foraging on algae, seagrass, and mangroves. In their pelagic juvenile stage, they feed on algae, pelagic crustaceans, and molluscs.
Flatback turtle	Primarily carnivorous, feeding on soft-bodied invertebrates including sponges found in epibenthos.
Hawksbill turtle	Omnivorous, feeding on algae, sponges, soft corals, and other soft-bodied invertebrates. Important foraging habitat has not been identified for the WA stock.

Green turtle

Post-hatchling habitat utilisation is unknown, but it is likely that they disperse through much of the Indian Ocean and Arafura Sea.

Juveniles are known to foraging in tidal/subtidal habitats generally within coral reefs, mangroves, sandy areas, rocky reefs, and mudflats where algal turf or seagrass meadows are presents. In the Pilbara juvenile green turtles are regularly seen foraging and resting in both coastal and offshore waters (DoEE 2017a). Juvenile green turtles were captured during each of the sawfish surveys for the Proposal, with the majority of individuals cause being <450 mm carapace length (HBI 2025). Further, drone surveys around the Proposal and visual observations at an acoustic receiver sight identified numerous green turtles (flight in 2024 identified >66 individuals, and >70 turtles visually observed) (HBI 2025).

Green turtles from the NWS Pilbara rookeries have been found to travel a median distance of 306 km (range: 60-2,638 km) to foraging areas (Ferreira et al. 2021). Adult green turtles are regularly observed foraging and resting in coastal and offshore waters in the Pilbara. Tagging studies completed on adult green turtles found that foraging largely occurs in shallow waters, depths ranging between one and 104.5 m (Ferreira et al. 2021). The species foraging BIA does not overlap with the Proposal (Figure 18). However, research suggests that the current foraging BIA is largely underestimated and tagged foraging green turtles only had 5% overlaps with the existing BIA (Figure 39; Ferreira et al. 2021). The foraging movements of the NWS Pilbara stock did however overlap with the 20 km inter-nesting buffer (i.e. habitat critical for the survival of the species), and therefore foraging still occurs within protected areas. The species habitat critical for the survival overlaps with the Proposal (Figure 20), and areas of high foraging have been identified either side of the Proposal (Figure 39; Ferreira et al. 2021).

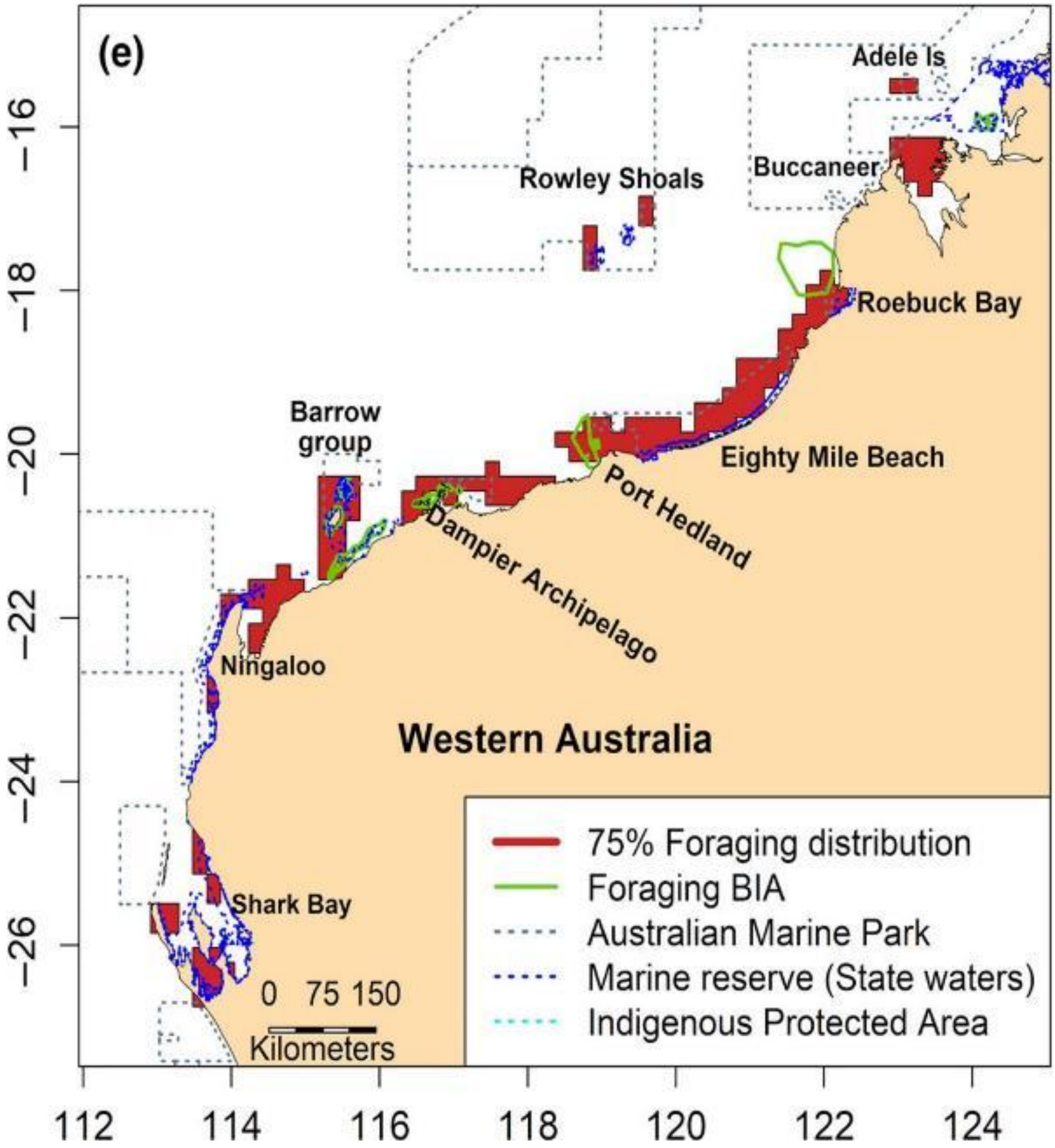


Figure 39: Green turtle foraging areas (Ferreira et al. 2021). 75% foraging distribution of green turtles in the north-west of Australia, overlaid with Marine Protected Areas and the Foraging BIAs formally recognised by the Australian Government (Ferreira et al. 2021)

Flatback turtle

Post-hatchling habitat is likely located in the waters over the Australian continental shelf (DoEE 2017a). This habitat utilisation was observed in recent modelling of emerging flatback turtle movements in the Pilbara region (Wilson et al. 2023). The results found that a large proportion of the hatchling core areas during all 3 time periods (Days 1–4, 10–15 and 25–30) were concentrated close to the coast (Figure 40), with 3 semi-discrete areas: along the coast west of South West Regnard Island, a large area north of Rosemary Island during days 10 to 15 (Figure 40b; d)

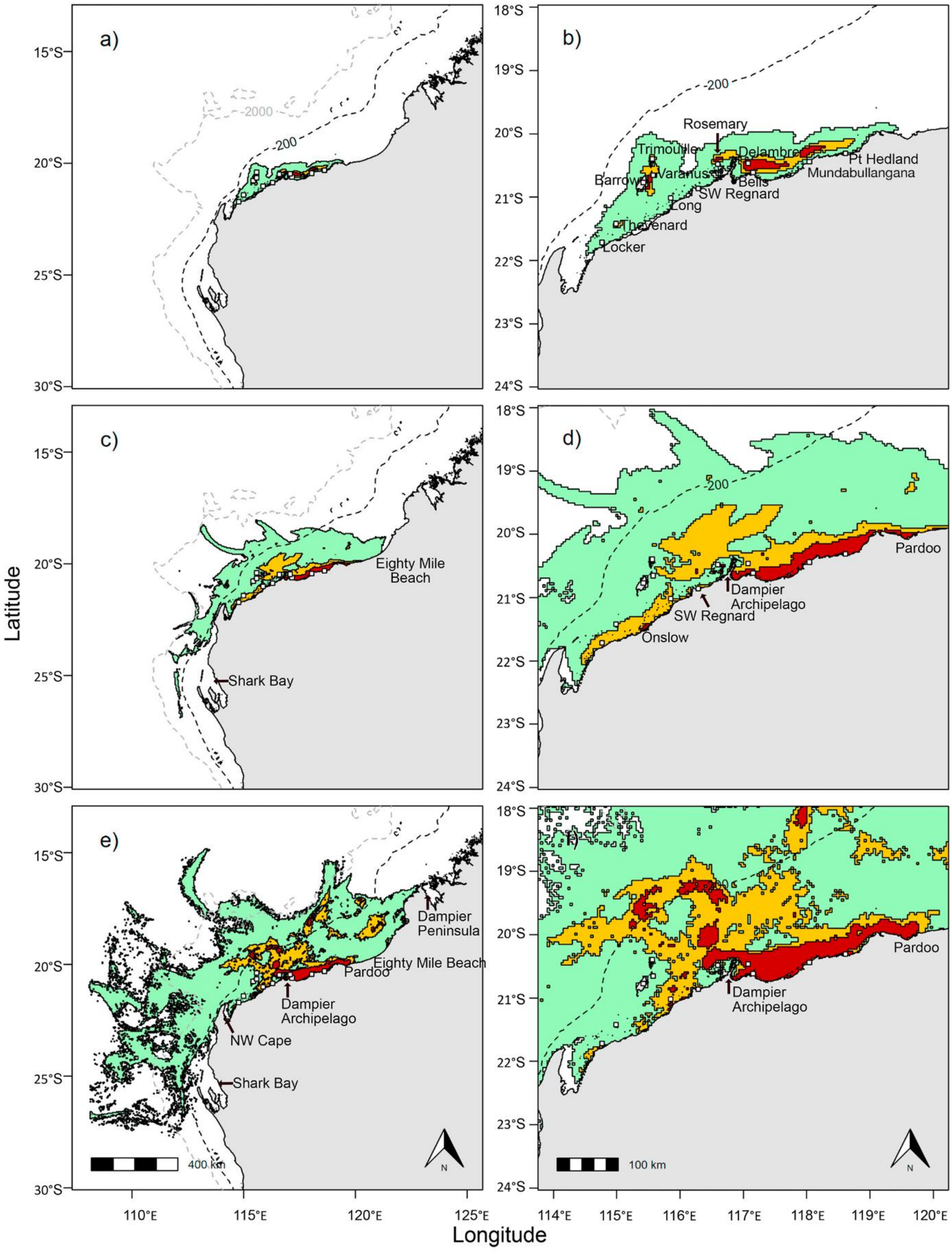


Figure 40: Distribution of virtual flatback turtles during their first 4 d (a,b), Days 10–15 (c,d) and Days 25–30 (e,f) after entering the sea, calculated by summing the number of particles per 4 × 4 km grid cell. White squares: release locations; coloured areas represent cumulative frequency distribution–red: 25%, orange: 50%, green: 95%; dashed lines represent depth contours–black: 200 m, grey: 2,000 m. Left panels are the entire distribution, right panels are zoomed to highlight core areas.

Juvenile flatback turtle grow to maturity in shallow coastal waters, likely in waters close to their natal beaches (DSEWPaC 2012e). Juvenile turtles prefer soft sediment habitats which support benthic invertebrates (DoEE 2017a).

Adult flatback turtles foraging grounds are strongly associated with geomorphology, with the species having a preference for terraces, deep holes and valleys (DCCEEW 2024d; Thums et al. 2017). When foraging flatback turtles used a wide range of the water column, with recent tagging studies showing foraging in water depths ranging from zero to 730 m, although the median and mean depths indicate a preference for shallower foraging habitats (typically <50 m; 28 m and 34 ± 29.6 m, respectively) (Peel et al. 2024). Flatback turtles migrate from nesting beaches to foraging areas and foraging habitat are present along the WA shallow waters (<130 m) and within 315 km of the shore (DoEE 2017a; Richards et al 2024). While migrating flatback turtles tended to occupy shallow, inshore waters with a median water column depth of 25 m (Peel et al. 2024).

Hawksbill turtle

Post-hatchling habitat utilisation is unknown. Juvenile hawksbill turtles are found in similar habitats as adults, including tidal and sub-tidal coral and rocky reef habitats, which provides food for juveniles. Juvenile hawksbill turtles are found to inhabit both clear and turbid waters, over reefs, seagrass meadows or on soft-bottom habitats.

Important foraging habitats have not been identified for the WA hawksbill stock (DoEE 2017a). Adult hawksbill turtles inhabit tidal and sub-tidal coral and rocky reefs to forage, can also be found in clear and turbid waters over reefs, seagrass meadows or soft-bottom habitats (DoEE 2017a Hawksbill foraging habitat ranges from one to 20 m, but foraging primarily occurs in water depths between 10 and 20 m and has a strong affinity for shallow coral reefs and intertidal reef habitats (Fossette et al. 2021b). Research has found that only 10% of the 75% foraging distribution of hawksbill turtles overlap with their foraging BIA, and while migrating hawkbill turtles display very little foraging behaviour (Fosette et al. 2021b). Foraging distribution extends from Exmouth Gulf to Adele Island in the Kimberley but is not continuous instead appears there are discrete foraging areas (Figure 41; Fossette et al. 2021b). The foraging BIA does not overlap with the Proposal (Figure 18) however studies suggest that foraging areas occur outside the recognised BIA (Fossette et al. 2021b).

Hawksbill turtles are known to migrate between Dampier Archipelago and Onslow but can migrate up to 2,400 km between nesting and foraging grounds (DSEWPaC 2012e). Tagging studies on WA hawksbill turtles found that the species migrated through shallow continental-shelf waters (<200 m) and primarily follow the coastline while dispersing in a north-easterly direction (Fossette et al. 2021b). Majority of migrating WA hawksbill turtles distribution has been found from Barrow Island to the northern part of Eight Mile Beach, with a clear migratory corridor with a relatively high overlap of migrating turtles (up to 56% was observed from Cape Preston to the Turtle Islands; Figure 42b). The migratory corridor covers an area of 13,119 and 17,640 km^2 for the occupancy index and number of turtles in a cell, respectively. While migrating the median water depth has been found to be 17.2 m (range = 1.2–69.2 m) (Fossette et al. 2021b).

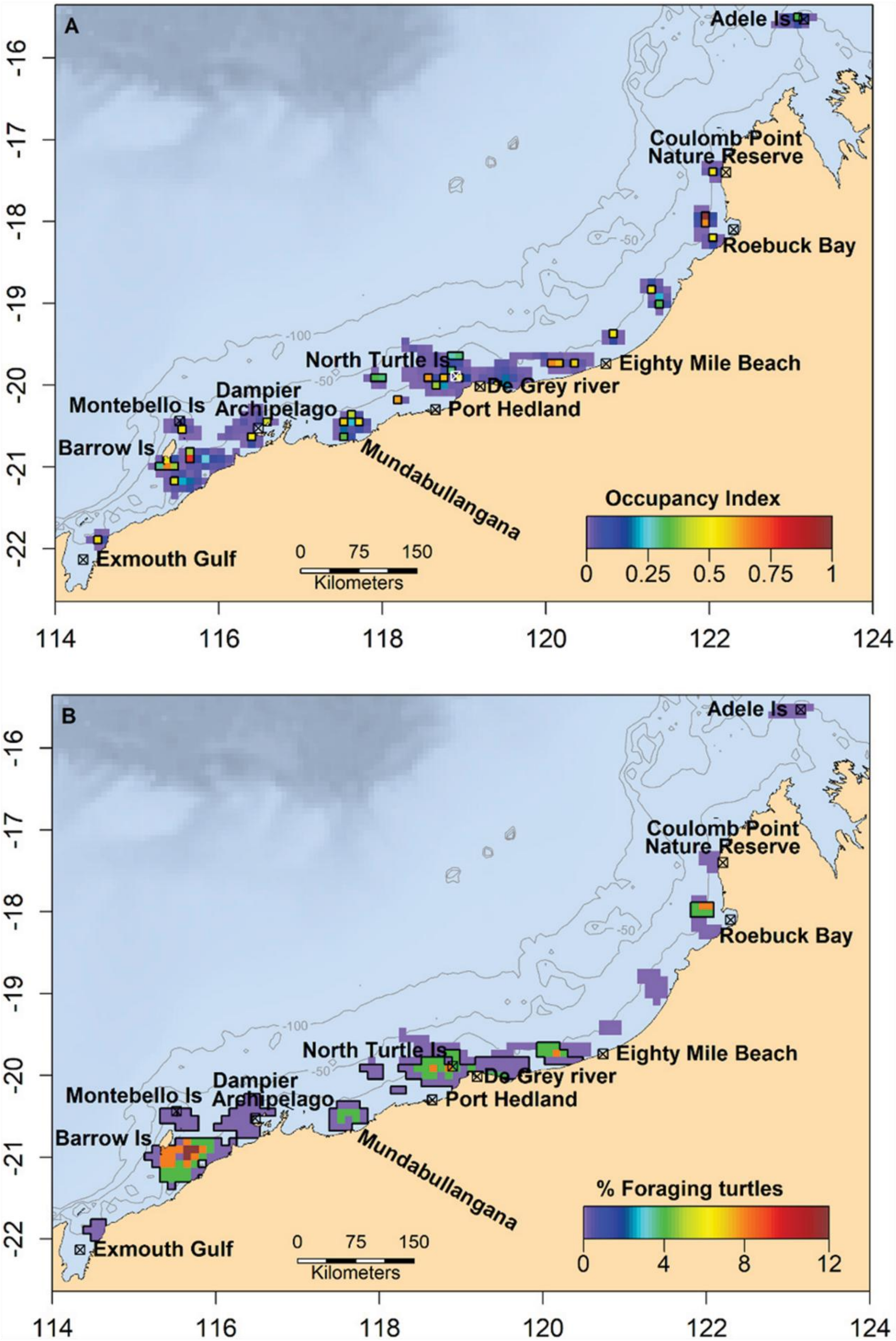


Figure 41: Foraging distribution of 36 hawksbill turtles off WA calculated using the occupancy index (A) and the percentage of foraging turtles per grid cell (B). The 75% distribution is shown as a black contour and the 20, 50 m, 100 m bathymetric contours as grey lines (Fossette et al. 2021b)

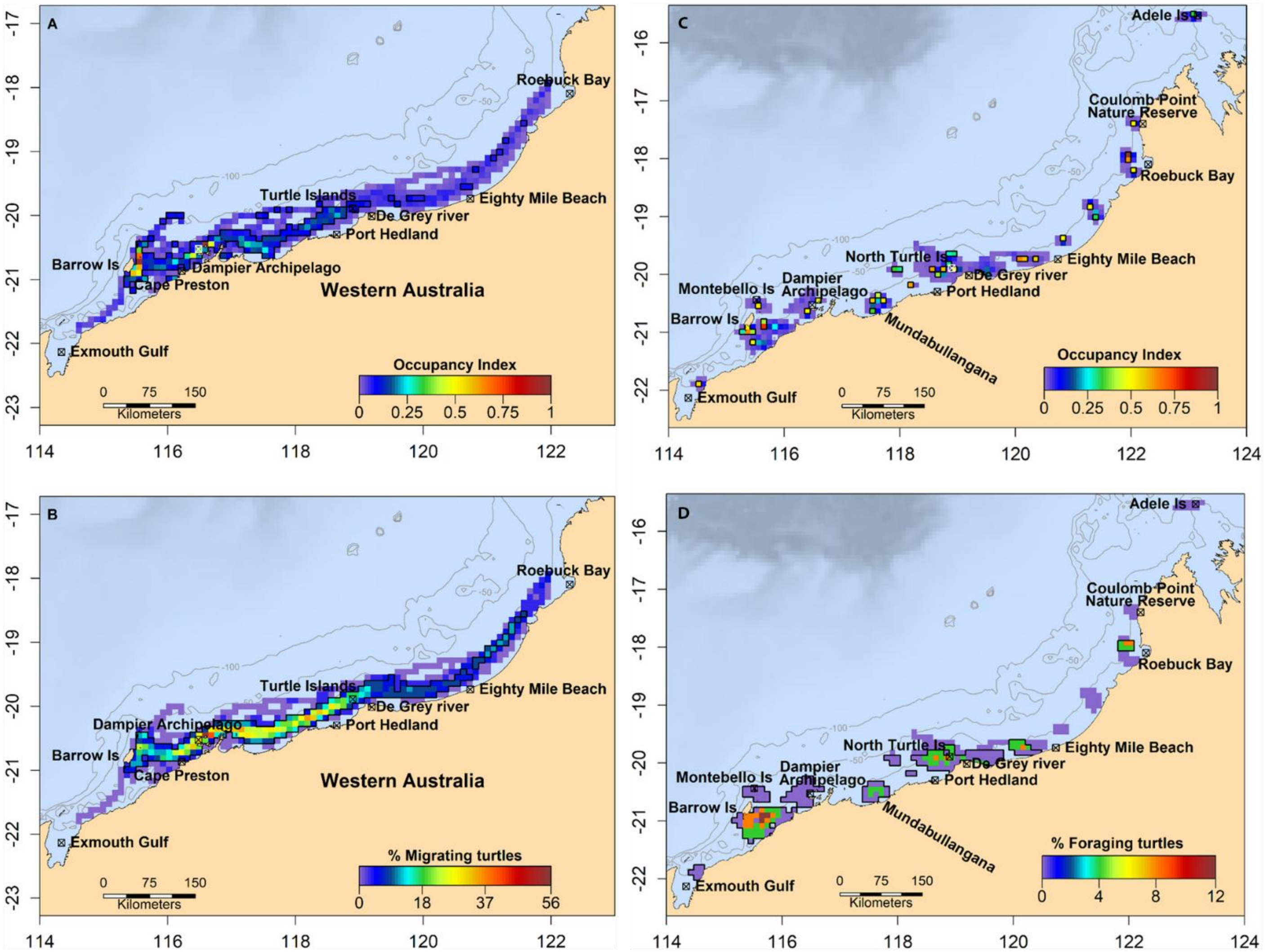


Figure 42: Migration distribution for 36 hawksbill turtles satellite tagged at WA rookeries using the occupancy index (A) and the percentage of migrating turtles per grid cell (B). Foraging distribution of 36 hawksbill turtles off WA calculated using the occupancy index (C) and the percentage of foraging turtles per grid cell (D). The 75% distribution is shown as a black contour and the 20, 50, and 100 m bathymetric contours as grey lines (Fossette et al. 2021b)

Nesting

Turtle nesting sites are selected carefully as nests can be disrupted by flooding or erosion (as well as by feral animals such as cats and foxes). After a period of incubation (in which time sand temperature will influence the male-female sex ratio), hatchlings will emerge and head to the open ocean using natural navigation cues. The number of marine turtles using Cape Preston beaches is documented to be very low, and in some years no nesting activities occur at all (Imbricata Environmental 2013). The eastern beach of Cape Preston, however, provides a suitable nesting habitat for marine turtles (Imbricata Environmental 2013). The mainland and island beaches adjacent to the Proposal support low abundance of turtle nesting, excluding Steamboat Island which is 15 km from the Proposal port infrastructure and salt stockpiles. Surveys completed for the Proposal have found that hawksbill turtles are the most abundant species (Pendoley Environmental 2023; 2024). Hatchlings fans were recorded on south-west Regnard Island, north-east Regnard Island, Cape Preston East beach and Steamboat Island (Pendoley Environmental 2023; 2024).

A summary of the species-specific nesting activities is presented below.

Green turtle

Female green turtles may reach sexual maturity between 25 and 50 years of age, depending on the different foraging grounds they inhabit (DCCEEW 2024d). Green turtles breed extensively throughout the North-west bioregion, and along the coastal (state) areas adjacent to it (Limpus 2008 in DSEWPaC 2012e). Breeding male and female green turtles move from their feeding grounds to areas near nesting beaches for mating, then females move onto the beach to lay their eggs, usually on several different nights. The NWS stock green turtles mating period typically ranges from September to December, with nesting occurring from November to March (peak December to February) (DoEE 2017a; Fossette et al. 2021a). Green turtle hatchlings typically emerge from January to May with peak hatching during February to March (DoEE 2017a).

Green turtles nesting in the Pilbara is primarily concentrated on island beaches rather than mainland beaches (Pendoley et al. 2016). The closest nesting BIA for green turtles is located ~30 km north east around the islands of the Dampier Archipelago, and the major/important nesting area for green turtles in the NWS stock are located at Lacepedes, Montebello, Barrow, Muiron, Browse Islands, and NWC (DoEE 2017a).

A review of turtle habitat usage of the Cape Preston area conducted by Imbricata Environmental in 2006 identified the eastern and south-eastern beaches as favoured by green turtles (LeProvost Environmental 2008; Imbricata Environmental 2013). Recent track census surveys for the Proposal (see Section 4.3.1 and 5.3.1) found very limited green turtle tracks and nesting on Steamboat Island (Pendoley Environmental 2024). The overall nester abundance on the surveyed for the Proposal area in 2023/24 was estimated to be two to three individuals and was comparable to the 2022/23 season of two to four individual green turtles (Pendoley Environmental 2024).

Flatback turtle

Flatback turtles reach sexual maturity at ~21 years of age. The mating period for the Pilbara stock is September to January. Nesting occurs from October to March (peak November to January) and hatchlings emerging from February and March (DoEE 2017a).

In WA, flatback nesting ranges from the southern Pilbara to the NT border (DBCA 2017). Flatback turtle predominantly nest on islands, but nesting has also been documented on mainland beaches such as Cape Preston, nearby to the Proposal area (Figure 25; Figure 22; Fossette et al. 2021a). A review of turtle habitat usage reports for the Cape Preston locality identified the south-western beaches as favoured by flatback turtles (LeProvost Environmental 2008; Imbricata Environmental 2013). The flatback turtles nesting BIA does not overlap with the Proposal area but is located ~30 km north-east of the Proposal, on islands of the Dampier Archipelago (Figure 18).

The closest major flatback turtle rookeries to Eramurra are located at Barrow Island, the Montebello Islands, Varanus Island and Rosemary Island (Imbricata Environmental 2013). Rookies are also located at Delambre Island and Bells beach (Peel et al. 2024). Recent track census surveys for the Proposal (see Section 4.3.1 and 5.3.1) identified nesting tracks on Sout West Regnard and Steamboat Island, no nesting was recorded on the mainland. The overall nest abundance on the surveyed for the Proposal in 2023/24 was estimated to be three to four individuals and was comparable to the 2022/23 season of two to three individual flatback turtles (Pendoley Environmental 2024).

Hawksbill turtle

Hawksbill turtles reach sexual maturity when they are >31 years old. The WA stock of hawksbill turtles can mate all year round. Similarly nesting and emergence occurs all year but the peak nesting period is October to January, and peak hatchling is from December to February (DoEE 2017a).

Hawksbill turtles breed extensively throughout the North-west bioregion and along the coastal (state) areas adjacent to it (DSEWPaC 2012e). Pendoley et al. (2016) found that most hawksbill nesting in the Pilbara region is located within the Onslow subregion. This subregion accounted for 42% of all hawksbill turtle nesting in the assessed Pilbara region. There is a single breeding stock in the region: the WA stock, which is centred on the Dampier Archipelago (DSEWPaC 2012e). Rosemary Island, which is part of the Island group of the Dampier Archipelago, supports the most significant hawksbill turtle rookery in WA and one of the largest in the Indian Ocean (DSEWPaC 2012e). Rosemary Island is more than ~50 km away from the Proposal.

The nesting BIA does not overlap with the Proposal but is located ~30 km north-east of the Proposal, on islands of the Dampier Archipelago (Figure 18). Despite the nesting BIA not overlapping with the Proposal, hawkbill turtles were the most abundant nesting species in the surveys completed for the Proposal (Pendoley Environmental 2024). The most recent track census surveys for the Proposal (see Section 4.3.1 and 5.3.1) found that hawksbill tracks were identified on all surveyed beaches in the 2023/24 season, excluding Forty Mile Beach (Gnoorea) (Figure 25 to Figure 32). The overall nester abundance on the surveyed for the Proposal area in 2023/24 was estimated to be 21-24 individuals and this with highest at Steamboat Island. The nester abundance in 2023/24 was higher due to Steamboat Island being included. With Steamboat Island excluded the estimated abundance for 2023/24 was eight to nine individuals which is comparable to 2022/23 estimated abundance of six to seven individual hawksbill turtles (Pendoley Environmental 2024).

Inter-nesting

During the 12 to 14 days between laying clutches, females turtles tend to remain in shallow nearshore waters near nesting beaches, using these areas for thermoregulation and resting. Species specific inter-nesting behaviours and requirements are presented below.

Green turtle

The inter-nesting period of the NWS stock of green turtles is from November to March (DoEE 2017a). The species inter-nesting BIA is located ~10 km north-east of the Proposal nearshore infrastructure but overlaps with the proposed spoil ground location (Figure 18), but the species habitat critical for the survival of the species inter-nesting buffer (20 km radius) overlaps with all Proposal marine aspects (Figure 20). Results from Ferreira et al. (2021) tagging study demonstrated that the current 20 km radius inter-nesting buffer zones are adequate in capturing the inter-nesting turtles' movements (Figure 43). Inter-nesting turtles from rookeries located in the NWS Pilbara stock have been found to utilise a smaller area than the designated 20 km inter-nesting buffer (Ferreira et al. 2021).

When inter-nesting green turtles appear to remain in shallow nearshore waters (<20 m), with results from Ferreira et al. (2021) showing a median water depth of 9 m for inter-nesting green turtles (range= 4 – 62 m).

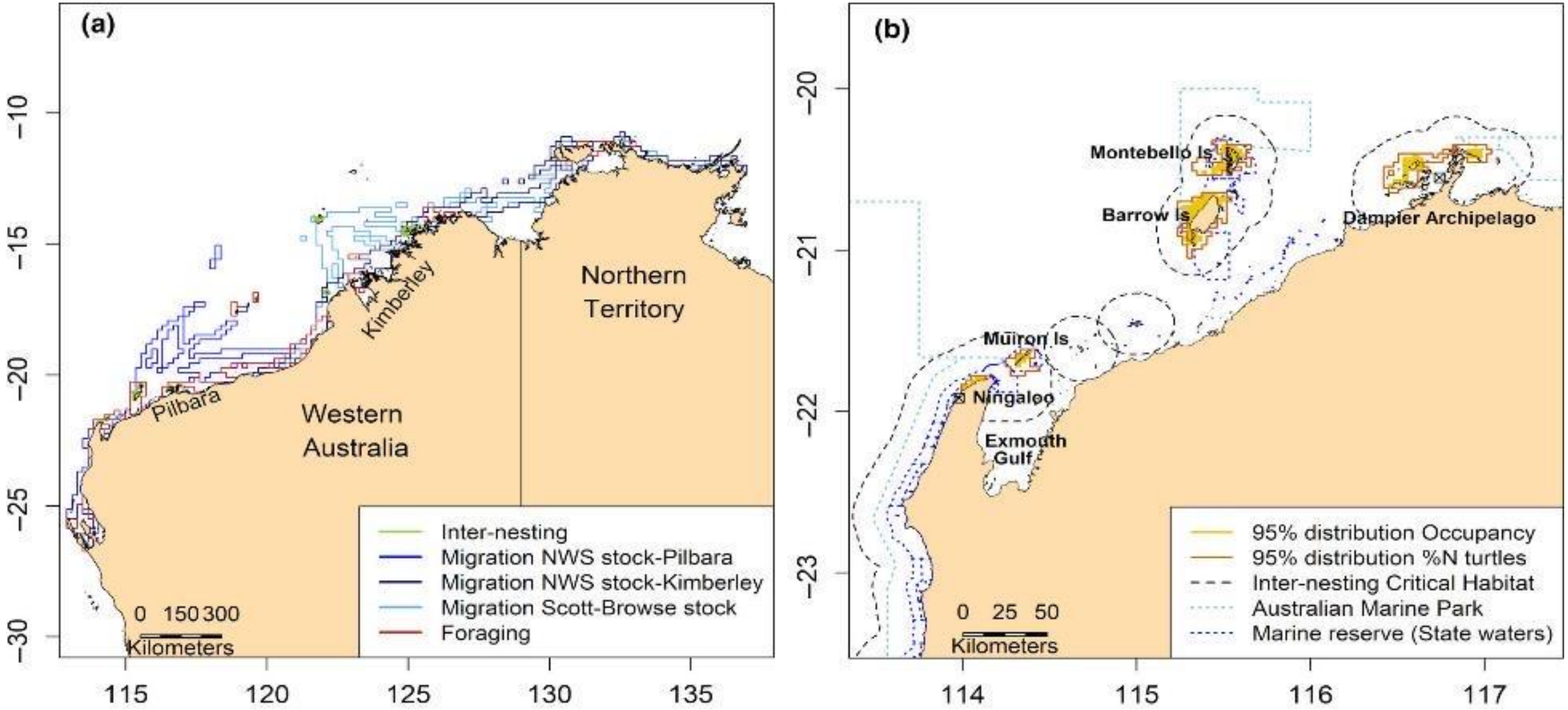


Figure 43: Green turtle movements; inter-nesting, migration, and foraging distribution of green turtles in the north-west of Australia (Ferreira et al. 2021) (a), 95% inter-nesting distribution at rookery scale with defined inter-nesting Habitat Critical Areas (DoEE 2017a) (b), overlaid with Marine Protected Areas (Ferreira et al. 2021).

Flatback turtle

Flatback turtles demonstrate a high level of nest site fidelity with wide-ranging inter-nesting movements within the Pilbara region, with the inter-nesting buffer BIA overlapping the Proposal area (Figure 18; DSEWPaC 2012e; Whittock et al. 2016). A recent study has shown during the inter-nesting period flatback turtles are primarily found within their BIA (>98% overlap) (Peel et al. 2024). While inter-nesting female turtles spend majority (89.6%) of their time in a median water depth of 9 m (range=0-229 m, average=12.7± 12.8 m) and 95% of the time this inter-nesting behaviour occurred within 54.2 km of the nesting beaches (Peel et al. 2024). Barrow Island and Roebuck Bay were identified as areas of importance for the species. During the species inter-nesting period (October to March) the turtles present in the waters of the Proposal area would be from Pilbara/NWS stock (Figure 44; Peel et al. 2024).

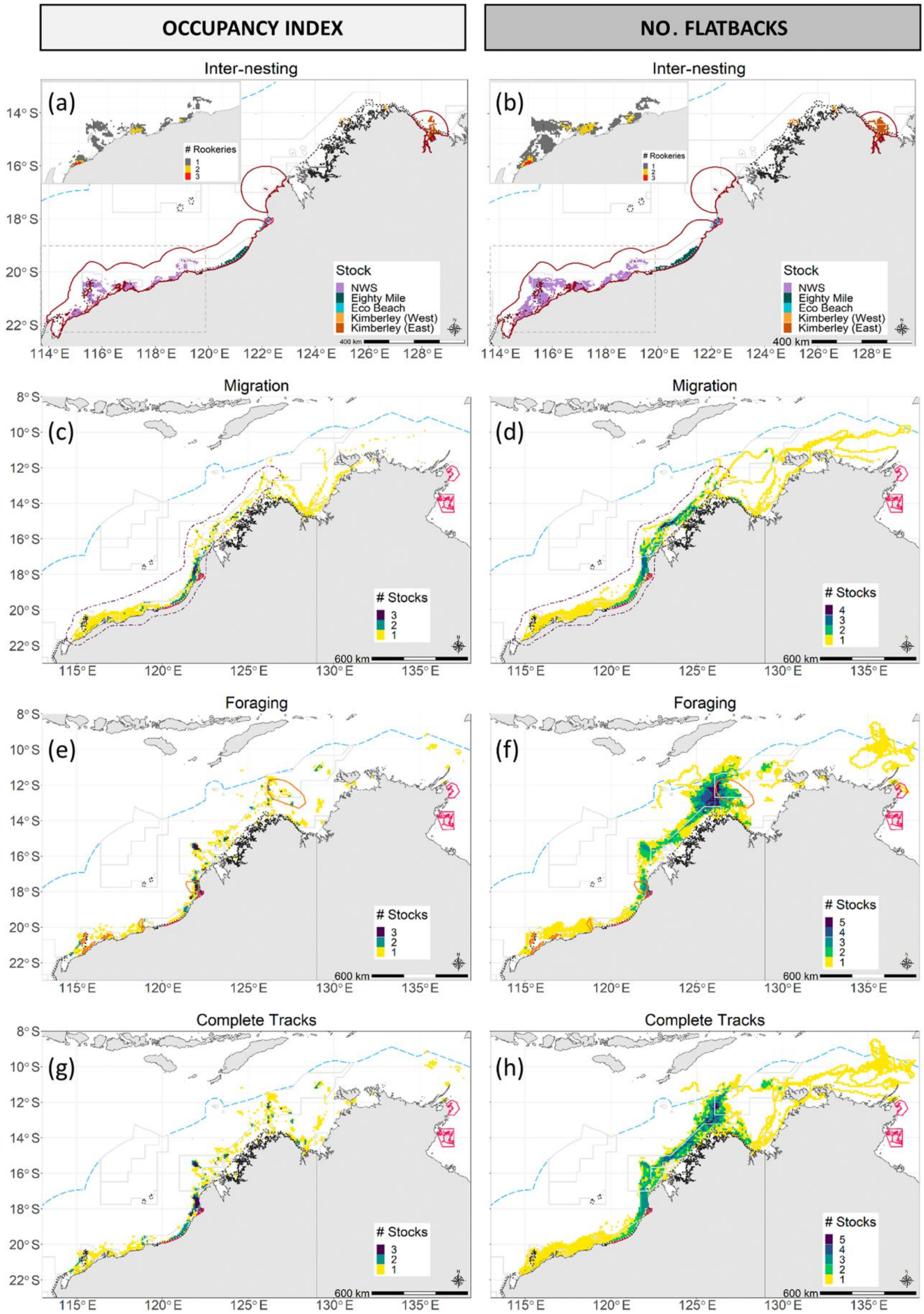


Figure 44: Flatback turtle stocks in a grid cell throughout northern WA delimited from occupancy indices (i.e. relative amount of time spent per grid cell; a, c, e) or the number of tagged flatbacks moving through grid cells (b, d, f) (Peel et al. 2024)

Inter-nesting behavioural phase (a, b), and at the 75% contour on a 10 × 10 km grid at a stock-level for migration (c, d) and foraging (e, f). (Peel et al 2024)

Hawksbill turtle

The closest inter-nesting BIA is located ~11 km from the Proposals nearshore infrastructure, to the north-east, at the 20 km buffer around Dampier Archipelago islands, but overlaps with the proposed spoil ground locations (Figure 18). The habitat critical for the survival of the species (i.e. the 20 km buffer around known rookeries as defined in the species recovery plan DoEE 2017a) overlaps with the Proposal (Figure 20). Tagging studies in WA have found that hawksbills turtles inter-nesting behaviour primarily occurs within the existing inter-nesting Habitat Critical Areas, with 95% inter-nesting distribution for four out of the five rookeries in the study were contained to the 20 km buffer (Fossette et al. 2021b). Given the known nesting of hawksbill turtles on the islands around the Proposal, it is likely that the waters around the Proposal provide inter-nesting habitat for hawksbill turtles.

Relevant policy and guidance

Green turtles are listed as Vulnerable, Migratory, and Marine under the EPBC Act and Vulnerable under the BC Act. Green turtles are globally (non-statutory) listed as Endangered by the IUCN.

Flatback turtles are listed Vulnerable, Migratory and Marine under the EPBC Act and Vulnerable under the BC Act. Flatback turtles are globally (non-statutory) listed as Data Deficient by the IUCN.

Hawksbill turtles are listed Vulnerable, Migratory and Marine under the EPBC Act and Vulnerable under the BC Act. Hawksbill turtles are globally (non-statutory) listed as Critically Endangered by the IUCN.

Relevant EPBC Act documents for marine turtles are:

- Recovery Plan for Marine Turtles in Australia (DoEE 2017a)
- Threat abatement plan for predation, habitat degradation, competition, and disease transmission by feral pigs (*Sus scrofa*) (DoEE 2017b)
- Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE 2018)
- Threat abatement plan for predation by the European red fox (DEWHA 2008b) (excluding hawksbill turtle)
- Threat abatement plan for predation by feral cats 2024 (DCCEEW 2024d)
- National Guidelines for the Survey of Cetaceans, Marine turtles and the Dugong (DCCEEW 2024a)
- Marine bioregional plan for the North-west Marine Region (DSEWPaC 2012a).

Threats and pressures

The biology and ecology of turtles renders the survival of their population susceptible to changes in their environment. Turtle growth is slow, although it varies among species, habitats, sex, and maturity. Depending on species, turtles require 20-50 years to reach sexual maturity, and female reproductive activity may vary from one to eight years depending on food availability to assist in fat storage for egg production and breeding migration (Pendoley 2005; Fossette et al. 2021a). As turtles have a high site fidelity for breeding and nesting, they are vulnerable to natural or anthropogenic habitat alteration. As migratory animals, restrictions to movement can hinder their ability to reach these areas. The most vulnerable life-stage for marine turtles is emerging hatchlings. When emerging there are high levels of predation by native (e.g. seabirds, goannas, sharks) and introduced (e.g. cats, foxes) species. Further, if disorientation occurs, the hatchlings path to the ocean will become less direct; thus, increasing predation risk, or are unable to find the ocean at all.

In relation to coastal development, key threats to turtles are light pollution (i.e. disturbance to nesting behaviour and misorientation of turtle hatchlings), direct habitat removal, degradation of nesting and foraging areas, vessel strike, underwater noise, and entrainment from dredgers. Based on the North-west Marine Bioregional Plan (Appendix A.1; DSEWPaC 2012a) habitat modification, human presence, litter debris, light pollution, invasive species, underwater noise, increased turbidity, vessel strike and dredge entrainment have been identified as existing threats that may be relevant to consider when assessing impacts of the Proposal.

Species specific threats and pressures are identified below.

Green turtle

Based on the North-west Marine Bioregional Plan (DSEWPaC 2012a; Appendix A.1), the species report card (DSEWPaC 2012c), and the turtle recovery plan (DoEE 2017a; Appendix A.3) the following existing threats have been identified:

- Habitat modification (dredging)
- Human presence (tourism, research)
- Nutrient pollution (urban development)
- Marine debris (shipping, vessels, and land-based activities)
- Light pollution (onshore-based activities)
- Vessel strike
- Invasive species (shipping and land-based activities)
- Increased turbidity.

Flatback turtle

Threats with a high-risk rating to flatback turtles identified within the Recovery plan for marine turtles include climate change and variability, chemical and terrestrial discharge (acute), light pollution and habitat modification (infrastructure/coastal development). Marine debris (entanglement), chemical and terrestrial discharge (chronic), terrestrial predation, habitat modification (dredging/trawling), indigenous take, vessel disturbance, and noise interference (acute and chronic) have been identified as moderate risks to the Pilbara flatback turtles (DoEE 2017a). In relation to coastal development, key threats to flatback turtles are light pollution (i.e. disturbance to nesting behaviour and misorientation of turtle hatchlings), reduced water quality, direct habitat removal, degradation of nesting and foraging areas, vessel strike, underwater noise, and entrainment from dredgers. The flatback turtles present in the waters surrounding the Proposal DE, the NWS that supports flatback turtle rookeries, is an area of very high cumulative threats linked to industrial development these NWS rookeries could benefit from higher levels of legal protection (Whittock et al. 2014; Thums et al. 2018; Ferreira et al. 2021; Fossette et al. 2021a, Ferreira et al. 2023).

Based on the North-west Marine Bioregional Plan (DSEWPaC 2012a; Appendix A.1), the species report card (DSEWPaC 2012c), and the turtle recovery plan (DoEE 2017a; Appendix A.3) the following existing threats have been identified:

- Habitat modification (dredging)
- Human presence
- Marine debris (shipping, vessels, and land-based activities)
- Light pollution (onshore-based activities)
- Invasive species (shipping and land-based activities)
- Vessel strike
- Increased turbidity.

Hawksbill turtle

Based on the North-west Marine Bioregional Plan (DSEWPaC 2012a; Appendix A.1), the species report card (DSEWPaC 2012c), and the turtle recovery plan (DoEE 2017a; Appendix A.3) the following existing threats have been identified:

- Light pollution
- Marine debris
- Terrestrial discharge
- Habitat modification (infrastructure/coastal development and dredging)
- Vessel strike
- Underwater noise.

Relevance to the Proposal area

Green turtle

Likelihood of occurrence: High

The Proposal is located within the inter-nesting BIA (Figure 18) and the habitat critical for the survival of the species (inter-nesting buffer) for the green turtle. The green turtles nesting BIA is located ~30 km north-east of the Proposal, and green turtles have been found to nest infrequently and in low density around the Proposal (O2 Marine 2022c; Pendoley Environmental 2023). Remotely piloted aerial system (RPAS) field work identified green turtles using the beaches of the Proposal area to Gnoorea Point at low and varying levels, therefore it can be assumed this area does not represent regionally important turtle habitat (O2 Marine 2022c). Juvenile green turtles have been recorded in shallow coastal waters in nearshore algal-rock benthic habitats and mangrove forests of the Proposal area. UAV surveys and visual observations within the tidal creek surrounding the Proposal identified a large number of green turtles both juveniles and adults. Juvenile green turtles, >80, were sighted by HBI researchers immediately west of the Intake Creek and >70 green turtles were sighted in the space 18 mins at the mouth of the creek (HBI 2023, 2025). Across the sawfish surveys, juvenile green turtles were caught in the nets during all survey event (2022, 2023, and 2024), including the creeks and nearby shallow environments. Areas suitable for green turtle foraging include shallow reef that surround the offshore islands, and mangrove habitat close to the mainland, which are present at the Proposal location. Therefore, it is likely that the nearshore and intertidal environments including creeks provide important foraging habitat for juvenile green turtles, including the intake creek.

It is likely that juveniles will be present foraging within the Intake Creek, other creek systems and the nearshore environment around the Proposal. Adult green turtles are likely to be present travelling, foraging, inter-nesting, and nesting in low abundance in the area around the Proposal.

Flatback turtle

Likelihood of occurrence: High

Flatback turtles are known to occur in the Proposal area (Figure 15), with nesting recorded on islands adjacent to the Proposal (Figure 25 to Figure 32) (Pendoley Environmental 2023; 2024), however nesting has been recorded in low abundance. Additionally, RPAS field work identified flatback turtles using the beaches of the Proposal area to Gnoorea Point at low and varying levels (O2 Marine 2022c). Results from the multiple field surveys (O2 Marine 2022c; Pendoley Environmental 2023; 2024) indicate that the Proposal are does not represent important nesting habitat and is not considered to be regionally important habitat. Flatback turtles BIA (Figure 18) and Habitat Critical for the Survival of the Species (Figure 20) overlap with the nearshore and offshore elements of the Proposal. It is likely that flatback turtles could be present in the water adjacent to the Proposal throughout the year, utilising the water for inter-nesting, foraging and migration (Peel et al. 2024; Figure 45) and nesting on beaches near the Proposal.

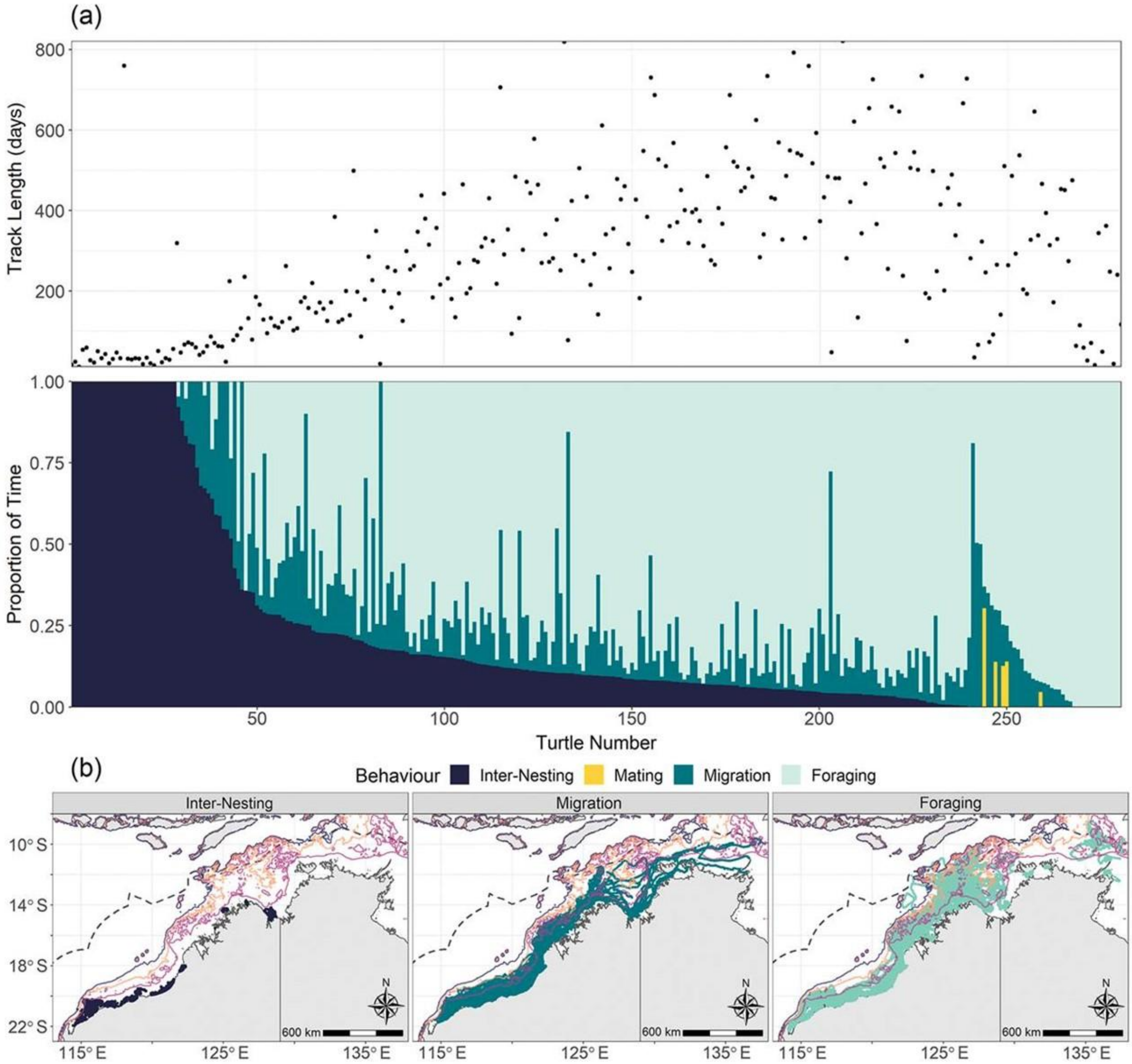


Figure 45: Track length in days and proportion of time satellite tracked flatback turtles (n=280) spent in four identified behavioural phases (Peel et al. 2024)

Hawksbill turtle

Likelihood of occurrence: High

Hawksbill turtles are known to occur in the waters of the Proposal (Figure 15) and known to forage and migrate in the waters adjacent to the Proposal (Figure 42). Hawksbill turtles have been identified nesting around the Proposal area including the mainland beaches; Cape Preston East beach, with highest nesting densities recorded at south-west Regnard Island and Steamboat Island (Pendoley Environmental 2023; 2024). Previous RPAS surveys found no hawksbill tracks on the beaches of the Proposal Area (Figure 24) but did identify non-species-specific tracks on the mainland beaches (O2 Marine 2022c). Pendoley Environmental (2023) survey using track census methods was able to identify tracks to a species level and identified hawksbill tracks at Cape Preston East beach in the area where O2 Marine (2022c) previously identified non-species-specific tracks.

Given hawksbill turtles are known to nest around the Proposal, it is likely that the waters around the Proposal provide inter-nesting habitat for hawksbill turtles. Further, the waters sounding the Proposal are likely to provide suitable and preferred foraging habitat for hawksbill turtles. It is highly likely that nesting, inter-nesting, foraging, migrating and hatchlings hawksbill turtles could be present in the environments around the Proposal.

6.2.2. Short-nosed sea snake

Population

Short-nosed sea snakes are endemic to WA and population estimates for the species is inadequately studied due to the remoteness of some locations in their known range. At Ashmore Reef surveys, prior to 2013, have demonstrated that the population has a decline of at least 90% over 15 year (three generation lengths) (Somaweera et al 2021). Morphological and mitochondrial analysis suggests separate breeding populations occur in the coastal regions WA. Further, it suggests that individuals found in coastal habitats spanning from Exmouth and Broome are genetically, ecologically and morphologically highly differentiated from the offshore Timor Sea form (Sanders et al. 2015). Historically short-nosed sea snakes were abundant at both Ashmore and Hibernia Reefs but were presumed to be extinct in the region by 1998. However, it was subsequently found in the mesophotic zone in water depth of 67 m (Liston 2021).

Distribution

Short-nosed sea snakes have a restricted geographical range of <10 km^2 and have a disjunct distribution either side of Australia's continental shelf-edge (Sanders et al. 2015). Short-nosed sea snakes were previously rarely seen in locations other than Ashmore Reef, but more recent field surveys have recorded the species in waters in along the northwest coast, from the Exmouth Gulf and offshore from Roebourne and Broome (Sanders et al. 2015; D'Anastasi et al. 2016; Udyawer et al. 2016). Habitat suitability threshold modelling by Udyawer et al. (2020) has identified a new potential distribution that extends from the Exmouth Gulf and around the Muiron Island to the Montebello Islands Marine Park (Udyawer et al. 2020), suggesting that they could possibly occur on coral reefs around the Proposal area (Figure 46).

Habitat and life history

Short-nosed sea snakes are a coral dependent species, found on the reef flats or in the shallow water (<10 m depth) of outer reefs (~70 km offshore) (Udyawer et al. 2016). The maximum depth of sea snakes originally ranged from 50 to 100 m, however the short-nosed sea snakes are now recorded in the mesophotic zone at depths of approximately 250 m (Crowe-Riddell et al. 2019; Liston 2021). During daylight hours sea snakes have been observed resting underneath small coral overhangs or coral heads in around 1 to 2 m of water. Sea snakes rarely move more than 50 m away from the reef flats.

It is estimated that along the north-western Australian coastline (Shark Bay to near Darwin), there is 14,365.95 km^2 of suitable habitat for the short-nosed sea snake. Key locations of suitable habitat for the short-nosed sea snake are Ashmore Reef, Exmouth Gulf, and Muiron Island to the Montebello Island (Udyawer et al. 2020).

Generally, sea snakes are long-lived and slow growing, they have small broods and high juvenile mortality (DSEWPaC 2011a). Sightings and reports of courting sea snakes have been recorded in late April (D'Anastasi et al. 2016), winter and late spring (Sanders et al. 2015), which is consistent with sea snake biology, of winter mating and parturition in spring or early summer.

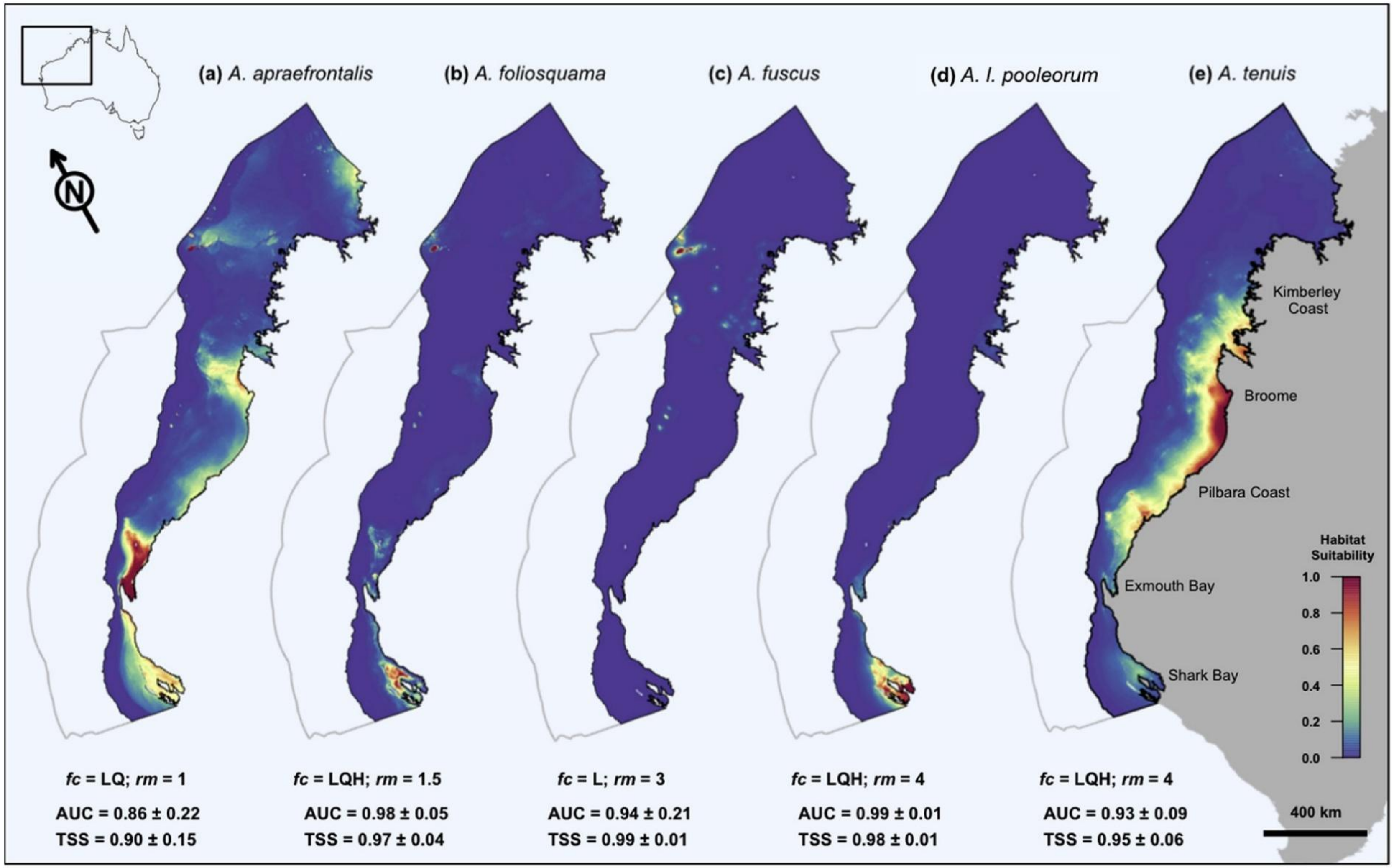


Figure 46: Sea snake habitat suitability (Udyawer et al. 2020). Modelled habitat suitability for sea snakes in northern WA, a) short-nosed sea snake, b) leaf-scaled sea snake) (Udyawer et al. 2020)

Relevant policy and guidance

The short-nosed sea snake is currently listed as Critically Endangered under both the EPBC and BC Act. The global (non-statutory) listing by the IUCN for the species is Data Deficient. Under DCCEEW a recovery plan is not required as further research is needed to fully understand the threats and ecological requirements of the short-nosed sea snake to determine the most appropriate management strategies. Other relevant EPBC Act documents are:

- Approved Conservation Advice for *Aipysurus apraefrontalis* (Short-nosed Sea Snake) (DSEWPaC 2011a)
- Commonwealth Listing Advice on *Aipysurus apraefrontalis* (Short-nosed Sea snake) (TSSC 2011a)
- Marine bioregional plan for the North-west Marine Region (DSEWPaC 2012a).

Threats and pressures

A severe population decline of the short-nosed sea snake has been observed in the Ashmore and Hibernia Reefs subpopulations, the cause of this decline is unknown. The major threats to the sea snakes are direct take from commercial fisheries (prawn trawlers in particular) and reef habitat degradation through coral bleaching and industrial operations (DCCEEW 2024b). Fisheries bycatch, habitat loss, changing predator populations, and rising sea temperatures are recognised as ongoing threats to the remaining short-nosed sea snake populations. Based on the North-west Marine Bioregional Plan (Appendix A.1; DSEWPaC 2012a), habitat modification, and chemical spills have been identified as existing threats that may be relevant to consider when assessing impacts of the Proposal. Further, entrainment and entrapment could also be a potential impact to the species. The population health of the 'coastal' and 'offshore-reef' populations of short-nosed sea snakes can be impacted by different threatening processes that operate at different scales and require separate management strategies.

Relevance to the Proposal area

Likelihood of occurrence: **Medium**

Short-nosed sea snakes are rarely seen in locations other than Ashmore Reef, Exmouth Gulf and around Muiron Island to the Montebello Islands (D'Anastasi et al. 2016). Habitat suitability is 50% in the waters of and around the Proposal (Figure 47), therefore has a medium likelihood of occurrence however given the species high conservation value and deficiency of sightings (which could be a result of the species being difficult to detect and/or there being a lack of adequate survey effort) across northern WA, a precautionary approach should be applied to the species, where it is possible the species could be present.

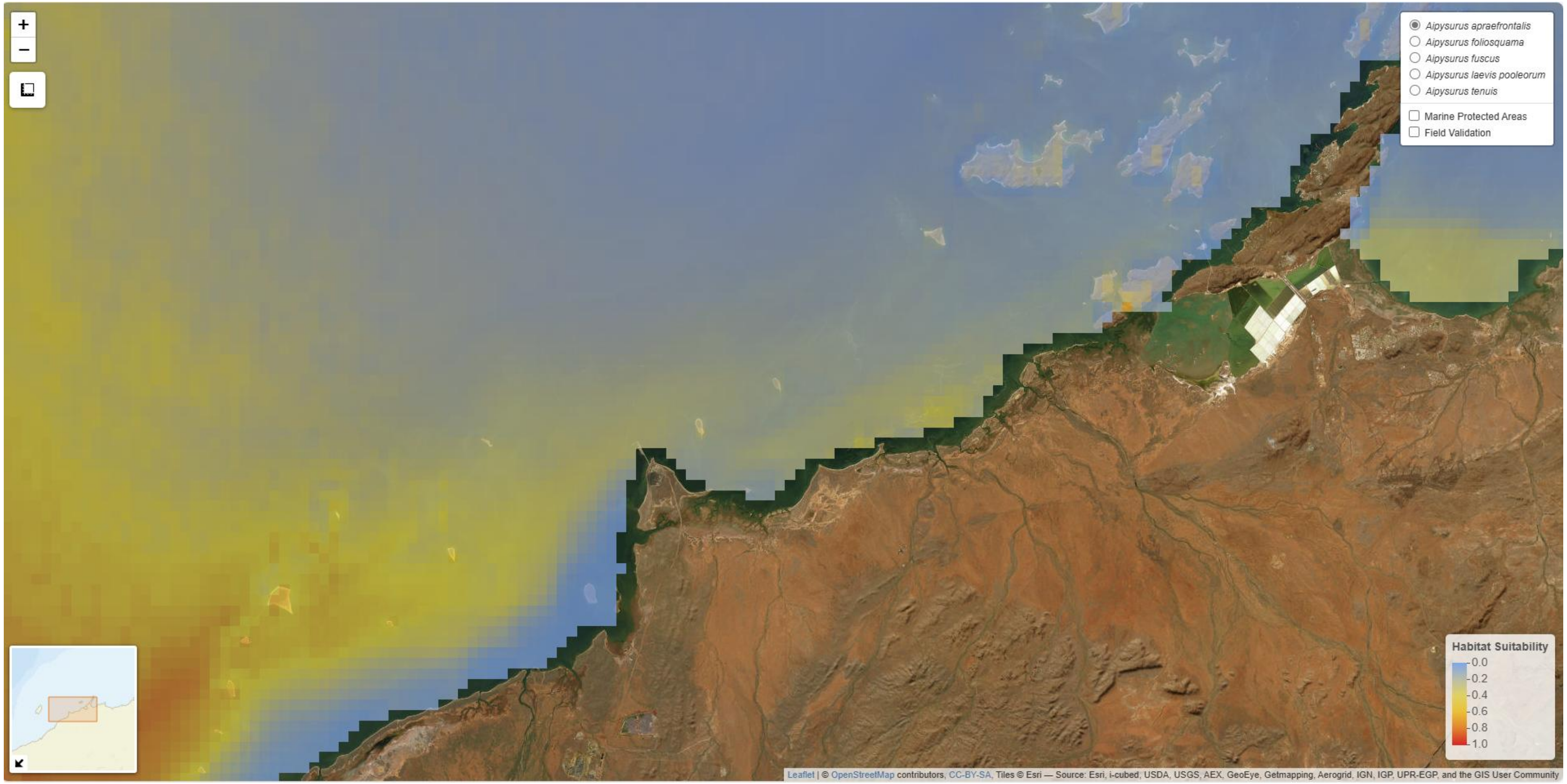


Figure 47: Short-nosed sea snake habitat suitability in relation to the Proposal area (https://goo.gl/emRMy5.; Udyawer et al. 2020)

6.2.3. Leaf-scaled sea snake

Population

Leaf-scaled sea snakes are endemic to WA and the species population is inadequately studied due to the remoteness of some locations in their known range. Studies have shown that there are distinct breeding populations off the coast of WA, with breeding populations established in Shark Bay, Ashmore Reef, and Barrow Island (Sanders et al. 2015; D'Anastasi et al. 2016). Sanders et al. (2015) utilised morphological variation and mitochondrial sequencing to confirm that specimens of the sea snake found at Barrow Island were not vagrants as previously suspected but instead represent separate breeding populations (at Barrow Island).

Distribution

Leaf-scaled sea snakes are known to have a restricted range of <10 km^2. D'anastasi et al. (2016) documented records of living leaf-scaled sea snakes (n = 16) in coastal WA, which illustrated a significant increase in their known geographic range and habitats to include seagrass meadows in subtropical Shark Bay (latitudes 24.5°S to 26.6°S). Habitat suitability threshold modelling by Udyawer et al. (2020) has identified a new distribution within coastal regions of Shark Bay and Barrow Island, which suggests that they could possibly occur on coral reefs adjacent to islands around the Proposal area (Figure 46; Udyawer et al. 2020).

Habitat and life history

Leaf-scaled sea snakes occupy protected parts of reef flats adjacent to coral and coral substrates, generally found in shallow water in <10 m depths. They can be found in exposed tidal pools and are able to tolerate high water temperatures (DSEWPaC 2012a). The species previously had only been suited in tropical shallow-water coral reefs, generally with dense coral cover. However, the discovery of a population at Shark Bay, WA, indicates the species can also inhabit cooler water temperatures and non-coral habitats, including seagrass habitats. Therefore, suitable habitat for the species includes coral reefs around islands in the Pilbara region and seagrass meadows (D'Anastasi et al. 2016; Udyawer et al. 2020). Leaf-scaled sea snakes are known to feed on wrasses, benthic sleepers (Eleotridae), eels, and blennies (Sanders et al. 2021).

It is estimated that along the north-western Australian coastline (Shark Bay to near Darwin), there is 7,456.79 km^2 of suitable habitat for the leaf-scaled sea snake. Key locations of suitable habitat for the leaf-scaled snake are Ashmore Reef, Shark Bay, Exmouth Gulf, Barrow and Montebello Islands (Udyawer et al. 2020).

Life history traits are thought to be similar to the short-nosed sea snake, where they are long-lived and slow growing with small broods and high juvenile mortality. Little is known of the age at which sea snakes reach sexual maturity. All phases of the reproductive cycle of sea snakes take place in the sea and reproductive seasonality varies among the species (DSEWPaC 2012a).

Relevant policy and guidance

The leaf-scaled sea snake is currently listed as Critically Endangered under both the EPBC and BC Act. The global (non-statutory) listing by the IUCN for the species is Data Deficient. Under DCCEEW a recovery plan is not required as further research is needed to fully understand the threats and ecological requirements of the leaf-scaled sea snake to determine the most appropriate management strategies. Other relevant EPBC Act documents are:

- Approved Conservation Advice for *Aipysurus foliosquama* (Leaf-scaled Sea Snake) (DSEWPaC 2011b)
- Commonwealth Listing Advice on *Aipysurus foliosquama* (Leaf-scaled Sea snake) (TSSC 2011b)
- Marine bioregional plan for the North-west Marine Region (DSEWPaC 2012a).

Threats and pressures

Similar to the short-nosed sea snake population in WA, the leaf-scaled sea snake population is also in decline. The major threats to the sea snakes are direct take from commercial fisheries and reef habitat degradation through coral bleaching and industrial operations (DCCEEW 2024c; Udyawer et al 2020). Based on the North-west Marine Bioregional Plan (Appendix A.1; DSEWPaC 2012a) the following have been identified as existing threats include habitat modification, reef habitat degradation through coral bleaching and industrial operations, and chemical spills.

Relevance to the Proposal area

Likelihood of occurrence: **Medium**

There have been low numbers of leaf-scaled sea snakes recorded throughout WA, with known sightings at Shark Bay, Ashmore Reef, and Barrow Island (Sanders et al. 2015; D'Anastasi et al. 2016). However, the species has a deficiency of sightings (which could be a result of the species being difficult to detect and/or there being a lack of adequate survey effort) across northern WA. The species niche model (Udyawer et al. 2020) indicates a 50% or greater possibility of habitat suitability in the Proposal area (Figure 48). Given the species high conservation value and dependence on shallow reef habitats and the potential to occur in seagrass meadows it could be present, it should be considered a key species.

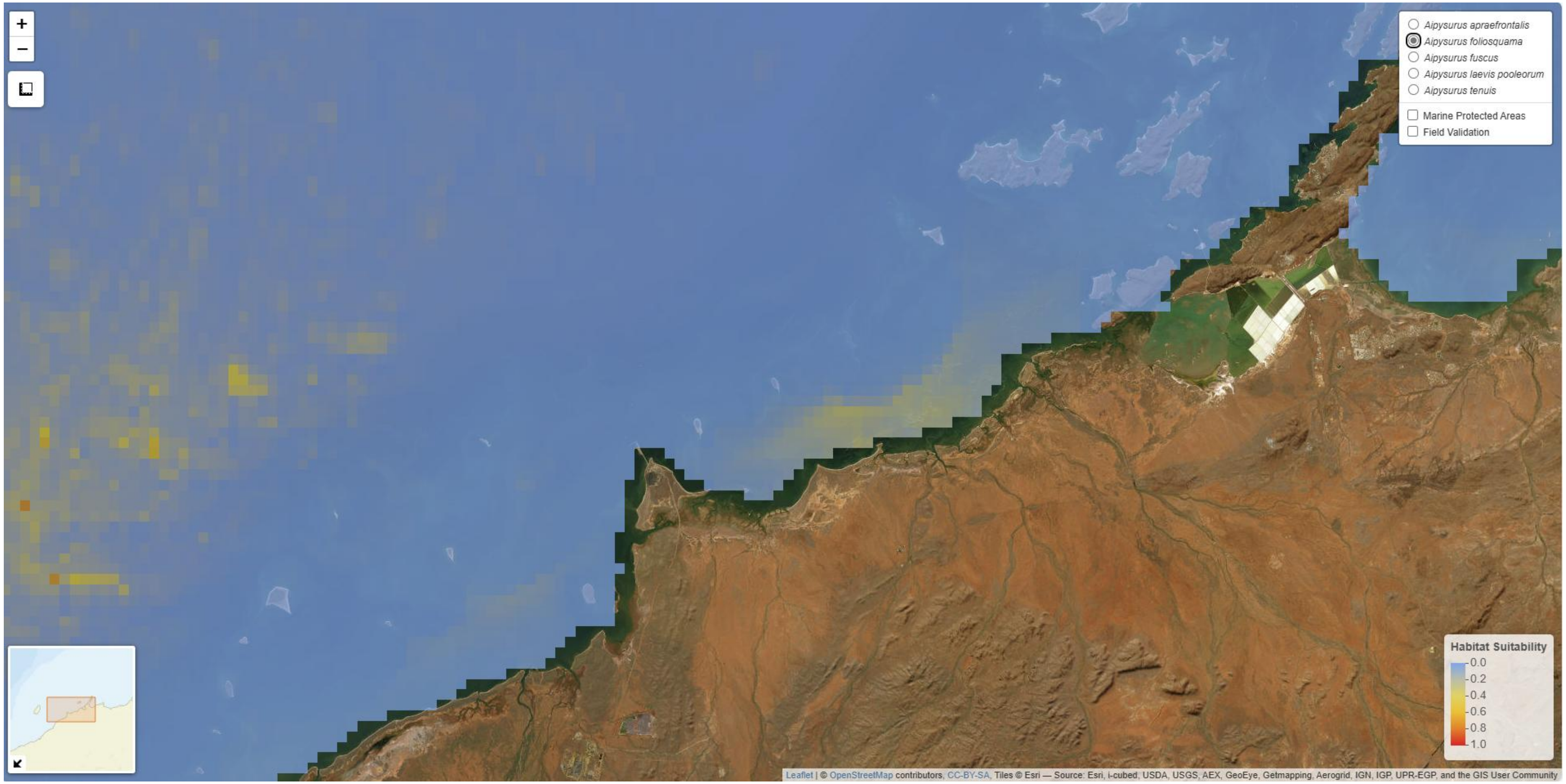


Figure 48: Leaf-scaled sea snake habitat suitability in relation to the Proposal area (https://goo.gl/emRMy5.; Udyawer et al. 2020)

6.3. Sharks and rays

The tidal creeks and areas surrounding the Proposal are known to provide habitat for a variety of elasmobranch species, as identified in HBI surveys (HBI 2023). Of these species identified in the surveys only the green sawfish is listed under the EPBC Act or the BC Act. Some of the other species identified have an international threatened listing (IUCN; non-statutory). These included; giant shovelnose ray (*Glaucostegus typus* -Critically Endangered IUCN), bottlenose wedgefish (*Rhynchobatus australiae* – Critically Endangered IUCN), lemon shark (*Negaprion acutidens*- Endangered IUCN), spinner shark (*Carcharhinus brevipinna*- IUCN Vulnerable), bull shark (*Carcharhinus leucas*- Vulnerable IUCN), spotted eagle ray (*Aetobatus ocellatus*- Vulnerable IUCN), pink whipray (*Pateobatus fai*- Vulnerable IUCN), and porcupine ray (*Urogymnus asperrimus* – Vulnerable IUCN) (HBI 2023; 2025)[8]. Given these species are likely to be present mitigation measures implemented to protect by key elasmobranchs will in hand act as mitigation for these IUCN listed elasmobranch species.

Globally there are five species of sawfish, four of these occur in Australian waters, including northern WA: green sawfish (*P. zijsron*), narrow sawfish (*Anoxypristis cuspidata*), dwarf sawfish (*Pristis clavate*), and largetooth sawfish (previously known as the freshwater sawfish) (*Pristis pristis*).

Largetooth sawfish are generally found in Kimberly, where the Fitzroy River is a globally important nursery (Lear et al. 2019). Adults are known to migrate down the whole Pilbara coast to the top of the Exmouth Gulf. Narrow sawfish are found from Onslow up to the Northern Kimberly. They are commonly found offshore in deeper waters and are only occasionally present within the Proposal area. The dwarf sawfish are found within the Kimberley region (Morgan et al. 2021) and are not likely to be found south of Cape Keraudren. The green sawfish has been identified by experts, Prof. David Morgan, and Dr. Karissa Lear (*pers. comms*), as having the highest likelihood of occurrence in the area and have the greatest risk of impact by the Proposal.

6.3.1. Green sawfish

Population

The global population size of green sawfish has not been estimated; however, the population has experienced significant declines and continues to decrease (Harry et al. 2022). The remaining viable population of green sawfish are mostly limited to northern Australia. Within this range, the green sawfish on the West Coast are distinct from, and more diverse than, those in the Gulf of Carpentaria or the East Coast (Ingelbrecht et al. 2024a). Therefore, the populations present in northern WA are of global conservation significance (Ingelbrecht et al. 2024a).

In the Pilbara, the green sawfish population appears to be genetically distinct from other worldwide populations, with some clear morphological differences evident, including differing number and shape of rostral teeth. It is hypothesised that the Dampier Archipelago may act as a natural barrier limiting genetic connectivity between western and eastern Pilbara populations. Recent work at Ashburton River and adjacent tidal creeks found that there the sawfish present had a high degree of relatedness (88%)

[8] The conservation listings by the IUCN do not necessarily reflect the status of these species in northern Western Australia (HBI 2023)

to at least one other individual (Ingelbrecht et al. 2024a). However, there is also evidence that green sawfish disperse over large spatial scales, indicating that populations could be replenished from elsewhere should they experience a decline, thereby reducing the risk of localised extinction for this species (Ingelbrecht et al. 2024b).

Distribution

Green sawfish in the Indo-West Pacific have undergone a significant reduction in extent of occurrence, with a 30-81% reduction in former distribution over the past century (Dulvy et al. 2016; Ingelbrecht et al. 2024b). In Australia, the known green sawfish distribution is from the Whitsundays in QLD across northern Australian waters to Shark Bay in WA. However, their distribution is not clearly defined due to similar morphology causing confusion with other members of the genus who reside in similar habitats (Thorburn et al. 2008).

Previous studies have indicated that both female and male green sawfish are regionally philopatric, with restricted gene flow at large spatial scales in northern Australia, which suggests limited dispersal in both sexes (Phillips et al. 2017; Ingelbrecht et al. 2024a). However, recent research has shown that green sawfish partake in long-distance movements by adults. Juveniles have small core use areas generally confined to shallow waters, with their home range increasing as they grow. The identification of half-siblings >500 km apart indicates long-distance movements by their parents (Figure 49; Ingelbrecht et al. 2024b). Therefore, it is possible that green sawfish could use the waters of and around the Proposal for migrations between pupping grounds.

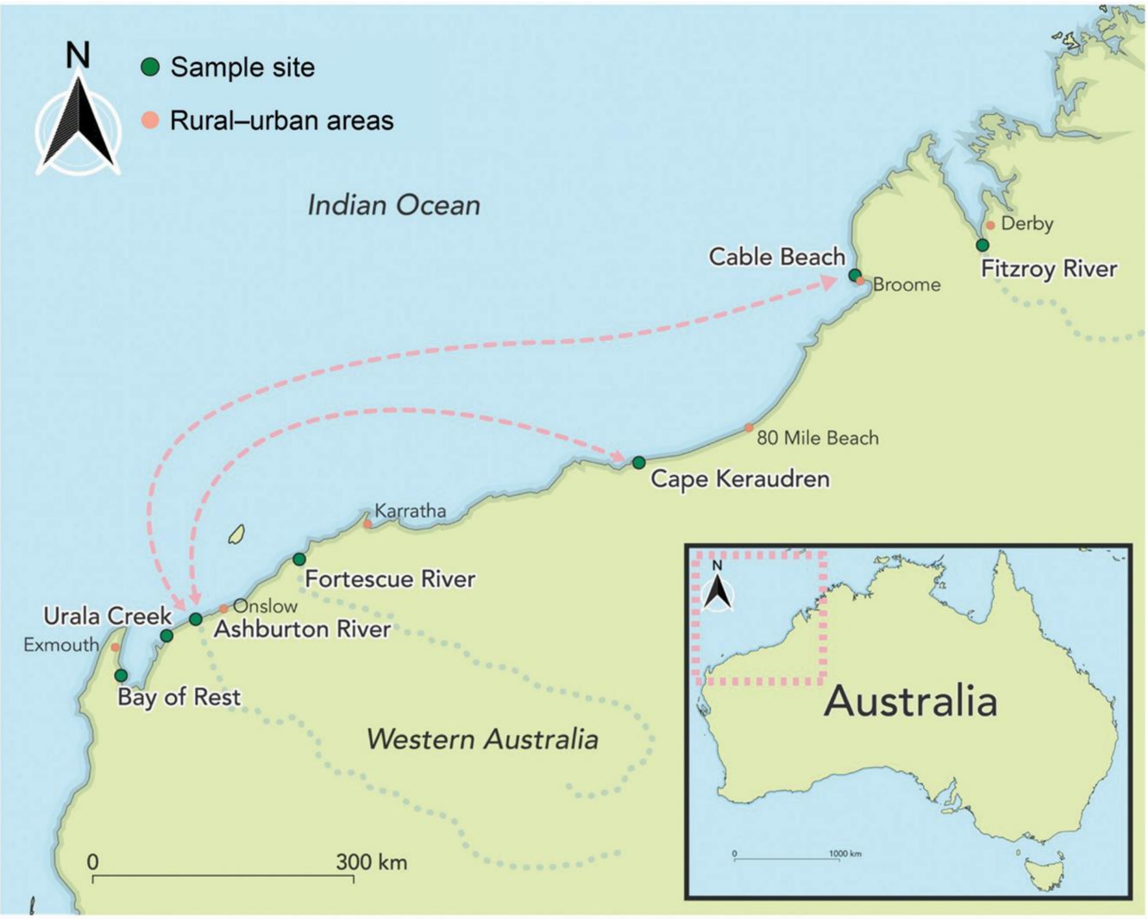


Figure 49: Ingelbrecht et al. (2024b) sampling locations for green sawfish (*P. zijsron*) in WA, illustrating the distance between capture locations of half siblings (arrows) captured at Cape Keraudren in 2008 and the Ashburton River in 2014, or the Ashburton River in 2014 and Cable Beach in 2022

Habitat and life history

Green sawfish inhabit inshore and offshore marine waters or shallow estuarine waters but do not occur in freshwater habitats and have a strong association with mangroves and mudflats (DoE 2015a). Mangrove habitats provide shelter and foraging opportunities. Green sawfish feed on various prey species, including shoaling fish (e.g. mullet), molluscs, small crustaceans, baitfish, and prawns (DCCEEW 2024d). Green sawfish use their rostrum to hunt, often slashing it side to side in shallow, sandy or muddy substrates. When foraging in creeks or intertidal areas, they use the incoming tide to enter and the outgoing tide to leave.

A sawfish survey conducted by O2 Marine and Harry Butler Institute (2023) identified that the mangrove creek and mud flat habitats could serve as sawfish nursery habitat. However, no sawfish were recorded by net or acoustic receivers, suggesting that the area may not be a primary nursery or pupping ground for any sawfish species. Three green sawfish were captured near the mouth of the Fortescue River, two of which were tagged with acoustic tags. These tagged individuals, which were >2 m total length (TL), were consistently detected at the Fortescue River, and did not enter the Eramurra acoustic array. This indicate that the Fortescue River estuary and surrounding creeks are likely an important secondary (and probably primary) nursery location and are important for late-stage juvenile green sawfish (O2 Marine and HBI 2023).

A movement study using acoustic telemetry near the Onslow area tracked individuals and found that they occupied shallow depths up to 2 m and moved up to 10 km during each tidal cycle (Morgan et al. 2017). Tagged individuals that were greater than 2 m TL were found to have a large home range (Morgan et al. 2017). The tagged sawfish moved towards the shore on the rising tide and away from the shore on the falling tide, and mostly remained in water depths <1.5 m. When entering the creeks remained within 500 to 700 m of the mouth of tidal creeks and avoid the upper reaches of these systems (Morgan et al. 2017).

Individuals often returned to within 100 m of previous high tide resting sites, demonstrating the repeated use of habitat (Stevens et al. 2008). The habitats in which adult and juvenile sawfish are found differ slightly (Compagno 1990; Harrison and Dulvy 2014). Morgan et al. (2017) study found that juvenile green sawfish have high site pupping site fidelity for at least 3 to 6 months and remain in their chosen nursery for at least 3 to 4 years. Following this they migrate into the nearshore marine waters after the wet season.

Adult green sawfish disperse widely over the continental shelf in water depths >100 m and are commonly caught as bycatch by commercial trawl fisheries (Harry et al. 2024). The waters fished by the Pilbara Fish Trawl Interim Managed Fishery (PFTIMF; Figure 50), have recorded a high number of adult and records indicate that adult green sawfish are using this offshore deeper habitat year around (peak catch recorded from the end April to start of May and mid-July to mid-August) (Harry et al. 2024). Therefore, it is likely that green sawfish migrate from their inshore pupping and nursery habitats to deeper offshore waters.

Sawfish are thought to be philopatric (Phillips et al. 2017; Ingelbrecht et al. 2023), with females returning to their natal estuaries to pup, however recent work suggests some parental movement to different locations (Ingelbrecht et al. 2024b). The Ashburton River Delta is the only major pupping site known along the Pilbara coastline; however, it is speculated that pupping for green sawfish is widespread along the northwest Australian coastline. There is evidence to support that green sawfish pup along the coast, from Shark Bay to the Exmouth Gulf and throughout Kimberley to Gulf of Carpentaria (Harry et al. 2022; Ingelbrecht et al. 2024a,b). Pupping in the Pilbara region occurs from August to December (Lear et al. 2023). Green sawfish are slow growing, late to mature and have low fecundity (Harrison and Dulvy 2014). They are relatively long-lived, believed to live up 50 years (Morgan et al. 2017).

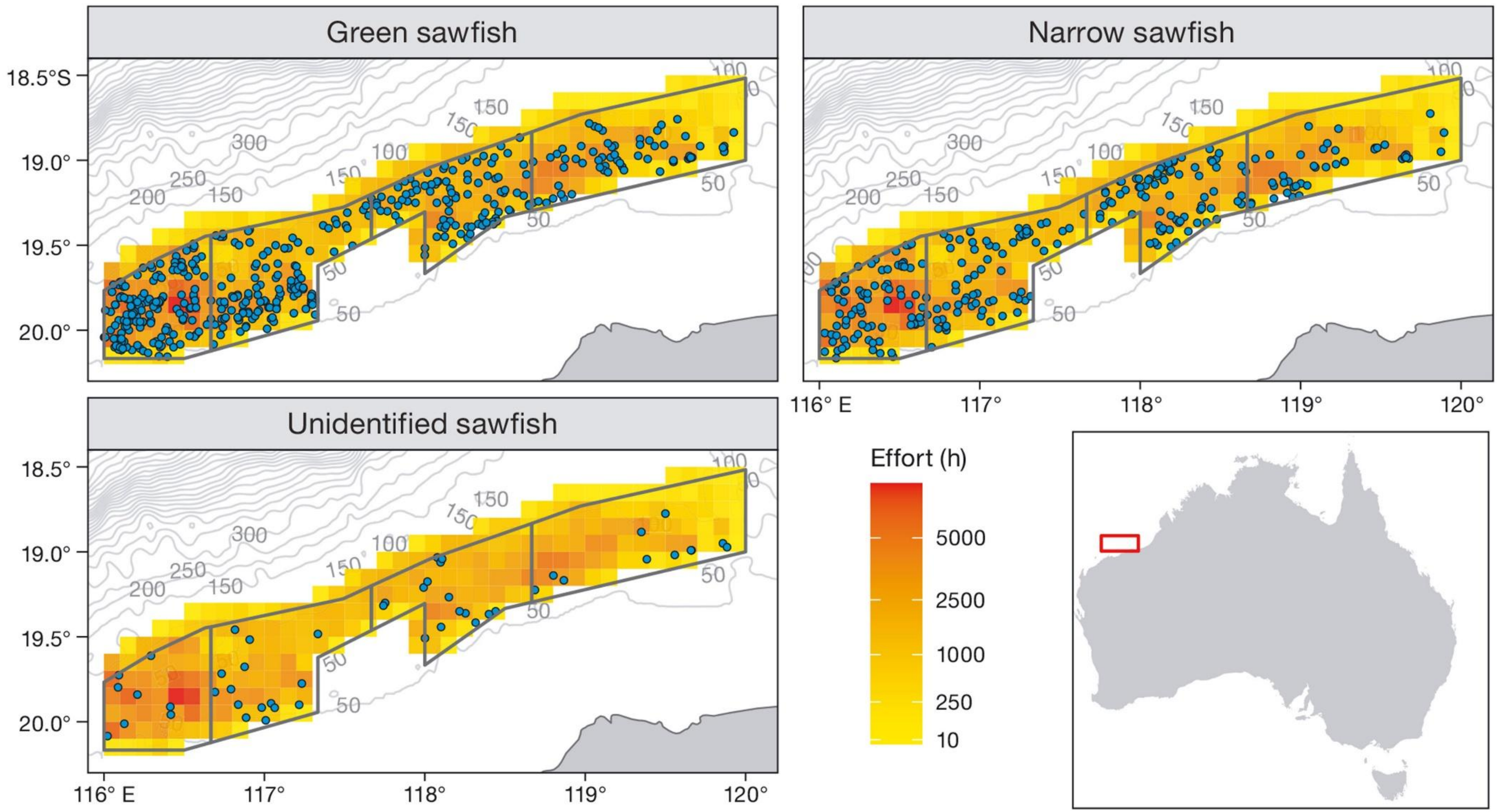


Figure 50: Spatial distribution of fishing effort (trawl hours) and reported sawfish captures (blue circles) in the Pilbara Trawl Fishery between 2006 and 2022 (Harry et al. 2024)

Relevant policy and guidance

Green sawfish are listed as Vulnerable, Migratory, and Marine under the EPBC Act. Under the BC Act they are listed as Vulnerable. Globally (non-statutory) they are listed as Critically Endangered by the IUCN. Relevant EPBC Act documents are:

- Sawfish and River Sharks Multispecies Recovery Plan (DoE 2015a)
- Approved Conservation Advice for Green Sawfish (DEWHA 2008a)
- Listing Advice for *Pristis zijsron* (Green Sawfish) (TSSC 2008)
- Marine bioregional plan for the North-west Marine Region (DSEWPaC 2012a).

Threats and pressures

Globally, overfishing and habitat alteration have caused major declines in green sawfish populations. In addition, loss of nursery habitat and reduction in habitat quality as a result of river regulation have also had major impacts (Thorburn et al. 2008; Kyne et al. 2013). In relation to coastal development, key threats to sawfish include habitat degradation from changes to coastal processes and reduction in water quality.

Only one main pupping site is known along the Pilbara coastline, the Ashburton River delta, while it is suspected that the species pups in other areas along the Pilbara coastline. The Ashburton River delta and surrounds are therefore critically important to the green sawfish population, and the recovery of the species globally (Morgan et al. 2015). The Proposal is not located near the Ashburton River, however kinship studies show a high degree of relatedness and therefore loss of genetic diversity within this pupping population could lead to incidences of inbreeding (Ingelbrecht et al. 2024a).

Barriers to movement could dampen the recovery of green sawfish populations through restricting available habitat and potential range extensions. There is significant uncertainty regarding the impact of existing Cape Preston Port infrastructure (as a barrier) on coastal sawfish movements and the potential effect on green sawfish movements in each direction. Barriers to movement, such as rock walls associated with Marine Offloading Facilities (MOFs) and Product Loading Facilities (PLFs) are key threats to sawfish populations. Sawfish are known to become more mobile (move further afield) with age and show reluctance travel around large or unfamiliar coastal structures (Lear et al. 2024). Dredged channels or increased depths in coastal areas could also restrict movement, particularly of juveniles which are limited to shallow areas.

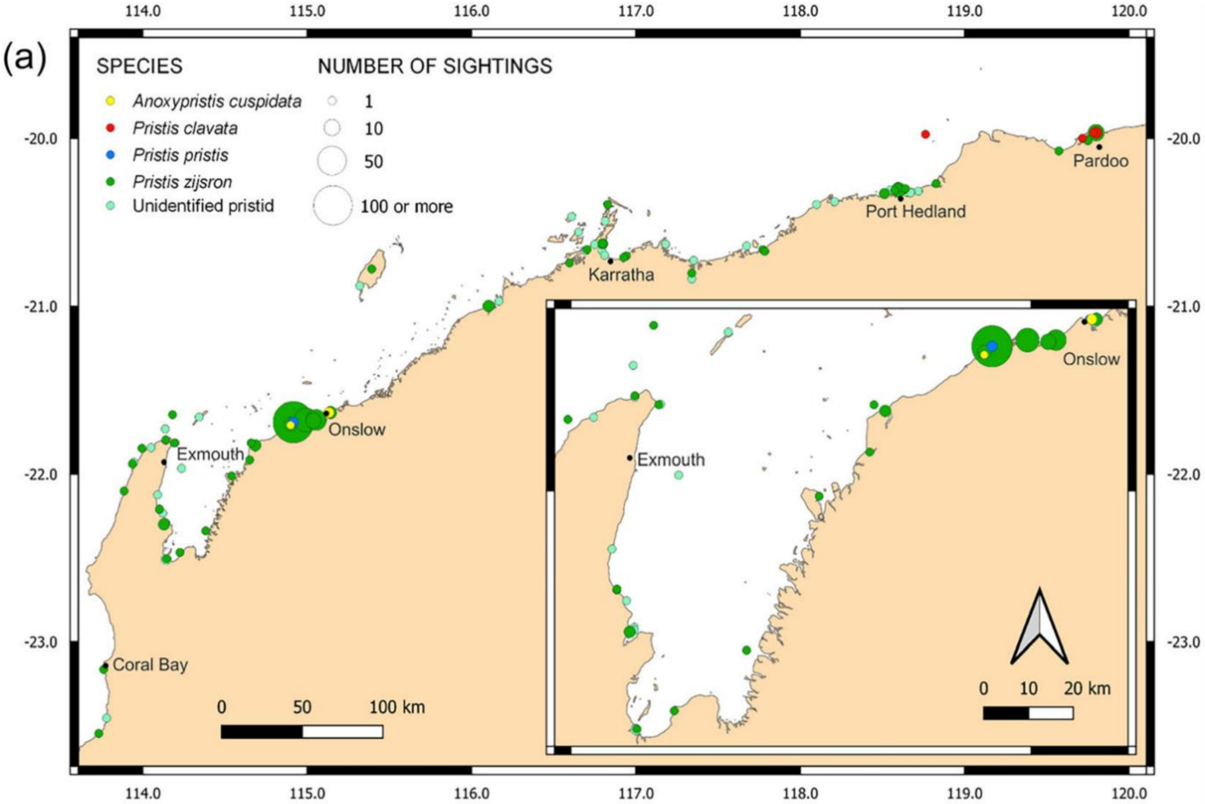
Based on the North-west Marine Bioregional Plan (Appendix A.1; DSEWPaC 2012a) the following existing threats have been identified that may be relevant when assessing the impacts of the Proposal:

- Habitat modification
- Sea level rise
- Marine debris
- Changes in hydrological regimes.

Relevance to the Proposal area

Likelihood of occurrence: **High**

Green sawfish are known to occur in both the nearshore and offshore waters from the Proposal (Figure 51; Figure 50). Surveys completed by HBI (2023) for the Proposal identified one large green sawfish near the mouth of the intake creek. As defined in the Sawfish and River Sharks recovery plan habitats that are critical to the survival of the green sawfish: is all areas where aggregations of individuals have been recorded displaying biologically important behaviours such as breeding, foraging, resting or migrating, are considered critical to the survival of the species unless population survey data suggests otherwise (DoE 2015a). Results from the HBI green sawfish noted that during the survey, the abundance of green sawfish was low. However, it is hypothesised that the area surrounding the Proposal provides secondary nursery habitat for larger juveniles and could provide foraging habitat (HBI 2023; 2025). Further, it is likely that the area of Cape Preston and Gnoorea may also support long-distance movements of green sawfish along the northern WA coastline, representing ‘stopover’ habitat. Movements of green sawfish, in particular juveniles, in the area is likely already restricted from the current coastal infrastructure (e.g. the Cape Preston groyne) due to juveniles preferences for shallow waters (HBI 2025). Small sawfish prefer extremely shallow waters. Green sawfish of varying age classes could be present in the Intake Creek, nearshore and offshore areas of and around the Proposal.



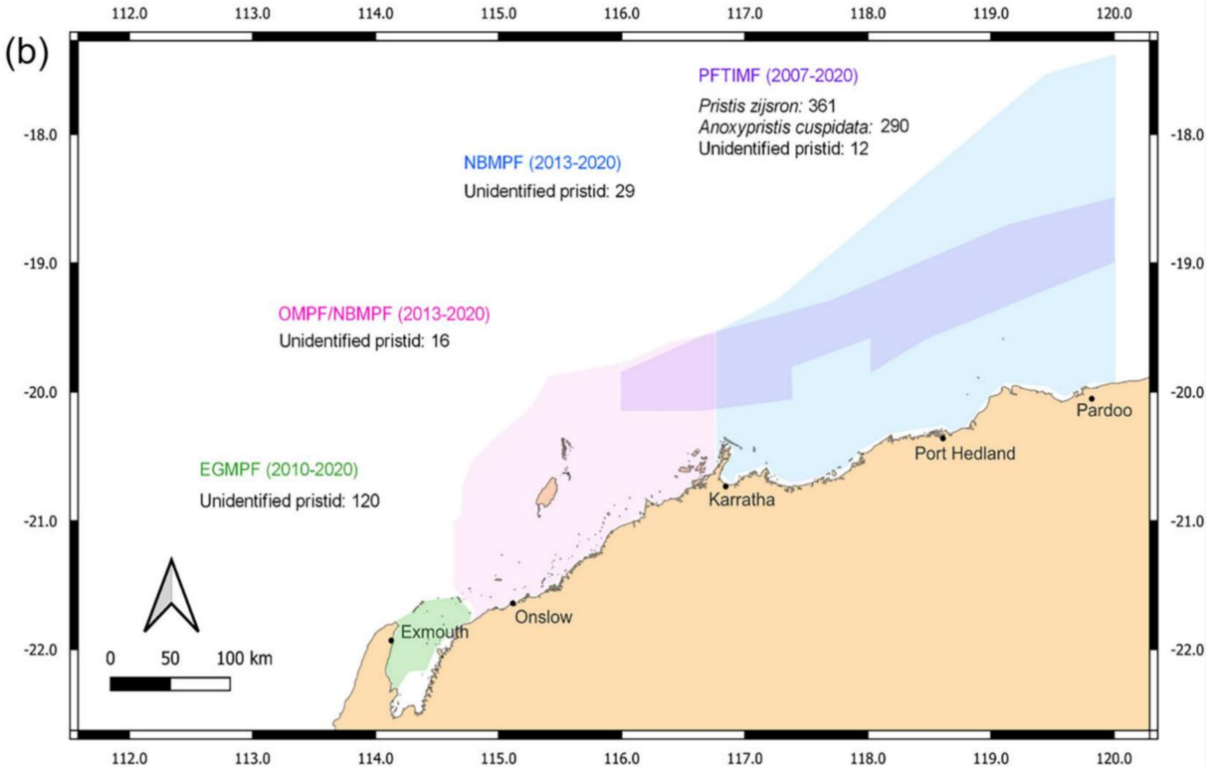


Figure 51: (a) Collated sightings record of sawfishes (*A. cuspidate, P. clavate, P. pristis, P. zaijsron*) in the Pilbara region. (b) Reported captures of sawfish from commercial fisheries in shaded polygons (EGMPF; OMPF: Onslow Managed Prawn Fishery; NBMPF: Nickol Bay Managed Prawn Fishery; PFTIMF: Pilbara Fish Trawl Interim Managed Fishery) (Bateman et al 2024)

6.3.2. Reef manta ray

Population

The reef manta rays global population is currently unknown, but throughout its range the species is found in small populations of <1,000 individuals (Marshall et al. 2022). The global population has had an estimated reduction of between 30 and 49% over the last 87-years and is still experiencing a declining trend (Marshall et al. 2019). No population estimates or trends are available for Australia.

Distribution

Globally, reef manta rays are distributed throughout the Pacific and Indian Oceans. In Australia, the species is found from ~30°S on the east and west coast, with a continuous distribution north from Shark Bay (WA) (26°S) to the Solitary Island Marine Park (New South Wales (NSW)) (26°S) (Figure 52; Armstrong et al. 2020a).

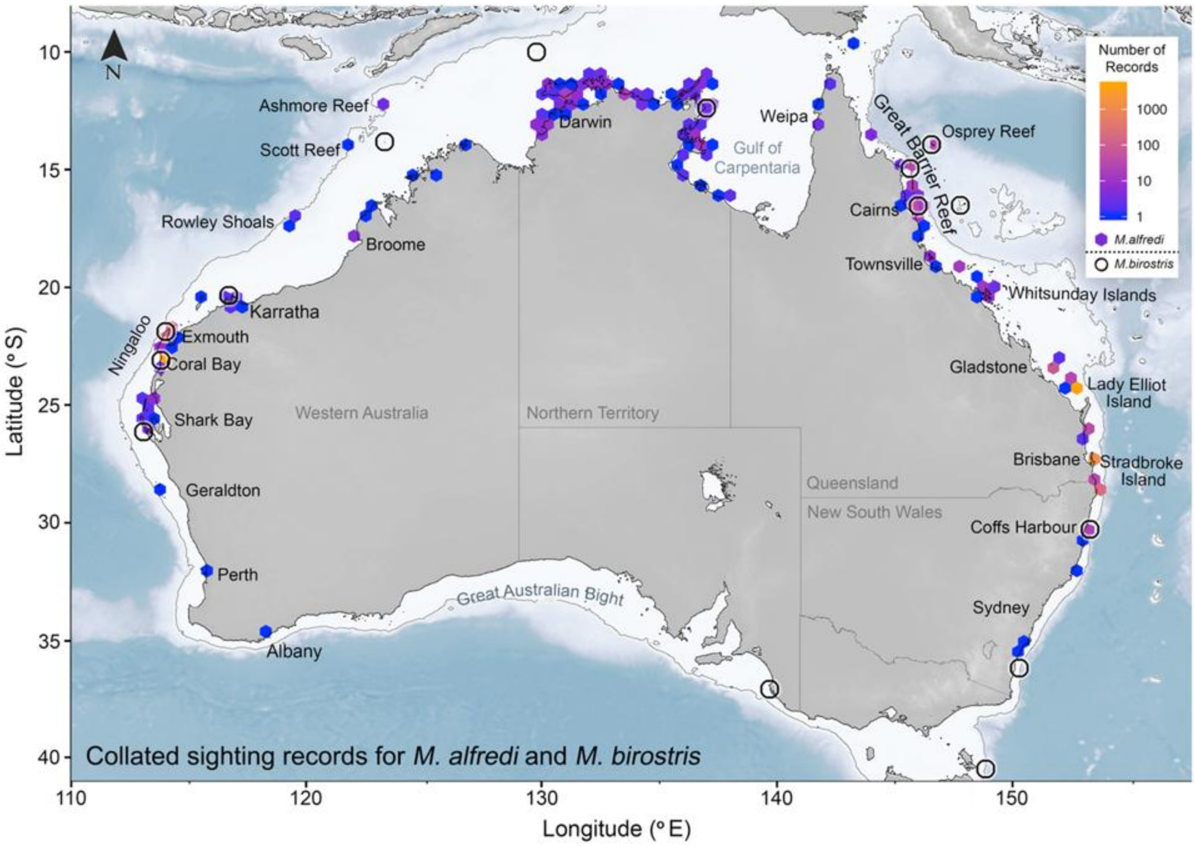


Figure 52: Collated sighting records for manta rays in Australia, with data sourced from scientific literature, image databases, aerial surveys, museum records, and online reports (Armstrong et al. 2020a)

Reef manta rays (*M. alfredi*) sightings are aggregated across a 0.5 ° gridded area and are represented by hexagonal cells, where colour is indicative of the sighting count (from 1 to >1000) per cell. Sightings of giant manta rays (*M. birostris*) are represented by open black circles and are indicative of location only (not count, due to the limited number of observations). Note that data from Cocos Keeling Island and Christmas Island are not shown. The unbroken grey line off the coast of Australia represents the 500 m isobath (Armstrong et al. 2020a).

Habitat and life history

Reef manta rays inhabit warm tropical to subtropical waters, both shallow (surface) and offshore deep waters (up to 432 m). They are known to exhibit diel movements, spending daylight hours inshore in shallow waters, then moving back offshore to deeper waters at night (Marshall et al. 2019). Reef manta rays utilise coastal shelf waters, showing preference for shallow depths of less than 20 m. Reef manta rays also require cleaning stations and reef habitat for reproduction. Juveniles have been observed using lagoons and shorelines. Tagged mantas at Ningaloo show broadscale (up to 700 km) emigration and reimmigration movements, and a high degree of site fidelity (Armstrong et al. 2020b).

Reef manta rays can grow up to 500 cm disc width (DW) and reach sexual maturity between 270-300 cm DW and 300-350 cm DW for male and females respectively. Female manta rays give birth to a single pup everyone to seven years (central tendency of a 4 to 5-year reproductive cycle), and across their lifespan (up to 45 years) have between four to seven pups (Marshall et al. 2022).

Relevant policy and guidance

The reef manta ray is classified as Migratory under the EPBC Act. No threat abatement or recovery plans exist for this species. The global (non-statutory) listing by the IUCN for reef manta rays is Vulnerable. The reef manta ray is not classified as a conservation value priority under the North-west Marine Bioregional Plan. There are no threat abatement plans, recovery plans, or listing advice for the species.

Threats and pressures

Globally, fragmentation, low connectivity between populations, infrequent migrations and slow life history traits results in a high potential for population decline from overexploitation are known threats to the reef manta ray (Marshall et al. 2022). Fisheries bycatch and targeted commercial catch are other major threats to the species due to the increase in demand for meat and gills (O'Malley et al. 2017).

Based on the North-west Marine Bioregional Plan (Appendix A.1; DSEWPaC 2012a), only chemical spills have been identified as an existing threat that may be relevant to consider when assessing impacts of the Proposal.

Relevance to the Proposal area

Likelihood of occurrence: **Medium**

Reef manta rays are known to occur in the waters around the Dampier Archipelago (Figure 52). Reef manta rays prefer shallow waters (<20 m), and this suitable habitat exists within the Proposal search area. Reef manta rays have no BIA or major populations in close proximity to the Proposal, however, due to their habitat preference for shallow water, and broadscale movements, it is possible for them to occur in the vicinity of the Proposal.

Conclusion

Key species were identified so that the correct level of attention is paid to those at greatest potential risk from the Proposal during impact assessment and management planning. The key species were selected based on their conservation significance and likelihood of occurrence within the Proposal area.

Mammals

- Humpback whale (Migratory): high likelihood of occurrence in nearshore and offshore waters. Peak numbers are in July to August, with the northern migration peak from May to August and southern migration peak in August to early September (Jenner et al. 2010a) (Table 23).
- Dugong (Migratory): high likelihood of occurrence in nearshore waters, year-round (Table 23) likely foraging where suitable seagrass habitat is present which could include the creeks and surrounding shallow areas.
- Humpback dolphin (Vulnerable and Migratory): high likelihood of occurrence in nearshore waters, year-round (Table 23) likely using the waters for foraging, socialising, travelling and breeding.
- Indo-Pacific bottlenose dolphin (Migratory): high likelihood of occurrence in nearshore waters, year-round (Table 23) likely using the waters for foraging, socialising, travelling and breeding.

Reptiles

- Green turtle (Vulnerable and Migratory): high likelihood of occurrence in nearshore and offshore waters year-round, including juveniles within the surrounding creeks. High likelihood of juvenile green turtles being present within the Proposals Intake Creek, likely that the creeks and shallow intertidal and nearshore areas provide important foraging habitat for juvenile green turtles. Nesting and inter-nesting occurring from November to March (Table 23). Peak nesting occurs from December to February.
- Flatback turtle (Vulnerable and Migratory): high likelihood of occurrence in nearshore and offshore waters year-round, with nesting and inter-nesting occurring from October to March (Table 23). Peak nesting occurs from November to January.
- Hawksbill turtle (Vulnerable and Migratory): high likelihood of occurrence in nearshore and offshore waters year-round, with nesting and inter-nesting occurring from October to March (Table 23). Peak nesting occurs from November to January.
- Short-nosed sea snake (Critically Endangered): medium likelihood of occurrence, and could be present throughout the year where suitable coral habitat is present
- Leaf-scaled sea snake (Critically Endangered): medium likelihood of occurrence, and could be present throughout the year where suitable coral or seagrass habitat is present

Fish

- Green sawfish (Vulnerable and Migratory): high likelihood of occurrence in inshore and nearshore waters, year-round (Table 23). Likely that juvenile green sawfish may intermittently use the Proposal Intake Creek for foraging and could provide secondary nursery habitat for juveniles.

- Reef manta ray (Migratory): medium likelihood of occurrence in nearshore and offshore waters, year-round (Table 23).

The Proposals Intake Creek has been identified to support a high diversity of elasmobranchs and fish species; therefore, it is likely that marine fauna would be present, including conservation significant marine fauna that have been identified within this desktop. It is likely that the Proposal Intake Creek and surrounding environment provides important foraging habitat for juvenile green turtles. It is likely that the Intake Creek provides suitable foraging habitat for both juvenile green turtles and green sawfish, therefore it has been assumed that both species have a high likelihood of occurrence within this area. The creek mouth and intertidal systems within the Proposal area are likely to provide important juvenile foraging habitat areas for turtles – especially green turtles.

The Proposal impact assessment and associated management plans should consider the threats identified in Section 6, potential impacts from the North-west bioregional plan (DSEWPaC 2012a) and relevant Threat Abatement Plans, Recovery Plans and Conservation Advices (Appendix A). Consistency with relevant species recovery plans and threat abatement plans is recommended (Appendix A). Management measures should consider avoidance of key species' ecological windows for sensitive periods, where possible (e.g. humpback whale migration, turtle nesting, green sawfish pupping) (Table 23).

Table 23: Key species' ecological windows (dark blue represents full duration of presence, light blue represents timing of specific behaviours, diagonal shading represents peak timing)

Species presence	J	F	M	A	M	J	J	A	S	O	N	D	Data Source
Dugong*													DBCA (2024); DCCEEW (2024b)
Australian humpback dolphin*													Hanf et al. (2022); Raudino et al. (2023)
Indo-Pacific bottlenose dolphin*													Hanf et al. (2022); Raudino et al. (2023)
Humpback whale													Jenner et al. (2010a); Irvine et al. (2018)
-Northward migration													Jenner et al. (2010a)
-Southward migration													Jenner et al. (2010a)
-Southward peak calves													Jenner et al. (2010a); Irvine et al. (2018)
Flatback turtle													DoEE (2017a); Peel et al. (2024)
-Foraging													DoEE (2017a); Pendoley Environmental (2022; 2023)
-Nesting and inter-nesting													DoEE (2017a)
-Hatchlings emerging													DoEE (2017a)
Green turtle													DoEE (2017a)
-Foraging													DoEE (2017a); Pendoley Environmental (2022; 2023)
-Nesting and inter-nesting													DoEE (2017a)
-Hatchlings emerging													DoEE (2017a); Pendoley Environmental (2022; 2023)
Hawksbill turtle													DoEE (2017a)
-Foraging													DoEE (2017a); Pendoley Environmental (2022; 2023)
-Nesting and inter-nesting													DoEE (2017a)
-Hatchlings emerging													DoEE (2017a); Pendoley Environmental (2022; 2023)
Green sawfish													Morgan et al. (2015); Morgan et al. (2017); HBI (2023)
-Pupping													Lear et al. (2023)
Reef Manta Ray													Armstrong et al. (2020a)
Short-nosed sea snake													Udyawer et al. (2020)
Leaf-scaled sea snake													Udyawer et al. (2020)

Species presence	J	F	M	A	M	J	J	A	S	O	N	D	Data Source
*timing of specific life history traits are variable and generally dependent on environmental variables, therefore species could be present year-round and could be displaying a variety of different life history traits (e.g. foraging, travelling, foraging, breeding)													

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Appendix A. Existing threats and pressures

Appendix A.1. North-west marine bioregional plan

Table A1-1: Key pressures and threats as identified in the North-west marine bioregional plan (DSEWPaC 2012a)

C= Concern (red shading), PC= Potential Concern (yellow shading), LC= Less Concern (green shading), NC= Not or Concern (grey shading), DD= Data Deficient or not assessed (white shading) adapted from DSEWPaC 2012a

Marine fauna	Underwater Noise	Habitat Modification	Human Presence	Change Hydrology	Increased Turbidity	Nutrient Pollution	Vessel Strike	Entrainment (dredge and seawater intake)	Chemical Spills	Litter/ Debris	Light Pollution	Invasive Species	Sea level rise	Hydrocarbon spills
Humpback whale	PC	DD	DD	NC	DD	DD	PC	NC	LC	DD	DD	NC	DD	LC
Australian humpback dolphin	PC	PC	PC	PC	DD	PC	PC	NC	PC	PC	NC	DD	LC	PC
Indo-pacific bottlenose dolphin	PC	PC	PC	PC	DD	PC	PC	NC	PC	PC	NC	DD	LC	PC
Dugong	LC	PC	LC	DD	DD	NC	PC	NC	LC	PC	DD	PC	PC	PC
Green turtle	PC	LC	C	DD	PC	PC	PC	PC	LC	C	C	C	LC	LC
Flatback turtle	PC	C	C	DD	LC	LC	NC	PC	LC	C	C	C	LC	LC
Hawksbill turtle	PC	LC	LC	DD	LC	LC	PC	PC	LC	C	C	NC	LC	LC
Sea snakes	DD	PC	NC	DD	DD	DD	LC	DD	DD	DD	DD	DD	DD	PC

Marine fauna	Underwater Noise	Habitat Modification	Human Presence	Change Hydrology	Increased Turbidity	Nutrient Pollution	Vessel Strike	Entrainment (dredge and seawater intake)	Chemical Spills	Litter/ Debris	Light Pollution	Invasive Species	Sea level rise	Hydrocarbon spills
Sawfish	DD	LC	DD	C	DD	LC	DD	DD	LC	PC	DD	DD	PC	DD
Whale shark	DD	NC	DD	DD	DD	DD	LC	DD	DD	DD	DD	NC	DD	DD
Other sharks & rays	DD	DD	NC	DD	DD	DD	DD	DD	DD	NC	DD	DD	DD	DD

Appendix A.2. Commercial fisheries bycatch

Table A2-1 Reported bycatch of protected and listed species from commercial, and charter fisheries in 2023 (Newman et al. 2024) (marine fauna species only – seabirds and freshwater species have been removed)

Common name	Scientific name	Alive	Dead	Unknown
Commercial				
Fish				
Green sawfish	*Pristis zijsron*	73	31	0
Narrow sawfish	*Anoxypristis cuspidata*	11	3	0
Dwarf sawfish	*Pristis clavata*	2	0	0
Sawfish (unspecified)	Pristidae	117	58	3
Syngnathids (unspecified)	Syngnathidae	74	33	0
Grey nurse shark	*Caracharias taurus*	10	0	2
White shark	*Carcharodon carcharias*	5	3	2
Mammals				
Dolphins (unspecified)	Delphinidae	2	13	0
Humpback whale	*Megaptera novaeangliae*	4	0	2
Reptiles				
Crocodiles (unspecified)	*Crocdylus spp.*	101	52	4
Green turtle	*Chelonia mydas*	17	0	0
Loggerhead turtle	*Caretta caretta*	9	0	1
Sea turtles (unspecified)	Cheloniidae	73	6	0
Olive sea snake	*Aipysurus laevis*	28	6	129
Olive-headed sea snake	*Hydrophis major*	34	5	0
Reef shallows sea snake	*Aipysurus duboisii*	41	3	0
Elegant sea snake	*Hydrophis elegans*	17	4	0
Spotted sea snake	*Hydrophis ocellatus*	16	2	0
Mosaic sea snake	*Aipysurus mosaicus*	0	1	0
Short-nosed Sea Snake	*Aipysurus apraefrontalis*	5	0	0
Small-headed Sea Snake	*Hydrophis macdowelli*	45	0	0
Stokes' Sea Snake	*Hydrophis stokesii*	44	2	0
Turtle-headed Sea Snake	*Emydocephalus spp.*	1	0	0
Sea Snakes (Unspecified)	Hydrophiinae	3,278	194	46
Charter				

Common name	Scientific name	Alive	Dead	Unknown
Green Sawfish	*Pristis zijsron*	5	0	0
Sawfishes (Unspecified)	Pristidae	1	0	0
Humphead Maori Wrasse	*Cheilinus undulatus*	70	0	0
Potato Rockcod	*Epinephelus tukula*	5	0	0
Queensland Groper	*Epinephelus lanceolatus*	14	0	0

Table A2-2: Reported bycatch of listed species in the Pilbara Fish Trawl Interim Managed Fishery in 2023 (Newman et al. 2024)

Species	Number alive	Number deceased	Number unknown	Total reported
Bottlenose dolphin	1	13	0	14
Pipefish	5	27	0	32
Green sawfish	25	29	0	54
Narrow sawfish	7	3	0	10
Unknown sawfish	7	3	0	10
Seahorses	6	2	0	8
Sea snakes	109	36	0	145
Turtles	2	0	0	2

Appendix A.3. Recovery plans

Table A3-1: Recovery plans for key species to be considered in the EIA

Species	Recovery Plan	Key Elements Relevant to Proposal EIA	Species specific threats

Flatback turtle
Green turtle
Hawksbill turtle
	Recovery Plan for Marine Turtles in Australia (DoEE 2017a)	Threats of concern:
		• Coastal development including residential, industrial and tourism development degrade both nesting beaches and foraging habitat. Acute chemical and terrestrial discharge
		• Light pollution on nesting beaches impacting nesting behaviour and hatchling success
		• Climate change both direct and indirect impacts on the turtle. Sex is determined by incubation temperature of the eggs. Rising sea levels and an increase in climatic events intensities could result in nesting beach erosion
		Reason for Plan:
		Review of the previous recovery plan (2003) found that numerous emerging and cumulative threats were not addressed. Monitoring of key nesting and foraging sites had not been adequately achieved.
			Green turtle (NWS Stock):
			• High
			  • Chemical and terrestrial discharge – acute
			  • Light pollution
			• Moderate
			  • Climate change and variability
			  • Marine debris (ingestion)
			  • Chemical and terrestrial discharge – chronic
			  • International take (outside and within Australia's jurisdiction)
			  • Terrestrial predation
			  • Fisheries bycatch (domestic and international)
			  • Light pollution
			Flatback turtle (Pilbara stock)
			• High
			  • Climate change and variability
			  • Chemical and terrestrial discharge (acute)
			  • Light pollution
			  • Habitat modification (infrastructure/coastal development)
			• Moderate
			  • Marine debris (entanglement)
			  • Chemical and terrestrial discharge (chronic)

Species	Recovery Plan	Key Elements Relevant to Proposal EIA	Species specific threats

			• Terrestrial predation
			• Habitat modification (dredging/trawling)
			• Indigenous take
			• Vessel disturbance
			• Noise interference (acute and chronic)
			Hawksbill turtle (Western Australian stock)
			• High
			  • Climate change and variability
			  • Light pollution
			• Moderate
			  • Marie debris (entanglement)
			  • Chemical and terrestrial discharge (acute and chronic)
			  • Terrestrial predation
			  • Fisheries bycatch (international and domestic)
			  • Habitat modification (infrastructure/coastal development and dredging/trawling)
			  • Vessel disturbance
			  • Noise interference (acute and chronic)

Green sawfish	Sawfish and River Sharks Multispecies Recovery Plan (DoE 2015a)	**Threats of concern:** • Changes in hydrological regimes from land-based activities • Habitat degradation and modification and marine debris **Reasons for plan:** Species population decline and range reduction of ~30%	NA

Appendix A.4. Threat abatement plans

Table A4-1: Threat abatement plans to be considered/acknowledged in the EIA

Threat Abatement Plan (TAP)	Objective and Priorities	Species
Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE 2018) *Thorough consideration recommended*	This plan has 5 objectives to prevent and mitigate the impacts of harmful marine debris on vertebrate marine life 1. Contribute to long-term prevention of the incidence of marine debris; 2. Understand the scale of impacts from marine plastic and microplastic on key species, ecological communities, and locations; 3. Remove existing marine debris; 4. Monitor the quantities, origins, types, and hazardous chemical contaminants of marine debris, and assess the effectiveness of management arrangements for reducing marine debris; and 5. Increase public understanding of the causes and impacts of harmful marine debris, including microplastic and hazardous chemical contaminants, to bring about behaviour change. Criteria for success remain consistent with those in the previous TAP and with national indicators for estuarine, coastal, and marine ecosystems: • Monitor the quantities, origins, types, and hazardous chemical contaminants of marine debris, and assess the effectiveness of management arrangements for reducing marine debris; • A general decline in the presence and extent of harmful marine debris in Australia's marine environment; and • A general decline in the number of marine vertebrates dying and being injured from ingestion of and/or entanglement in harmful marine debris.	• Dugong • Humpback whale • Indo-pacific bottlenose dolphin • Flatback turtle • Green turtle • Hawksbill turtle
Threat Abatement Plan for predation, habitat degradation, competition, and disease transmission by feral pigs (*Sus scrofa*) (DoEE 2017b) *Acknowledgement recommended*	This plan has 6 objectives to prevent further species and ecological communities from becoming threatened or extinct due to predation, habitat degradation, competition, and disease transmission by feral pigs: 1. Prioritise key species, ecological communities, ecosystems, and locations across Australia for strategic feral pig management; 2. Encourage the integration of feral pig management into land management activities at regional, state and territory, and national levels;	• Flatback turtle • Green turtle • Hawksbill turtle

Threat Abatement Plan (TAP)	Objective and Priorities	Species
	3. Encourage further scientific research into feral pig impacts on nationally threatened species and ecological communities, and feral pig ecology and control; 4. Record and monitor feral pig control programs, so their effectiveness can be evaluated; 5. Build capacity for feral pig management and raise feral pig awareness amongst landholders and land managers; and 6. Improve public awareness about feral pigs and the environmental damage and problems they cause.	
Threat Abatement Plan for Predation by the European Red Fox (DEWHA 2008b) *Acknowledgement recommended*	This plan has 5 objectives to prevent and minimise the impacts of foxes on biodiversity by protecting affected native species and ecological communities, prevent further species and ecological communities from becoming threatened: 1. Prevent foxes occupying new areas in Australia and eradicate foxes from high-conservation-value 'islands'; 2. Promote the maintenance and recovery of native species and ecological communities that are affected by fox predation; 3. Improve knowledge and understanding of foxes impacts and interactions with other species and other ecological processes; 4. Improve the effectiveness, target specificity, integration, and humaneness of control options for foxes; and 5. Increase awareness of all stakeholders of the objectives and actions of the TAP, and of the need to control and manage foxes.	• Flatback turtle • Green turtle
Threat abatement plan for predation by feral cats 2024 (DCCEEW 2024d) *Acknowledgement recommended*	This plan has 9 objectives to minimise the impacts of feral cats on biodiversity by protecting affected native species and ecological communities, prevent further species and ecological communities from becoming threatened: 1. Coordinate and enhance the legislative, regulatory and planning frameworks 2. Plan and implement cat management programs within an evidence-based framework, and use this to help maintain broad stakeholder and community support 3. Undertake research on cat ecology and impacts to inform management undertaken across multiple objectives 4. Refine existing tools and their use, and develop new tools, for directly controlling feral cats 5. Prevent cats from spreading further, to islands that are currently without cats	• Green turtle • Hawksbill turtle • Fatback turtle

Threat Abatement Plan (TAP)	Objective and Priorities	Species
	6. Protect the most cat-susceptible species: Remove and exclude cats from an expanded network of cat-free islands and fenced havens, and manage those havens to maintain or enhance their conservation values 7. Protect species with moderate to high susceptibility to cats: Suppress feral cat density in and near prioritised populations of these species 8. Reduce the burden of cat predation across all native species using integrated management of habitat and species interactions over large areas 9. Reduce density of free-roaming cats around areas of human habitation and infrastructure.	

Appendix B. PSMT search results

Appendix B.1. Mammals

Species		BC Act	EPBC Act				PMST Rank
Common Name	Scientific Name		Threatened Category	Migratory	Marine	Cetacean	
Dugong	*Dugong dugon*	MI	-	Yes	Yes	-	Known
Australian humpback dolphin	*Sousa sahulensis*	P4 & MI	-	Yes	-	Yes	Known
Humpback whale	*Megaptera novaeangliae*	CD & MI	-	Yes	-	Yes	Known
Indo-Pacific bottlenose dolphin	*Tursiops aduncus*	MI	-	Yes	-	Yes	Likely
Pygmy blue whale	*Balaenoptera musculus brevicauda*	EN	EN	Yes	-	Yes	Known
Blue whale	*Balaenoptera musculus*	EN	EN	Yes	-	Yes	Likely
Bottlenose dolphin	*Tursiops truncatus s. str.*	-	-	Yes	-	Yes	May
Killer whale	*Orcinus orca*	MI	-	Yes	-	Yes	May
Minke whale	*Balaenoptera acutorostrata*	-	-	-	-	Yes	May
Spotted dolphin	*Stenella attenuata*	MI	-	Yes	-	Yes	May

Species		BC Act	EPBC Act				PMST Rank
Common Name	Scientific Name		Threatened Category	Migratory	Marine	Cetacean	
Bryde's whale	*Balaenoptera edeni*	MI	-	Yes	-	Yes	May
Common dolphin	*Delphinus delphis*	-	-	-	-	Yes	May
Southern right whale	*Eubalaena australis*	VU	EN	Yes	-	Yes	May
Risso's dolphin	*Grampus griseus*	-	-	Yes	-	Yes	May
Australian snubfin dolphin	*Orcaella heinsohni*		VU	Yes	-	Yes	Likely

Appendix B.2. Reptiles

Species		BC Act	EPBC Act				PMST Rank
Common Name	Scientific Name		Threatened Category	Migratory	Marine	Cetacean	
Leaf-scaled sea snake	*Aipysurus foliosquama*	CR	CR	-	Yes	-	Known
Loggerhead turtle	*Caretta caretta*	EN	EN	Yes	Yes	-	Known
Green turtle	*Chelonia mydas*	VU	VU	Yes	Yes	-	Known
Hawksbill turtle	*Eretmochelys imbricata*	VU	VU	Yes	Yes	-	Known
Flatback turtle	*Natator depressus*	VU	VU	Yes	Yes	-	Known
Short-nosed sea snake	*Aipysurus apraefrontalis*	CR	CR	-	Yes	-	Likely
Leatherback turtle	*Dermochelys coriacea*	VU	EN	Yes	Yes	-	Likely
Dubois' sea snake	*Aipysurus duboisii*	-	-	-	Yes	-	May
Spine-tailed sea snake	*Aipysurus eydouxii*	-	-	-	Yes	-	May
Olive sea snake	*Aipysurus laevis*	-	-	-	Yes	-	May
Brown-lined sea snake	*Aipysurus tenuis*	-	-	-	Yes	-	May
Stokes' sea snake	*Astrotia stokesii*	-	-	-	Yes	-	May
Spotted sea snake	*Chitulia ornata*	-	-	-	Yes	-	May

Species		BC Act	EPBC Act				PMST Rank
Common Name	Scientific Name		Threatened Category	Migratory	Marine	Cetacean	
Spectacled sea snake	*Disteira kingii*	-	-	-	Yes	-	May
Olive-headed sea snake	*Disteira major*	-	-	-	Yes	-	May
Turtle-headed sea snake	*Emydocephalus annulatus*	-	-	-	Yes	-	May
North-western mangrove sea snake	*Ephalophis greyi*	-	-	-	Yes	-	May
Black-ringed sea snake	*Hydrelaps darwiniensis*	-	-	-	Yes	-	May
Elegant sea snake	*Hydrophis elegans*	-	-	-	Yes	-	May
Small-headed sea snake	*Hydrophis macdowelli*	-	-	-	Yes	-	May
Fine-spined sea snake	*Leioselasma czeblukovi*	-	-	-	Yes	-	May
Yellow-bellied sea snake	*Pelamis platurus*	-	-	-	Yes	-	May
Horned sea snake	*Acalyptophis peronii*		-	-	Yes	-	May

Appendix B.3. Sharks and rays

Species		BC Act	EPBC Act				PMST Rank
Common Name	Scientific Name		Threatened Category	Migratory	Marine	Cetacean	
Southern Blue Fin Tuna	*Thunnus maccoyii*	-	CD**	-	-	-	Likely
Reef manta ray	*Mobula alfredi*	MI	-	Yes	-	-	Known
Dwarf sawfish	*Pristis clavata*	P1 & MI	VU	Yes	-	-	Known
Green sawfish	*Pristis zijsron*	VU	VU	Yes	-	-	Known
Narrow sawfish	*Anoxypristis cuspidata*	MI	-	Yes	-	-	Likely
Grey nurse shark (west coast population)	*Carcharias taurus (west coast population)*	VU	VU	-	-	-	Likely
Scalloped hammerhead shark	*Sphyrna lewini*	-	CD	-	-	-	Likely
Giant manta ray	*Mobula birostris*	MI	-	Yes	Yes	-	Likely
Freshwater sawfish	*Pristis pristis*	P3 & MI	VU	Yes	-	-	May
Helen's pygmy pipehorse	*Acentronura larsonae*	-	-	-	Yes	-	May

Species		BC Act	EPBC Act				PMST Rank
Common Name	Scientific Name		Threatened Category	Migratory	Marine	Cetacean	
Braun's pughead pipefish	*Bulbonaricus brauni*	-	-	-	Yes	-	May
Three-keel pipefish	*Campichthys tricarinatus*	-	-	-	Yes	-	May
Oceanic whitetip shark	*Carcharhinus longimanus*	-	-	Yes	-	-	May
White shark	*Carcharodon carcharias*	VU	VU	Yes	-	-	May
Pacific short-bodied pipefish	*Choeroichthys brachysoma*	-	-	-	Yes	-	May
Muiron island pipefish	*Choeroichthys latispinosus*	-	-	-	Yes	-	May
Pig-snouted pipefish	*Choeroichthys suillus*	-	-	-	Yes	-	May
Banded pipefish	*Doryrhamphus dactyliophorus*	-	-	-	Yes	-	May
Cleaner pipefish	*Doryrhamphus janssi*	-	-	-	Yes	-	May
Many-banded pipefish	*Doryrhamphus multiannulatus*	-	-	-	Yes	-	May
Flagtail pipefish	*Doryrhamphus negrosensis*	-	-	-	Yes	-	May
Ladder pipefish	*Festucalex scalaris*	-	-	-	Yes	-	May

Species		BC Act	EPBC Act				PMST Rank
Common Name	Scientific Name		Threatened Category	Migratory	Marine	Cetacean	
Tiger pipefish	*Filicampus tigris*	-	-	-	Yes	-	May
Brock's pipefish	*Halicampus brocki*	-	-	-	Yes	-	May
Mud pipefish	*Halicampus grayi*	-	-	-	Yes	-	May
Glittering pipefish	*Halicampus nitidus*	-	-	-	Yes	-	May
Spiny-snout pipefish	*Halicampus spinirostris*	-	-	-	Yes	-	May
Ribboned pipehorse	*Haliichthys taeniophorus*	-	-	-	Yes	-	May
Beady pipefish	*Hippichthys penicillus*	-	-	-	Yes	-	May
Western spiny seahorse	*Hippocampus angustus*	-	-	-	Yes	-	May
Spiny seahorse	*Hippocampus histrix*	-	-	-	Yes	-	May
Spotted seahorse	*Hippocampus kuda*	-	-	-	Yes	-	May
Flat-face seahorse	*Hippocampus planifrons*	-	-	-	Yes	-	May
Three-spot seahorse	*Hippocampus trimaculatus*	-	-	-	Yes	-	May
Tidepool pipefish	*Micrognathus micronotopterus*	-	-	-	Yes	-	May

Species		BC Act	EPBC Act				PMST Rank
Common Name	Scientific Name		Threatened Category	Migratory	Marine	Cetacean	
Black rock pipefish	*Phoxocampus belcheri*	-	-	-	Yes	-	May
Whale shark	*Rhincodon typus*	MI	VU	Yes	-	-	May
Pallid pipehorse	*Solegnathus hardwickii*	-	-	-	Yes	-	May
Straightstick Pipefish	*Trachyrhamphus longirostris*	-	-	-	Yes	-	May
Gunther's pipehorse	*Solegnathus lettiensis*	-	-	-	Yes	-	May
Robust ghostpipefish	*Solenostomus cyanopterus*	-	-	-	Yes	-	May
Double-end pipehorse	*Syngnathoides biaculeatus*	-	-	-	Yes	-	May
Bentstick pipefish	*Trachyrhamphus bicoarctatus*	-	-	-	Yes	-	May

Appendix C. Literature review

Table C1: Summary of key reports used to inform this desktop

Article Title	Survey/study effort	Key findings	Reference
Mammals			
Sparse seagrass meadows are critical dugong habitat: A novel rapid assessment of habitat-wildlife associations using paired drone and in-water surveys	This study used drones for dugong surveys with underwater benthic habitat assessment techniques at the local spatial scale (~30 km^2), to determine the drivers of dugong (*D. dugon*) distribution across three locations in the Pilbara, WA. Survey locations include Exmouth Gulf, Mangrove Passage, and Regnard Island, and multiple aerial surveys conducted from May 2018 to June 2018, Regnard Island was conducted in May 2018 and November 2018.	The key findings from the study were: • Dugongs were present at the Regnard Island survey location • Low cover (typical for the region 2-10%) of colonising seagrass was a key driver of the presence and abundance of dugongs • *Halophila ovalis* and *Halodule uninervis* were the main predictors of dugong presence and abundance across the three locations surveyed. • Where both seagrass species simultaneously occurred, the likelihood of dugongs being present increased by over 60 times. The presence of *H. uninervis* alone was predicted to increase the abundance of dugongs by 1.4 times across all locations and by 6.8 times in one location, Exmouth Gulf, compared to when no seagrass was present • The report presents a method that can be employed in environmental impact assessments to predict and confirm potential seagrass habitat for dugong foraging.	Said et al. (2025)
Demographic History and Adaptive Evolution of Indo- Pacific Bottlenose Dolphins (*Tursiops aduncus*) in Western Australia	This study used a seascape genomics approach combined with population demographic modelling to investigate the demographic and environmental factors that have influence the population structure of WAs Indo-Pacific bottlenose dolphins. This involved large- scale environmental data gathered via remote sensing with RADseq genomic data from 133 individuals at 19 sampling sites. Using population genetic and outlier detection analyses, we identified three distinct genetic clusters, coinciding with tropical, subtropical and temperate provincial bioregions. Sampling sites extended from Albany to Cygnet Bay and included Dampier Archipelago and took place from 1998 to 2018.	The key findings from the study were: • multi- locus heterozygosity declined from north to south, dolphins from the southernmost cluster inhabiting temperate waters had higher heterozygosity in potentially adaptive loci compared to dolphins from subtropical and tropical waters. • Ongoing adaptation to cold-temperature waters in the southernmost cluster, possibly linked to distinct selective pressures between bioregions. • marine realm, without apparent physical boundaries, only a combined approach can fully elucidate the intricate environmental and genetic interactions shaping the evolutionary trajectory of marine mammals • Results indicate a minimum of three population clusters; North (EXM, ONS, DMP, PHE, BRO, BEA, CYG), central (DHA, WSB, ESB) and south (ALB, AUG, BUN, MAN, PCO, ROT, PSC) • Population relevant to the Proposal area would be part of the North population cluster.	Marfurt et al. (2024)
Aerial abundance estimates for two sympatric dolphin species at a regional scale using distance sampling and density surface modeling	This study focused on the distribution and abundance of Indo-Pacific bottlenose dolphins (*T. aduncus*) and Australian humpback dolphins (*S. sahulensis*) along the Pilbara coastline of Western Australia, covering an area of approximately 33,420 km^2. Using aerial surveys and density surface modelling, the research found that dolphin densities were highest in nearshore waters, particularly in the Exmouth Gulf, Dampier Archipelago, and Great Sandy Islands. Bottlenose dolphins were more widely distributed and abundant compared to the more vulnerable humpback dolphins, whose distribution was patchier and primarily concentrated near these coastal hotspots.	The key findings from this study were: • Dolphin densities were greatest in nearshore waters, particularly around the Exmouth Gulf, Dampier Archipelago, and Great Sandy Islands. • Bottlenose dolphins (Tursiops aduncus) were more abundant and widely distributed compared to humpback dolphins (Sousa sahulensis), which exhibited a patchier distribution. • Humpback dolphins, listed as vulnerable, were found in smaller numbers and primarily concentrated in specific hotspots along the Pilbara coastline. • Distribution patterns varied regionally, with some areas of lower dolphin abundance between the northern Exmouth Gulf and Dampier Archipelago. • Both species favoured shallow coastal waters, highlighting the importance of these habitats for foraging and other ecological activities.	Raudino et al. (2023)
Dolphin Distribution and Habitat Suitability in North Western Australia: Applications and Implications of a Broad-Scale, Non-targeted Dataset	This publication summaries current distribution and preferred habitat of the Australian humpback dolphin, and bottlenose dolphin. The study uses opportunistic aerial dolphin sightings recorded in 2012, 2013, 2014, and 2015 within a 10,600 km^2 study area which encapsulated the Exmouth Gulf and coastal waters north to the	The key findings of the aerial surveys document in the paper were: • Bottlenose dolphins were (n= 661) the most commonly occurring species within the study area • There was a clear distinction between the habitat suitability of the humpback and bottlenose dolphins, with the only potential areas of overlapping high habitat was around the North West Cape, Muiron Islands, and south-western Barrow Island	Hanf et al. (2022)

Article Title	Survey/study effort	Key findings	Reference
	north-east of Barrow Island and out to the 20 m isobath, overlapping with the Project. The surveys were undertaken as part of the Wheatstone Project.	• Humpback dolphins have highest habitat suitability in shallow intertidal areas of both the offshore islands and the mainland • The Exmouth Gulf had high suitability for the humpback dolphin. Whereas bottlenose dolphins' highest suitability was in greater depths, generally further offshore. • Surveys were unable to confirm presence of the Australian snubfin dolphin, with the sightings (n=9) only deemed 'probable'.	
Pygmy blue whale movement, distribution, and important areas in the Eastern Indian Ocean	This publication summarises the movement of Pygmy Blue Whales (*B. m. brevicauda*) in the South-east Indian waters. The study area extended along the Western Australian coast and encapsulates the Potential vessel movement area. The study involved the combination of passive acoustic monitoring and satellite telemetry to quantify the pygmy blue whale distribution and important areas.	The key findings of the acoustic monitoring and tagging surveys document in the paper were: • showed extensive use of the slope habitat off WA, with minimal use of the shelf habitat, only 7% of tagged whales occupied shelf waters • During their northern migration (April to June) from Ningaloo up to the Rowley shoals the whale had high use and low move persistence supports possible Foraging BIA off Ningaloo • For the southern migration (November to December) the whales could be found north-west of WA.	Thums et al. (2022)
Migratory Movements of Pygmy Blue Whales (*Balaenoptera musculus brevicauda*) between Australia and Indonesia as Revealed by Satellite Telemetry	This publication summarises the movements of pygmy blue whales (*B. m. brevicauda*) from satellite tags deployed in2009 and 2011. The tags were deployed on 11 whales within the Perth Canyon in March and April with a track day ranged between 8–308.The study area extended along the Western Australian coast and is relevant to the Project area	The key findings of this satellite survey documented in the paper were: • Results showed that from March–April before reaching the NWC the whales stayed closer to the coast (100 ±1.7km). • After passing the NWC and travelling towards Indonesia they were further offshore (238.0 ±13.9km) • Pygmy blue whales occupied different water depths at different times of the year March-April (1369.5 ±47.4m), May (2617 ±143.5m), June–September (3788.5 ±66.4m).	Double et al. (2014)
Demographic characteristics of Australian humpback dolphins reveal important habitat toward the southwestern limit of their range	This publication summaries photo-identification data collected via boat-base surveys conducted between 2013 and 2015. The aim was to estimate abundance, site fidelity and residence patterns of Australian humpback dolphins. The study is relevant to the Project area.	The key findings of this report were: • Abundance estimates varied from 65 to 102 individuals • Super-population size was estimated to be 129 individuals I the 130 km2 survey area • Density estimated to be 1 humpback dolphin per km2, which is the highest recorded for the species • High number of resighted individuals, 63% individuals exhibited high level of site fidelity.	Hunt et al. (2017)
Evidence for a widely expanded humpback whale calving range along the Western Australian coast	This publication summarises the sightings of neonate and post neonate humpback whale calves in North West Cape. Using the size, colour, and direction of the calf movements to suggest an expansion of the breeding area for the Humpback Whales. Surveys were completed in 2013 and 2015. This survey does not overlap with the Project, but the results are relevant to the Project area.	The key findings of the aerial surveys documented in this paper were: • There was a high abundance of calves spotted on along NWC in both 2013 and 2015 with estimated abundances 463-603 and 557-725 respectively, with majority of the calves were neonates (85% in 2013; 94% in2015) • The majority of calves sighted in both years (85% in 2013; 94% in 2015) were neonates • The findings from these surveys suggest the breeding grounds for the breeding stock D population of the humpback whales extends at least 1,000km south to NWC (22°430S) then currently recognised.	Irvine et al. (2018)
A Description of Megafauna Distribution and Abundance in the SW Pilbara Using Aerial and Acoustic Surveys – Final Report 2010 (Jenner et al. 2010a) A Description of Megafauna Distribution and Abundance in the SW Pilbara Using Aerial and Acoustic Surveys – Mid-Study Field Report December 2010 (Jenner et al. 2010c)	This report provided the supplementary information to complete the Final Response to Submissions on the Draft EIS/ERMP for the Wheatstone Project. It represents the final report of the aerial survey program, with two previous reports being submitted as Appendix 3 and 4 of the Draft EIS/ERMP. A series of aerial and acoustic surveys were completed near the Project to determine megafauna distribution and abundance in this area and to relate the encounters to populations known to exist in the broader regional area. This report constitutes supplementary information required for the draft EIS/ERMP, appearing as an Appendix in the Technical Appendix – Marine Mammals for the Wheatstone Project. The report provides an initial examination of the data collected between May and December 2009 and constitutes the mid study field report of the aerial survey program. The report summarised the first 3 months of acoustic and 8 months of aerial survey data. Acoustic surveys began in mid-April 2009 and spanned 78 days at an offshore site and 94 days at an inshore site. Aerial surveys	The key findings of this report were: • A total of 1221 Humpback Whales were sighted in 26 aerial surveys over the southwest Pilbara offshore region between May 2009 and May 2010 • Nearshore waters (5-50 m depths) recorded lower densities of humpback whales than offshore waters (50-950 m depths) • Pygmy blue whales, sperm whales, killer whales, minke whales and pilot whales were also sighted during aerial surveys • Acoustic surveys conducted between May-December 2009 identified the presence of humpback whales, pygmy blue whales, Brydes whales and dwarf minke whales in the study area • Pygmy blue whales and dwarf minke whales were present in deeper waters of the offshore study area from mid-May onwards although, in the 2009 season, these species were recorded in lower numbers (based on call rates) than in previous seasons • Nearshore aerial surveys (restricted to depths less than 50 m) reported regular sightings of dugongs, dolphins, manta rays and turtles throughout the survey.	Jenner et al. (2010a,b)

Article Title	Survey/study effort	Key findings	Reference
	consisted of 17 flights beginning in mid-May and extending through to 24 December 2009.	• Four whale sharks were recorded during aerial surveys conducted between May and December 2009 in the Project area • No high-density concentrations of megafauna were identified between May and December near the Ashburton North Strategic Industrial Area, where nearshore and offshore infrastructure were to be located.	
A Description of Megafauna Distribution and Abundance in the SW Pilbara Using Aerial and Acoustic Surveys – Mid-Study Study Field Report August 2009 (Jenner and Jenner 2009)	This report constitutes supplementary information required for the draft EIS/ERMP, appearing as an Appendix in the Wheatstone Project Draft EIS/ERMP. The report provides an initial examination of the data collected between May and August 2009 and constitutes the mid study field report of the aerial and acoustic survey program.	The key findings of the report were the same as those summarised the in the Final Report (Jenner et al. 2010a). Humpback whales: • Cow/calf were observed mostly resting in shallow waters 50 m offshore Pygmy blue whales • Were detected in deeper waters offshore from mid-May, the whales could be completing either their north or southward migration :	Jenner and Jenner (2009)
Sea noise logger deployment Wheatstone and Onslow, April to July 2009, Preliminary Analysis, undertaken by CMST for URS/Chevron	This report details the deployment of five sea noise loggers throughout the Wheatstone Project area and discusses the preliminary analysis of the data from the noise loggers.	The key findings of the survey: • The noise loggers detected various whale species including pygmy blue, dwarf minke, Brydes, and humpback whales. However, seasonal patterns could not be delineated • Offshore noise loggers recorded noises primarily from seismic survey and vessels over the course of deployment. The vessels and seismic surveys detected at the offshore deployment location, were believed to be associated with surveys of the deep waters adjacent to the continental shelf to the south of the Project area • Pygmy blue whales were present offshore from May to July and were believed to be north bound pygmy blue whales. The time integrated count of individual calling pygmy blue whales from the Project area from a nearby 2006 data set was compared with the similar count made in 2009 over the matching time period in Julian days. Six times fewer whales were recorded in 2009 compared with 2006. • Dwarf Minke whales were detected and counted at the offshore site and were present over the April to July. The time integrated counts of individual calling dwarf minke whales in 2009 were compared with the same calculation for the nearby site made in 2006 and seven times fewer dwarf minke whale detections were made in 2009 • Brydes whales were detected on once in April in 43 m of water at a site west of Onslow, humpback whales were present at the 43 m depth inshore site and at the offshore site.	McCauley and Salgado (2009)
How many dolphins live near a coastal development?	This publication summaries the results of boat-based surveys completed near the town of Onslow in the Pilbara region from 2012 to 2015. The aim of the survey was to estimate abundance, density and movement patters of the Indo-pacific bottlenose dolphin and the Australian humpback dolphin.	The key findings of the boat-based surveys were: • Indo-Pacific bottlenose dolphin (Tursiops aduncus) total abundance estimate corrected for the unmarked proportion of the population was 79 SE ± 24 (CI 43-148) for Onslow • There were insufficient resighting's of Australian humpback dolphins (Sousa sahulensis) to model abundance accurately • The densities were similar between both sites for each species; 0.59 bottlenose dolphins per km^2 in coastal Onslow waters versus 0.83 bottlenose dolphins per km^2 around Thevenard Island and 0.36 humpback dolphins per km^2 at Onslow and 0.38 humpback dolphins per km^2 around Thevenard Island. The density of humpback dolphins, although low, is comparable to estimates across their range. • The study confirms that Indo-Pacific bottlenose and Australian humpback dolphins use the waters near Onslow • Low re-capture rates suggest that their home ranges are larger than, and only partially overlapping, the 128 km^2 area. • More intense sampling effort would be required to precisely estimate abundance for humpback dolphins.	Raudino et al. (2018)

Article Title	Survey/study effort	Key findings	Reference
Technical Appendix Marine Mammals Wheatstone Project EIS/ERMP	This report summaries the contextual and preliminary survey results from the Chevron Wheatstone surveys to support the assessment of the Project. The summary is related to marine mammals including a review of existing literature for marine mammals, aerial, and the acoustic surveys undertaken in the Project area to determine the distributions and abundances of identified fauna. The appendix summaries the preliminary results of these surveys.	Key findings included: • Blue whales were identified by acoustic and aerial surveys in the Project area, in deep waters of the continental slope. Migratory blue whales may transit the area between October to December annually. • Humpback whales were observed in waters of the continental slope approximately 50 km west of Onslow when migrating north, and 35 km offshore in water waters of the continental slope when migrating south • Indo Pacific humpback dolphins and the spotted bottlenose dolphin were identified as occurring within the Project area, but were not detected in the aerial or the acoustic surveys • Dugongs were detected via aerial surveys in coastal waters of the continental shelf, but generally in waters less than 12 m in depth.	RPS (2010)
Pygmy blue whale movement, distribution, and important areas in the Eastern Indian Ocean	This publication summarises the movement of Pygmy Blue Whales (*Balaenoptera musculus brevicauda*) in the South-east Indian waters. The study area extended along the Western Australian coast and encapsulates the Potential vessel movement area. The study involved the combination of passive acoustic monitoring and satellite telemetry to quantify the pygmy blue whale distribution and important areas.	The key findings of the acoustic monitoring and tagging surveys document in the paper were: • showed extensive use of the slope habitat off WA, with minimal use of the shelf habitat, only 7% of tagged whales occupied shelf waters • During their northern migration (April to June) from Ningaloo up to the Rowley shoals the whale had high use and low move persistence supports possible Foraging BIA off Ningaloo • For the southern migration (November to December) the whales could be found north-west of WA.	Thums et al. (2022)
Reptiles			
I still call Australia home: Satellite telemetry informs the protection of flatback turtles in Western Australian Waters	This report present the results of complied satellite tracking data of 280 flatback turtles deployed between 2005 and 2020. The aim of the research was to investigate movements and level of spatial protected to the five genetic stocks in WA during different behavioural phases. The report is relevant to the Project as identifies habitat use of the species in the waters adjacent to the Project.	Flatback turtle: • Flatback turtles spend 99.5% of their time in Australian water • >98% overlap with biologically important areas during the inter-nesting phase of their life cycle • Up to 85.6% and 59.1% overlap between marine reserves and the foraging and migratory range.	Peel et al. (2024)
Vulnerability of sea turtle nesting sites to erosion and inundation: A decision support framework to maximize conservation	This report aimed to identify flatback turtle nesting beaches that are at the greatest risk from erosion and inundation in the Pilbara region of WA. To do this the study used Integrated Valuation of Ecosystem Services and Trade-offs (InVEST) Coastal Vulnerability Model. A relative exposure index was calculated for 402 nesting beaches in terms of six geophysical variables: wind and wave exposure, surge potential, relief, observed sea level rise, and coastal geomorphology, and coupled with published information on the distribution and abundance of turtle tracks in the region.	The key findings of the paper were: • majority of beaches (74%) had intermediate to high exposure • 36% of the beaches with high abundance of flatback turtle tracks (the top 25% of the frequency distribution) had high exposure • Results suggest that coastal exposure is a key vulnerability to the reproductive success of sea turtles nesting in the Pilbara region • Nesting beach mainland around the Proposal were unquantified in terms they had old flatback turtle tracks and/or tracks from green and/or hawksbill turtles. But nesting confirmed on the island beaches • The nesting beaches around the Proposal were classified as having a high average exposure index for sea turtle nesting beaches.	Gammon et al. (2022)
Using aerial photogrammetry to assess stock-wide marine turtle nesting distribution, abundance and cumulative exposure to industrial activity	This publication summaries nesting distribution of the flatback turtles in the Pilbara region on WA, from Islands in the Exmouth Gulf to Bedout Island in the north and Mulla Mulla Downs Creek in the east.	The key findings of the paper that are relevant were: • Majority of nesting occurs on Islands (85.3%) • No flatback turtle nesting was observed on mainland southwest of Urala Beach, between Beadon Creek (Onslow) and Dampier • 77% of rookeries were in protected areas. • Estimated to be 1953 nesting females on Barrow Island.	Fossette et al. (2021a)
Movements and distribution of hawksbill turtles in the Eastern Indian Ocean	This publication presents the result from a hawksbill turtle satellite transmitter study completed at six rookeries (5 in WA and 1 in Timor-Leste) between 2000-2017. This data was used to quantify inter-nesting, migratory and foraging habitat use and overlap with protected area. Rookeries include: Beacon Island, Delambre Island, Rosemary Island, Varanus Island, Montebello's Southeast Island, and Timor-Leste.	The key findings of the paper were: • During the inter-nesting period the turtles remained in a relatively small area, average 50% occupancy core of 39 ± 28 km^2 • Apart from one rookery, most of their inter-nesting distribution was contained within existing protected areas.	Fossette et al. (2021b)

Article Title	Survey/study effort	Key findings	Reference
		• Turtles migrating from WA rookeries remained in shallow continental-shelf waters (< 200 m), mainly following the coastline while dispersing in a north-easterly direction, whereas turtles from Timor-Leste crossed international waters. • high overlap of individual turtles (56%) in a migratory corridor along the Pilbara coast, an area previously identified as critical for other migratory megafauna species. • There were at least 13 foraging grounds identified which extended over ~900 km, in water depths ranging from 1.5-84 m • There was only 33% of this area was encompassed by either designated BIA for foraging hawksbill turtles (10%), or Australian and State-protected areas (23%).	
Prioritising search effort to locate previously unknown populations of endangered marine reptiles	This report used correlative modelling approach to understand habitat associations and identify suitable habitats for five of these species (*Aipysurus apraefrontalis, A. foliosquama, A. fuscus, A. l. pooleorum* and *A. tenuis*). With the aim to prioritise future survey regions to locate unknown populations. This reports mapped the habitat suitability for the Project area.	The key findings of the paper that are relevant were: • *A. apraefrontalis* key areas of suitable habitat: Ashmore Reef, Exmouth Gulf, Muiron and Montebello Islands • *A. foliosquama* key areas of suitable habitat: Ashmore Reed, Shark Bay, Exmouth Gulf, Barrow and Montebello Islands.	Udyawer et al. (2020)
Molecules and Morphology Reveal Overlooked Populations of Two Presumed Extinct Australian Sea Snakes (Aipysurus: Hydrophiinae)	The study investigates overlooked populations of the critically endangered leaf-scaled sea snake (Aipysurus foliosquama) and short-nosed sea snake (Aipysurus apraefrontalis), previously thought to be restricted to Ashmore and Hibernia Reefs. Molecular and morphological analyses confirm that these species have distinct breeding populations along the northwest Australian coast, including Barrow Island.	• A specimen of Aipysurus foliosquama was collected on Barrow Island in 2010, confirming a distinct coastal population separate from those at Ashmore Reef. • Coastal habitats where these sea snakes are found are under increasing pressure from industrial developments, dredging, and marine infrastructure projects, posing significant threats to their survival. • Sea snakes have been omitted from environmental impact assessments in the region, and this study underscores the urgency of incorporating them into conservation planning to protect their remaining populations.	Sanders et al. (2015)
New range and habitat records for threatened Australian sea snakes raise challenges for conservation	This report summarises extensive field surveys, habitat data and molecular genetics to document the first unequivocal records of living *A. foliosquama* and *A. apraefrontalis* since they were listed as Critically Endangered, in coastal WA.	The key findings of the paper that are relevant were: • Capture/records of living *A. foliosquama* (n = 16) and *A. apraefrontalis* (n = 7) • Significantly increases the known geographic range and habitats of *A. foliosquama*.	D'Anastasi et al (2016)
Twenty years of turtle tracks: marine turtle nesting activity at remote locations in the Pilbara, Western Australia.	This publication summarises data collected on three species of marine turtle (flatback, green and hawksbill) between 1992 and 2012 to identify reproductive habitat and species-specific abundances at 154 locations in the Pilbara region.	• Green turtles most abundant, nesting at few sights but in greater numbers (1200.5 ±62.0) • Flatback abundance 877.4 ±29.5 • Hawksbill abundance 314.1 ±17.1, and least widespread – concentrated in the Onslow and Dampier subregions • Flatback and hawksbill nested primarily on islands (93%) • Flatback turtle nests more widely distributed.	Pendoley et al. (2016)
Sharks and fish			
Collaborative methods identify a remote global diversity hotspot of threatened, large-bodied rhino rays	This publication identified 2,343 records of globally threatened rays of the order Rhinopristiformes from the Pilbara region of WA. The study location is an important refuge and pupping area for green sawfish (*Pristis zijsron*), bottlenose wedgefish (*Rhynchobatus australiae*), shark rays (*Rhina ancylostoma*) and eyebrow wedgefish (*Rhynchobatus palpebratus*). This study does overlap with the Project DE.	The key findings of this paper: • All eight species of the Australian rhino-rays are found along the Pilbara coastline, as well as seven of the eight in the Exmouth Gulf • The Ningaloo Coast World Heritage Area and adjacent Exmouth Gulf host all life stages of giant shovelnose ray (*Glaucostegus typus*).	Bateman et al. (2024)
Identification of Western Australian Grey Nurse Shark aggregation sites	This desktop study was developed to broadly identify areas in WA where potential grey nurse sharks' aggregations may occur. Using commercial sharks' fishers, unpublished research data, anecdotal reports and/or captures from recreational fishers and divers.	The key findings of the paper were: • No sharks were sighted at the 9 sites in the NWC area by divers • Remoted Operate Vehicle surveys of deep-water sites failed • Desktop study was unable to confirm locations of grey nurse shark aggregations off WA • Grey nurse shark remain widely distributed along the WA coastline.	Chidlow et al. (2006)

Article Title	Survey/study effort	Key findings	Reference
Trends in catch rates of sawfish on the Australian North West Shelf	This publication collects known data of sawfish bycatch by the Pilbara Trawl Fishery to verify populations of sawfish in the Pilbara region. The study hypothesizes sawfish populations are stabilizing or increasing due to a reduction of inshore fisheries. The critically endangered green sawfish are known to inhabit the waters adjacent to the Project area (offshore).	The key findings of the paper: • Sawfish population trends follow seasonal patterns that are hypothesized to be related to an annual migration • Green and narrow sawfish undergo a cross-shelf migration in their lifetime • No significant depth preference related trends for either species.	Harry et al. (2024)
Examination of Connectivity of hammerhead sharks in Northern Australia	This publication is part of the Marine Biodiversity hub Proposal A5. The aim of this paper was to fill in management gap on whether Australian hammerhead shark stocks are shared with neighbouring countries. Using satellite tagging and tracking, genetic analysis and parasites.	The key findings of the paper that are relevant were: • sharks tagged in Exmouth Gulf showed movements restricted to the Gulf and adjacent island • Results for S. lewini revealed that Indo-Pacific populations (eastern and northern Australia, Papua New Guinea (PNG), Philippines, Taiwan, Fiji) are distinct from those from Western Australia (WA) and the Central Pacific • parasite assemblages of *S. lewini* from Australian waters were significantly different between the NT, QLD and NSW.	Heupel et al. (2020)
Growth and morphology of Critically Endangered green sawfish *Pristis zijsron* in globally important nursery habitats	This publication assessed size development of Green Sawfish through recapture techniques in the Ashburton River and small tidal creeks surrounding Onslow, WA. The study hypothesizes the slower growth rate of green sawfish in this region, compared to the north-eastern population and nearby populations, potentially due to anthropogenic factors, differential productivity, environmental parameters, etc	The key findings of the paper were: • Growth of juvenile sawfish in WA coast is significantly slower compared to populations on the north-eastern coast of Australia • Juvenile sawfish growth rates in the mouth of the Ashburton River are much higher compared to nearby populations in the tidal creeks of Onslow, WA • Differences in the number of rostral teeth of green sawfish between the WA population and other populations throughout their current distribution indicate substantial genetic differentiation in this species globally.	Lear et al. (2023)
Effects of coastal development on sawfish movements and the need for marine animal crossing solutions	This publication assessed the effects of major anthropogenic development on the movement behaviour of juvenile green sawfish in the Ashburton river in WA. The study identified problems surrounding development that discourage sawfish residency and pupping, such as the deepening of channels deter juvenile sawfish as deeper waters may indicate more predators. The study suggested several potential structure-specific modifications that could enhance marine faunal passage through coastal developments	The key findings of the paper: • Pupping of green sawfish continues regardless of anthropogenic development • Juvenile sawfish were not detected in waters deeper than 7m.	Lear et al. (2024)
North-western Australia as a hotspot for endangered elasmobranchs with reference to sawfishes and the Northern River Shark	This publication collected donated sawfish rostra for morphological examination. The rostras were identified to site location and further measured by length and weight. The study hypothesized species distribution and viable adult and pupping habitats. Through the study, the authors created a comprehensive distribution map of sawfish species in WA.	The key findings of the paper: • Species distribution throughout WA • Newborns pups appear to have different nursing locations; generally, locations are shallow, nearshore habitats • Knowledge gap of species distribution between King Sound and Ord River.	Morgan et al. (2011)
Habitat use and site fidelity of neonate and juvenile green sawfish Pristis zijsron in a nursery area in Western Australia	This report presents the results from green sawfish surveys completed in 2011 within the Ashburton River and adjacent tidal mangrove areas. Captured green sawfish were measures, sexed and maturity status determined, and if large enough has a V13 acoustic transmitter (Vemco attached).	• 37 juvenile green sawfish were captured and tagged • Sawfish displayed high site fidelity near the mouth of the Ashburton River (<700 m upstream) or in the adjacent tidal mangrove creeks • Neonates stayed close to the river mouth for several months, with movement increasing with growth. • larger individuals, movement between the river mouth or creeks and nearshore coastal habitats was majority tidally driven, with nearshore coastal habitats used during low tide and protected tidal waters (mangrove creeks) used during high tide. Emigration from the river estuary appeared to be influenced by increases in freshwater discharge and high turbidity brought on by cyclonic rainfall events.	Morgan et al. (2017)
Evidence of long-distance movement of green sawfish (Pristis zijsron) in Western Australia	This report presents evidence of long-distance movements of the green sawfish across the coastline of Western Australia by analysing genetic diversity through the study of single-nucleotide polymorphisms (SNP's).	• Long-Distance Kinship Connections: Genetic analysis revealed that green sawfish (Pristis zijsron) individuals separated by over 500 km were identified as half-siblings, indicating extensive dispersal. • Long-distance kinship links are likely due to parental movement rather than juvenile dispersal.	Ingelbrecht et al. (2024a)

Article Title	Survey/study effort	Key findings	Reference
		• findings highlight the potential for P. zijsron populations to be replenished from distant areas, however, human developments along the coastline could disrupt these connectivity pathways.	
I still call Australia home: Satellite telemetry informs the protection of flatback turtles in Western Australian waters	This publication analysed the tracks of 280 tagged flatback sea turtles, confirming its primary residency in Australian waters. This compilation of satellite tracking datasets determined remotes areas of importance for the species and highlighted where management strategies need to improve for conservation.	The key findings of this paper: • Flatback turtles spend the majority of their time in neritic habitats and reside 99.5% of their time in the Australian exclusive economic zone • Multiple stocks overlapped in migration between Eighty Mile Beach into the northern Kimberley's. • peak areas of space use relative to number of flatbacks migrating were observed across larger areas in waters close to shore in the Pilbara (<50 m deep) and Kimberley (<100 m deep), notably along Eighty Mile Beach, at Roebuck Bay, and northward into the Kimberley's • Overlapping stocks foraging areas were identified at Thevenard Island, at Roebuck Bay, and along the Dampier peninsula into the northern Kimberley.	Peel et al. (2024)
Movement, distribution, and marine reserve use by an endangered migratory giant	This publication presents tracking data from 29 whale sharks tagged off Ningaloo tagged were deployed from 2010 to 2016 with a deployment range of 9–261 days. Tags tracked the sharks' movements from Ningaloo and their use of the south-eastern Indian Ocean. The tagging site does not overlap with the Project area but is relevant for whale shark movements along the WA coastline.	The key findings of the satellite telemetry documented in the paper were: • Movement of the whale sharks away from the Ningaloo Marine Protected area and returning intra-annually • A seasonal shift in Whale shark habitat suitability, highlighted areas of higher habitat suitability that are not protected between Onslow and Port Hedland • Sharks showed high site fidelity returning to the Ningaloo after traveling away, supporting evidence that Ningaloo is post-nursey location.	Reynolds et al. (2017)
Evidence for behavioural thermoregulation by the world's largest fish	This publication summarises the horizontal movement of 4 tagged whale sharks (*R. typus*) in 2008 to investigate the diving behaviour and vertical use of habitat.. The vertical movements and prolonged periods spent at the surface are relevant to the Project.	The key finding of the remote-sensing data documented in the paper were: • The vertical movements showed that the sharks dive in three ways: Night-time bounce (I.e. rapid descent and ascent) dives; Day time bounce dives; Daytime deep and long (340m, 169min) dives, with extremely long (146 min) post dive surface intervals. • Bounce dives were the most common for the sharks tagged at Ningaloo and for the shark tagged off Christmas Island it travelled to Indonesia and 47% of its dives were daytime deep and long dives • Results support thermoregulatory behaviour of whale sharks, with a negative relationship observed between temperature and mean surface duration. This relationship breaks down at 25°C.	Thums et al. (2013)

Appendix D. Summary of other species and likelihood of occurrence assessment

Appendix D.1. Mammals

Common name (scientific name)	Listing Status	Relevant policy and guidance, threatening processes and reasons for listing	Population, distribution, primary habitat(s) and life history	Surveys and sightings within the Proposal area and surrounding waters	Likelihood of occurrence in the Proposal area
Blue whale (*Balaenoptera musculus*) Pygmy blue whale (*B. m. brevicauda*)	EPBC Act Endangered Migratory Cetacean BC Act Endangered	Relevant EPBC Act documents are: • Conservation Management Plan for the Blue Whale (DoE 2015b) • Threat Abatement Plan for the Impacts of Marine Debris on the Vertebrate Wildlife of Australia's Coasts and Oceans (DoEE 2018)	Population: Blue whales (*B. musculus*) are difficult to study and there are many information gaps regarding their spatial ecology. A recent study has shown that at least three populations exist in the central and northern Indian Ocean, rather than there being one resident population (Leroy et al. 2021). There are two recognised subspecies of blue whales in the southern hemisphere: • Antarctic blue whale (*B. m. intermedia*) • Pygmy blue whale (*B. m. brevicauda*)	No sightings	Low The blue whale migration BIA use to overlap with the entire Pilbara coastal waters. However, revised PMST search and search of the AMSIS sight noted that the distribution BIA no longer overlaps with the Proposal area.

Common name (scientific name)	Listing Status	Relevant policy and guidance, threatening processes and reasons for listing	Population, distribution, primary habitat(s) and life history	Surveys and sightings within the Proposal area and surrounding waters	Likelihood of occurrence in the Proposal area
	IUCN Endangered	• Marine bioregional plan for the North-west Marine Region (DSEWPaC 2012a). Threats to blue whales include human-made underwater noise (resulting in hearing impairment, communication interference, elevated stress levels and/or avoidance of important habitat), vessel strike and climate variability and change (DCCEEW 2024b). Based on the North-west Marine Bioregional Plan (Appendix A.1; DSEWPaC 2012a) the following existing threats have been identified that may be relevant to consider when assessing impacts of the Proposal: • Underwater noise • Vessel strike.	The pygmy blue whale subpopulation migratory routes follow the North-West WA coastline, including the area in the vicinity of the Proposal area. The Antarctic blue whales are generally found south of 60˚S. Reliable estimates of the blue whale population size in the Australian region are not currently available as the species range over very large areas that are difficult to survey, particularly where aggregation areas are still mostly unknown (DCCEEW 2024b). Distribution: Blue whale sightings in Australian waters are widespread, and it is likely that the whales occur around the continent at various times of the year (DCCEEW 2024b). Much of the Australian continental shelf and coastal waters have no particular significance to the whales and are used only for migration and opportunistic feeding (DCCEEW 2024b). Pygmy blue whales are found off the coast of WA as they complete their northern and southern migrations. The highest densities of the pygmy blue whales off the north-west WA coastline occurs between April to June during their northern migration and November-December during their southern migration (Thums et al. 2022). The pygmy blue whale distribution BIA is large and extends from the coastline to far offshore (Figure 17; Figure D-1). Studies in the Proposal area and ecological knowledge from elsewhere suggests that pygmy blue whales are predominantly distributed in deep, offshore pelagic waters. During their northern migration they remain nearer to the coastline (100±61.7 km) until they reach the North-West Cape, at which point they then move further offshore (238±13.9 km) towards Indonesia (Double et al. 2014). Habitat and life history: Pygmy blue whales are slow growing, long-lived species living for at least 80-90 years or longer (Sears and Perrin 2009). The mating habits of the blue whale is unknown, however the age of sexual maturity for females is around 10 years (Branch 2008). Conditions in blue whale breeding areas are poorly known, but these areas may lie in deep water adjacent to tropical island groups, where advection of water by currents causes upwelling of nutrients and therefore heightened food production. Pygmy blue whales forage off the WA coastline, with two BIA identified off the north-west coast; Ningaloo Reef (a fringing reef along North-West Cape) near Exmouth and around Scott Reef and Seringapatam Reef (Thums et al. 2022). The most important areas identified along the WA coast were: • Perth Canyon • the shelf edge off Geraldton • the shelf edge from Ningaloo Reef to the Rowley Shoals (not continuous) and including a couple of small areas near the shelf edge off approx. 25°S • the Banda Sea. Off WA, the pygmy blue whales show extensive use of slope habitat during both their northern and southern migration, with limited use of the continental shelf habitat (Figure D-1; Thums et al. 2022).		When migrating along the WA coastline pygmy blue whales are much further offshore especially along the Pilbara coastline, as confirmed by Thums et al. (2022; Figure D1-1), Mustika et al. (2024), and Double et al. (2014) with data indicating a distance of some 250 km offshore. Pygmy blue whales are unlikely to be present within the Proposal area and is does not represent suitable habitat for the species. Tagging studies showing that the whales have preference for offshore waters in the Pilbara, during both their northern and southern migrations; migrating along the coastal slope, with limited use of the continental shelf (Figure D1-2; Double et al. 2014; Thums et al. 2022; Mustika et al. 2024).
Australian snubfin dolphin (*Orcaella heinsohni*)	EPBC Act Vulnerable Migratory Cetacean BC Act P4 Migratory IUCN	Relevant EPBC Act documents are: • Conservation Advice for *Orcaella heinsohni* (Australian snubfin dolphin) (DCCEEW 2025b) • Marine bioregional plan for the North-west Marine Region (DSEWPaC 2012a). Existing threats to be species as outlined in the North-west marine bioregional plan and the conservation advice, include: • Habitat loss and degradation	Population: There currently is no range-wide population estimate available for the Australian snubfin dolphin (here in 'snubfin dolphin'). Two large-scale studies completed in Australia indicate that the species occurs in small populations (<150 individuals) and in low densities (≤1.33 individuals per km^2) (DCCEEW 2025b). Important populations in WA have been identified at Roebuck Bay and Cygnet Bay. Population estimates in the Gulf of Carpentaria indicate ~1,000 individuals and less than 100 individuals in Cleveland Bay, north-east Queensland, however population estimates for the species are difficult due to the species being elusive and are different to identify. Population estimates within WA waters have yet to be completed, with vagrant individuals identified along the Pilbara coast and into the Exmouth Gulf (Hanf et al. 2022). Distribution:	No sightings since 2016	Low Infrequent sightings, often probable, have been recorded in the Pilbara region, suggesting the species occurs further into the waters of WA than previously thought (Hanf et al. 2022). Research suggests that snubfin dolphins in Exmouth Gulf and around NWC in recent times indicate the species scarcity in the area (Raudino et al. 2018; Bejder et al. 2019; Haughey et al. 2020; Sprogis et al. 2020;

Common name (scientific name)	Listing Status	Relevant policy and guidance, threatening processes and reasons for listing	Population, distribution, primary habitat(s) and life history	Surveys and sightings within the Proposal area and surrounding waters	Likelihood of occurrence in the Proposal area
	Vulnerable	• Coastal development • Vessel strike • Human presence • Hydrocarbon spills • Changes in hydrological regimes • Underwater noise • Marine debris • Nutrient pollution • Chemical pollution • Sea level rise.	Snubfin dolphins are found in coastal, shallow waters in the sub-tropical and tropical zones of Australia and Papua New Guinea. In Australia, the species has been reported from Exmouth Gulf, WA, across the northern coastline of Australia, within the Gulf of Carpentaria and along the east coast of Australia to as far south as the Brisbane River, QLD (DCCEEW 2025b). In WA, the species distribution is uneven in coastal regions, with the species primarily occurring in the Kimbereley region. Australian snubfin dolphins have been sighted around NWC, and vagrant sightings across the Pilbara, however individuals were not sighted since 2016. Therefore, snubfin dolphins in the Pilbara may occur in very low densities. Habitat and life history: Snubfin dolphins are generally found in water depths less than 20 m deep, often close to the coast, rivers, or creek mouths (Parra et al. 2002). The species is often found in turbid, sheltered coastal and estuarine environments (DCCEEW 2025b). Embayments with low wave energy and which contain seagrass, mangroves, and rivers are known to be hotspots for snubfin dolphins, such as the Gulf of Carpentaria (Groom et al. 2017; DCCEEW 2025b). The species have similar habitats to the Indo-pacific humpback dolphin, with evidence the species are sympatric (occurring in the same area) throughout their Australian range, exhibiting resource portioning in areas where they co-occur (Parra 2006; Hanf et al. 2022). Snubfin dolphins are generalist feeders, preying on a variety of fish and cephalopods, including bottom dwelling fish (e.g. grunts, flatheads, and whiting) and pelagic fish (e.g. cardinal fishes, anchovies, and barracudas). Mangrove and seagrass habitats support fish and therefore are considered important foraging habitat for the species (DCCEEW 2025b). Life history traits for the snubfin dolphin are poorly known, but likely similar to other small inshore dolphins; Indo-Pacific bottlenose dolphin and Australian humpback dolphin. Sexual maturity is thought to be reaches at ~9 years of age. Females give birth to a single calf every 2-5 years and have a gestation period of 11 months. Calves are likely to be dependent on their mother until 2 years of age (DCCEEW 2025b).		Hanf et al. 2022) and suggests that vagrant individuals may occasionally occur in the Pilbara (Hanf et al. 2022) and the waters adjacent to the Proposal.

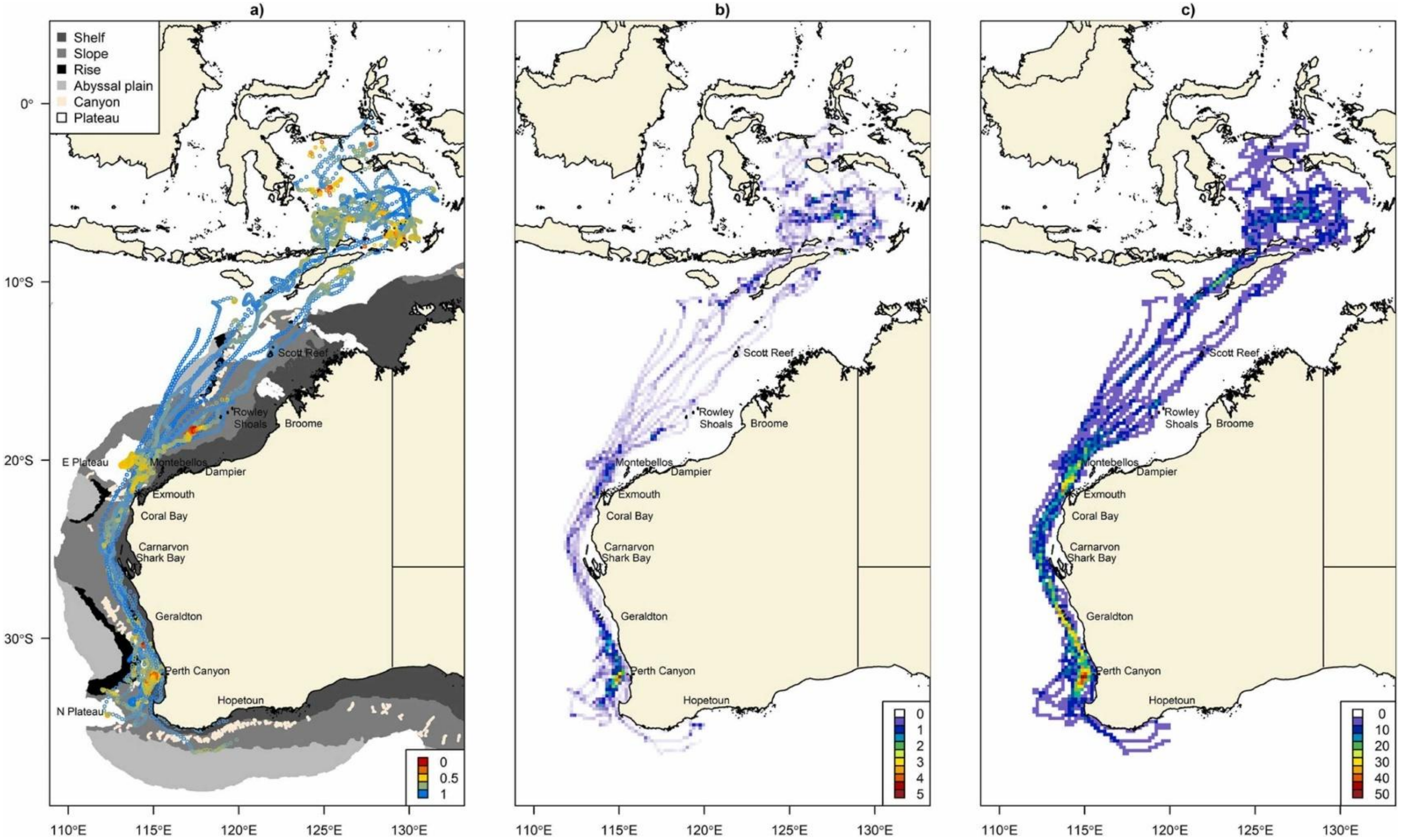

Figure D-1: Modelled pygmy blue whale migration and occupancy (Thums et al. 2022)

a) Pygmy blue whale (n = 16) state space modelled position estimates are colour coded by move persistence with cooler colours indicating high move persistence (indicative of migration) and warmer colours indicating low move persistence (indicative of foraging, and/or resting/breeding). b) shows the distributions calculated using the modelled position estimates with occupancy (time spent per grid cell in days), and c) shows percentage of pygmy blue whales per grid cell. Satellite tag deployment locations marked with an asterisk, including North-west Cape (n = 6), Perth Canyon (n = 15), Bonney Upwelling, South Australia (n = 1), noting that only data from Hopetoun WA to Indonesia is shown for the latter deployment. Geomorphic features of the Australian Exclusive Economic Zone are also shown, including the Exmouth (E) Plateau and the Naturaliste (N) plateau (Thums et al. 2022)

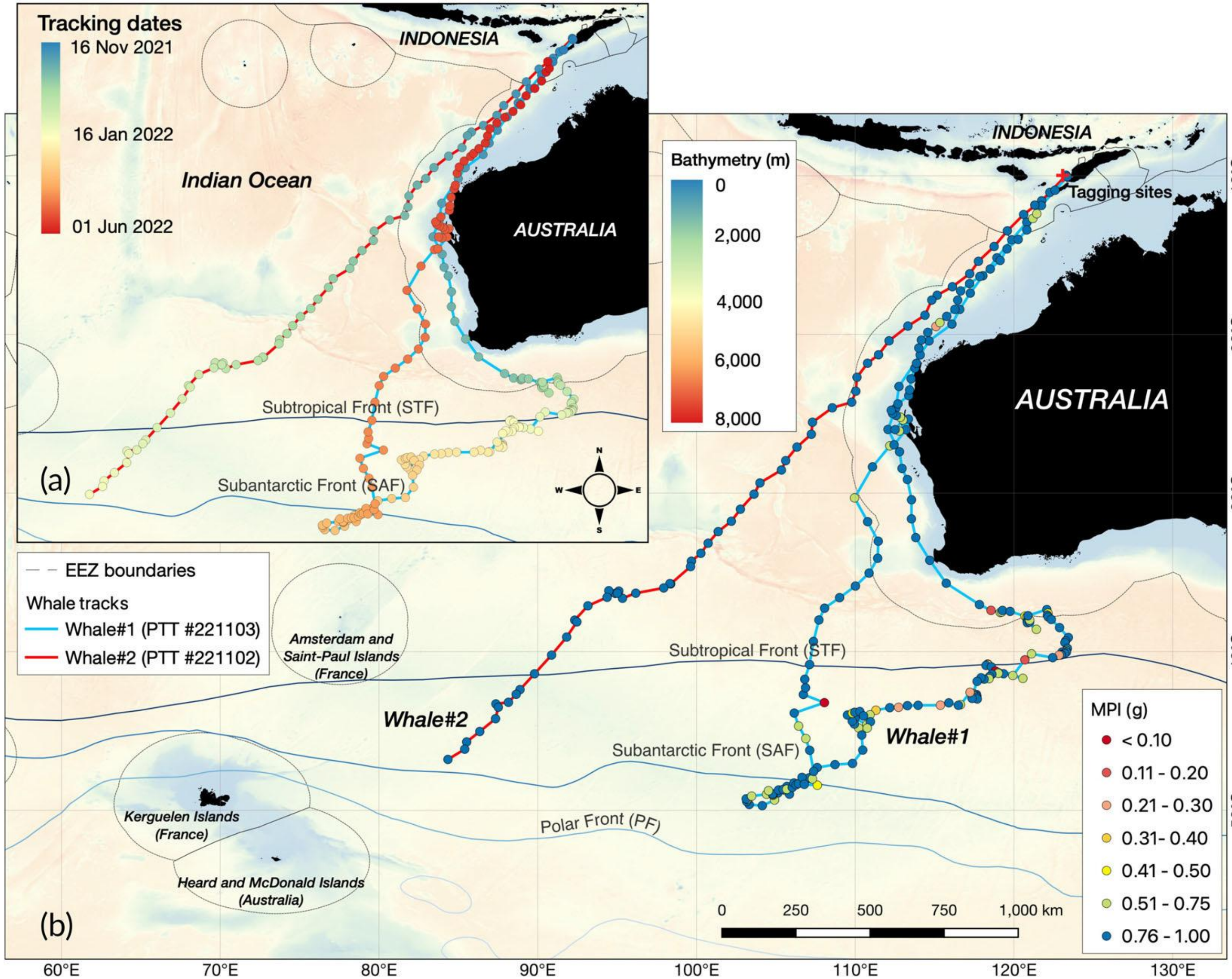

Figure D-2: The movement tracks of two satellite tagged pygmy blue whales. (a) Whale tracks based on dates; the colour dots represent tracking dates; (b) whale tracks based on the move persistence index ranging from 0 to 1 (Mustika et al. 2024)

Appendix D.2. Reptiles

Common name (scientific name)	Listing Status	Relevant policy and guidance, threatening processes and reasons for listing	Population, distribution, primary habitat(s) and life history	Surveys and sightings within the Proposal area and surrounding waters	Likelihood of occurrence in the Proposal area
Loggerhead turtle (*Caretta caretta*)	EPBC Act Endangered Marine Migratory BC Act Endangered IUCN Vulnerable	• Recovery Plan for Marine Turtles in Australia (DoEE 2017a) • Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pig (*Sus scrofa*) (2017) (DoEE 2017b) • Threat Abatement Plan for the Impacts of Marine Debris on the Vertebrate Wildlife of Australia's Coasts and Oceans (DoEE 2018) • Threat abatement plan for predation by the European red fox (DEWHA 2008b) • Marine bioregional plan for the North-west Marine Region (DSEWPaC 2012a). Based on the North-west Marine Bioregional Plan (DSEWPaC 2012a), the species report card (DSEWPaC 2012c), and the turtle recovery plan (DoEE 2017a) the following existing threats have been identified for loggerhead turtles: • Chemical and terrestrial discharge – acute • Habitat modification (infrastructure/coastal development, and dredging/trawling) • Human presence (tourism, research) • Marine debris (shipping, vessels, and land-based activities) • Light pollution (onshore-based activities) • Invasive species (shipping and land-based activities) • Increased turbidity • Vessel strike • Noise interference (acute and chronic).	Population: Global population estimates for the loggerhead turtle are not available, however the populations experiencing different trends across the species range (DCCEEW 2024d). There are ten subpopulations (IUCN assessment criteria) based on nesting site throughout their range. Within Australia there are two distinct genetic stocks in Australia, turtles that could be present in the waters adjacent to the Proposal would be the part of the Western Australia (WA) stock (DoEE 2017a). The WA stock of the logger heard turtles is considered to be stable and is one of the largest in the world. Distribution: Loggerhead turtles are distributed globally throughout tropical, sub-tropical, and temperate waters (DCCEEW 2024d). In Australia, loggerhead turtles are found throughout eastern, northern, and western Australia. The WA stocks nesting distribution includes Dirk Hartog Island, Muiron Islands, Gnaraloo Bay and Ningaloo coast (DoEE 2017a). Habitat and life history: Adult loggerhead turtles are carnivorous, feeding predominantly on benthic invertebrates in habitats ranging from near shore to 55 m. During their post-hatchling stage, they feed on algae, pelagic crustaceans, and molluscs. Post-hatchling loggerheads are generalist feeders; feeding on seagrass, macroalgae, sponges, invertebrates, pelagic crustaceans, and molluscs (DoEE 2017a). Foraging habitat for post-hatchling/young juveniles is currently unknown but thought to be in the waters of the Indian Ocean (DoEE 2017a). Juvenile/adult loggerhead turtles forage in tidal/sub-tidal habitats with hard and soft substrates present, such as rocky and coral reefs, muddy bays, sand flats, estuaries, and seagrass meadows (DoEE 2017a). Loggerhead turtles are found near or at the surface of the ocean and move with the ocean currents, choosing a wide variety of tidal and sub-tidal habitat as feeding areas and showing fidelity to both their foraging and breeding areas nesting on open, sandy beaches (DoEE 2017a). Post-nesting turtles can travel between 22 km and 2,394 km away from their nesting location (Tucker et al. 2020). The species has been found to travel up to 6,470 km to foraging grounds in Papua New Guinea (Mau et al. 2013; Tucker et al. 2020). Tracking of loggerheads from the Exmouth nesting population has revealed loggerheads migrate north and forage in waters off the Kimberley coast (Whiting et al. 2018). The mating period of the WA loggerhead turtle stock is currently unknown. Nesting occurs from November to March, with peak nesting observed in January. Hatchlings emerge from January through to May (DoEE 2017a). Important nesting locations for loggerhead turtles in WA are Dirk Hartog Island, Muiron Islands, Gnaraloo Bay, and Ningaloo Coast. Minor important locations include the mainland from Shark Bay to southern North-West Shelf (Northern end Ningaloo Marine Park) (DoEE 2017a). The Proposal area is not considered important nesting habitat for the species, and nesting has not been recorded on the mainland beaches or on offshore islands of the Proposal area (O2 Marine 2022c; Pendoley Environmental 2023). During the inter-nesting period (November to May), loggerhead turtles are generally found in water depths ranging from 2 to 20 m (Tucker et al. 2020).	Figure 15	Low The species BIA does not overlap with the Proposal. Loggerhead turtles are infrequently sighted within the Proposal area. The Proposal area does not represent important nesting habitat for the species, with majority of nesting occurring on south Pilbara breach, namely in Exmouth. Loggerhead turtles migrate along the WA coastline to their Kimberley foraging grounds so may be infrequently present.
Leatherback turtle (*Dermochelys coriacea*)	EPBC Act Endangered Marine Migratory BC Act	• Recovery Plan for Marine Turtles in Australia (DoEE 2017a) • Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (DEWHA 2008c)	Population: Estimates on the current global population size is unknown, however the global population of the species has had continued decline over the last 90 years and is continuing to display a declining trend (Wallace et al. 2013). Leatherbacks globally form seven biologically described regional management units. In the Indo-pacific region there are potentially three genetic stocks, turtles that could be present in the waters adjacent to the Proposal would be the part of the Western Australia (WA) stock (DoEE 2017a). The WA stock is thought to be part of the	No sightings.	Low Leatherback turtles are not known to nesting in the Pilbara region, and no inter-nesting or foraging BIA overlaps the Proposals. Leatherback turtles are infrequently recorded in the waters of the Pilbara and known to

Common name (scientific name)	Listing Status	Relevant policy and guidance, threatening processes and reasons for listing	Population, distribution, primary habitat(s) and life history	Surveys and sightings within the Proposal area and surrounding waters	Likelihood of occurrence in the Proposal area
	Endangered IUCN Vulnerable	• Commonwealth Listing Advice on *Dermochelys coriacea* (TSSC 2009a) • Threat abatement plan for predation, habitat degradation, competition, and disease transmission by feral pigs (*Sus scrofa*) (DoEE 2017b) • Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE 2018) • Threat abatement plan for predation by the European red fox (DEWHA 2008b) • Marine bioregional plan for the North-west Marine Region (DSEWPaC 2012a).	leatherback subpopulation that nest in Andaman and Nicobar Island (India). The leatherback turtle population trend in Australia is unknown. Distribution: Leatherback turtles have a circumglobal distribution. Leatherback turtles nest on tropical beaches and forage in temperate and sub-polar latitudes (Wallace et al. 2013). Leatherbacks are not known to nest in WA, and leatherback turtles utilise Australian coastal waters for foraging. Predominately found in central eastern Australia (Sunshine Coast to central NSW, southern-east Australia (Tasmania, Victoria, and eastern southern Australia) and WA (DoEE 2017a). Habitat and life history: Leatherback turtles are believed to occasionally forage in the NWS waters (DSEWPaC 2012e), however they are rarely seen in the coastal areas. There are no discrete genetic stocks, breeding aggregations, defined areas of critical habitat, or BIAs for leatherback turtles in WA. Leatherback turtles are oceanic and remain planktivorous throughout their life, foraging on jellyfish and ascidians (e.g. sea squirts). There has been no confirmed nesting of leatherback turtles along the Pilbara coast, however Limpus (2009) noted two unconfirmed reports of leatherback turtle nesting attempts along the WA coast. There are a few small known nesting areas for the leatherback turtles in Australia located in southern QLD and the NT (DoEE 2017a).		forage in the waters of the North West Shelf. Given the species' wide geographical range they may occur infrequently.

Appendix D.3. Sharks and rays

Common name (scientific name)	Listing Status	Relevant policy and guidance, threatening processes and reasons for listing	Population, distribution, primary habitat(s) and life history	Surveys and sightings within the Proposal area and surrounding waters	Likelihood of occurrence in the Proposal area
Narrow sawfish (*Anoxypristis cuspidata*)	EPBC Act Migratory BC Act - IUCN Critically Endangered	Narrow sawfish are currently undergoing threatened listing assessment, due for completion 30 April 2025. There is no adopted or made Recovery Plan or Threat Abatement plans documented for the narrow sawfish. Major threats to narrow sawfish globally are intense fishing pressures and bycatch, additionally loss or degradation of inshore estuarine and coastal habitats.	Population: There is no population estimate for the global population of narrow sawfish, however the population decreasing (Haque et al. 2023). The narrow sawfish global population has thought to have been subject to an 80% reduction since the 1960s (D'Anastasi et al. 2013), with a decline of >80% in the last 18 years (three generation lengths) (Haque et al. 2023). There is evidence that the global population of narrow sawfish form subpopulations, with no interbreeding, and distinct global stocks. Narrow sawfish population in Australia are thought to have decline of 30-49% in the last three generation lengths (18years) (Haque et al. 2023). In Australia there are subpopulations on the west and east coast, and mostly likely, the Gulf of Carpentaria is a third stock. Within Australia Green et al. (2018) have shown that there is broad-scale population structure for the Narrow sawfish, between four geographic regions: • North-west Australia • Gulf of Carpentaria (Australia) • Eastern Australia • Papua New Guinea. There is limited female dispersal between populations, with females showing fine-scale philopatric behaviour and evidence of male-based dispersal (Feutry et al. 2021). Distribution: Historically, narrow sawfish were found across the tropical Indo-west Pacific including the Arabian Sea and adjacent waters, Southeast Asia, Papua New Guinea, and northern Australia (Haque et al. 2023). The current distribution for narrow sawfish is restricted to the eastern Arabian Sea, part of south Asia, Papua New Guinea, and Australia. In WA narrow sawfish are known to occur from Onslow through to the northern Kimberley. Habitat and life history: Narrow sawfish are primarily found in offshore waters in deep waters. This is reflected in trawl fisheries bycatch in water depths of 50 to 200 m. However, they do occur in smaller numbers along the coast.	No sightings within the Proposal area.	Low Narrow sawfish are found predominantly in offshore waters deeper than 40 m. Additionally, there are no identified BIAs for sawfish around the Proposal area.
Dwarf sawfish (*Pristis clavata*)	EPBC Act Vulnerable Migratory BC Act - IUCN Critically Endangered	• Approved Conservation Advice for *Pristis clavata* (dwarf sawfish) (DEWHA 2009) • Commonwealth Listing Advice on *Pristis clavata* (TSSC 2009b) • Sawfish and River Sharks Multispecies Recovery Plan (DoE 2015a) • Marine bioregional plan for the North Marine Region (DSEWPaC 2012a)	Population: The global population size for dwarf sawfish is currently unknown. Globally, dwarf sawfish have undergone a significant decline and range contraction, and the species population trend is decreasing (Grant et al. 2022). Currently there is insufficient data to estimate the Australian population of dwarf sawfish (TSSC 2009b). Distribution: Historically dwarf sawfish were found widely across the Indo-West Pacific but is not 'possibly extinct' through its east Indian and Southeast Asian range, now dwarf sawfish restricted to southern New Guinea and tropical north Australia (Grant et al. 2022). There is very little information about the dwarf sawfish movements and distribution in Australia, apart from in the Kimberly region (Morgan et al. 2011). They are unlikely to be found south of Cape Keraudren, WA. Habitat and life history: Dwarf sawfish inhabit coastal nearshore habitats, including tidal flats and mangroves, generally in waters depths between 0 and 20 m (Last et al. 2016). Dwarf sawfish are able to tolerate low salinity environments, including brackish and saltwater habitats. Juveniles and subadults are known to inhabit estuaries in northern Australia, whereas adults are primarily found in coastal environments. The Kimberley region is known to provide nursery	No sightings	Low Dwarf sawfish have not been identified within the Proposal area, and are unlikely to be found south of Cape Keraudren, WA. The creek systems around the Proposal area are not known to provide nursery habitat for dwarf sawfish.

Common name (scientific name)	Listing Status	Relevant policy and guidance, threatening processes and reasons for listing	Population, distribution, primary habitat(s) and life history	Surveys and sightings within the Proposal area and surrounding waters	Likelihood of occurrence in the Proposal area
			habitat, including the Fitzroy River estuary which is an important nursery for the species during the late dry season (Morgan et al. 2021), until they reach 3-years of age. The Fitzroy River Dwarf sawfish can live for up to 50 years and have an estimated age of maturity between 8 to 10 years. It is though that pupping occurs from the wet season to be beginning of the dry season (May).		
Grey nurse shark (west coast population) (*Carcharias taurus*)	EPBC Act Vulnerable Migratory BC Act - IUCN Critically Endangered (global) Near threatened (west coast population)	• Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*) (DoE 2014) • Threat abatement plan for the impact of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE 2018a) • Marine bioregional plan for the North-west Marine Region (DSEWPaC 2012a). Globally, ecotourism, recreational fishing, commercial fishing, net entanglements, and shark finning are threats posed for the grey nurse shark (DCCEEW 2022). Based on the North-west Marine Bioregional Plan (Appendix A.1; DSEWPaC 2012a) only chemical spills have been identified as an existing threat that may be relevant to consider when assessing impacts of the Proposal.	Population: Globally, there are at least five genetically distinct sub populations and across these populations the global population of grey nurse sharks (also known as the sand tiger shark) is decreasing (Rigby et al. 2021). In Australia, there are two genetically distinct subpopulations; east and west coast population the west coast population is relevant to sharks found in the waters of WA (DoE 2014). Historically (prior to 1997), grey nurse sharks were abundant in temperate WA water and had a stable population. Trends and population estimates for the west coast population are not currently known due to low animals are encounters and indeterminate frequency making contemporary population estimates difficult (Cavanagh et al. 2003; Chidlow et al. 2006). Distribution: Globally, grey nurse sharks are distributed through subtropical and temperate waters. In WA, grey nurse sharks have a board inshore distribution, primarily found in cool temperate waters of the south-west, but have been recorded north of the NWS (Hoschke et al. 2023). Grey nurse sightings collected from fisheries, divers, and charter boat operators, reported occasional sightings in the Exmouth/Muiron Islands (Chidlow et al. 2006). Point Murat Navy Pier in Exmouth, WA (21°49.013'S, 114°11.489'E) is the first confirmed aggregation site in WA, where sharks return to the site over multiple years (Hoschke and Whisson 2016). Habitat and life history: Grey nurse sharks are known to inhabit waters depths up to 168 m on the western continental shelf, and up to 230 m on the east coast of Australia. However, grey nurse sharks are more commonly sighted in small groups in shallow waters, between 15 to 40 m around inshore rocky reefs (Hoschke and Whisson 2016; Hoschke et al. 2023). Grey nurse sharks have a relatively low reproductive rate, with a maximum of two pups born every 2-years. Gestation is thought to be between nine to 12 months (DoE 2014). The grey nurse shark has a slow growth rate taking from 4 to 6 years to mature, however the precise timing of mating and pupping in Australian waters is unknown.). A study by McAuley (2004) found that three juveniles travelled hundreds of kilometres along the WA Midwest coast between Perth and Kalbarri, suggesting that grey nurse sharks undertake regional movements (Branstetter and Musick 1994). Grey nurse sharks have a varied diet often consisting of a variety of fish, squid, small sharks and rays, crabs, and lobsters (Compagno 1984; DoE 2014).	No sightings within the Proposal area.	Low The Proposal area does not represent important habitat for the species. The northern most aggregation site of grey nurse sharks is located within Exmouth Gulf. Grey nurse sharks appear to inhabit water temperatures between 17 and 24°C (Hoschke and Whisson 2016). The species temperature range is within the sea temperature range of the Proposal area, which varies from 18°C in the cooler months to a maximum of 31.5°C during the wet season. Grey nurse sharks may enter the Proposal area from time to time, but their occurrence is expected to be rare.
Scalloped hammerhead shark (*Sphyrna lewini*)	EPBC Act Conservation Dependent BC Act - IUCN Critically Endangered	• Listing Advice for *Sphyrna lewini* (scalloped hammerhead) (TSSC 2024). Globally, recreational fishing, commercial fishing, net entanglements, and illegal shark finning are threats to the scalloped hammerhead shark (FRDC 2019). Based on the North-west Marine Bioregional Plan (DSEWPaC 2012a) only chemical spills have been identified as an existing threat that may be relevant to consider when assessing impacts of the Proposal.	Population: The global population of scalloped hammerheads have experienced severe population decline, with an estimated population loss of >80% over the last seven decades (Rigby et al. 2019; Pacoureau et al. 2021). Globally, scalloped hammerheads appear to form genetically distinct groups in the Northwest Atlantic, Caribbean Sea, and Southwest Atlantic (Simpfendorfer et al. 2019). In Australia, scalloped hammerheads are part of the Indo-Pacific stock. Within this stock Papua New Guinea, Australia (excluding WA), and Indonesia appear to have high gene flow and dispersal across the region (Heupel et al. 2020). In WA, there is evidence of limited gene flow to other regions and limited connectivity, suggesting very little movement/exchange of scalloped hammerheads to or from WA. Thus, there is potentially two sub-populations in Australia; (1) in waters of WA and potentially more broadly across the Indian Ocean, and (2) the rest of northern Australia, connected to Indonesia and PNG (Figure D-4; Heupel et al 2020; TSSC 2024). Distribution:	Figure D-6	Low Scalloped hammerheads have been recorded in the waters offshore from the Proposal (Figure D-6). No sightings were reported in the DBCA database as the species does not have a threatened listing under the BC Act. The shallow waters of northern Australia may provide nursery habitat for scalloped hammerheads. The species may be infrequently present in the waters of and adjacent to the Proposal area, but more likely to be found in deeper waters where key

Common name (scientific name)	Listing Status	Relevant policy and guidance, threatening processes and reasons for listing	Population, distribution, primary habitat(s) and life history	Surveys and sightings within the Proposal area and surrounding waters	Likelihood of occurrence in the Proposal area
			Scalloped hammerheads occur globally in coastal warm temperate and tropical and waters (TSSC 2024). In Australia, the species is recorded around the northern coastline to ~34°S on both east and west coasts, from Sydney, NSW to Geographe Bay, WA (TSSC 2024). The distribution of scalloped hammerheads is segregated by size and sex, and in Australia the population is primarily small adult males and juveniles (Figure D-5; Chin et al. 2017). Adult females are predominantly found in the waters off Indonesia and Papua New Guinea (Chin et al. 2017). This suggests a population structure where the female scalloped hammerhead sharks migrate back to Australia to give birth in northern Australian nurseries (Chin et al. 2017). In WA, the scalloped hammerhead is the most commonly sighted along the NWC, Exmouth, and along the southern Pilbara coastline (Figure D-6; Bartes and Braccini 2021). Habitat and life history: The scalloped hammerhead is typically found in continental shelf waters, but also regularly enters estuaries and open ocean environments ranging from the intertidal zone to at least 275 m deep (Compagno 1984), but has been recorded in water depths up to 1,042 m (TSSC 2024). Scalloped hammerhead sharks form aggregations at sites, which are generally found along the continental shelf and in shallow inshore waters. Scalloped hammerheads are known to partake in long distance migrations and can be found in open oceanic waters (Chin et al. 2017). Female scalloped hammerheads are reproductively philopatric (i.e. they return to the nursery in which they were born to give birth), and are thought to display similar behaviours as other hammerheads, where females move to shallow nursery areas to give birth. It is thought that a proportion of adult females may migrate from Australian to Indonesia/PNG waters and return to give birth to their young in nursery areas in coastal areas of northern Australia (Chin et al. 2017; TSSC 2024). This could also suggest that the waters of northern Australia may provide important nursery habitats for the scalloped hammerhead sharks (TSSC 2024). This is supported by Traditional Ecological Knowledge that identifies the importance of shallow inshore habitats for immature hammerhead sharks (TSSC 2024). Newborn scalloped hammerheads tend to stay in coastal zones. Their lifespan is estimated at 21 years for males and up to 35 years for females (Clarke 1971; FRDC 2019). Males reach maturity between 5.7 to 8.9 years and females reach maturity when they reach approximately 200 cm in length, however it can take females up to 15 years to reach reproductive age (FRDC 2019). Their diet consists of a variety of fish, squid, crustaceans as well as other small sharks and rays (FRDC 2019; DCCEEW 2024d).		ecological features (narrow shelf, canyons, and Exmouth plateau) facilitate upwelling and enhance local productivity (DSEWPaC 2012b).
Whale shark (*Rhincodon typus*)	EPBC Act Vulnerable Migratory BC Act Other Protected Fauna IUCN Endangered Largely depleted	• Conservation Advice *Rhincodon typus* whale shark (TSSC 2015) • Commonwealth Listing Advice on *Rhincodon typus* (Whale shark) (TSSC 2001) • Marine bioregional plan for the North-west Marine Region (DSEWPaC 2012a). Whale sharks have experienced significant worldwide population declines over the last 75 years with an estimated worldwide decline of more than 50% (Pierce and Norman 2016). Whale sharks are a cryptic species, with many biological and ecological unknowns especially in relation to growth, mating behaviour and age of maturity. Whale sharks have slow life history traits and little genetic connectivity between the oceanic basins (Vignaud et al. 2014) so they are	Population: Globally, whale sharks for subpopulations based on genetic structure and location, with subpopulations thought to occur in the Indo-Pacific and Atlantic Oceans. The Indo-Pacific population is thought to account for 63 to75% of the global population and there is evidence of recent population expansion within this subpopulation (Pierce and Norman 2016; Yagishita et al. 2020). In WA, whale sharks are abundant and form a yearly aggregation at Ningaloo, with an estimated 300 to 500 resident individuals (Meekan et al. 2006). The whale sharks are Ningaloo are dominated by juvenile males, and there is mounting evidence to suggest that Ningaloo is a post-nursery site where juvenile sharks visit to mature and forage (Reynolds et al. 2017). Distribution: Globally whale sharks are found throughout the three oceanic basins, including the Indian and Pacific oceans. The sharks form annual aggregations at Ningaloo with the peak occurring from March to July, coinciding with a pulse of coral spawning (Meekan et al. 2020). Satellite tracking has revealed that whale sharks leaving Ningaloo remain relatively close to the coastline, showing a preference to warmer shallower waters, with a mean minimum distance of 1,667 km (±316 km) from Ningaloo (Norman et al. 2016). Reynolds et al. (2017) found that most of the tagged sharks travelled north or north-east from the Ningaloo marine park. The tagging results also showed homing movements of the Ningaloo whale sharks, with tagged sharks returning to the Ningaloo marine park. Of the 25 sharks tagged, 9 of the sharks returned to the northern end of the Ningaloo marine park after travelling more than	None within Proposal search area.	Low The Proposal's anchorage areas align with the inshore boundary of the whale sharks foraging BIA and is located approximately 50 km from the high-density foraging BIA of Ningaloo Reef (Figure 19). The shallow and flat bathymetric characteristics of the Proposal area do not represent preferred whale shark habitat.

Common name (scientific name)	Listing Status	Relevant policy and guidance, threatening processes and reasons for listing	Population, distribution, primary habitat(s) and life history	Surveys and sightings within the Proposal area and surrounding waters	Likelihood of occurrence in the Proposal area
		at risk of overexploitation. A major threat to whale sharks is fishing, both intentional and unintentional. Whale sharks spend extended periods of time at the surface and their long migrations make them more susceptible to strikes from ships and propellers. A recent study of the Ningaloo population found that 15.5% of the sharks had evidence of major scarring, and 38.8% had minor or major scarring (Lester et al. 2020). The rate of mortality from ship strikes on the whale sharks is unknown, due to the sharks sinking when dead and large ships either not registering strikes or not reporting. Other minor threats to whale sharks have been identified as disturbances from ecotourism, marine debris, and climate change. Based on the North-west Marine Bioregional Plan (Appendix A.1; DSEWPaC 2012a) only chemical spills have been identified as existing threats that may be relevant to consider when assessing impacts of the Proposal.	300 km, indicating high levels of site fidelity (Reynolds et al. 2017). These results suggested that the sharks are present all year round, not just during the seasonal aggregation (Reynolds et al. 2017). Habitat and life history: Whale sharks can be found in warm tropical and subtropical waters, with preference for a narrow thermal range between 23 to 28 ˚C. Whale sharks are thought to reach sexual maturity when their length is greater than or equal to 8 m (Norman and Stevens 2007). Whale sharks are migratory, traveling a range of horizontal and vertical distances. The sharks thermoregulate, using both shallow and deep water. They generally spend prolonged periods on the surface to feed, basking in the warmer water, then dive to deeper cooler waters. Thums et al. (2013) found that whale sharks dive in three ways: • Nighttime bounce dives (i.e. rapid descent and ascent) • Day time bounce dives • Day time deep and long (340 m, 169 min) dives, with extremely long (146 min) post dive surface intervals. Whale sharks are large filter feeders, the Ningaloo sharks have been observed feeding on krill (Euphausiaceae) swarms, crab megalopa larvae, chaetognaths, copepods, stomatopod larvae and small fish (Marcus et al. 2019). Due to their size, the sharks must consume large amounts of food, which can often be patchy, and as a result they must be highly mobile. Whale sharks seasonal movements are thought to be linked to fish spawning or zooplankton blooms. Recent research focusing on Ningaloo whale shark fatty acids suggests that coastal demersal zooplankton or other meso-pelagic organism off the continental shelf make up key components of their diet (Marcus et al. 2019). Reynolds and colleagues (2017) showed a seasonal shift in habitat suitability for the whale sharks, highlighting that the area from Onslow to Port Hedland have a higher habitat suitability than existing MPAs but are not recognised as a protected area (Figure D-7). The results suggest that the current MPA network may not be adequate to protect the whale shark year-round (Reynolds et al. 2017).		
Giant manta ray (*Mobula birostris*)	EPBC Act Migratory BC Act - IUCN Endangered	Globally the major threat and cause of mortality for the giant manta ray are fisheries, both direct catch and bycatch. Minor threats to the giant manta ray are habitat loss and degradation of swallow coastal lagoons, which juveniles use as nurseries. The preference and prolonged periods spent offshore makes boat strikes another minor threat (Marshall et al. 2020). Based on the North-west Marine Bioregional Plan (Appendix A.1; DSEWPaC 2012a), only chemical spills have been identified as existing threats that may be relevant to consider when assessing impacts of the Proposal.	Population The global population of the giant manta ray (*M. birostris*) is found to be between 41°S and 40°S. In Australia the giant manta rays are distributed on both the east and west coast, their distribution is patchy, with majority of the Australian populations occurring at the Ningaloo Reef and the Great Barrier Reef (Figure 52; Armstrong et al. 2020a). Giant manta rays form seasonal aggregates during autumn and winter in the Ningaloo marine park (Armstrong et al. 2020a). Distribution Giant manta rays are found throughout the Atlantic, Pacific and Indian Oceans, in tropical, subtropical, and temperate waters, found between 41°N and 40°S (Armstrong et al 2020b). Information on the global distribution of giant manta rays and their population sizes is lacking. Giant manta rays are found in surface waters of shallow reefs, both inshore and offshore, however there is limited information regarding the Australian distribution of the giant manta ray, and there have been few coastal sightings in scattered locations. Habitat use and life history Giant manta rays have low coastal sightings, suggesting a preference for offshore waters (Armstrong et al. 2020a), spending prolonged periods of time offshore (Stewart et al. 2016). They exhibit diel patterns, moving inshore during the day to clean and socialise, and moving offshore to feed at night. Giant manta rays can dive as deep as 1000 m (Marshall et al. 2020). Giant manta rays can inhabit both marine neritic (pelagic, coral reef, and estuaries) and oceanic (epipelagic 0-200 m, and mesopelagic 200-1000 m) environments (Marshall et al. 2020). Juveniles have been observed using lagoons and sometimes offshore locations but are separate from the adult population	Giant manta ray have been sighted around Dampier (Armstrong et al. 2020b). Species rarely seen in coastal waters, preferring offshore oceanic waters.	Low Giant manta rays are rarely seen close to the coast due to their preference for offshore waters and have no BIAs or major population within close proximity to the Proposal (Armstrong et al. 2020a).

Common name (scientific name)	Listing Status	Relevant policy and guidance, threatening processes and reasons for listing	Population, distribution, primary habitat(s) and life history	Surveys and sightings within the Proposal area and surrounding waters	Likelihood of occurrence in the Proposal area
			(Stewart et al. 2018). Giant manta rays have slow life history traits, making them highly susceptible to overexploitation (Marshall et al. 2020).		
Southern bluefin tuna (*Thunnus maccoyii*	EPBC Act -[9] BC Act - IUCN Endangered	• Listing Advice *Thunnus maccoyii* Southern Bluefin Tuna (DCCEEW 2024e). Commercial fishing is the major threat to the southern bluefin tuna (TSSC 2010). The species has undergone a very severe reduction in numbers as a result of heavy fishing pressure throughout its range, in 1930. Methods of fishing includes purse seine, longline and net fishing. Based on the North-west Marine Bioregional Plan (Appendix A.1; DSEWPaC 2012a), habitat modification, changed hydrology, chemical spills and dredge entrainment are existing threats that may be relevant to consider when assessing impacts of the Proposal.	Population: Southern bluefin tuna historically have been intensively fished, resulting in low population numbers. In 2009, the global population was estimated to be 460,000 mature individuals. More recent population estimates are not available, but the global population appears to be increasing (Collette et al. 2021). In Australia, southern bluefin tuna stock assessments indicate a strong increase in numbers since the early 2000s (DCCEEW 2024e). Distribution: Southern bluefin tuna are migratory, crossing the Pacific, Atlantic and Indian Ocean during annual migrations. Southern bluefin tuna typically occur in waters latitudes between 30–50°S. Every year between September and April, adult southern bluefin tuna (aged 11-12 years) migrate from southern feeding areas to their single identified spawning ground in the waters south of Indonesia (TSSC 2010; ASBTIA 2021). When migrating to their spawning grounds individuals are found close to the coastline, with ~84% of their time spent in the Australian Fishing Zone (Commonwealth waters, generally from 3 nautical miles to 200 nautical miles from the Australian coast) (Patterson et al. 2008). Habitat and life history: Southern bluefin tuna spawn only in the Indian Ocean near Java. Larvae and juvenile fish are swept south by the Leeuwin Current along the WA coastline and reach the Great Australian Bight within the first two years of their life (ASBTIA 2022; DCCEEW 2024d). They are seldom found in nearshore surface waters after five years of age (DCCEEW 2024d). Southern bluefin tuna are a long-lived species, up to 40 years. They are carnivorous opportunistic feeders, predating on a variety of crustaceans, cephalopods, and small pelagic fish species (ASBTIA 2022). Aerial surveys have identified southern bluefin tuna in Australian waters moving further east in recent years, although it is unclear if this is a temporary change or a long-term shift in migration patterns (CCSBT 2020; DCCEEW 2024d).	No sightings.	Low Southern bluefin tuna are a deep water migratory fish species and are unlikely to be found in the nearshore waters of the Proposal. Spawning does not occur in the Proposal area, and it is unlikely that foraging grounds are restricted to the Proposal area.

[9] Southern bluefin tuna no longer have an EPBC Act listing status, listing advice for the species was published on the 11 July 2024

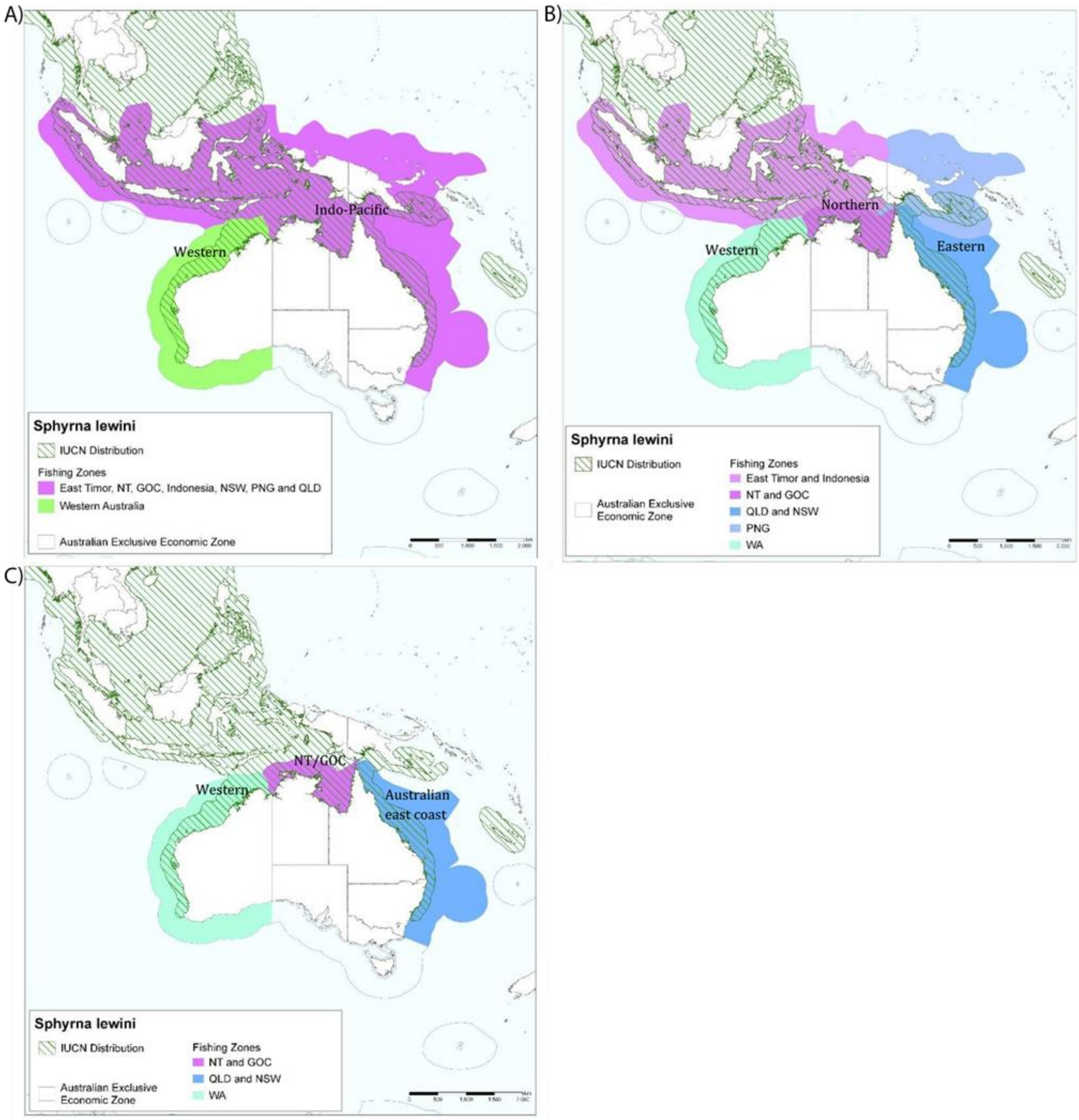

Figure D-4: Modelled stock-structure scenarios for the scalloped hammerhead (TSSC 2024)

A) continental shelf movements but with stock divide around the WA-NT border

B) continental shelf movements but with stock divides at (1) the Torres Strait land bridge and (2) around the WA-NT border

C) limited movement

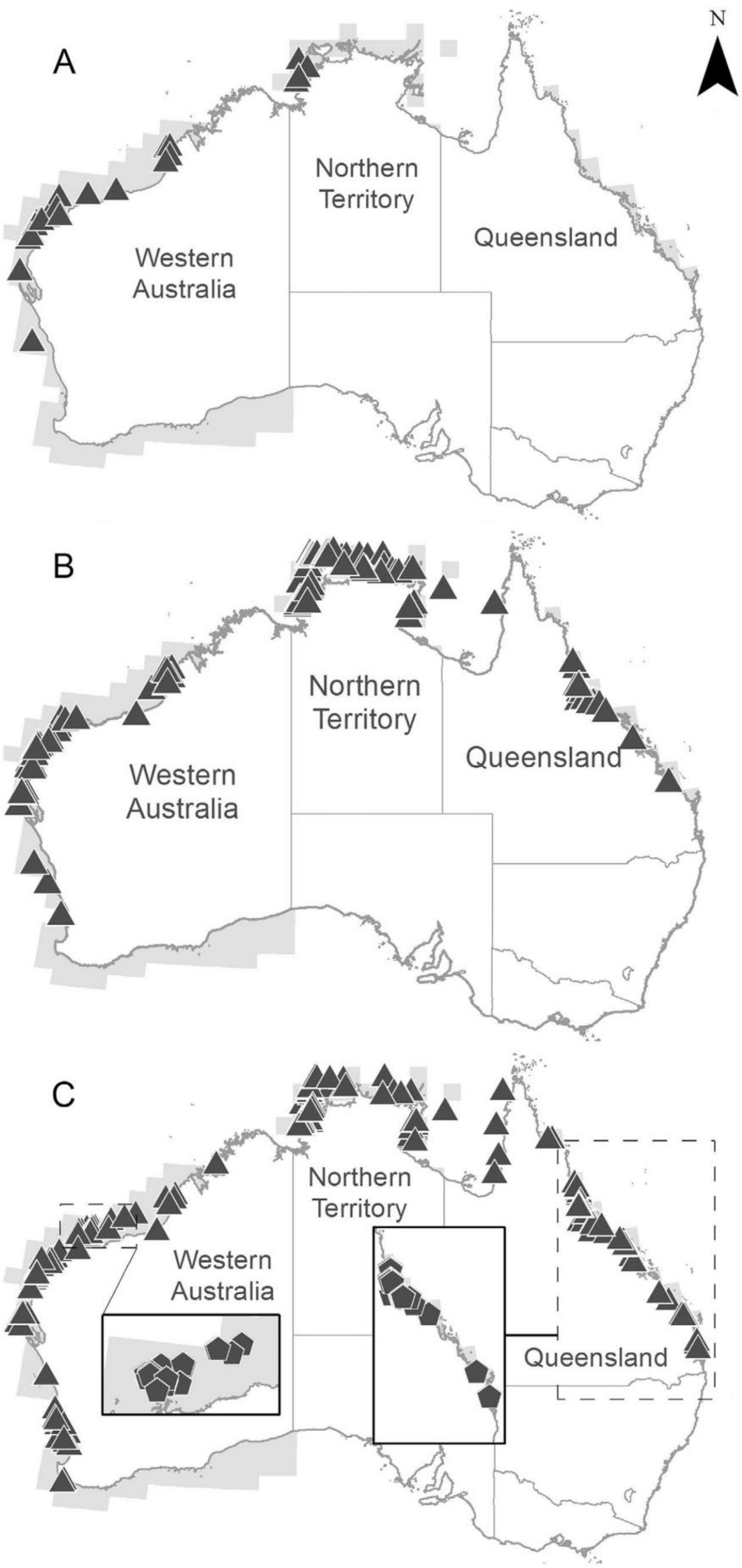

Figure D-5: Scalloped hammerhead distribution (Chin et al. 2017)

Indicative distribution of scalloped hammerhead (triangles) sharks for sex and size categories from sampled locations. a) adult females, b) adult males, c) immature and neonate individuals of both sexes (inserts show indicative distribution of neonates). Grey shading denotes spatial grids where fishing and sampling effort occurred (Chin et al. 2017)

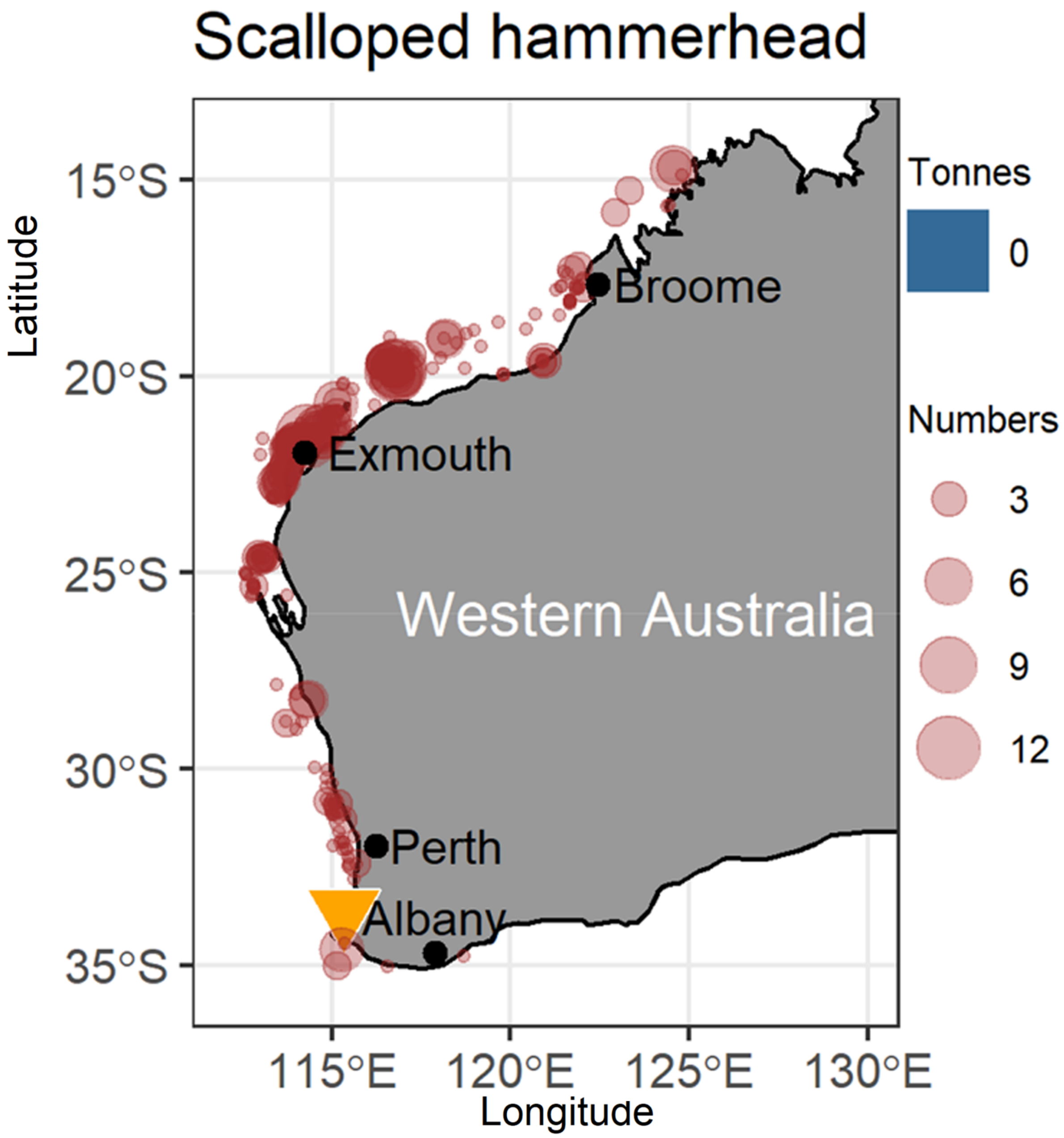

Figure D-6: Spatial distribution of commercial catch and scientific observations (Bartes and Braccini 2021)

Blue squares reported catch (tonnes) by spatial block (all financial years aggregated); red bubbles, number of individuals observed by scientific personnel; yellow triangle, edge for the distribution reported by Last and Stevens (2009)

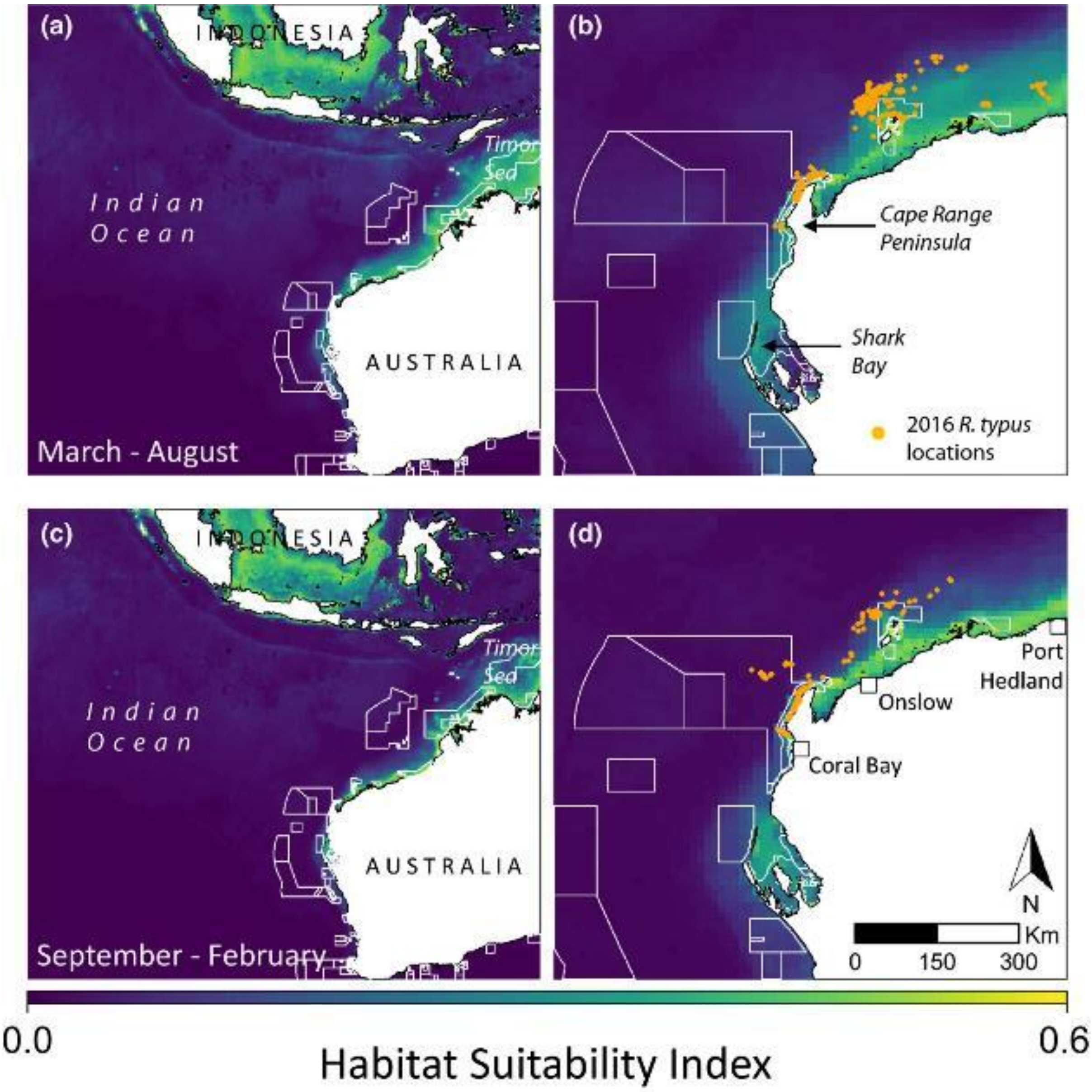

Figure D-7: Whale shark habitat suitability (Reynolds et al. 2017).

Whale shark relative habitat suitability in the Indian Ocean: a & b habitat suitability during whale shark season (March-August), c & d habitat suitability in non-whale shark season (September-February). White outlines are existing MPA, and orange dots are locations of 4 whale sharks tagged in 2016 by Reynolds et al. (2017)

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