NESP Marine and Coastal Hub Workshop

Bass Strait Ecosystem and Offshore Renewable Energy

Day 1: Bass Strait ecosystem, current uses and modelling supporting future offshore wind industry development

Date: Wednesday 9th April 2025 (11:00 – 16:00 AEDT)

Meeting Purpose: This workshop aims to outline the current range of activities in the Bass Strait region and describe the status of ecosystem modelling that is being conducted through NESP Marine and Coastal Hub research to support the development of an offshore wind industry in the region.

Location: CSIRO Auditorium and Virtual Attendance

Outline of Day 1

Timing	Item	Presenter
11:00 – 11:10	Welcome and outline of the day	Alistair Hobday (CSIRO)
11:10 – 11:20	NESP Marine and Coastal Hub research investments	Alan Jordan (UTAS)
11:20 – 11:40	Bass Strait geomorphology and habitats	Rachel Nanson (Geoscience Australia) Jac Monk (UTas)
11:40 – 12:00	Bass Strait ecosystem values	Steffan Howe (Parks Australia)
12:00 – 12:20	Current uses and activities	Piers Dunstan (CSIRO)
12:20 – 12:40	Fisheries futures	Rowan Trebilco (CSIRO)
12:40 – 13:00	Oil/gas futures, decommissioning	Garnet Hooper (NOPSEMA)
13:00 – 13:30	Lunch Break	
13:30 – 13:50	Offshore wind research investments	Mark Say (DCCEEW)
13:50 – 14:10	Cumulative risk assessment in Bass Strait: Overview of Hub project 4.7	Keith Hayes (CSIRO)
14:10 – 14:30	Priority species and data sources	Myriam Lacharite (UTAS)
14:30 – 14:50	Expert identification methodology	Geoff Hosack (CSIRO)
14:50 – 15:10	Current and future Oceanographic conditions in Bass Strait: 2km resolution modelling (BASS2)	Clothilde Langlais (CSIRO)
15:10 – 15:40	Atlantis EcoSpace/EcoSim	Javier Porobic Garate (CSIRO)
15:40 – 16:00	Q&A session	
16:00	Session close	

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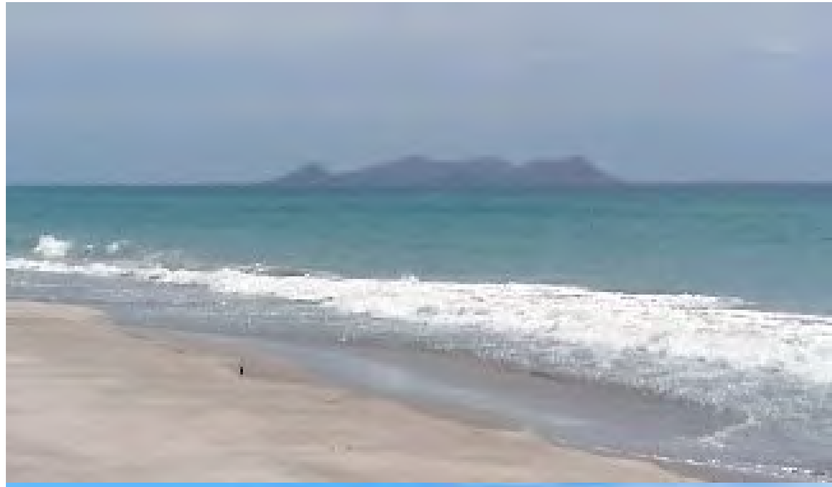
NESP Marine and Coastal Hub Workshop

Bass Strait Ecosystem and Offshore Renewable Energy

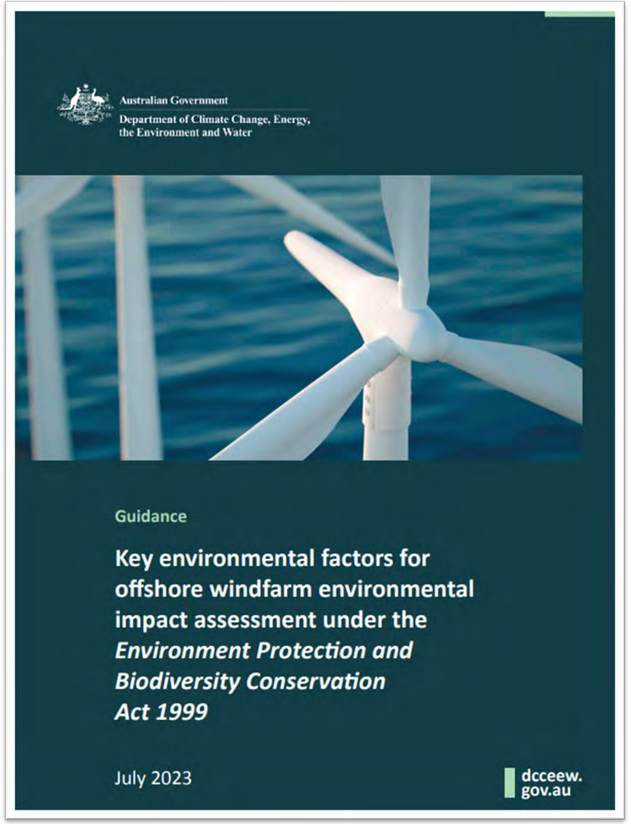
Day 1: Bass Strait ecosystem, current uses and modelling supporting future offshore wind industry development

Alan Jordan: NESP Marine and Coastal Hub, University of Tasmania



Project 3.3: Guiding research and best practice standards for the sustainable development of offshore renewables and other emerging marine industries in Australia

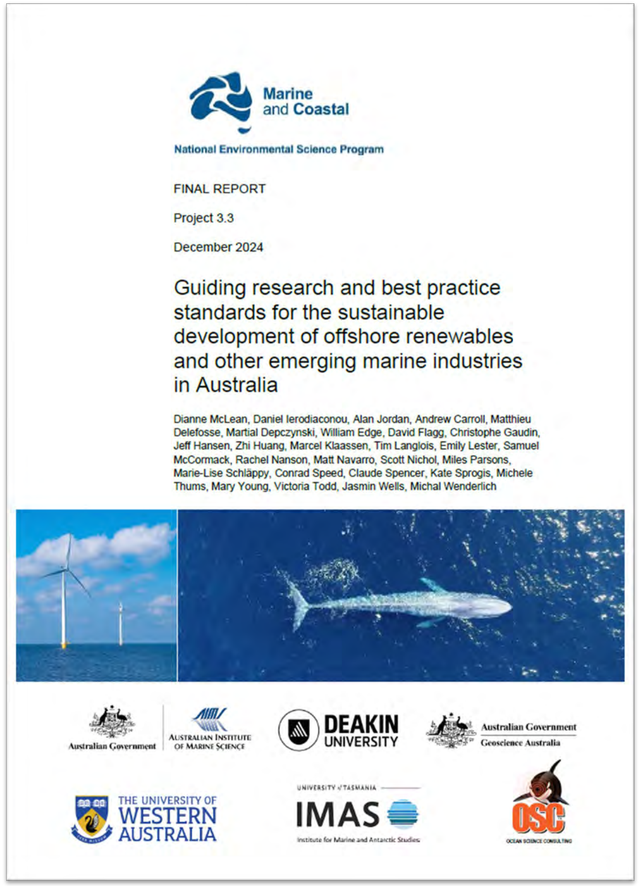
Project Leads: Dr Dianne McLean (AIMS), Assoc. Prof Daniel Ierodiaconou (Deakin)



Identify the extent of existing environmental data, Indigenous values and best-practice monitoring standards to inform the sustainable development of ORE projects in Australia.

The project includes an inventory of existing information sources and expertise with respect to the following thematic areas:

1. Seabed geomorphology and habitat characteristics
2. Interactions with oceanography
3. Interacting species and habitats
4. Potential impacts of installation, operation, and decommissioning
5. Monitoring needs and associated best practice
6. Indigenous communities and ORE development areas



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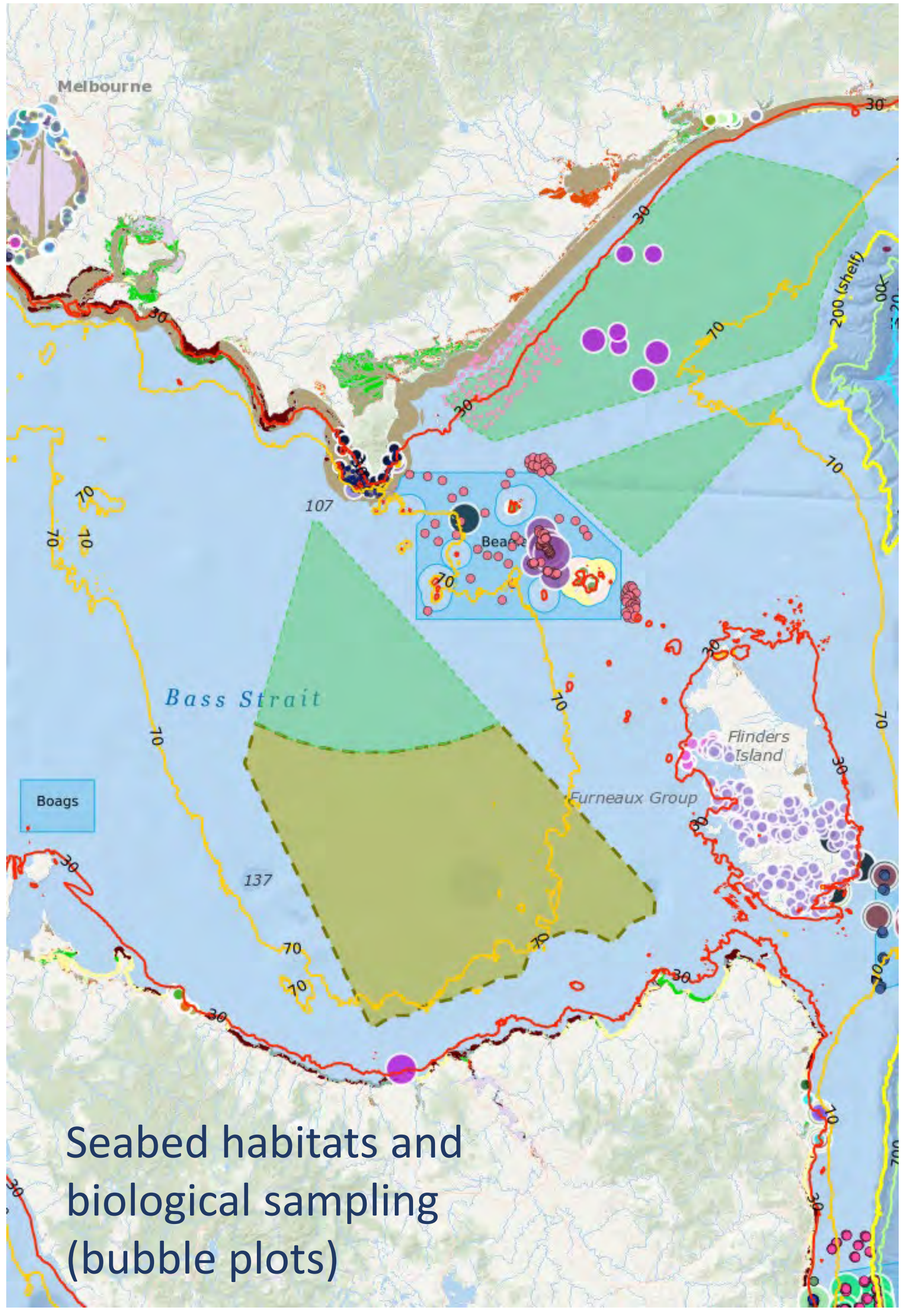
Bass Strait and Gippsland Offshore Wind Farm region: environmental knowledge base

6.1. Bathymetry
6.2. Seabed geology
6.3. Seabed geomorphology
6.4. Sedimentology
6.5. Seabed habitats and benthic biodiversity
6.6. Oceanography
6.7. Threatened and migratory marine species
    6.7.1. Cetaceans and pinnipeds
    6.7.2. Birds
    6.7.3. Sharks
    6.7.4. Reptiles
    6.7.5. Other species

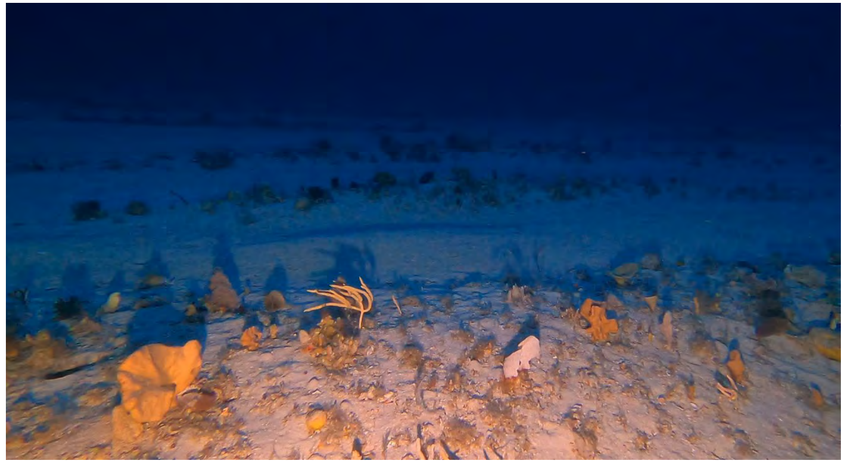
Seabed geomorphology and habitat characteristics

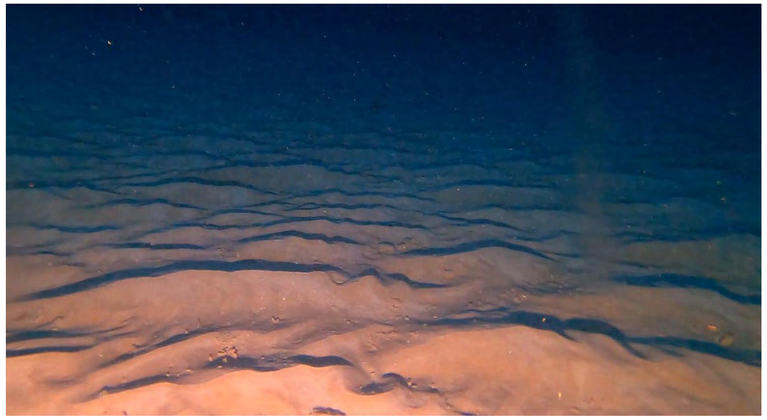


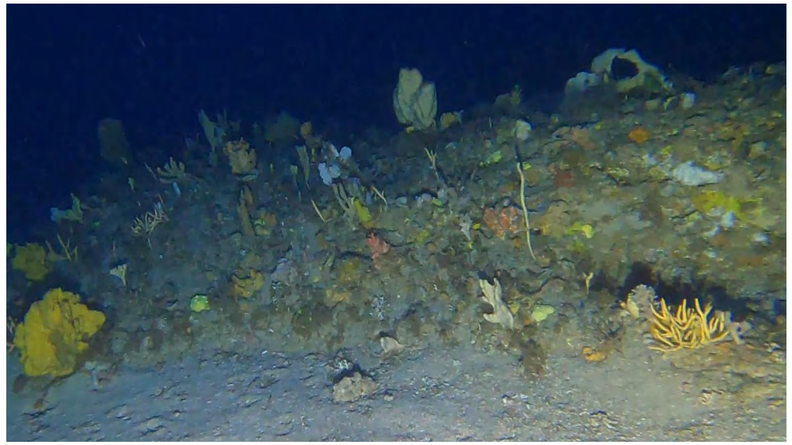
Seabed habitats and biological sampling (bubble plots)

East Bass Strait region – seabed habitats and biodiversity data

- Wide continental shelf
- Biological sampling concentrated within marine parks and Flinders Island
- Mid-shelf dominated by mobile carbonate sand, but often containing sessile invertebrate assemblages







Images from Monk et al. 2024

Project 3.3: Species inventories

Bass Strait OWF: Cetaceans (toothed)

SPECIES	FAMILY OCCURENCE	EPBC STATUS	AREA AS % OF OWF			OBSERVATION COUNTS	SEASONALITY	NUMBER
			VBA	SNES	PUBS	OBIS-ALA	J F M A M J J A S O N D	PUBS
Dusky Dolphin *Lagenorhynchus obscurus*	**Delphinidae** -	Migratory	0	98	7	0		1
Killer Whale *Orcinus orca*	**Delphinidae** -	Migratory	19	93	61	72		7
Sperm Whale *Physeter macrocephalus*	**Physeteridae** -	Migratory	12	7	2	265		3
Bottlenose Dolphin Species *Tursiops spp.*	**Delphinidae** -	Cetacean	0	98	32	0		2
Common Dolphin *Delphinus delphis*	**Delphinidae** -	Cetacean	34	98	94	190		2
False Killer Whale *Pseudorca crassidens*	**Delphinidae** -	Cetacean	1	57	1	22		1
Indo-Pacific Bottlenose Dolphin *Tursiops aduncus*	**Delphinidae** -	Cetacean	34	6	0	2		1
Long-Finned Pilot Whale *Globicephala melas*	**Delphinidae** -	Cetacean	4	7	26	213		3
Striped Dolphin *Stenella coeruleoalba*	**Delphinidae** -	Cetacean	0	0		2		0
Dwarf Sperm Whale *Kogia sima*	**Kogiidae** -	Cetacean	0	7	0	31		1
Pygmy Sperm Whale *Kogia breviceps*	**Kogiidae** -	Cetacean	7	7	1	69		1
Cuvier's Beaked Whale *Ziphius cavirostris*	**Ziphiidae** -	Cetacean	2	7		9		0
Gray's Beaked Whale *Mesoplodon grayi*	**Ziphiidae** -	Cetacean	2	1		26		0
Hector's Beaked Whale *Mesoplodon hectori*	**Ziphiidae** -	Cetacean	0	7		1		0
Shepherd's Beaked Whale *Tasmacetus shepherdi*	**Ziphiidae** -	Cetacean	0	0		26		0
Strap-Toothed Beaked Whale *Mesoplodon layardii*	**Ziphiidae** -	Cetacean	2	7	0	15		1

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Bass Strait OWF: Bird

SPECIES	FAMILY OCCURENCE	EPBC STATUS	AREA AS % OF OWF			OBSERVATION COUNTS		SEASONALITY	NUMBER
			VBA	SNES	PUBS	BLA	OBIS-ALA	J F M A M J J A S O N D	PUBS
Orange-Bellied Parrot *Neophema chrysogaster*	**Psittacidae** Rare	Critically Endangered	12	21		11	72		0
Swift Parrot *Lathamus discolor*	**Psittacidae** Rare	Critically Endangered	15	2	5	360	655		1
Curlew Sandpiper *Calidris ferruginea*	**Scolopacidae** Common	Critically Endangered	53	100	5	198	3717		1
Far Eastern Curlew *Numenius madagascariensis*	**Scolopacidae** Common	Critically Endangered	71	100	100	323	1970		2
Great Knot *Calidris tenuirostris*	**Scolopacidae** Common	Critically Endangered	17	0	0	25	404		1
Lesser Sand Plover *Charadrius mongolus*	**Charadriidae** Rare	Endangered	11	0		49	544		0
Chatham Albatross *Thalassarche eremita*	**Diomedeidae** Vagrant	Endangered	0	24		0	0		0
Grey-Headed Albatross *Thalassarche chrysostoma*	**Diomedeidae** Rare	Endangered	2	95		1	46		0
Northern Royal Albatross *Diomedea sanfordi*	**Diomedeidae** Common	Endangered	0	98		1	36		0
Shy Albatross *Thalassarche cauta*	**Diomedeidae** Common	Endangered	28	98	100	748	2328		7
Southern Giant Petrel *Macronectes giganteus*	**Procellariidae** Rare	Endangered	4	98		6	79		0
Red Knot *Calidris canutus*	**Scolopacidae** Common	Endangered	35	100		112	2380		0
White-Throated Needletail *Hirundapus caudacutus*	**Apodidae** Common	Vulnerable	85	3		262	1480		0
Greater Sand Plover *Charadrius leschenaultii*	**Charadriidae** Rare	Vulnerable	8	2		6	159		0
Antipodean Albatross *Diomedea antipodensis*	**Diomedeidae** Rare	Vulnerable	0	98		0	0		0
Black-Browed Albatross *Thalassarche melanophris*	**Diomedeidae** Common	Vulnerable	17	98	57	118	5912		1
Buller's Albatross *Thalassarche bulleri*	**Diomedeidae** Rare	Vulnerable	2	98	98	1	77		1
Campbell Albatross *Thalassarche impavida*	**Diomedeidae** Vagrant	Vulnerable	0	98	98	0	86		2
Gibson's Albatross *Diomedea gibsoni*	**Diomedeidae** Rare	Vulnerable	0	96		0	0		0
Indian Yellow-Nosed Albatross *Thalassarche carteri*	**Diomedeidae** Common	Vulnerable	7	98		18	81		0
Salvin's Albatross *Thalassarche salvini*	**Diomedeidae** Vagrant	Vulnerable	0	98		0	109		0
Sooty Albatross *Phoebetria fusca*	**Diomedeidae** Rare	Vulnerable	2	95		0	10		0
Southern Royal Albatross *Diomedea epomophora*	**Diomedeidae** Vagrant	Vulnerable	2	98	98	0	68		1
Wandering Albatross *Diomedea exulans*	**Diomedeidae** Rare	Vulnerable	9	98		4	229		0
White-Capped Albatross *Thalassarche steadi*	**Diomedeidae** Rare	Vulnerable	0	98		0	980		0
Fairy Tern *Sternula nereis*	**Laridae** Common	Vulnerable	62	0		378	1849		0
Blue Petrel *Halobaena caerulea*	**Procellariidae** Rare	Vulnerable	2	97		5	85		0
Northern Giant Petrel *Macronectes halli*	**Procellariidae** Vagrant	Vulnerable	6	98		6	356		0
Soft-Plumaged Petrel *Pterodroma mollis*	**Procellariidae** Rare	Vulnerable	0	24		1	7		0
Little Penguin *Eudyptula minor*	**Spheniscidae** Common	Marine	72	0	4	934	116507		5
Australasian Gannet *Morus serrator*	**Sulidae** Common	Marine	98	0	3	1645	5914		2
Little Tern *Sternula albifrons*	**Laridae** Common	Migratory	70	1		282	3007		0
Short-Tailed Shearwater *Ardenna tenuirostris*	**Procellariidae** Common	Migratory	100	0	70	1620	34842		3

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Potential impacts of installation, operation, and decommissioning

Case studies for developing a knowledge resource base

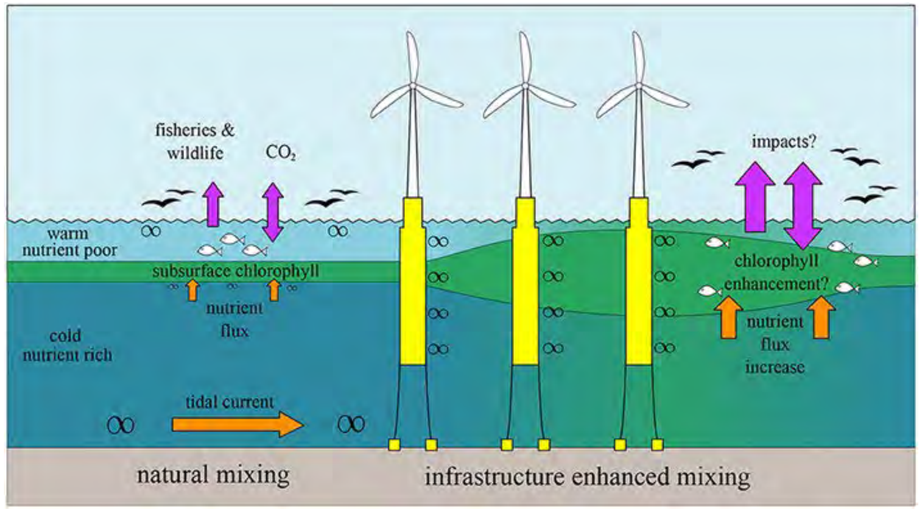
Case Study 1: Baseline information on the impacts of noise

Case study 2: The uniqueness of Australia's coastal seafloor

Case study 3: Oceanographic changes

- Anthropogenic mixing
- Increased turbidity
- Benthic changes (scour)
- Wind wake effects

11.4. Another potential impact: pollutants



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Monitoring needs and associated best practices

Marine Biodiversity Hub | Marine Sampling Field Manuals

Ocean best practices
Repository of community practices in Ocean Research, Applications and Data/Information Management

TETHYS

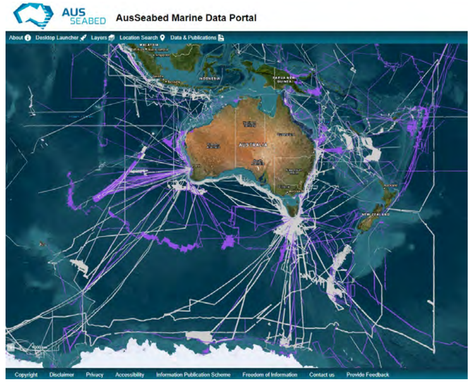
HELCOM

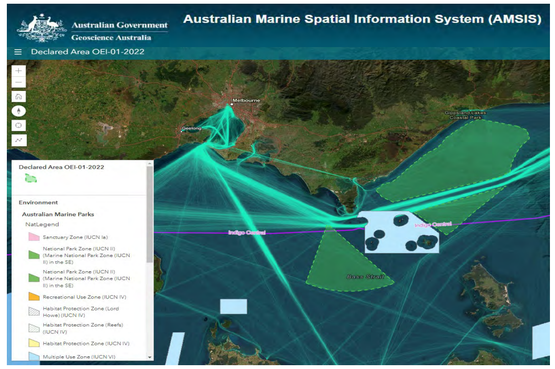
Australian Government
Department of Climate Change, Energy, the Environment and Water

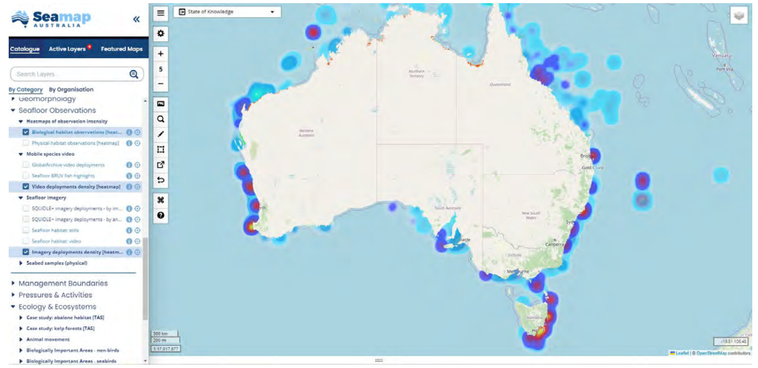
National Guidelines for the Survey of Cetaceans, Marine Turtles and the Dugong

Seabed data portals

Ausseabed, Seamap Australia, IMOS AODN, AMSIS, NSW and Victorian LiDAR, Coast Kit







Australian Government
Geoscience Australia

Bringing the Seabed to the Surface

Seabed geomorphology mapping to support Australia's offshore renewable energy industry

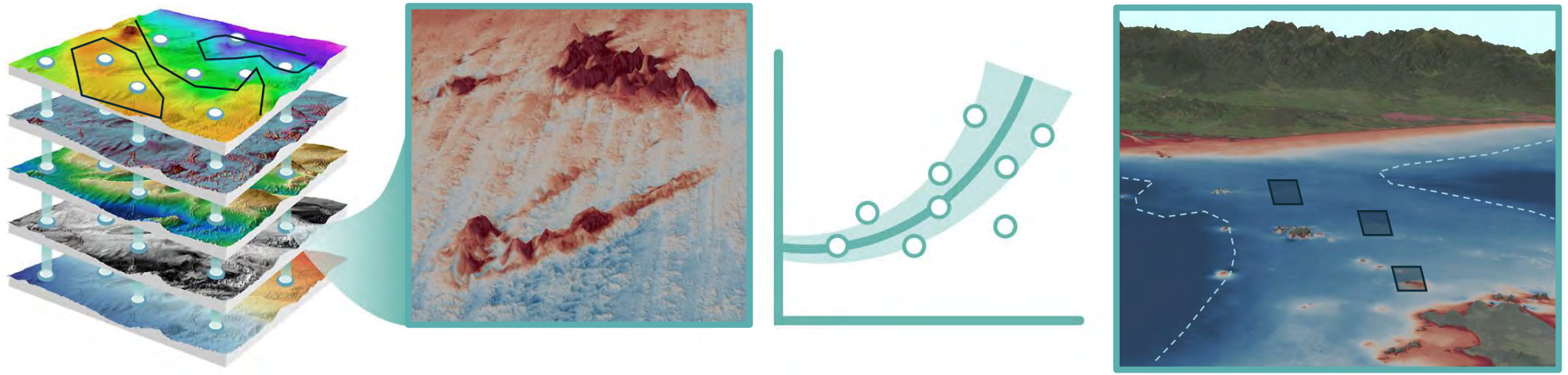
NESP MaC Hub Stakeholder Forum 2025

Rachel Nanson, Mardi McNeil, Zhi Huang, Andrew Carroll, Scott Nichol, Aero Leplastrier, Donna Audas and Team

Marine and Coastal Geoscience Section
Oceans, Reefs, Coasts and the Antarctic Branch

Marine geomorphology mapping

Foundational data → Extrapolation and modelling → Marine geomorphology maps



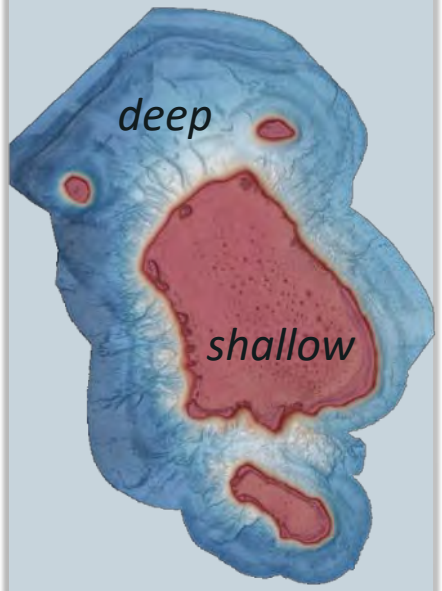
1. Morphology

bathymetry

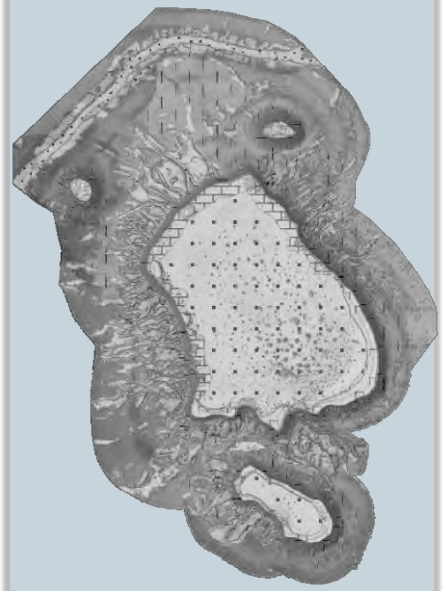
Modified from Misiuk, B. and Brown, C.J., (2023)

Geomorphology mapping to support informed ORE development

Bathymetry grids



Morphology (mapped shapes)

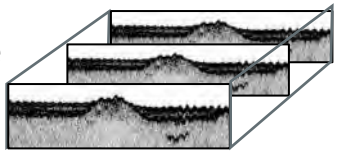


Additional seabed data

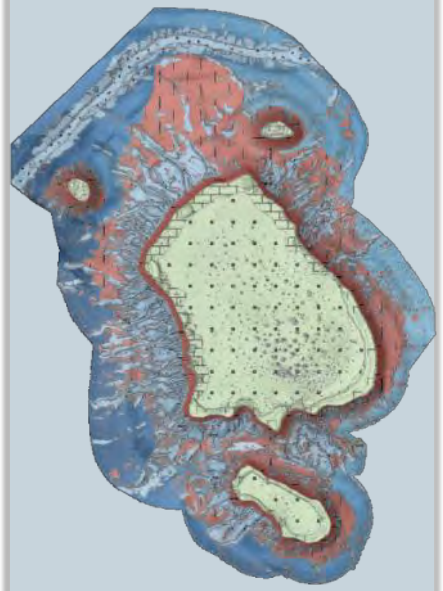
Backscatter (hardness)

Sediment samples

Sub-surface images



Geomorphology (seabed features)



Marine applications

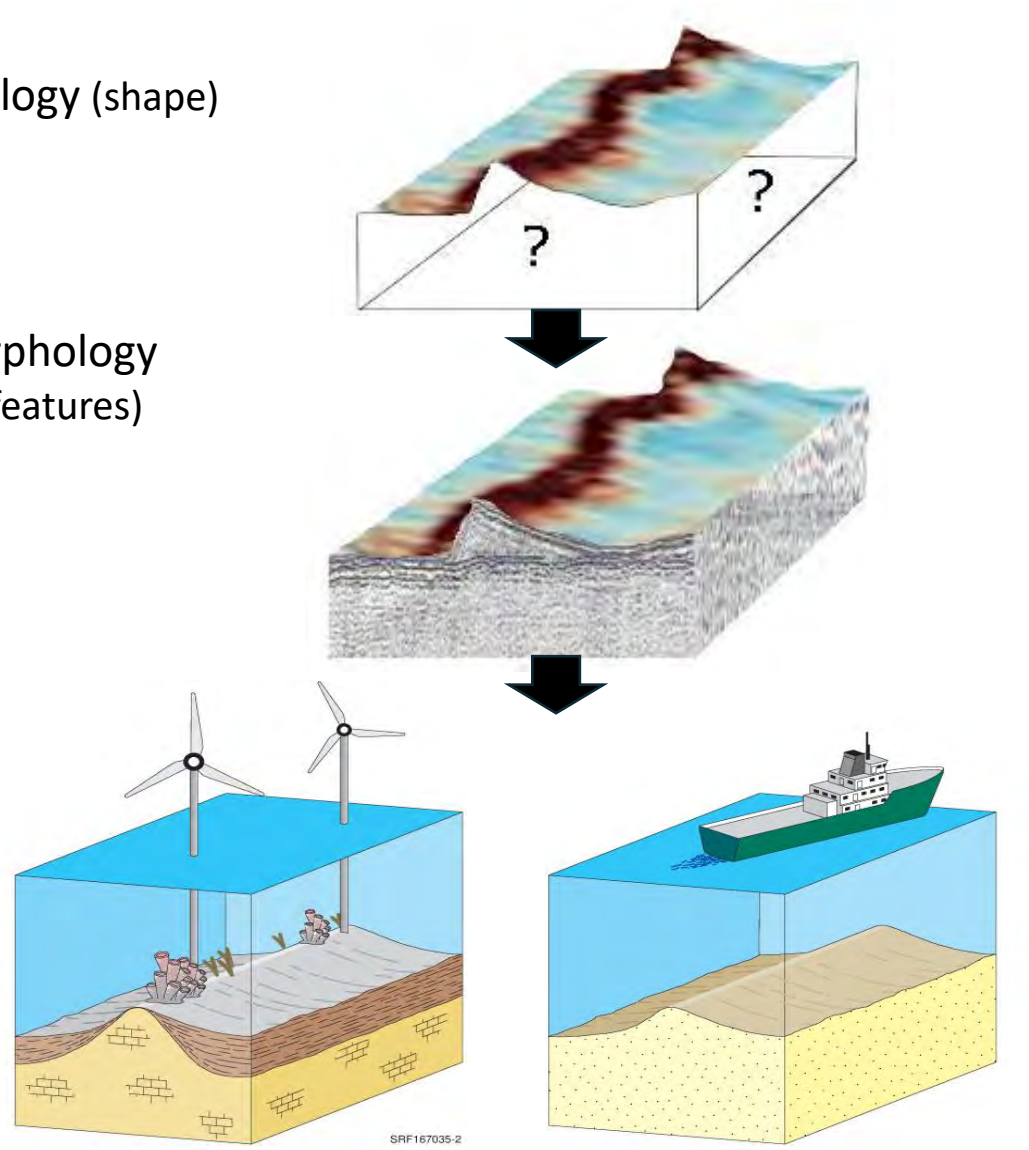
- Renewable Resources
- Hazard Management
- Sediment budgets
- Past environments
- Conservation
- Management

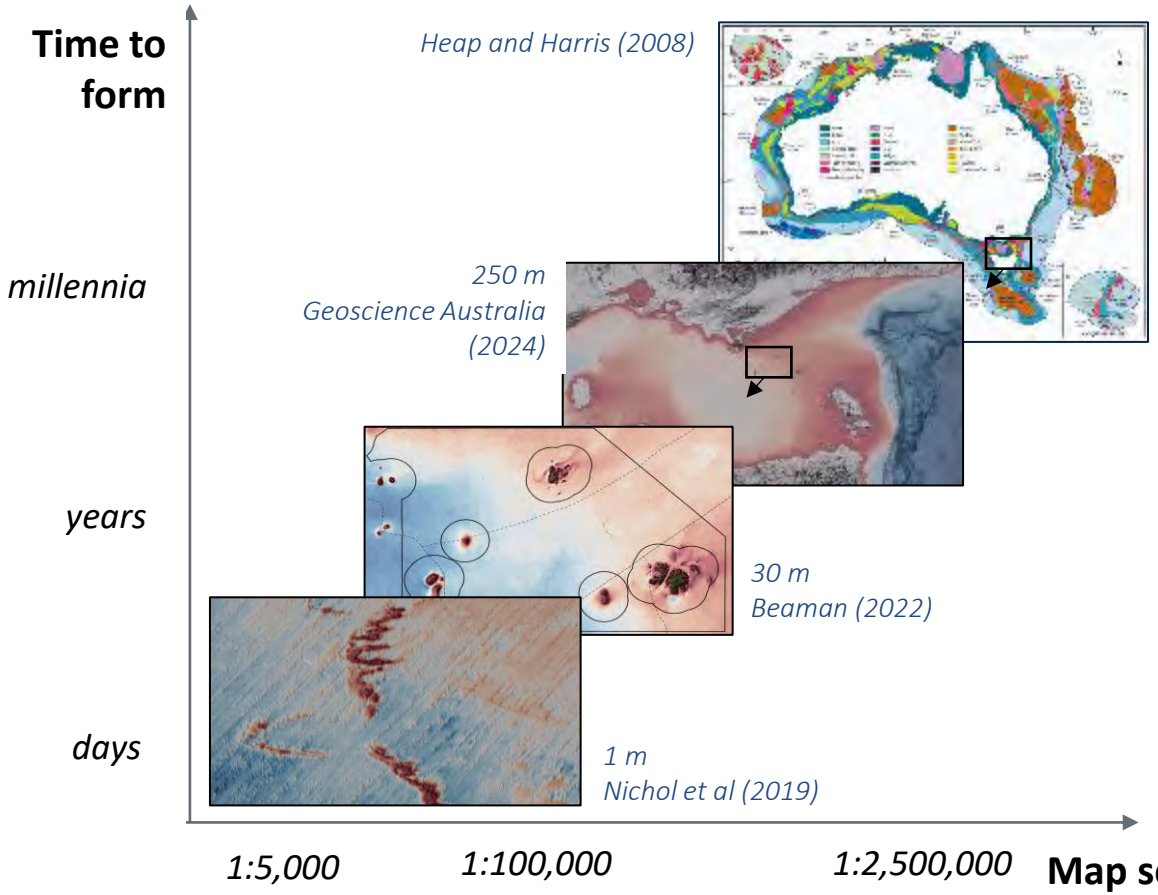
DATA → INFORMATION → KNOWLEDGE → **INFORMED DECISIONS**

Marine geomorphology mapping challenges – subsurface and scale

Morphology (shape)

Geomorphology (seabed features)





To learn more about how to map seabed geomorphology using an *Ocean Best Practice* approach visit the International Seabed Geomorphology Mapping Working Group webpages

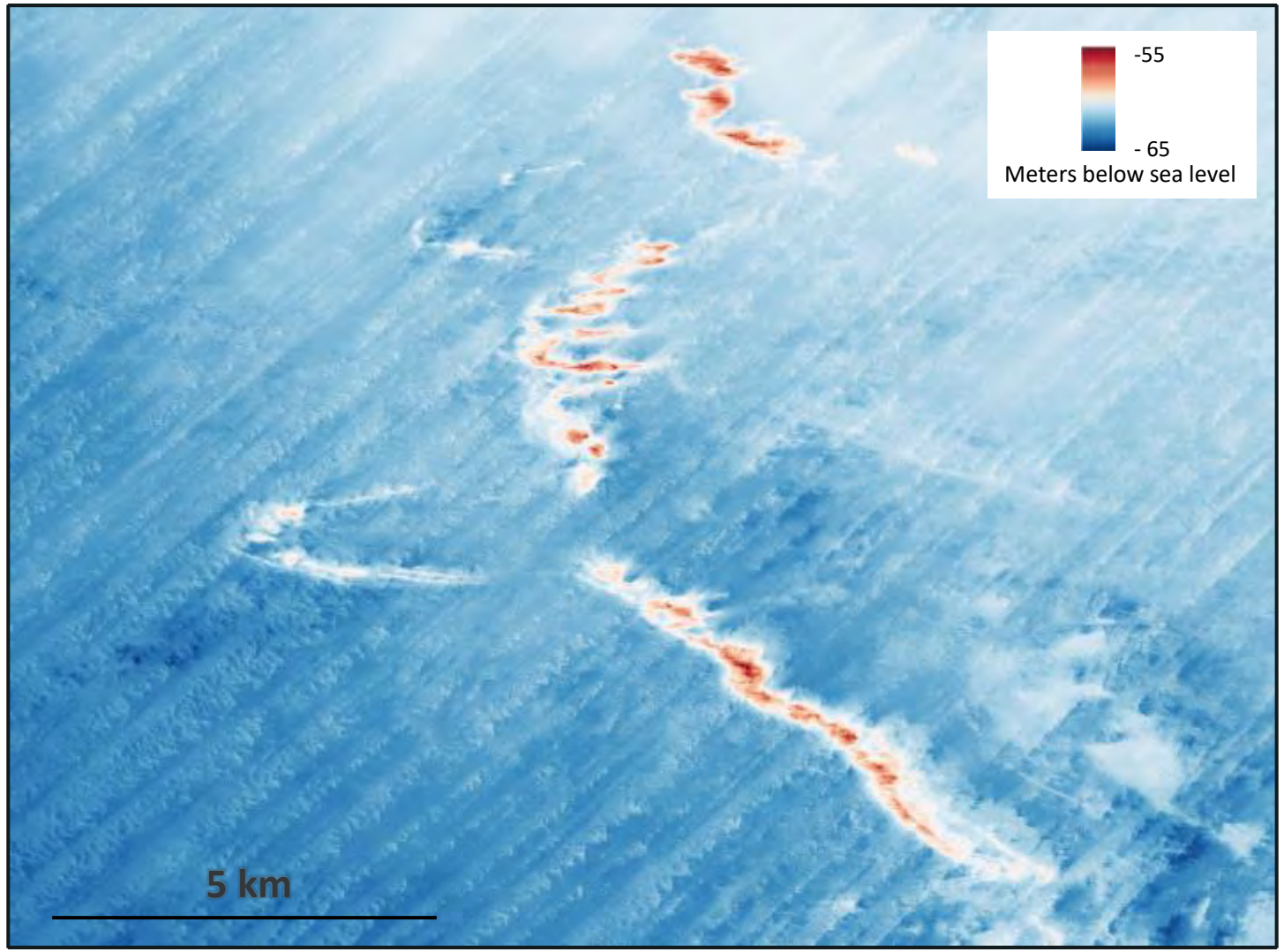
Marine geomorphology mapping challenges – subsurface and scale

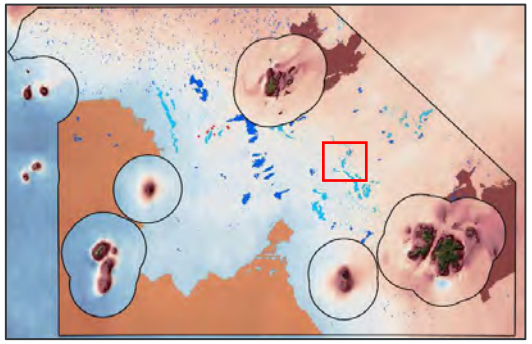
Bathymetry

250 m grid

30 m grid

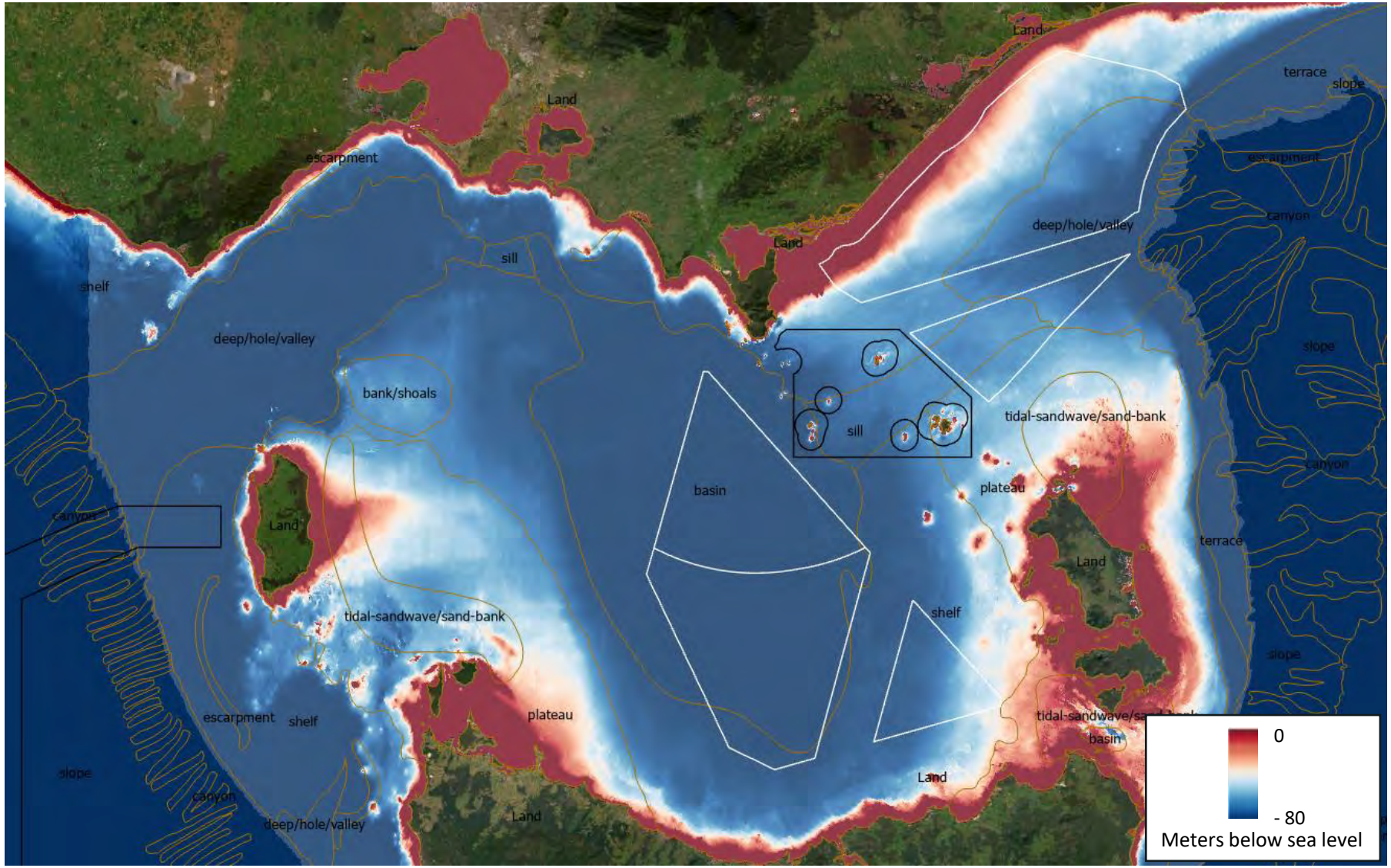
1 m grid





Geoscience Australia's Resourcing Australia's Prosperity initiative (RAPi)

Bass Strait Geomorphology mapping – national scale (250 m)

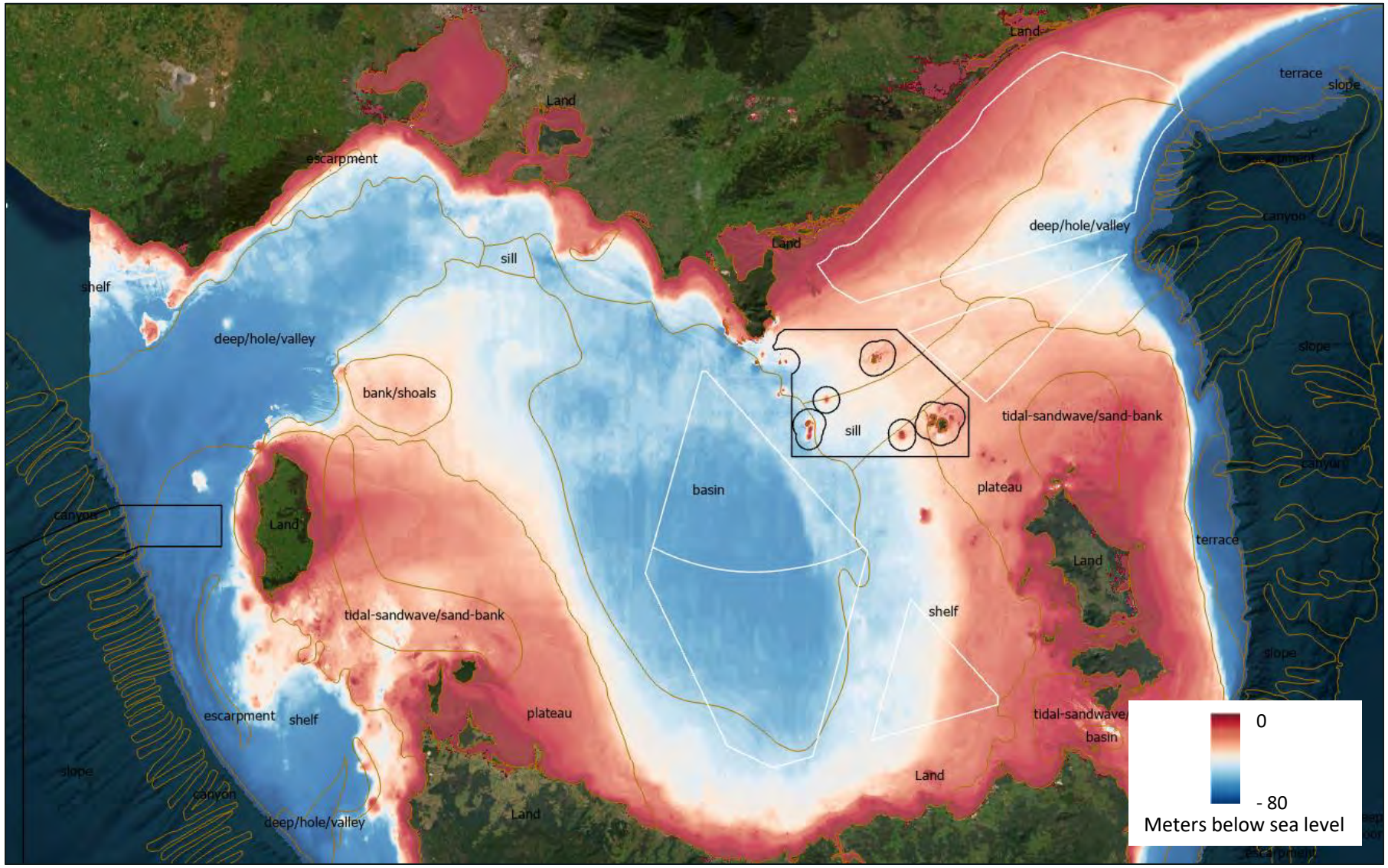


Geoscience Australia (2024)

Heap and Harris (2008)

Geoscience Australia - DCCEEW RERI Project 14

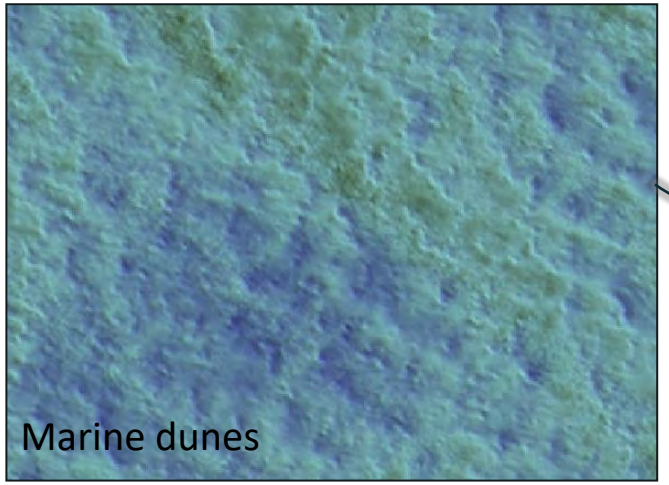
Bass Strait Geomorphology mapping – regional scale (30 m)

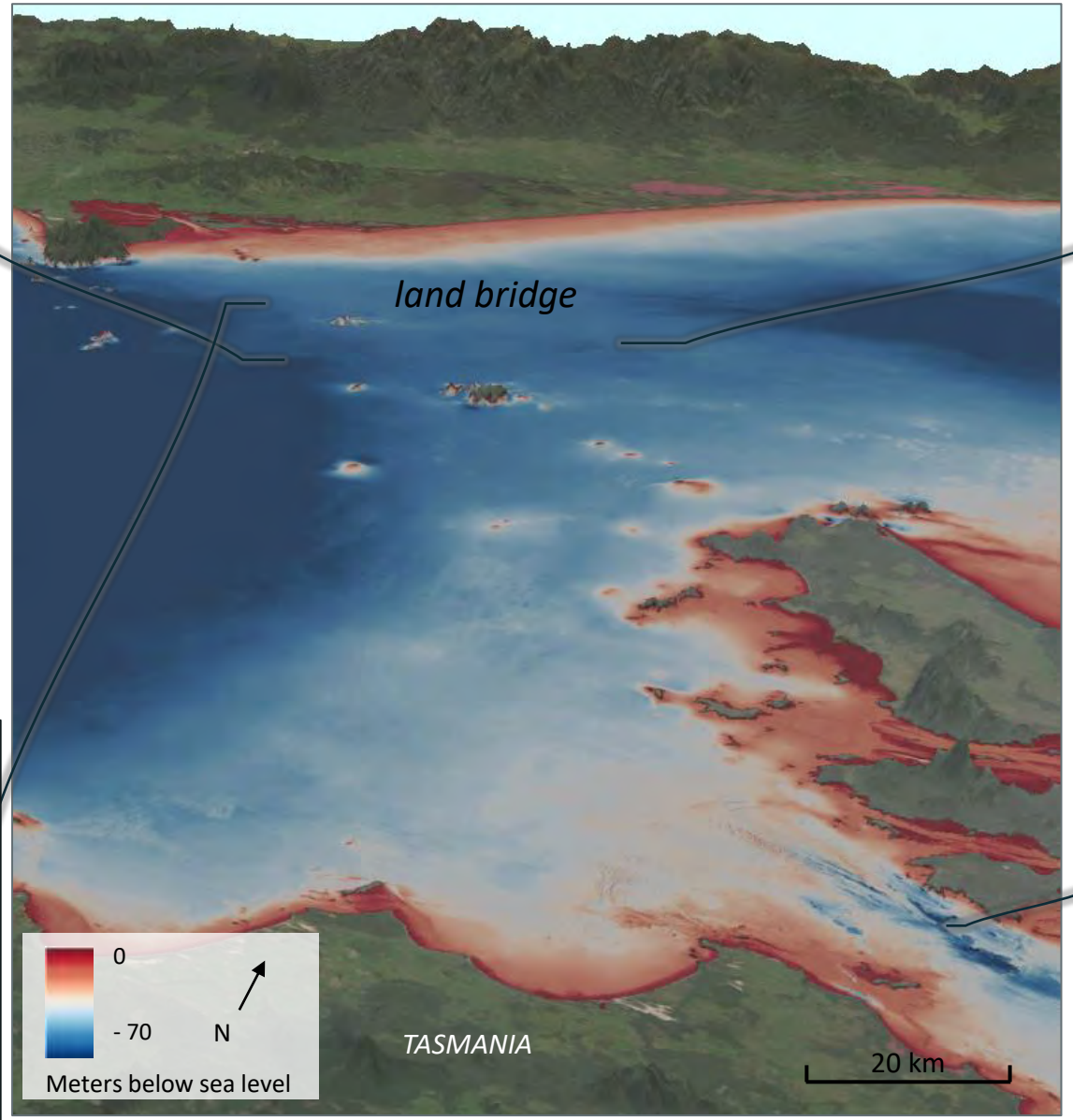


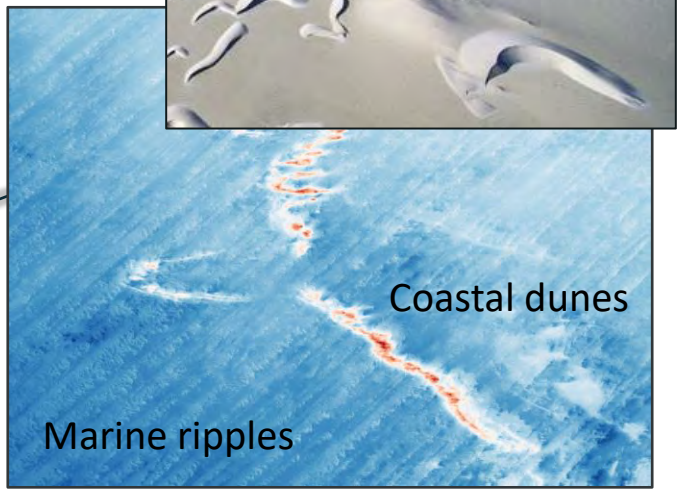
Beaman (2022)

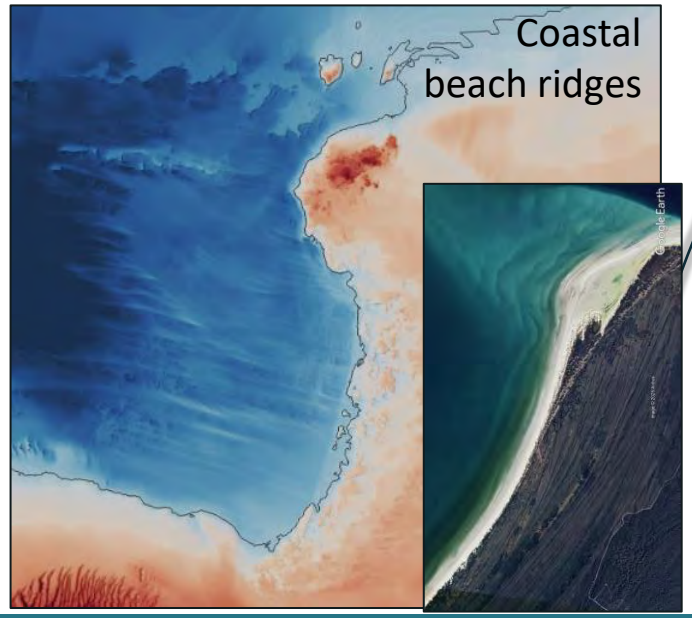
Heap and Harris (2008)

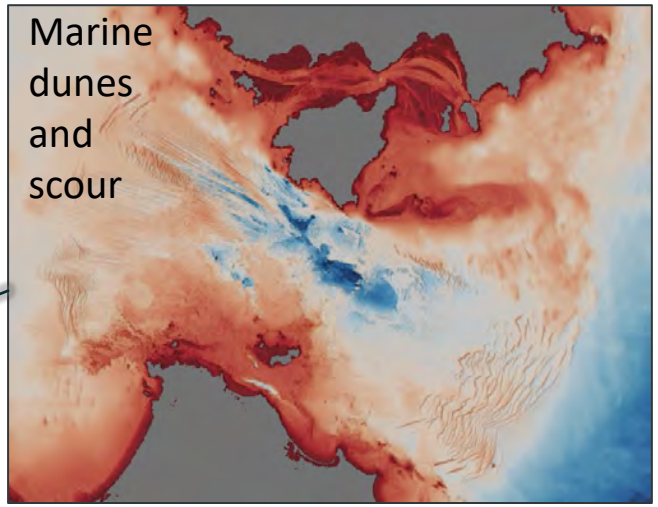
Marine geomorphology in the Bass Strait





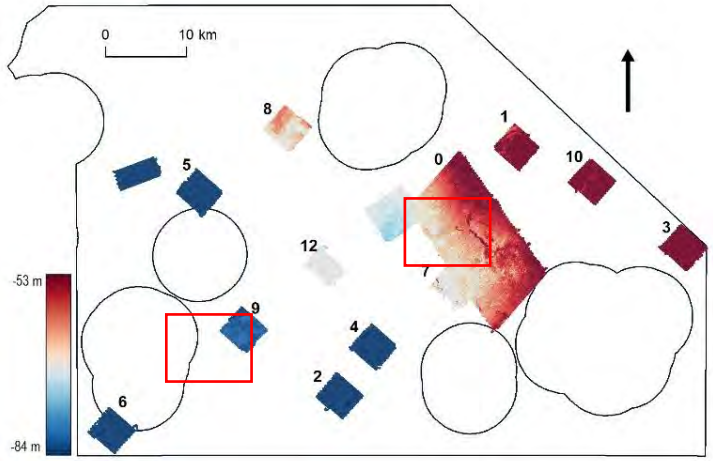


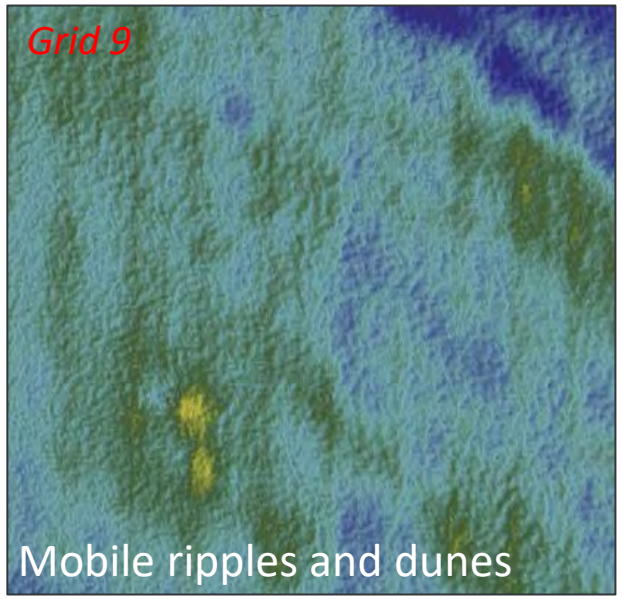


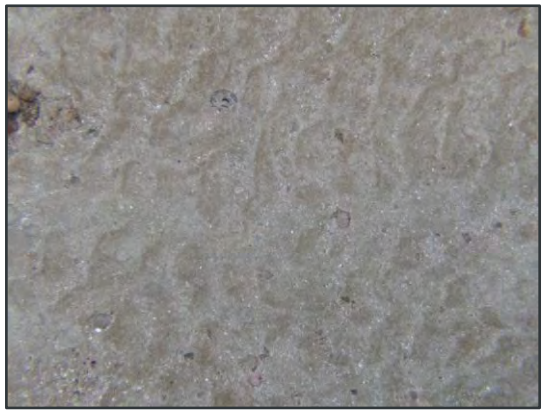


Marine geomorphology in the Bass Strait

NESP Project D3 – rocky reef habitat mapping (Beagle MP)



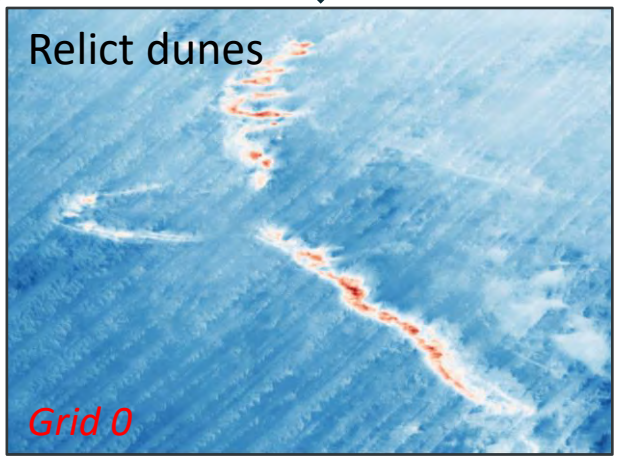




50 m

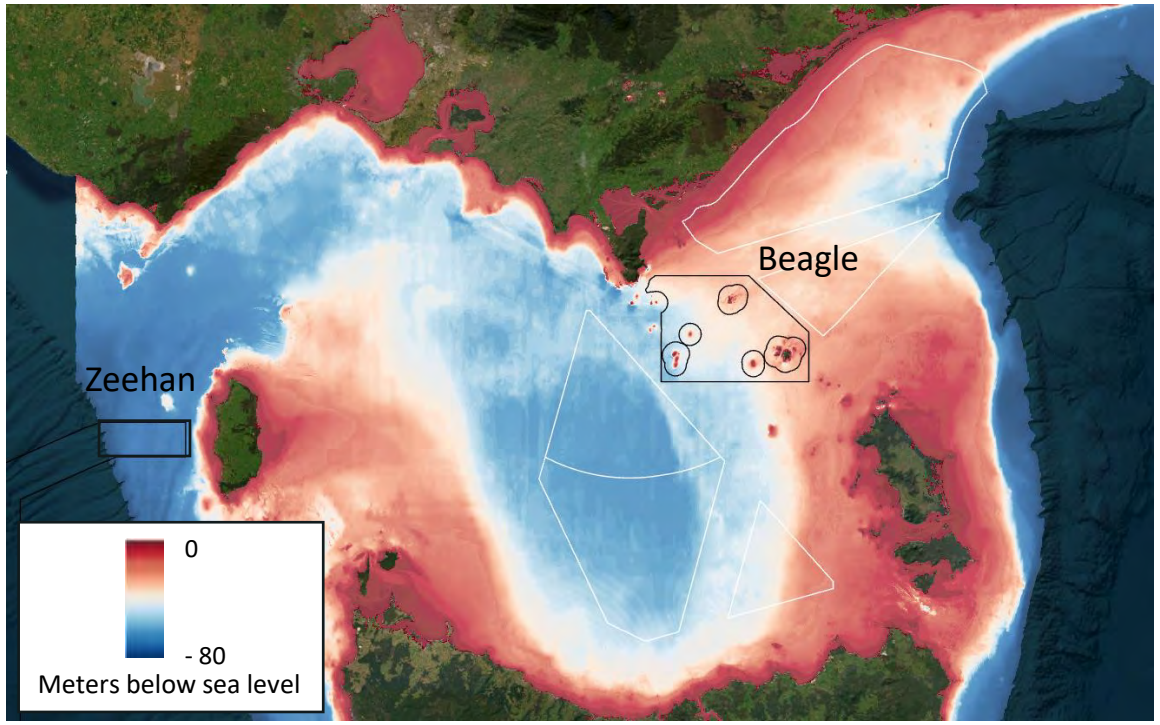
Sediment transport

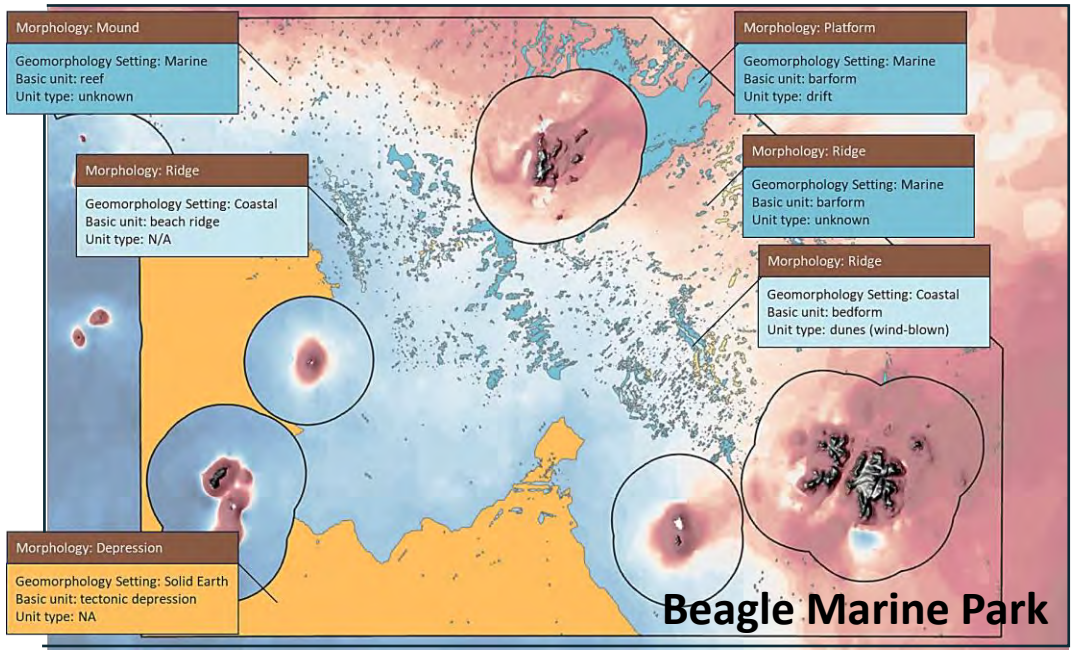
80 m

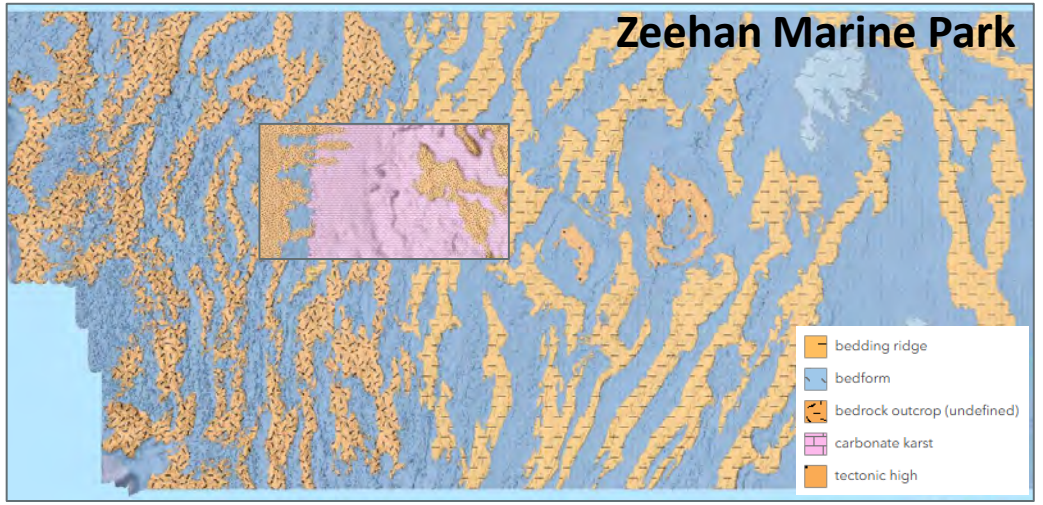


Example marine geomorphology mapping in the Bass Strait

Parks Australia 2023







To learn more about the *Ocean Best Practice* approach we used to map these marine parks visit the International Seabed Geomorphology Mapping Working Group webpages

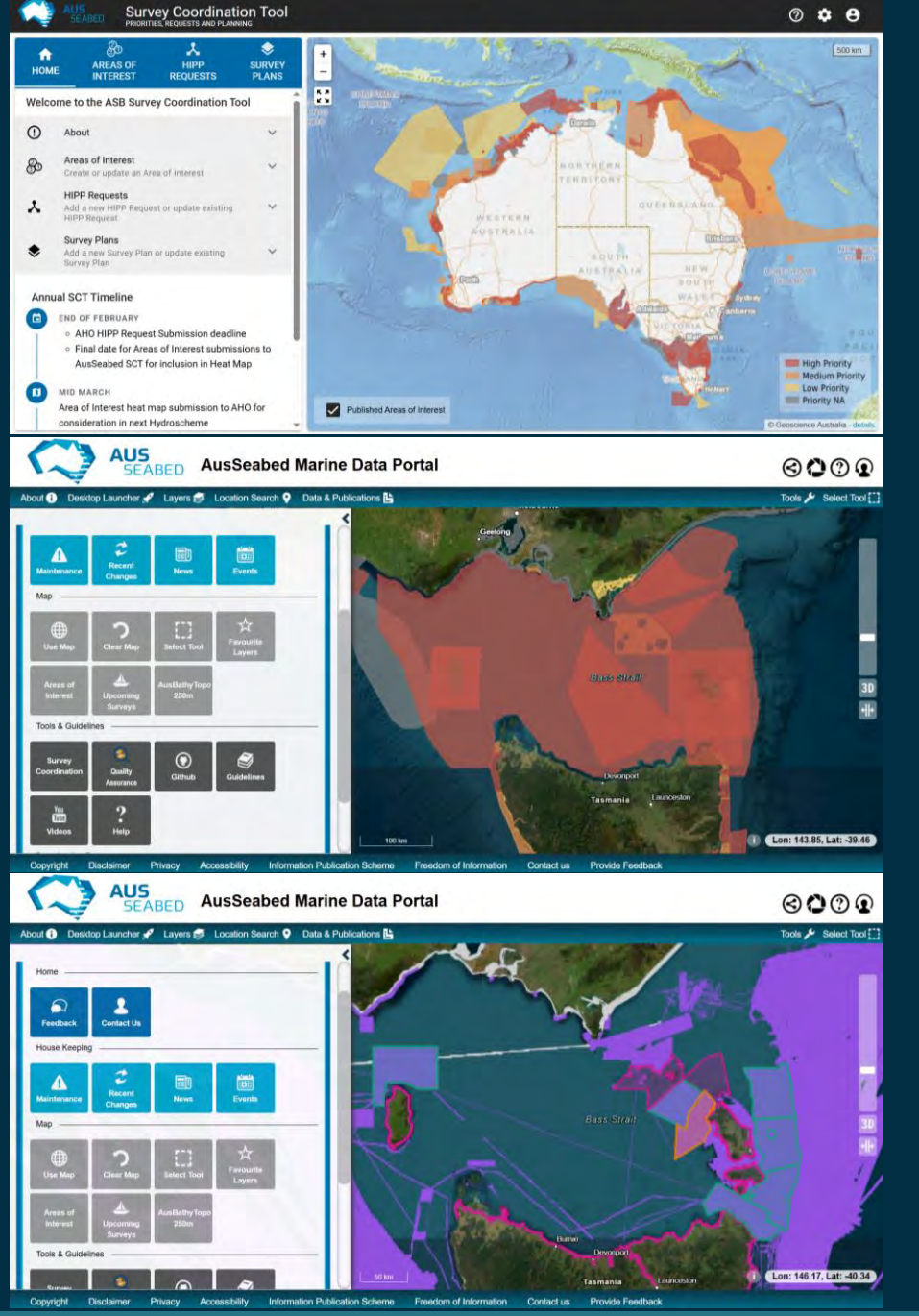
Guiding Coordination

Survey Coordination Tool
https://coordination.ausseabed.gov.au/

- Submission of AHO HIPP Requests
- Areas of Interest
- Upcoming Surveys

AusSeabed Marine Data Portal
https://portal.ga.gov.au/persona/marine

- Published Areas of Interest
- Published Upcoming Surveys
- Known existing bathymetric data coverage
- Published AusBathyTopo series (regional and national compilations)
- Published survey data from government, academic, and private sectors
- Other marine geophysical data
- Geomorphological products… and more

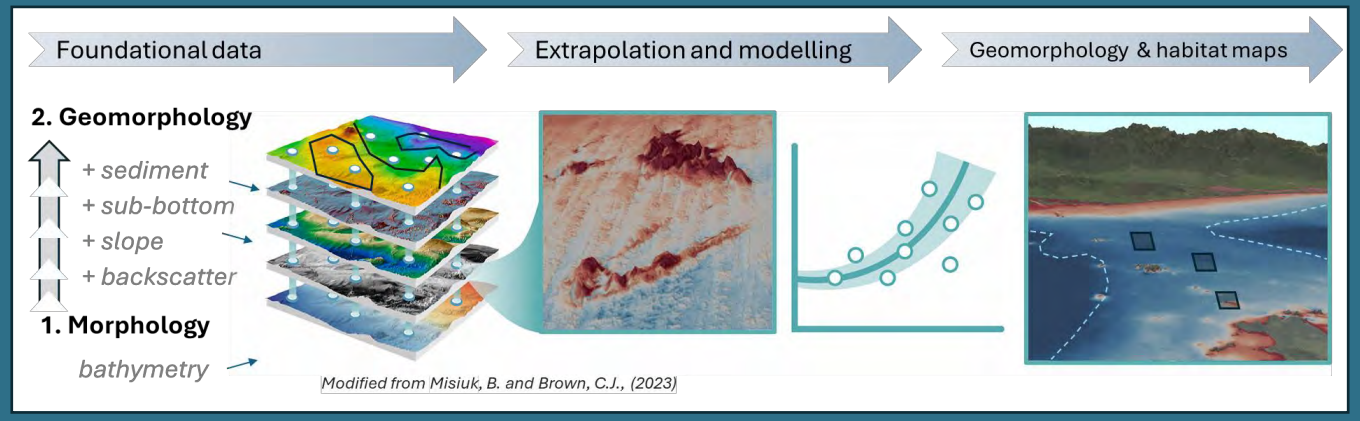


Australian Government
Geoscience Australia

Thank you

Acknowledging the work of the entire Geoscience Australia team, and all of our collaborative partners that have contributed to the work presented today

Further information:
Donna.audas@ga.gov.au
Rachel.nanson@ga.gov.au



To learn more about how to map seabed geomorphology using an *Ocean Best Practice* approach visit the International Seabed Geomorphology Mapping Working Group webpages

Australian Marine Parks

Bass Strait ecosystem values

Ben Sellers, Steffan Howe, Dave Logan, Cath Samson, Natalie Bool – *Parks Australia*

Piers Dunstan, Jac Monk, Tim Langlois, Keith Hayes – *NESP Marine & Coastal Hub*

Australian Government
Parks Australia

Australian Marine Parks

Marine and Coastal
National Environmental Science Program

Australian Marine Parks

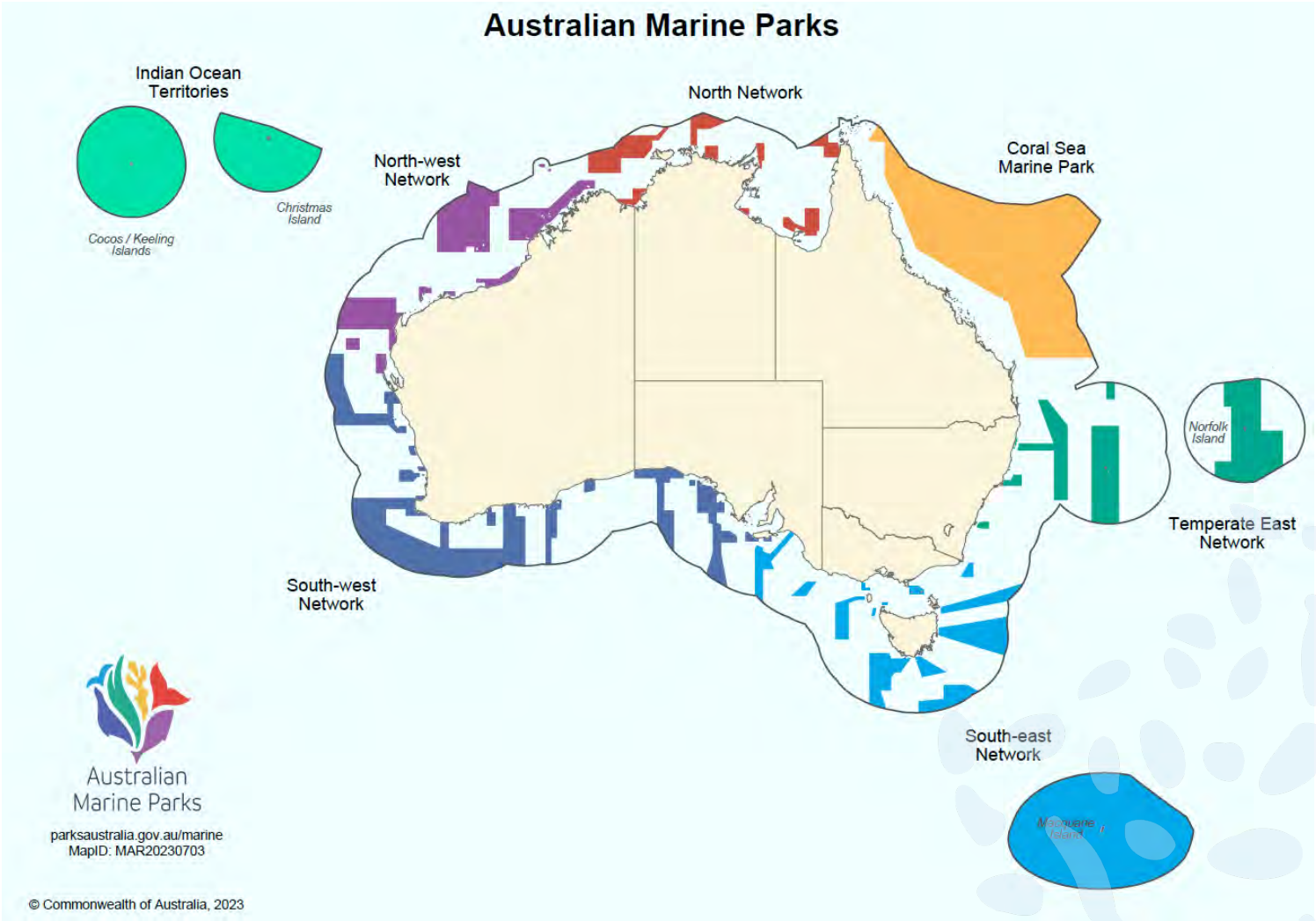
Australian Government
Parks Australia

Australian Marine Parks

60 parks covering 3.8 million km^2 (43% of Australia's marine jurisdiction)

Protecting & conserving the natural, cultural & heritage values

Supporting the ecologically sustainable use & enjoyment they provide.



Natural Values in the South-east Network

Australian Government
Parks Australia

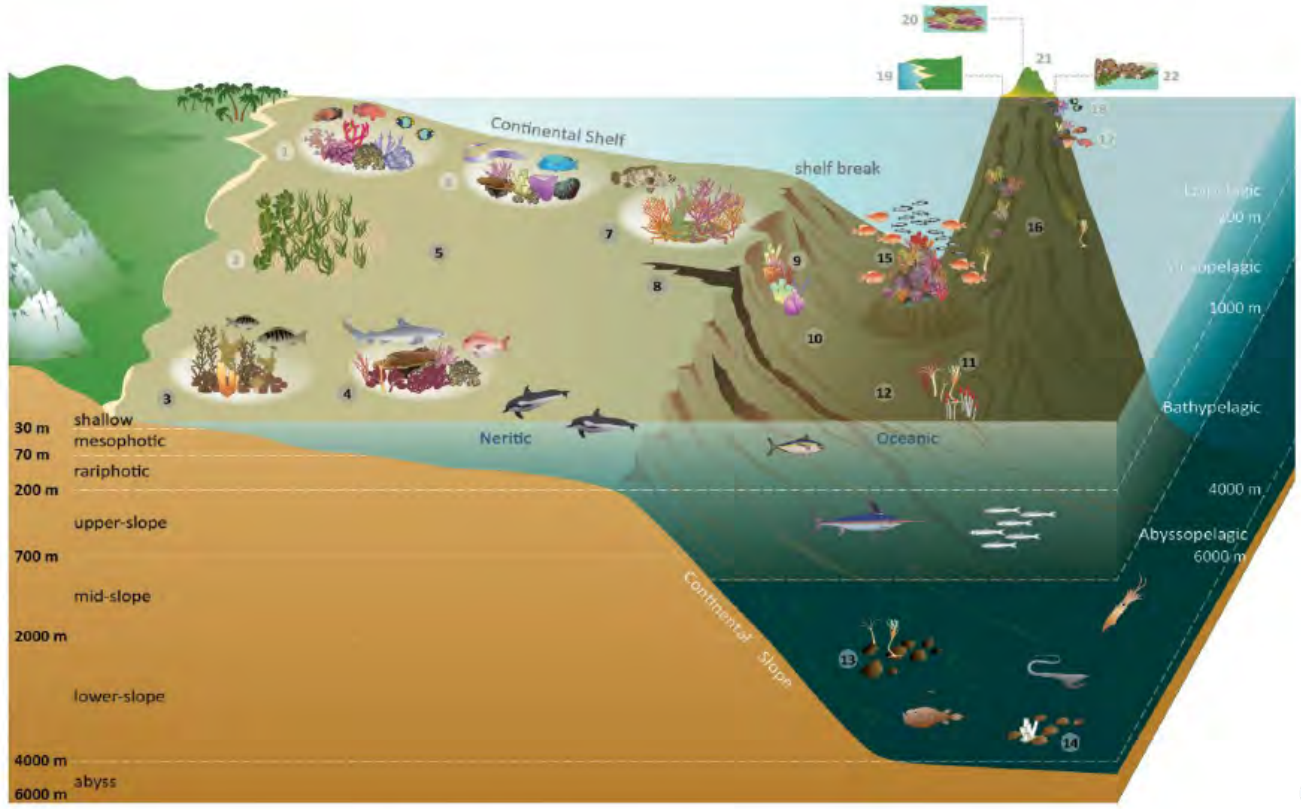
Australian Marine Parks

Various ecosystem types

KEFs, BIAs & key natural values

Ancient land bridge

World, National & Commonwealth Heritage



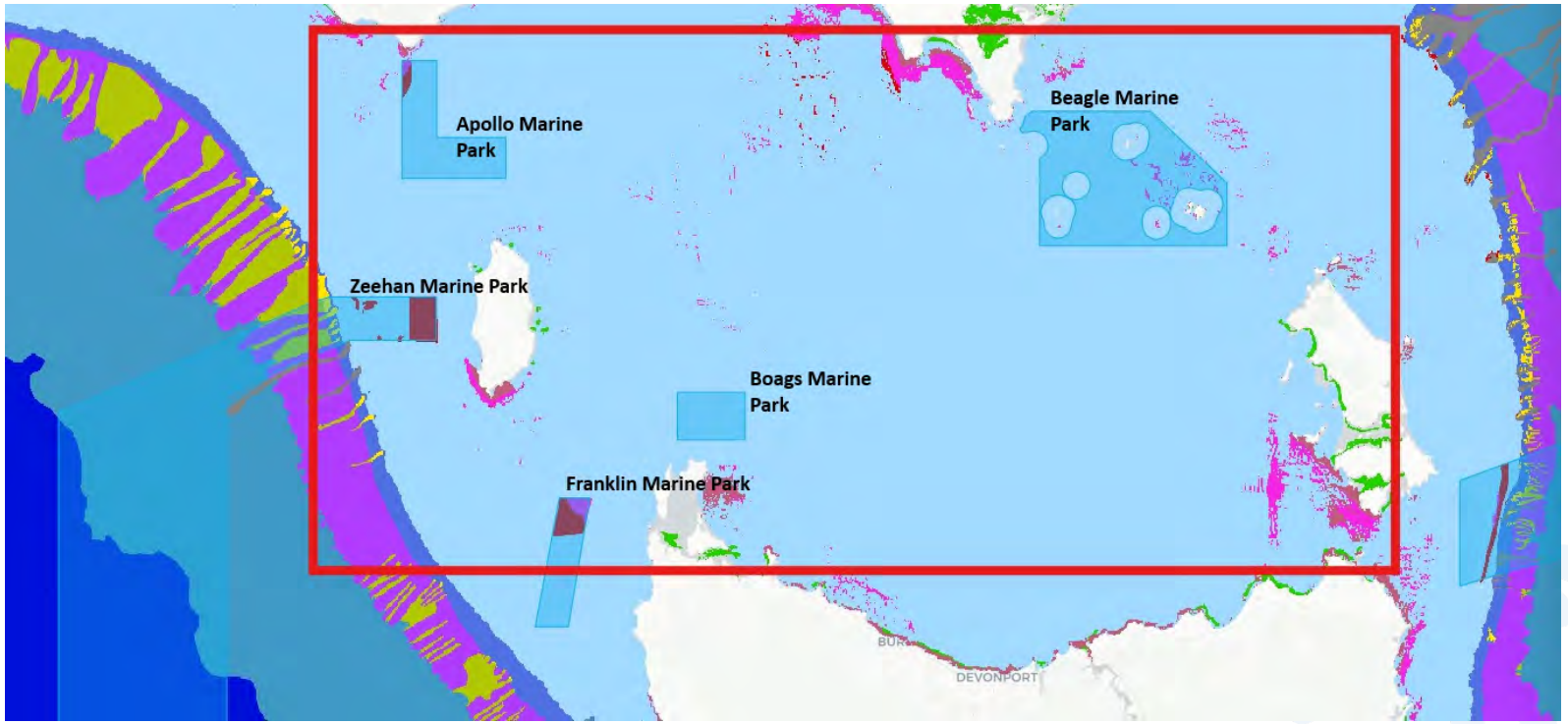
MV City of Rayville. Credit: Dave Hurst

Bass Strait Marine Parks

Australian Government
Parks Australia

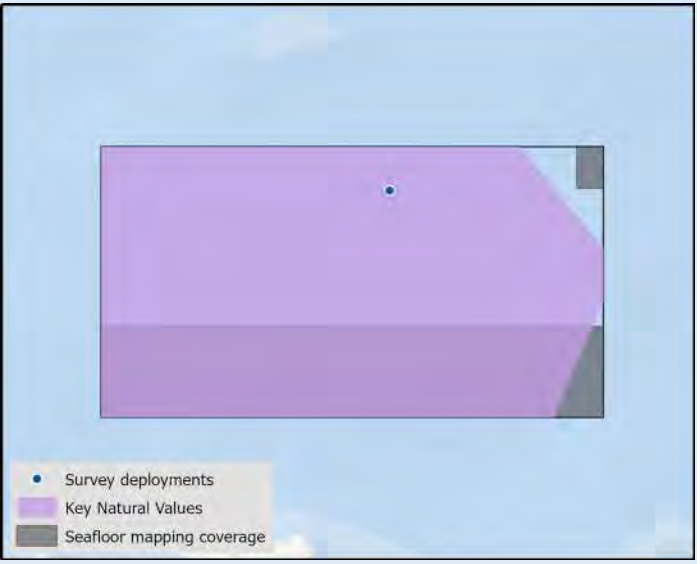
Australian Marine Parks

- Apollo
- Zeehan (Eastern arm)
- Boags
- Franklin
- Beagle



MV City of Rayville. Credit: Dave Hurst

Boags Marine Park Natural Values



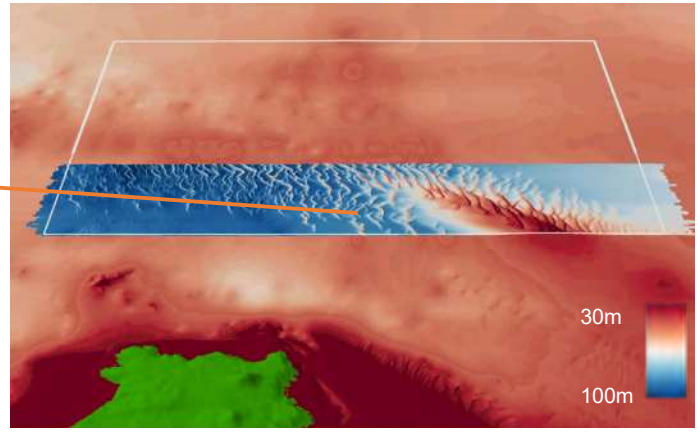
Depth - 10m - 62m

30.9% of seafloor mapped, almost all at high resolution to support habitat mapping and biodiversity surveys.

Overall knowledge status

Boags Marine Park has a **low to medium level of knowledge**. Fine-scale mapping of the southern end of the park has revealed seafloor features expected to occur throughout the park. No known biological surveys have been undertaken.

Source; Geoscience Australia



Source; Geoscience Australia

Mobile dune fields

A prominent and striking feature of the park are the extensive, mobile dune fields caused by the combination of shallow depths (40-60m) and strong-tidal currents in the area. Several of the dunes are over 10m high. These mobile dunes are unlikely to support complex sessile invertebrate communities like those observed in Beagle Marine Park, and are instead likely to be dominated by organisms that live in and on the sediments, such as polychaete worms[1].

Shy Albatross. Credit: Wild Ocean Tasmania

Feature of interest KNV

The endangered Shy Albatross (*Thalassarche cauta*) is an endemic Australian seabird, which breeds exclusively on three offshore Tasmanian islands. The park contains core foraging areas for early incubating and post-fledgling Shy Albatross from nearby Albatross Island[3].

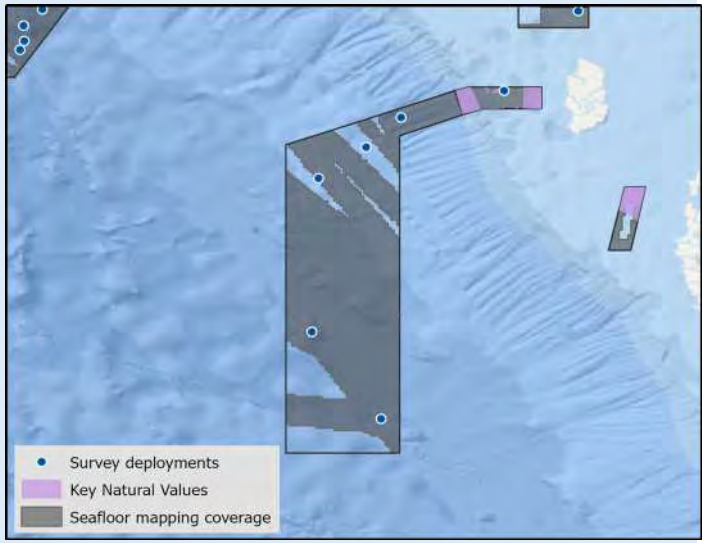
KNV

KNV= Key Natural Values
Habitat or species that are particularly important to management

Zeehan Marine Park Natural Values

Australian Government
Parks Australia

Australian Marine Parks



Depth - 91m – 5174m

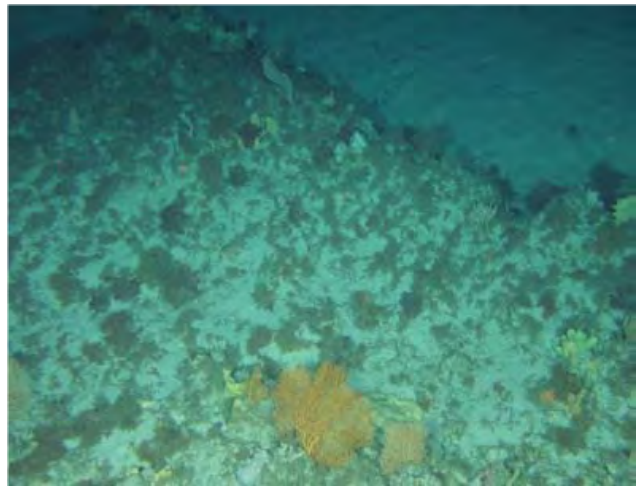
75.5% of seafloor mapped, most at medium resolution to support biodiversity surveys.

KNV

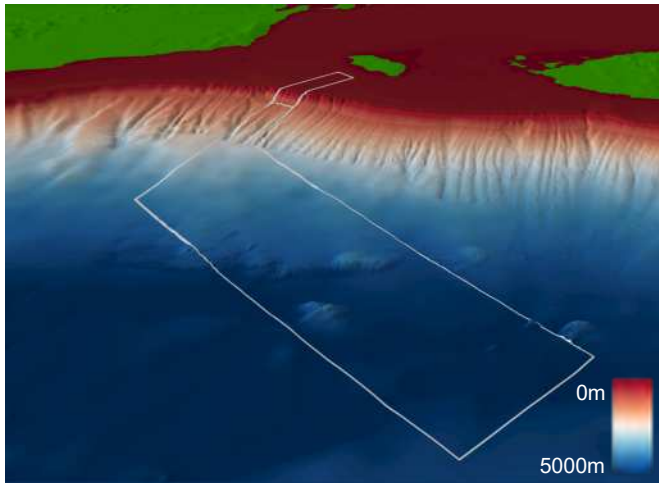
KNV= Key Natural Values
Habitat or species that are particularly important to management

Overall knowledge status

Zeehan Marine Park has a **medium level of knowledge**. The shelf reefs areas have been the focus of research efforts owing to their unique structure and potential as valuable high biodiversity habitats[1].



Source: A. Williams et la. 2007



Source; Geoscience Australia

Deep reef habitats

Rocky limestone reefs of varying size which support large sponges, sea whips and large soft and hard bryozoans[2].

Five relatively small canyons occur within the park featuring rocky outcrops that support a diverse community of associated fauna.

KNV

Shy Albatross. Credit: Wild Ocean Tasmania

Feature of interest

KNV

Shy Albatross (*Thalassarche cauta*) is Australia's only endemic albatross, with Zeehan a core foraging area for early incubating albatross from Albatross Island[3].

Source: A. Williams et la. 2007.

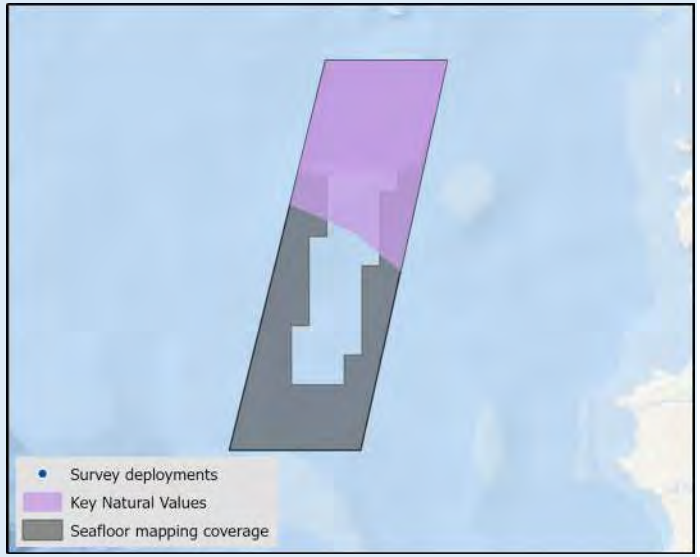
Benthic fauna

Coarse sediments provide valuable foraging grounds for crustaceans[2].

Franklin Marine Park Natural Values

Australian Government
Parks Australia

Australian Marine Parks



Depth - 49m – 116m

55% of seafloor mapped, almost all at medium to high resolution to support habitat mapping and biodiversity surveys.

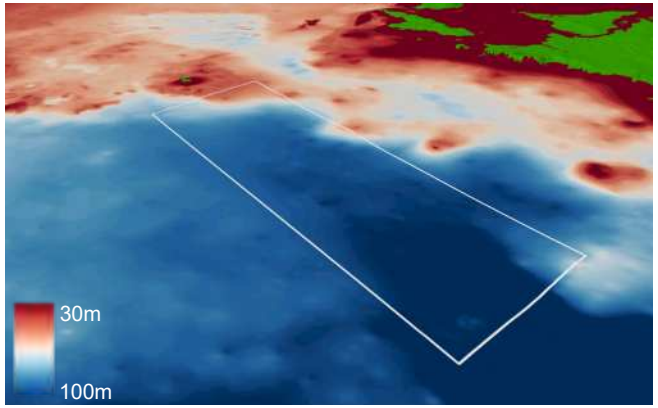
KNV

KNV= Key Natural Values
Habitat or species that are particularly important to management

Overall knowledge status

Franklin Marine Park has a **medium level of knowledge**. The reef habitats have been a focus of fine-scale mapping efforts in the park. The northern and southern ends of the park have been continuously mapped[1]. Limited biological surveys have been undertaken.

Source: Wild Ocean Tasmania



Source; Geoscience Australia

KNV

Feature of interest

The northern half of the Franklin Marine Park is a core foraging area for the endangered Shy Albatross (*Thalassarche cauta*) which breeds exclusively on three offshore Tasmanian islands – one of which is Albatross Island to the north-east of the park[3].

Source: IMAS

KNV

Golden kelp forests

The northern section of the park contains complex reef that supports golden kelp forests (*Ecklonia radiata*).

Source: IMAS

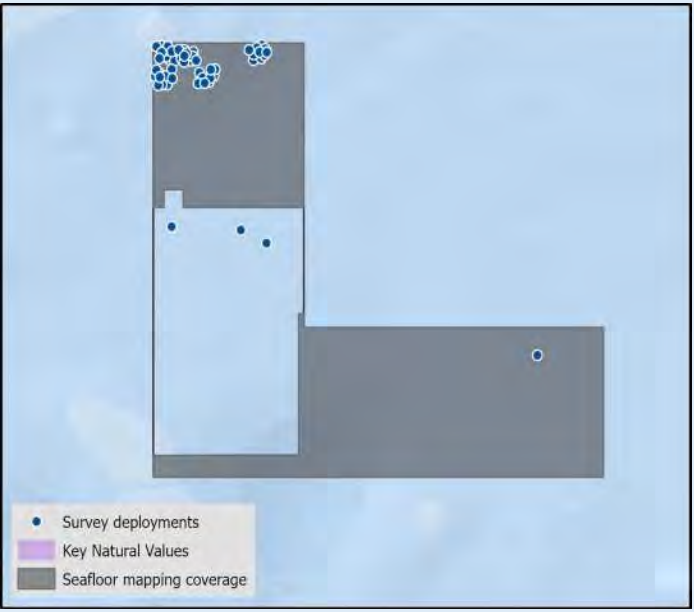
Reef habitats

Sponge dominated limestone pavement outcrops.

Apollo Marine Park Natural Values

Australian Government
Parks Australia

Australian Marine Parks

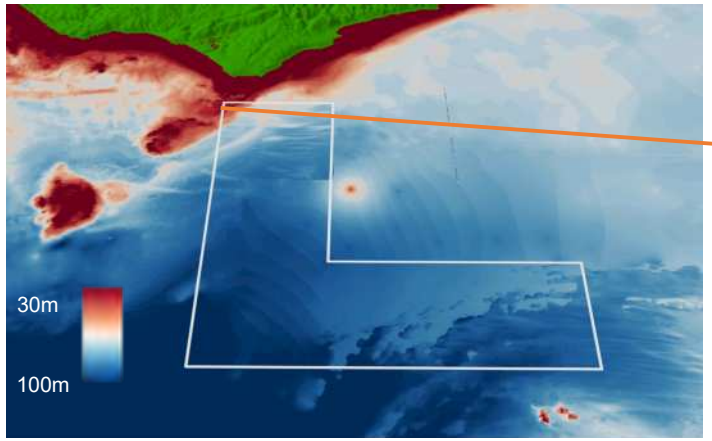


Depth - 47m -101m

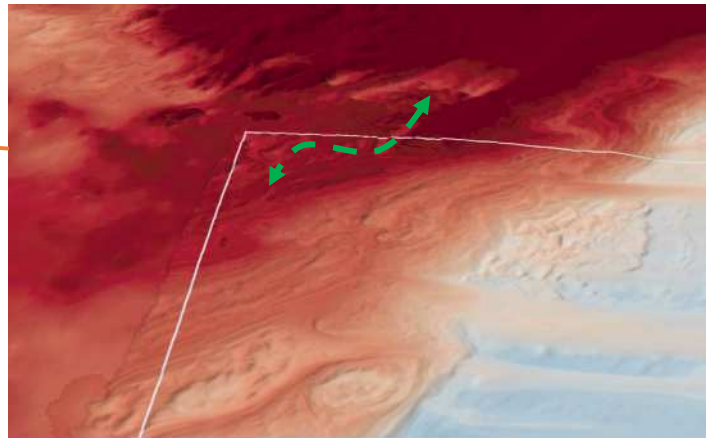
60% of seafloor mapped, most at medium to high resolution to support habitat mapping and biodiversity surveys.

Overall knowledge status

Apollo Marine Park has a **low to medium level of knowledge**. Fine-scale mapping includes high biodiversity areas of deep (mesophotic) reef ecosystems in the north west corner. This area has been a focus for fish community surveys, with data from 50 Baited Remote Underwater Video systems yet to be analysed. The south east section of the park has also been mapped with interpretation of seabed features yet to be undertaken.



Source: Geoscience Australia



Source: Geoscience Australia

Feature of interest

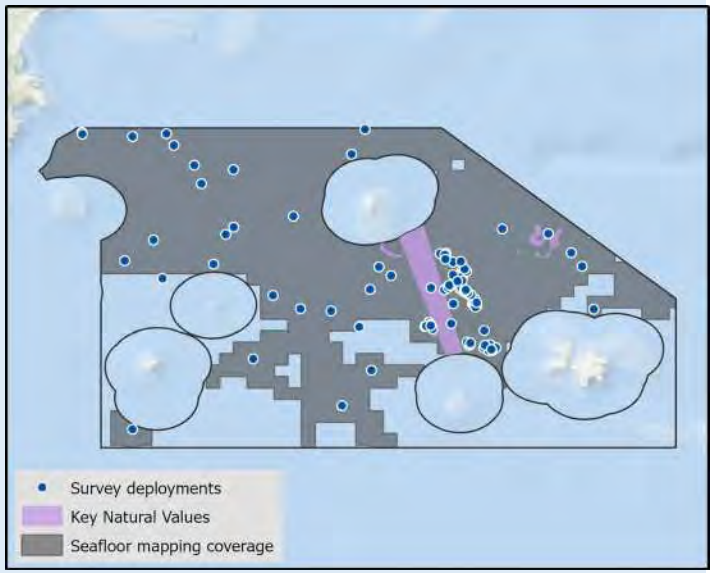
Prized Southern Rock Lobsters (*Jasus edwardsii*) are thought to migrate throughout the year between the highly productive state waters and Apollo Marine Park reef systems.

Southern Rock Lobster (Credit: Antonia Cooper)

Beagle Marine Park Natural Values

Australian Government
Parks Australia

Australian Marine Parks



KNV

KNV= Key Natural Values
Habitat or species that are particularly important to management

Depth - 46m - 77m

62% of seafloor mapped, much of it at medium to high resolution to support habitat mapping and biodiversity surveys.

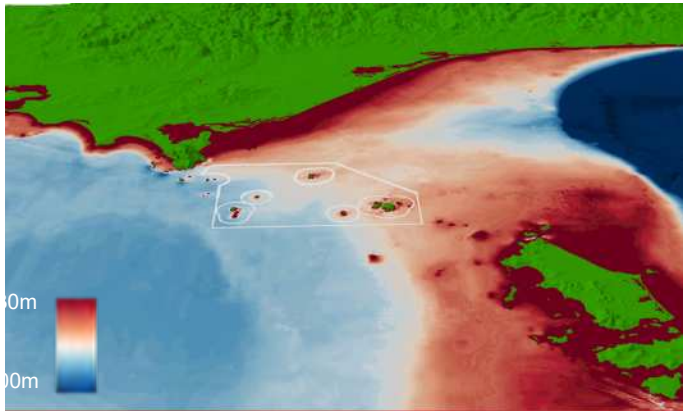
Overall knowledge status

Beagle Marine Park has a **medium level of knowledge**. Representative areas of the park and some identified priority park values have been mapped. Biological surveys have focused on the deep rocky reefs.

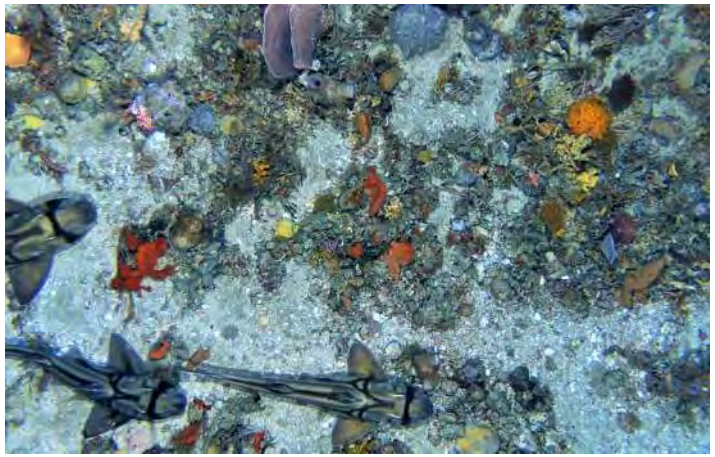
Source: IMAS/IMOS

Deep rocky reefs KNV

Deep (mesophotic) reef is a rare ecosystem in the bioregions within Bass Strait. This reef is exposed to large currents leading to high biological productivity and provides habitat for a diverse range of species.



Source; Geoscience Australia



Source: IMAS/IMOS

Feature of interest

An aggregation of hundreds of Port Jackson Sharks (*Heterodontus portusjacksoni*) was observed along the central reef ridges between Hogan Island group and Kent Island group in July 2018 and August 2024

Sentinel Parks – Beagle

Australian Government
Parks Australia

Australian Marine Parks

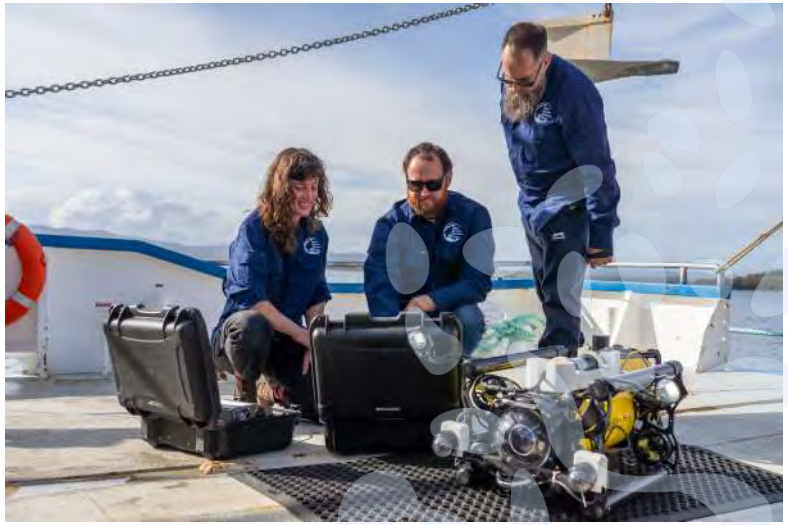
First repeat surveys in Beagle MP

- ROV surveys recently completed
  - Large aggregations of Port Jackson sharks
  - Juvenile & adult long spined urchins & associated barren
- Further ROV surveys planned

Pilot monitoring protocol

- *Aligned with NESP SOPs*
- *Specific monitoring questions (values & pressures)*
- *Methods, gear, survey design, frequency, timing*

Source; Jac Monk, IMAS



Source; Jac Monk, IMAS

Questions?

Source; Jac Monk IMAS

FUTURES of SEAFOOD

PRESENTATION

Futures Scenario Modelling

Rowan Trebilco, **CSIRO**

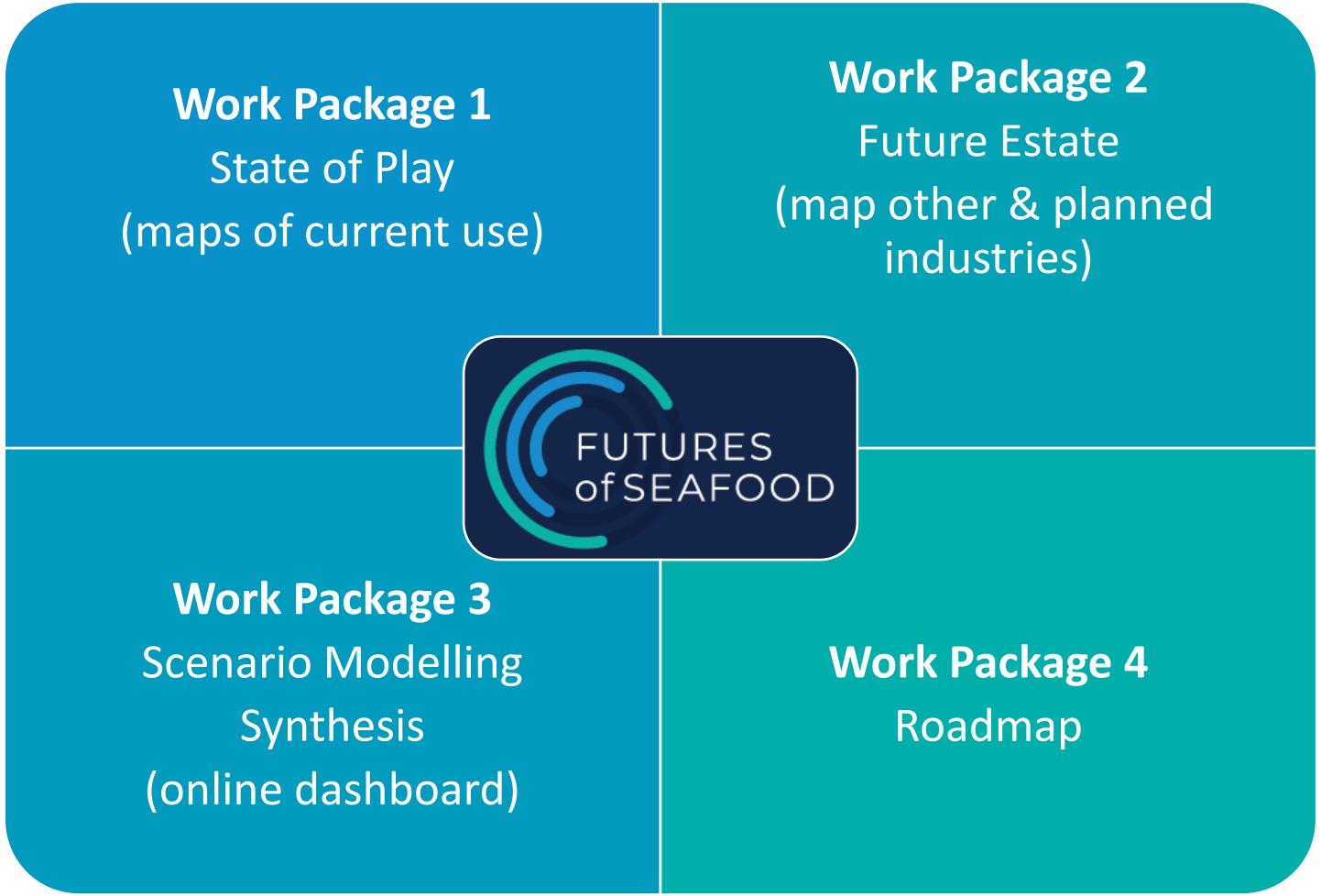
CSIRO Project Co-Leads

Beth Fulton & Rodrigo Bustamante

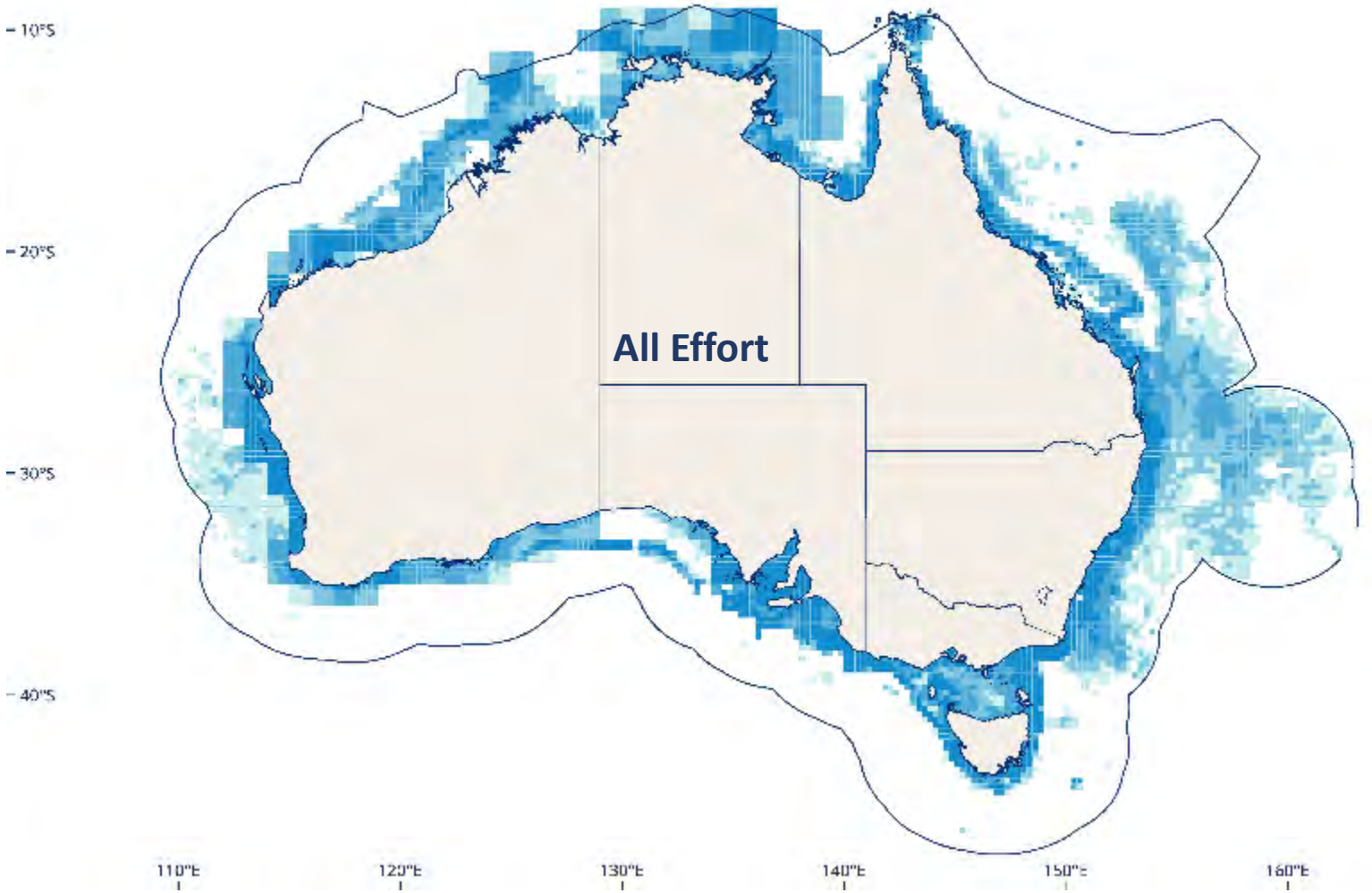
Summary

- Futures of Seafood = seafood focused to see implications of expansion of other sectors + climate change
- Systems modelling of entire Australian marine estate
- Some overlap with NESP project
- Key differences:
  - simpler representation of energy & shipping components
  - slightly simpler ecosystem detail too (fewer detailed species of conservation concern)

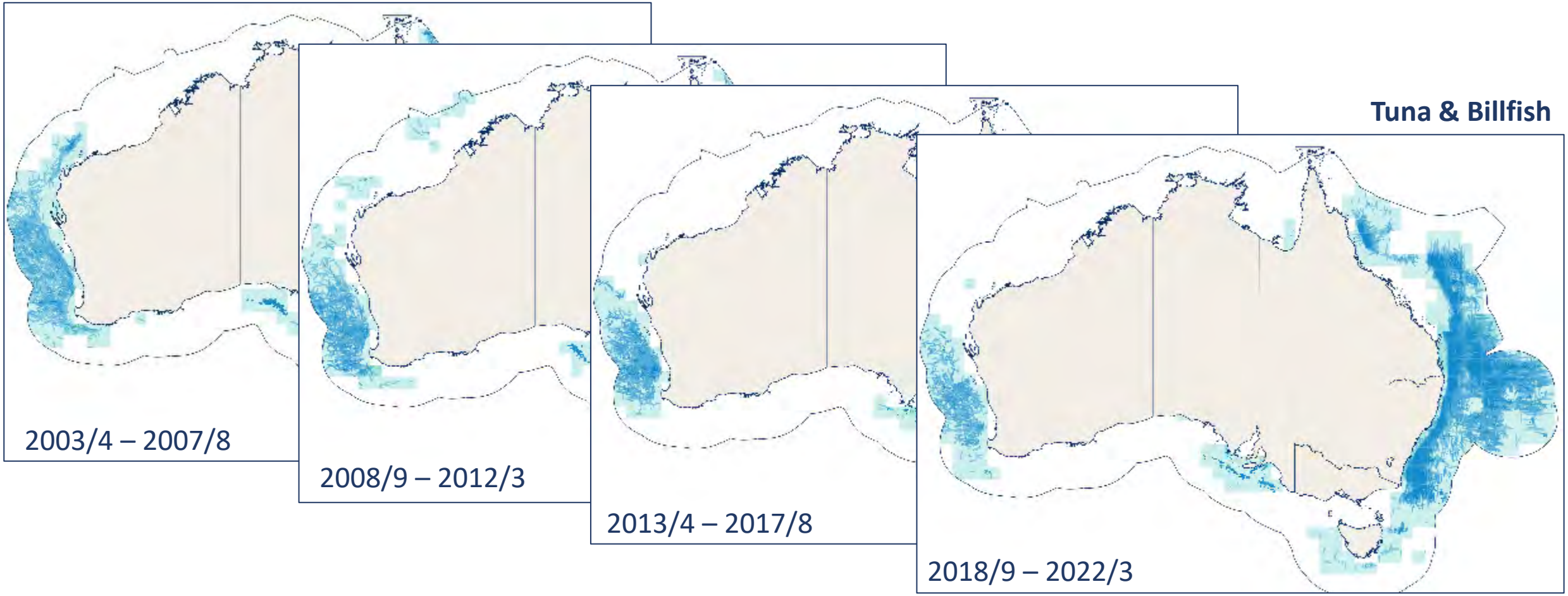
How it Fits Together



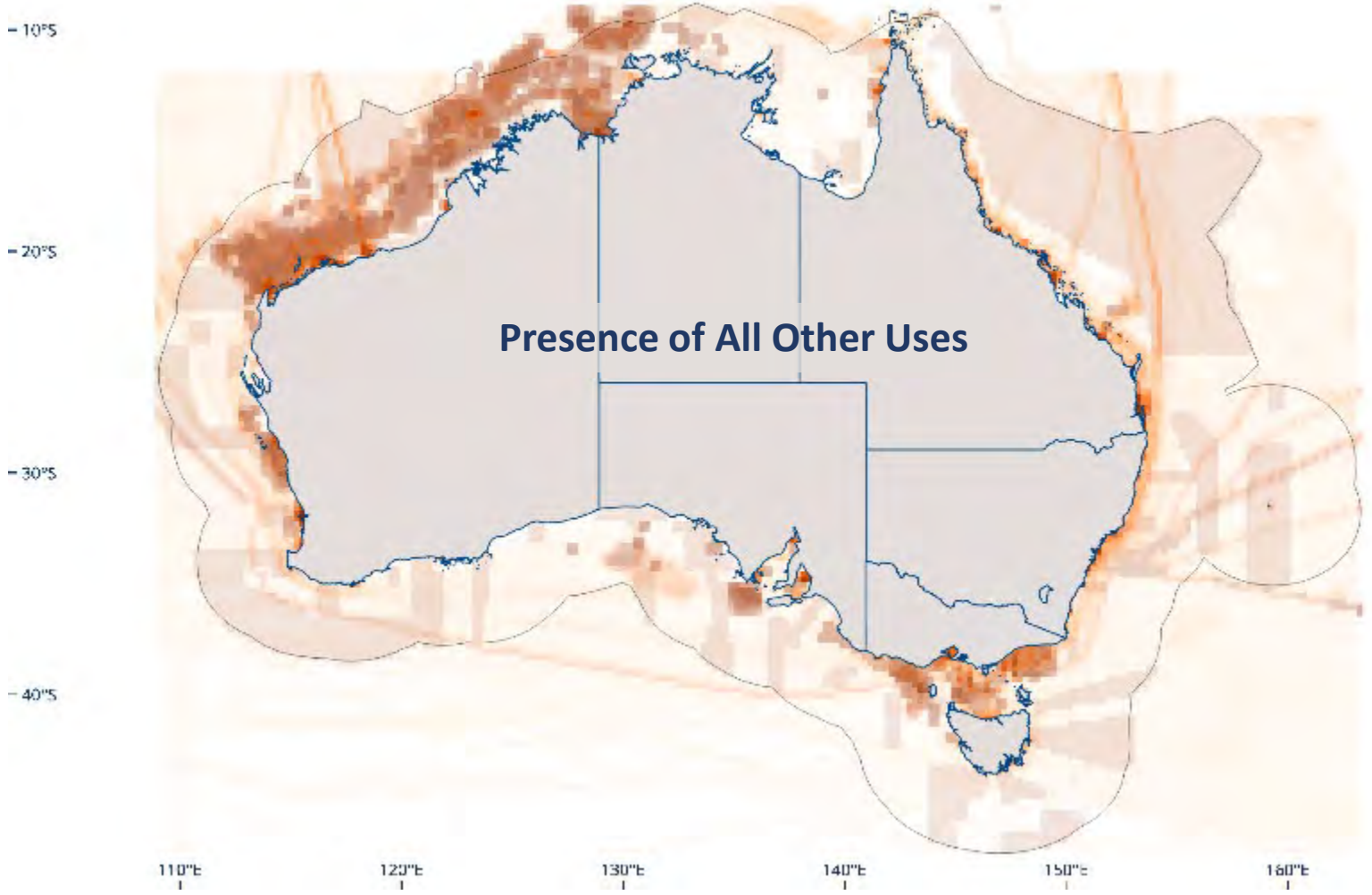
Data Atlas: Fisheries



Data Atlas: Fisheries Through Time

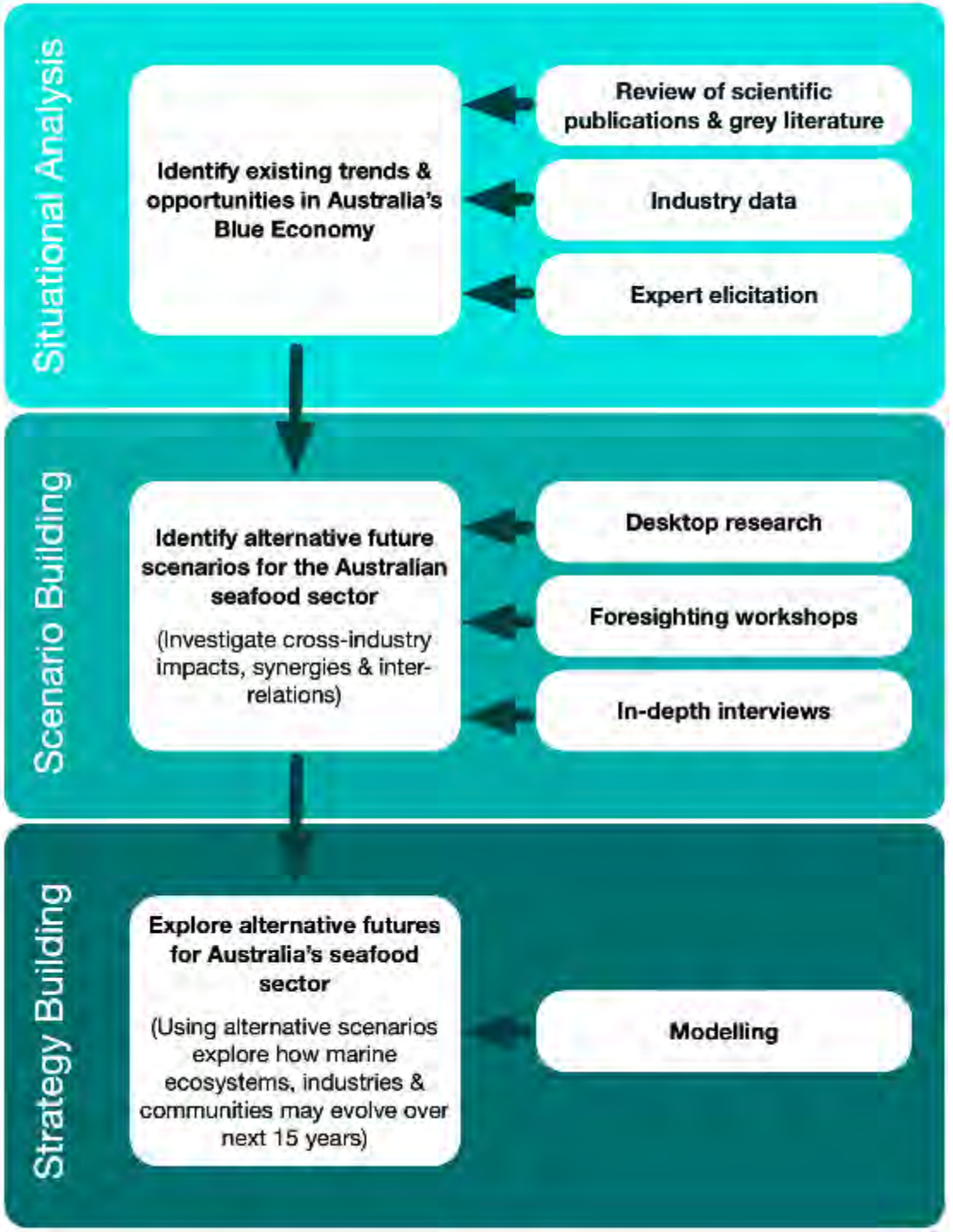


Data Atlas: Other Users



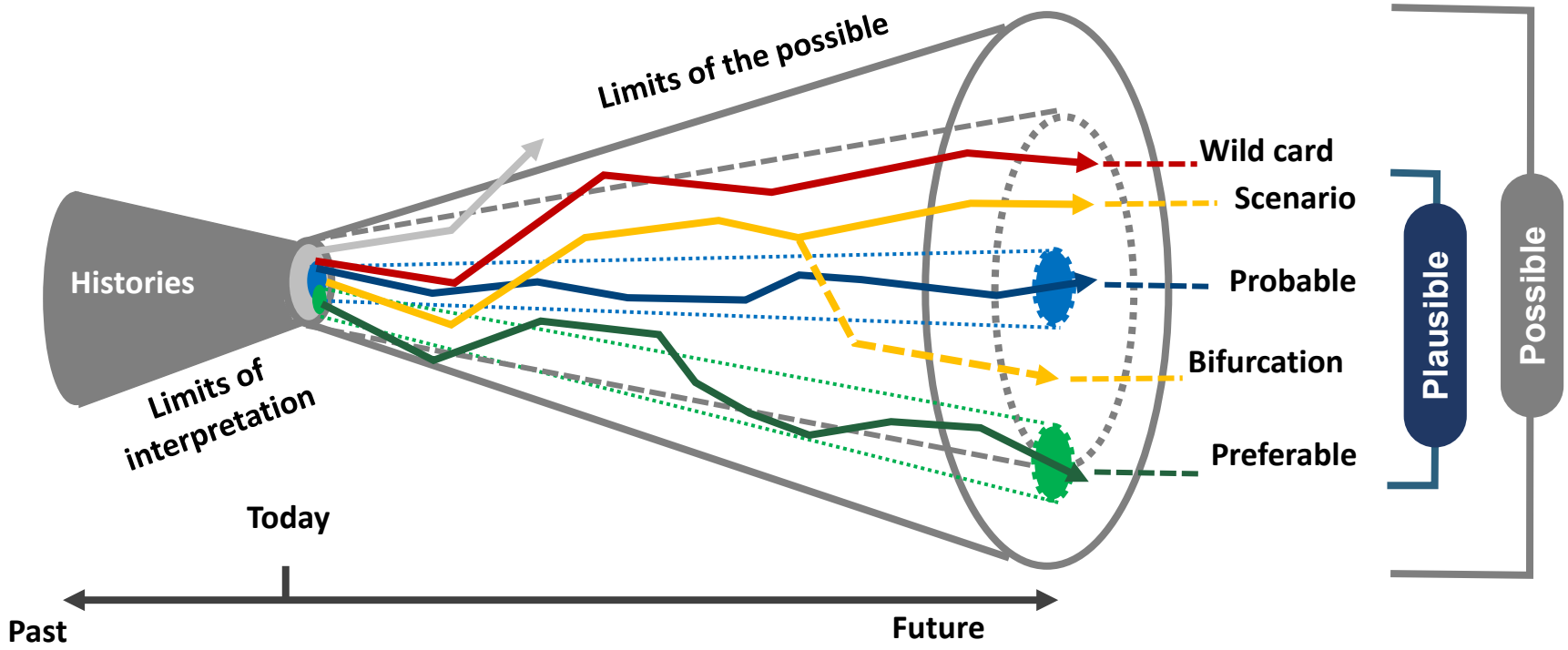
Modelling Logic & Input

- Data from WP1
- Background information from Futures of Seafood workshops
- Workshops to elicit scenarios
- Update existing models for projections
- Instructive hands-on system modelling
- Online library of results



Exploring Future Options – **Why Model** a Scenario?

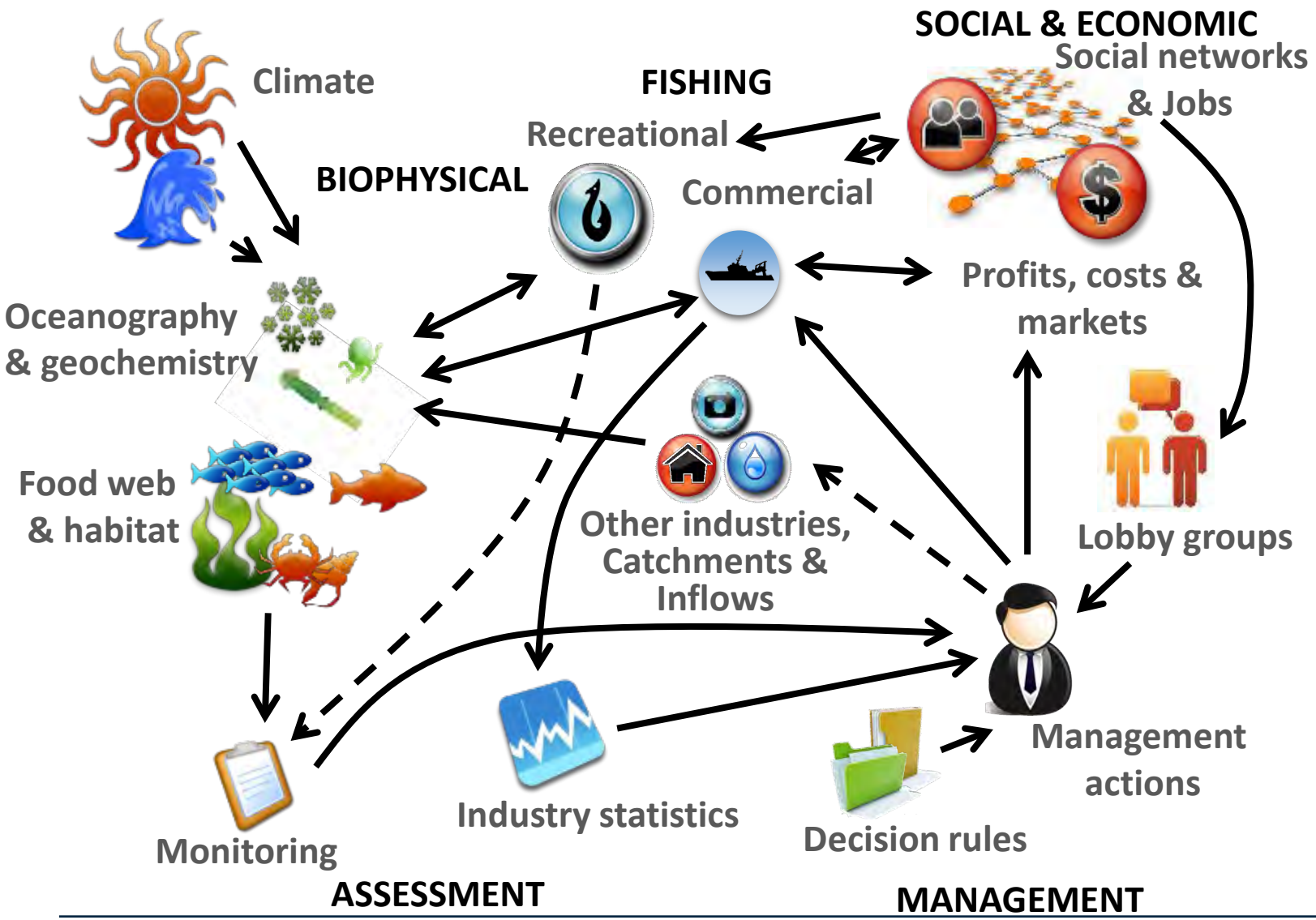
- Projection (done well) allows for flexibility & internal consistency
- What is feasible? Likely? Desired? Bifurcations?
- Indicators? Implications?



Model Mosaic - Multiple lines of Evidence

- Using mosaic of existing ecosystem models
- Forced with scenarios from workshops and steering committees
- Producing dynamic maps and time series of potential future production
- Southern model domain overlaps NESP project area (using variants of the same model types)

Content - **Fisheries**

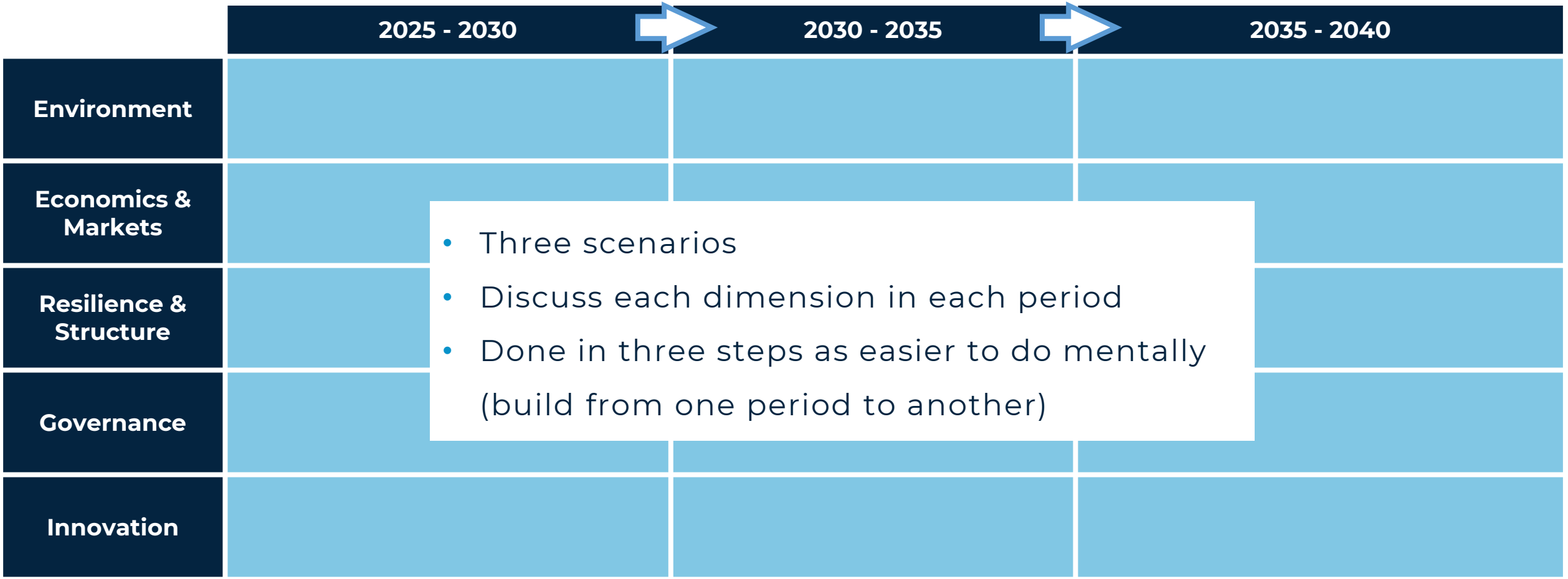


- **Also aquaculture:** projections accounting for potential demand, market, environment & production
- Similar concepts to modelling for NESP project but simpler representations for wind & shipping relevant components

Drivers Considered

- Defined via workshops

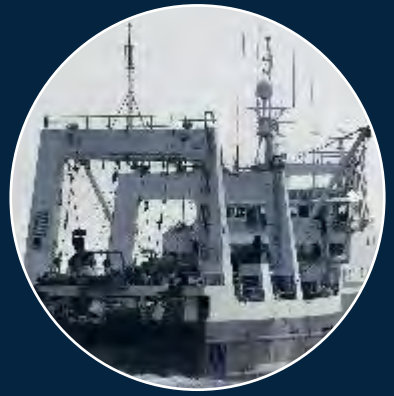
Scenarios: Defined in three steps



Three Future **Scenarios**: Overall concepts

Struggling

Severe climate change, constraints on productive capacity, lack of access & poor market/government support sees Seafood Industry decline. Governance burdensome & fragmented.



Surviving

Seafood production initially holds steady before growing (especially via aquaculture). Business differentiation strengthens. International ownership of fishing fleet. First Nation sovereignty recognized over the EEZ.

Thriving

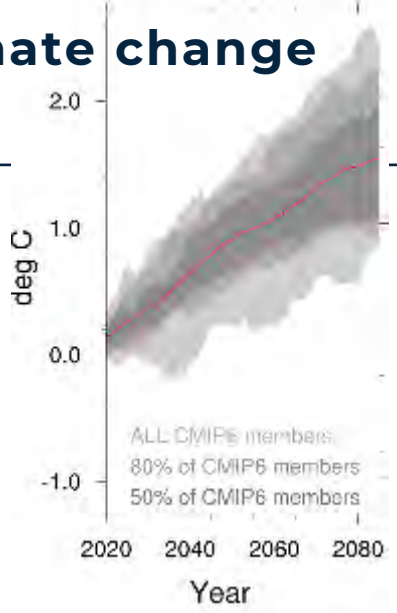
Seafood production grows. Industry flourishing sustainable, & regenerative. Planning & management of EEZ seen as inclusive, consultative, data driven & evidenced based. Partners with First Nations & Pacific, supports regional communities.

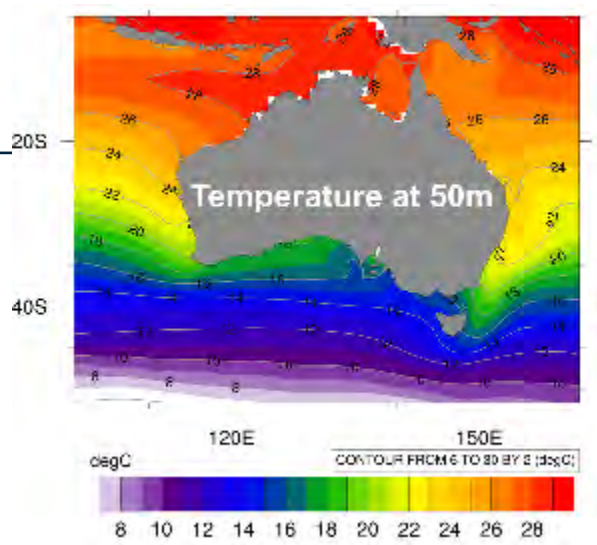
Model Forcing

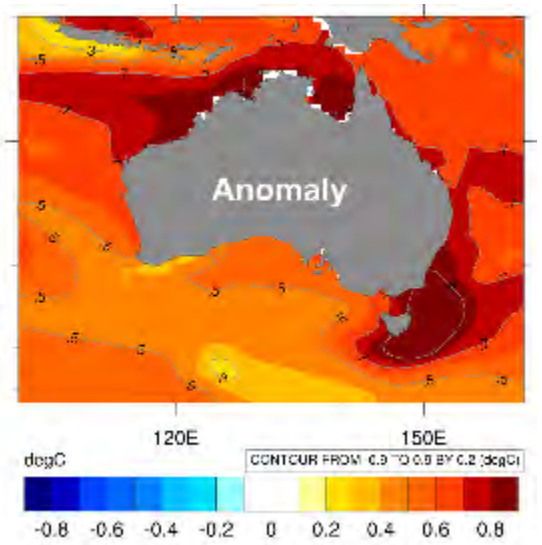
Including (for example)

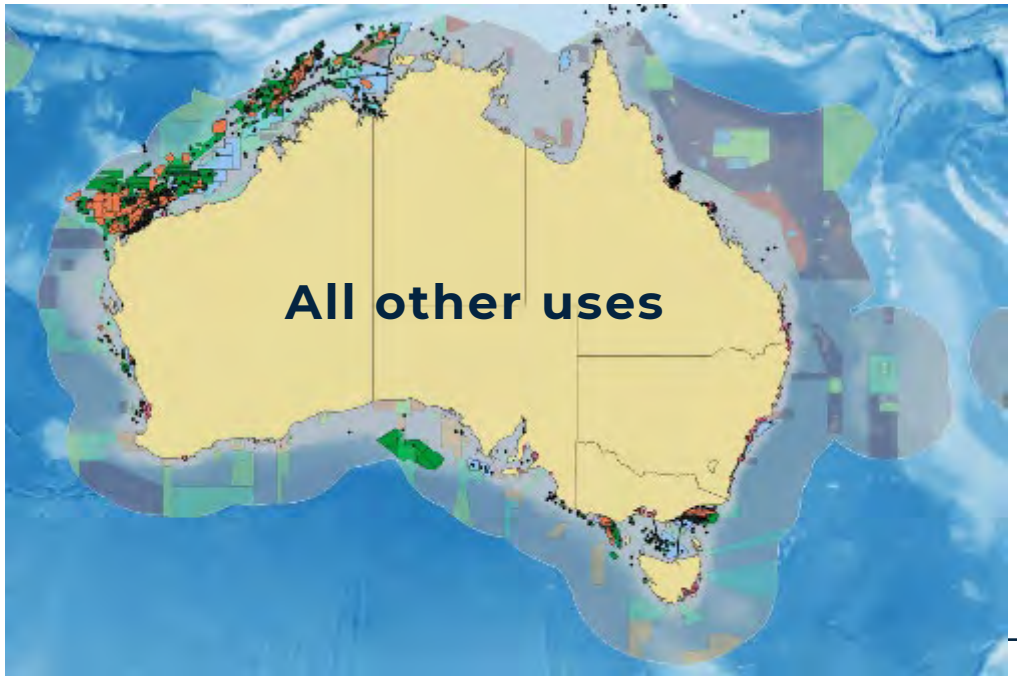
- Parks
- Renewable energy
- Restoration sites
- Native Title
- Tourism hotspots
- Petroleum leases, rigs, pipelines

Climate change



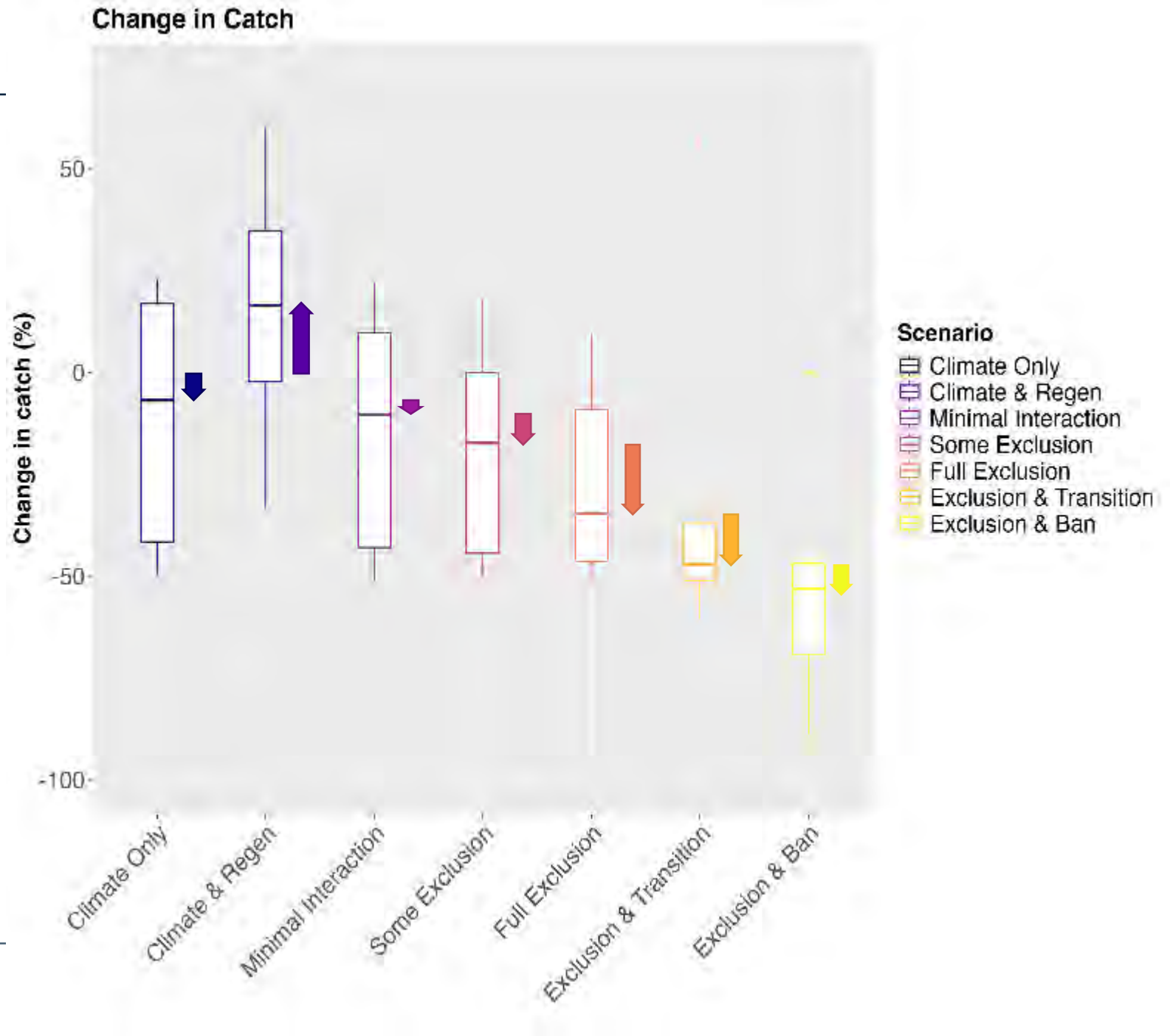






Results: Unpacking Cumulative Effects

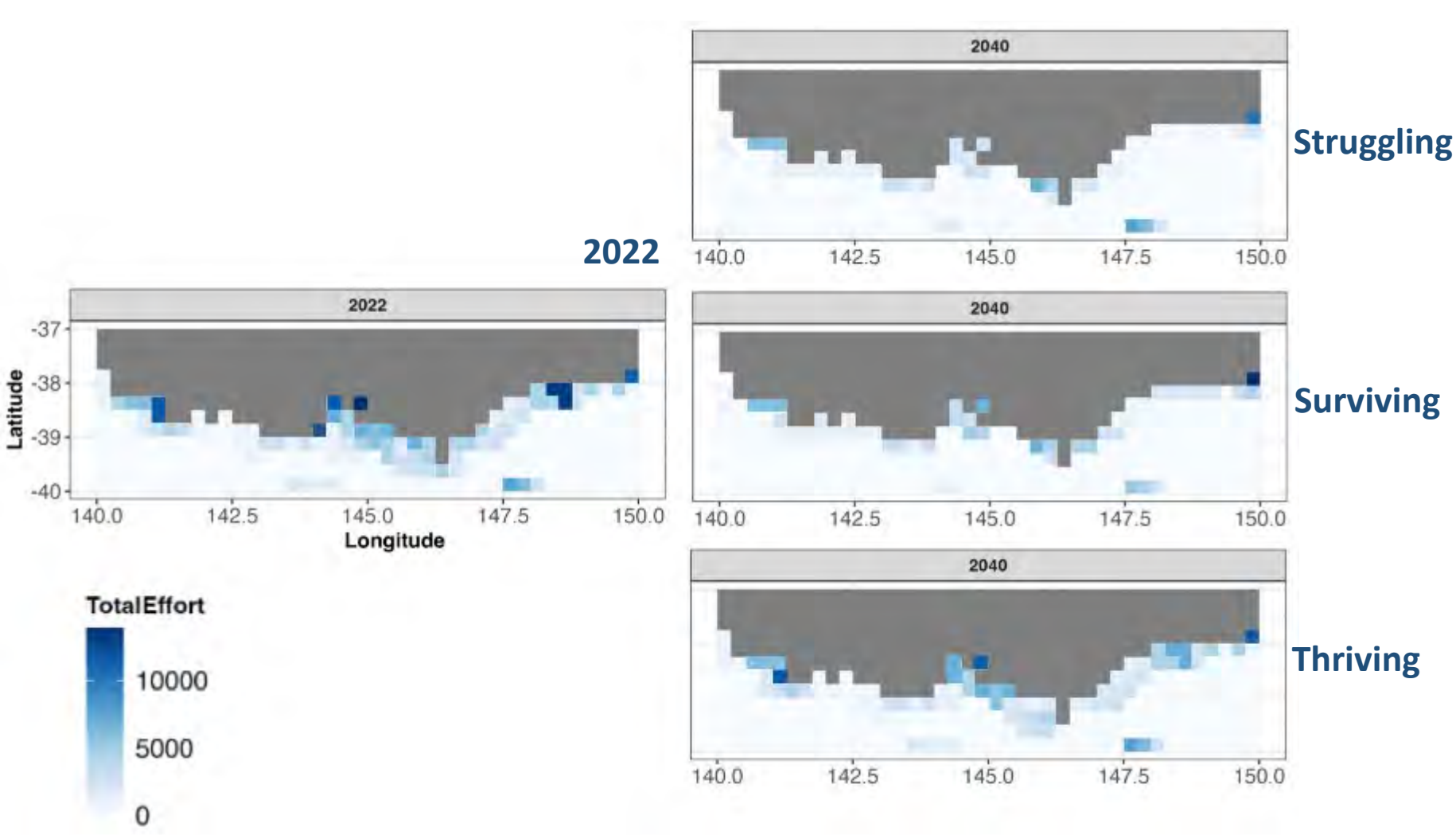
- Looking at change in
  - ecosystem components
  - catch
  - effort



Results: Effort

Change vs 2022

- Also presenting changes in spatial patterns given scenarios of marine spatial planning & exclusion



Next Steps

- Preliminary results being presented in a series of workshops April 2025
  - Fishing industry
  - All other interested groups
- Refine based on feedback
- Finalised by mid-2025 (to be public on the Futures of Seafood website alongside the Atlas)

Summary & Questions

- Futures of Seafood = seafood focused to see implications of expansion of other sectors + climate change
- Systems modelling of entire Australian marine estate
- Some overlap with NESP project
- Key differences:
  - simpler representation of energy & shipping components
  - slightly simpler ecosystem detail too (fewer detailed species of conservation concern)
- Questions?

FUTURES of SEAFOOD

CSIRO

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"Futures of Seafood. Wild. Aquaculture. Recreational. Aboriginal and Torres Strait Islanders" is supported by Seafood Industry Australia with funding from Fisheries Research and Development Corporation, Blue Economy CRC, the Department of Agriculture, Fisheries and Forestry, and the Department Climate Change, Energy, Environment and Water.

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NOPSEMA | Australia's offshore energy regulator

Bass Strait oil and gas futures

Regional context

nopsema.gov.au

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Acknowledgement of Country

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Outline

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- Oil and gas environmental legislation
- The role of NOPSEMA
- Gippsland offshore energy activities
- Future challenges (examples)
- NOPSEMA/OIR research strategy

Legislation administered by NOPSEMA

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- ***Offshore Petroleum and Greenhouse Gas Storage Act 2006***
  - NOPSEMA established as independent statutory authority under the *OPGGS Act* 1 Jan 2012
  - The associated regulations are the *Offshore Petroleum Greenhouse Gas Storage (Environment) Regulations 2023* (the Environment Regulations)
- ***Offshore Electricity Infrastructure Act 2021 (OEI Act)***
  - NOPSEMA was established as the offshore infrastructure regulator (OIR) under the *OEI Act* on 2 June 2022.
  - OIR provides regulatory oversight of work health and safety, structural integrity and environmental management of OEI activities.

Streamlined regulation of environmental management for offshore oil and gas activities

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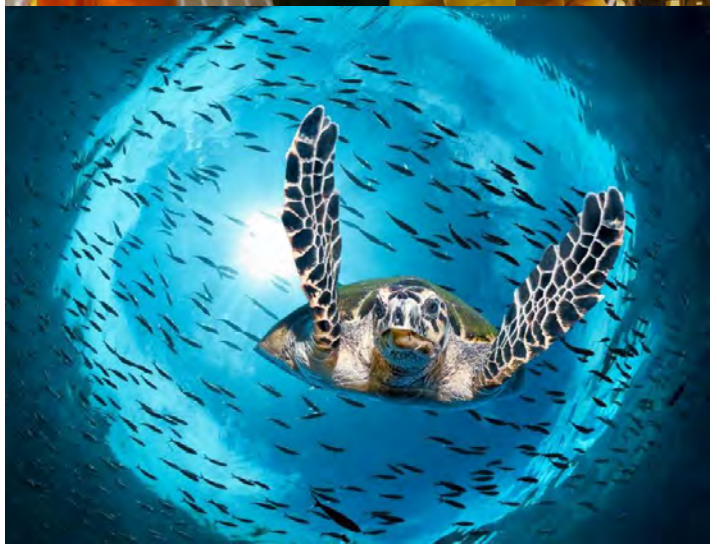
- On 28 February 2014, the process for streamlined environmental approvals for offshore oil and gas and greenhouse gas storage activities in Commonwealth waters came into effect – NOPSEMA EPBC Act Program
- Oil and Gas projects and activities assessed and approved by NOPSEMA require no separate referral, assessment and approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).



Legal requirements

- Section 572 of the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* requires titleholders to:
  - Maintain all structures, equipment and property in a title area for proper removal
  - Full Removal of all structures when neither used nor to be used
  - Alternative end states
- Section 270 of the Act requires NOPSEMA to be satisfied that titleholders have removed all property brought into the surrender area prior to surrender of a title, including:
  - Plugging and abandoning wells
  - providing for the conservation and protection of natural resources
  - Making good on any damage to the seabed or subsoil to NOPSEMA's satisfaction

Regulatory activities

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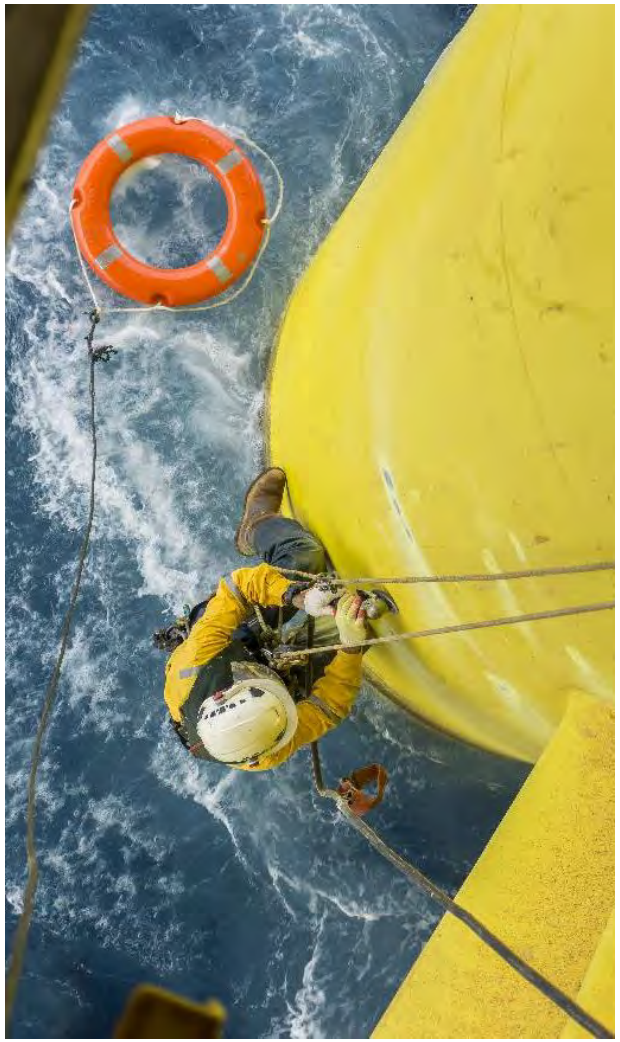
- Regulate health and safety, well integrity, and environmental management in Commonwealth waters.
- Permissioning documents (Environment Plans, Well Operations Management Plans, Safety Cases)
- Administer an objective-based regulatory regime.
- This approach sets high level requirements to be achieved but does not prescribe how the requirements must be met.
- Activities comprise:
    - Assessment
    - Inspection
    - Investigation
    - Enforcement
    - Promotion
    - Advisory.



Gippsland offshore energy production

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A brief history and current status

- Australia's first offshore well drilled in Bass Strait in 1965 (Barracouta gas field)
- Australia's first offshore and largest oil field discovered (Kingfish)
- Currently up to 13 platforms, 4 subsea facilities, 26 pipelines and approx. half of wells no longer producing
- Current overlap with OEI activities undertaken under feasibility licences:
    - 5 management plans submitted (all in Gippsland)
    - All activities are limited in scope to:
        - Geotechnical studies (coring, CPT, grab samples)
        - Metocean studies (LiDAR/wave rider buoys)
    - The OEI framework does not apply to geophysical surveys or biological/ecological surveying.
- Four OEI feasibility licence areas overlap existing/historic oil and gas infrastructure

Gippsland offshore energy production

Horizon scan

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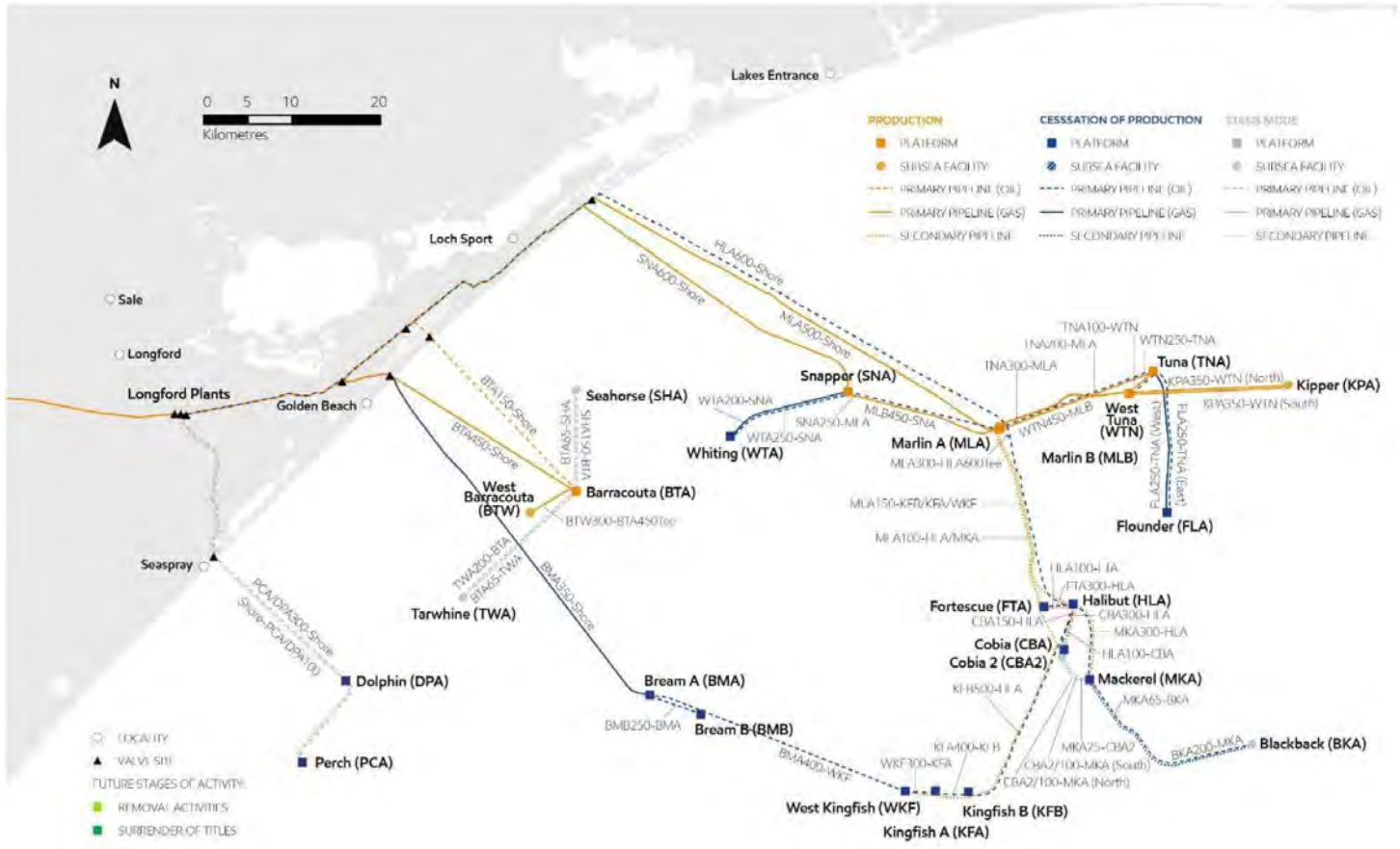
- Future oil and gas activities:
  - Ongoing production (10-15 years)
  - Oil and gas activities expected to continue - Government policy (gas strategy) supports extending this timeframe
  - No alternative end states accepted in Gippsland to date
  - Decommissioning activities (up to 15+ years).

Decommissioning journey

Current situation



Gippsland

- 18 fixed facilities (inc. 2 concrete gravity structures)
- 790 km pipelines (+ 50 km in State waters)
- 107 km flexible risers and umbilicals
- 6 subsea facilities
- 417 wells

*Status of facilities and pipelines, December 2024 (Source: https://corporate.exxonmobil.com/-/media/global/files/locations/australia/2024-annual-decommissioning-report-final.pdf)

Offshore energy activities in Gippsland

Oil and gas titles, wells and pipelines

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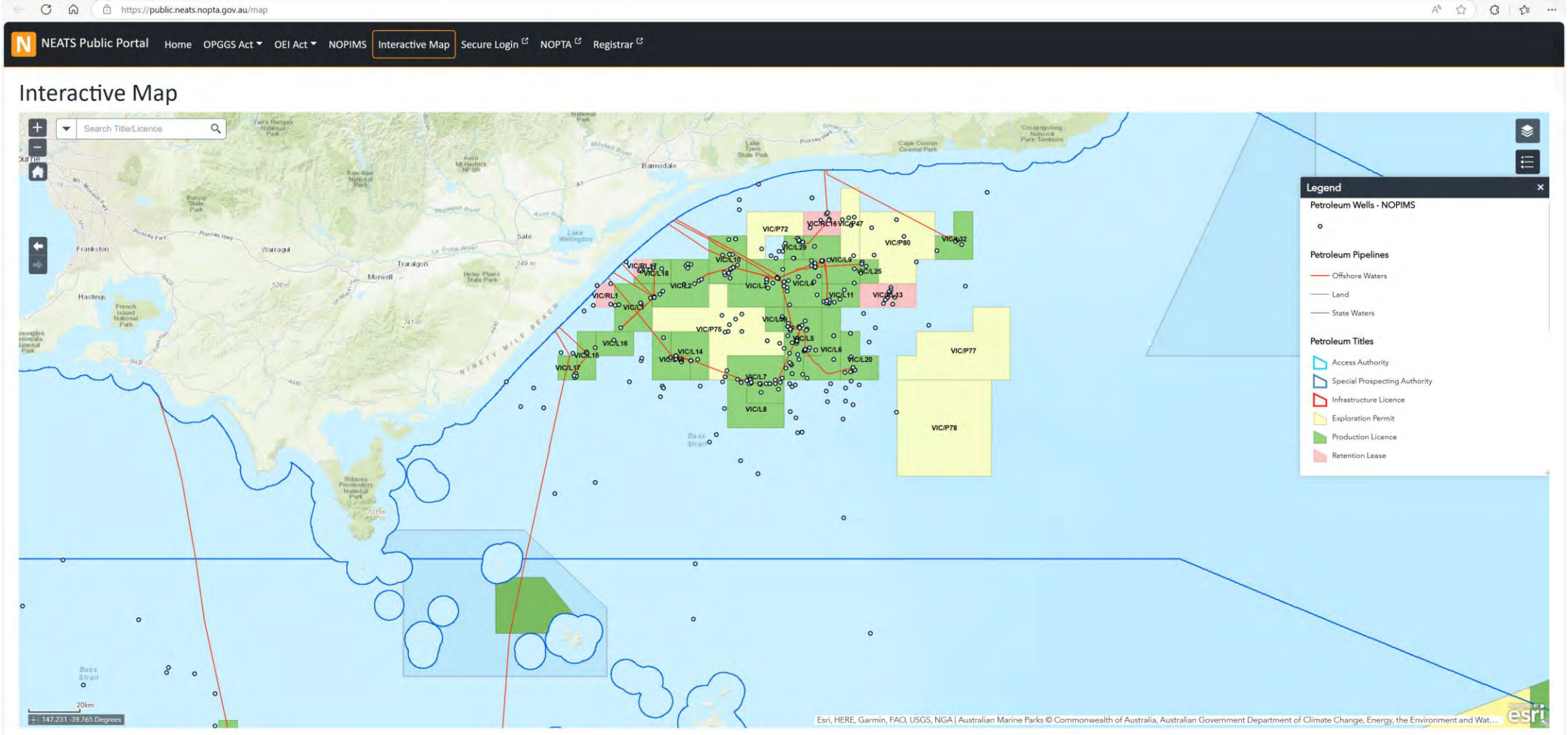

NEATS = National Electronic Approvals Tracking System

Offshore energy activities in Gippsland

Greenhouse gas titles over oil and gas wells, pipelines

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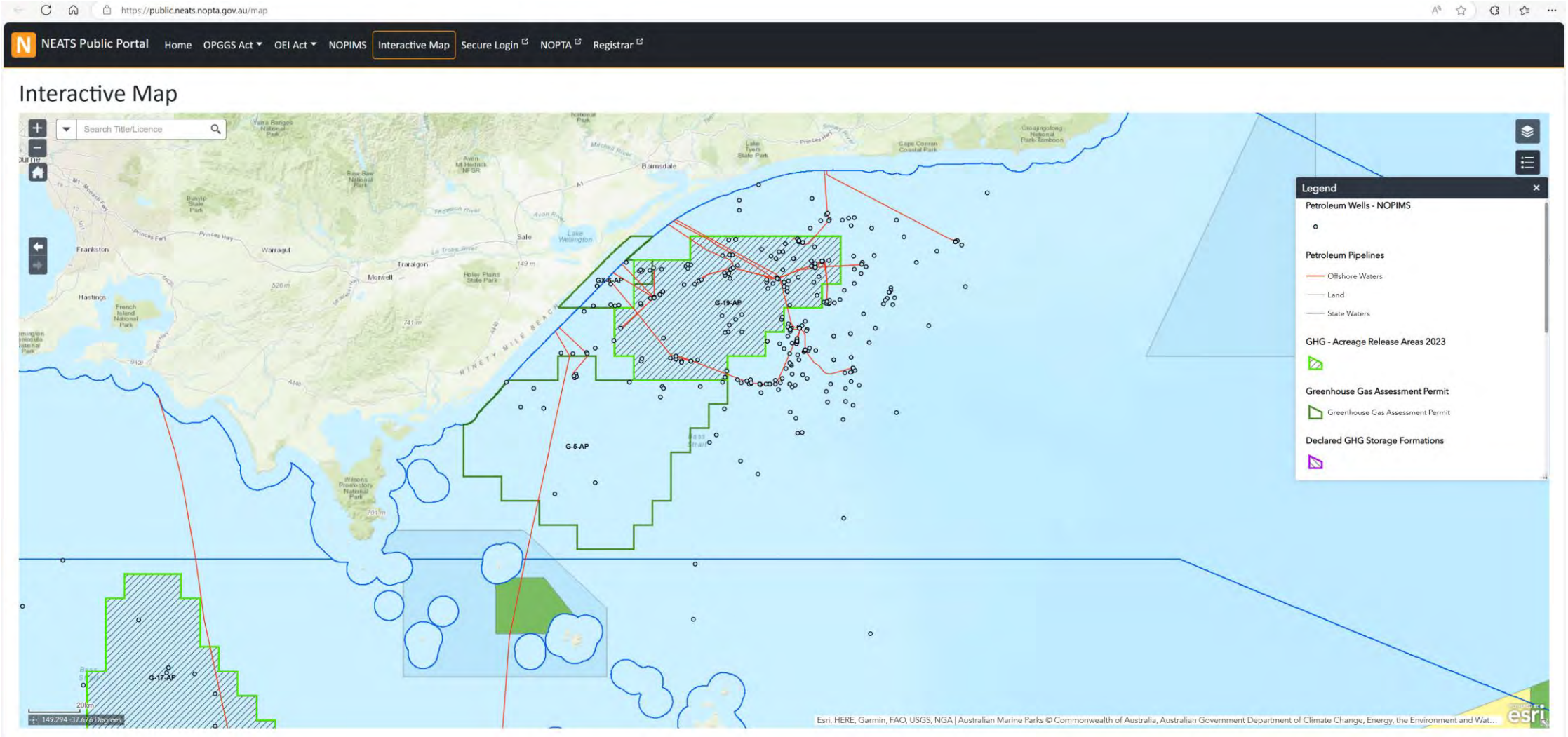

Offshore energy activities in Gippsland

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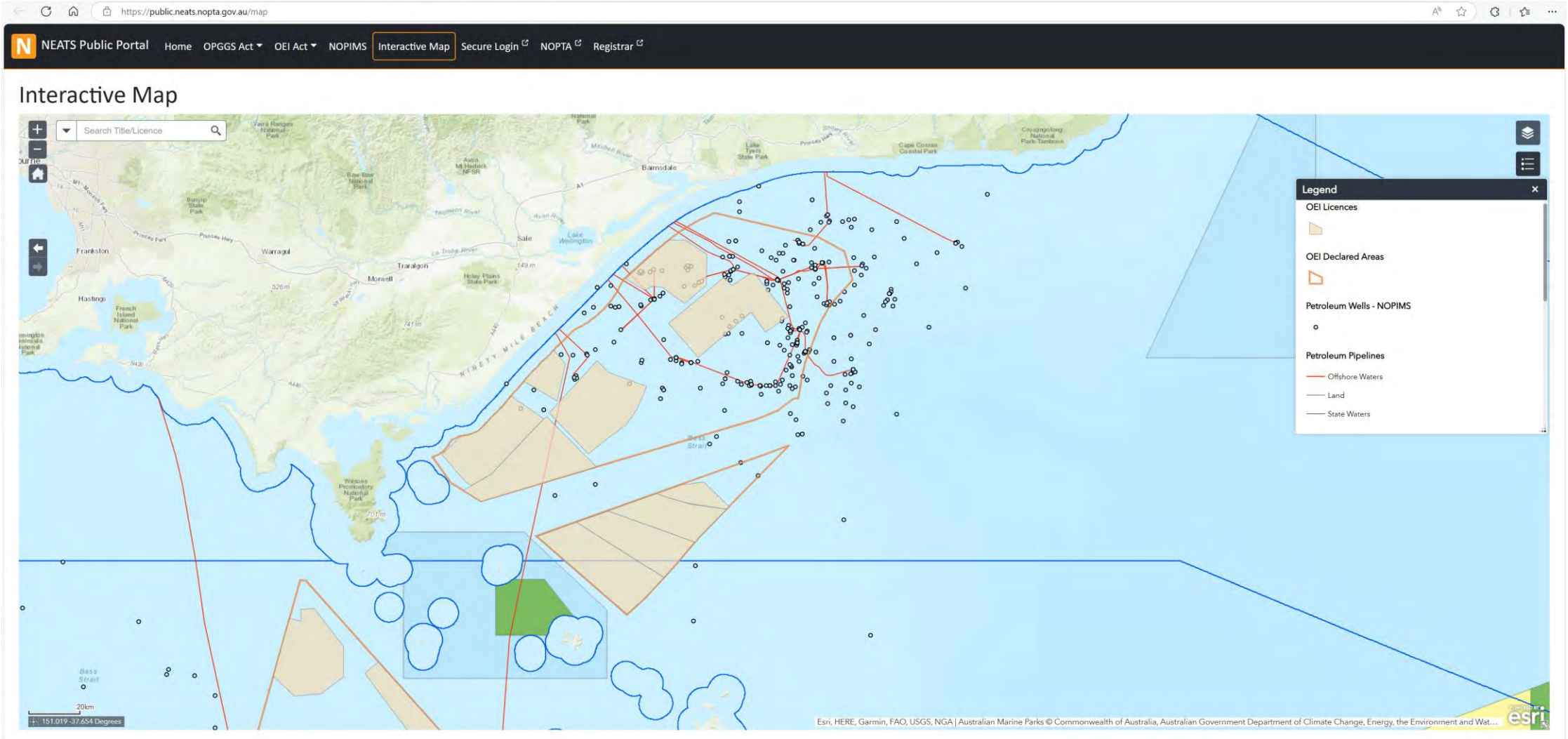
Offshore Energy Infrastructure declared areas and licenses over O&G wells, pipelines



Gippsland offshore energy production

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Engaging with Industry and Research organisations to consider future challenges, such as:

- Competition for resources
  - Concurrent decommissioning and construction activities
  - Vessels, ports, personnel etc.
- Potential for cumulative impacts, such as
  - Construction activities (multiple sites); construction and decommissioning activities
  - New infrastructure and any historic infrastructure left in situ
- Potentially over a prolonged period (particularly if schedules are impacted)
- Environmental management and regulation across multiple jurisdictions and legislation

Addressing uncertainty

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Three key solutions to address the challenge

- ➔ Conservative decision making - precautionary management measures
- ➔ Monitoring and adaptive management
- ➔ Reducing uncertainty – collaborative, co-designed approaches to scientific research designed to enhance confidence in environmental assessments and management

National Offshore Petroleum Safety and Environmental Management Authority

Level 8 Alluvion, 58 Mounts Bay Rd, Perth WA 6000
GPO Box 2568, Perth WA 6001 Australia

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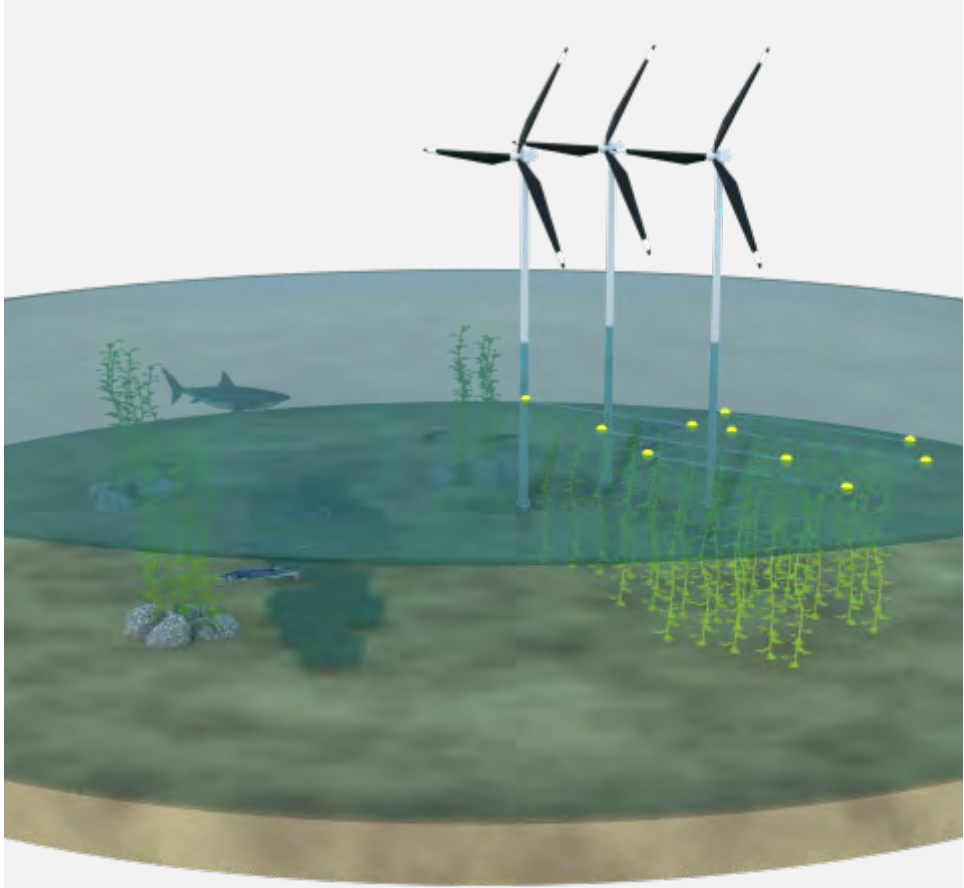
Modelling cumulative effects

Beth Fulton | 2025



Ecosystem Modelling - Roadmap

- What are ecosystem models
- Model map
- Model ecology
- Human components

- **Text like this indicates points where input from you would be VERY helpful**

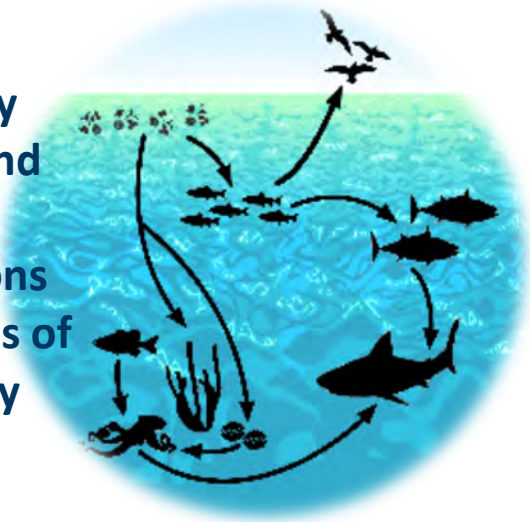
Marine Model Roadmap

Ecosystem Modelling - Ensemble

- Ensemble approach
  - 2 different model types (so we can cover structural uncertainty)
  - Do they come to same answers? If yes more confident

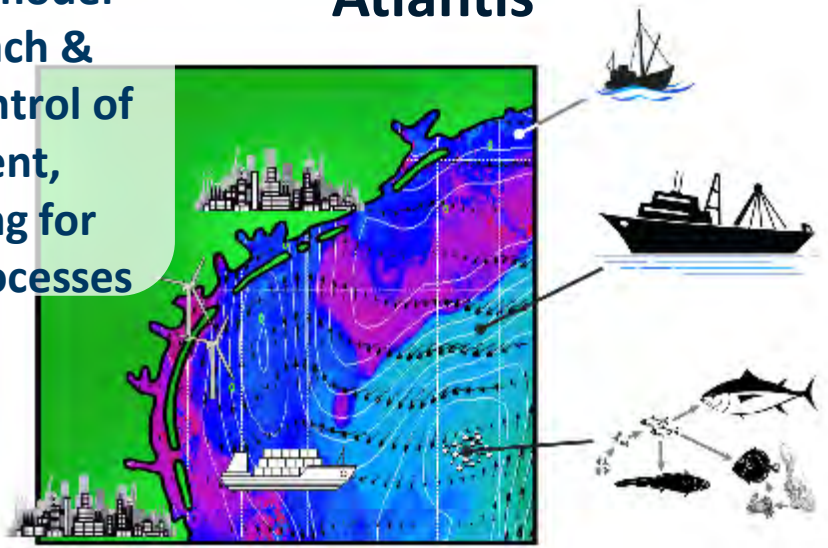
Ecopath with Ecosim

Primarily trophic and habitat connections and sources of mortality



Hybrid model approach & more control of content, allowing for more processes

Atlantis



Use of Models

Our use

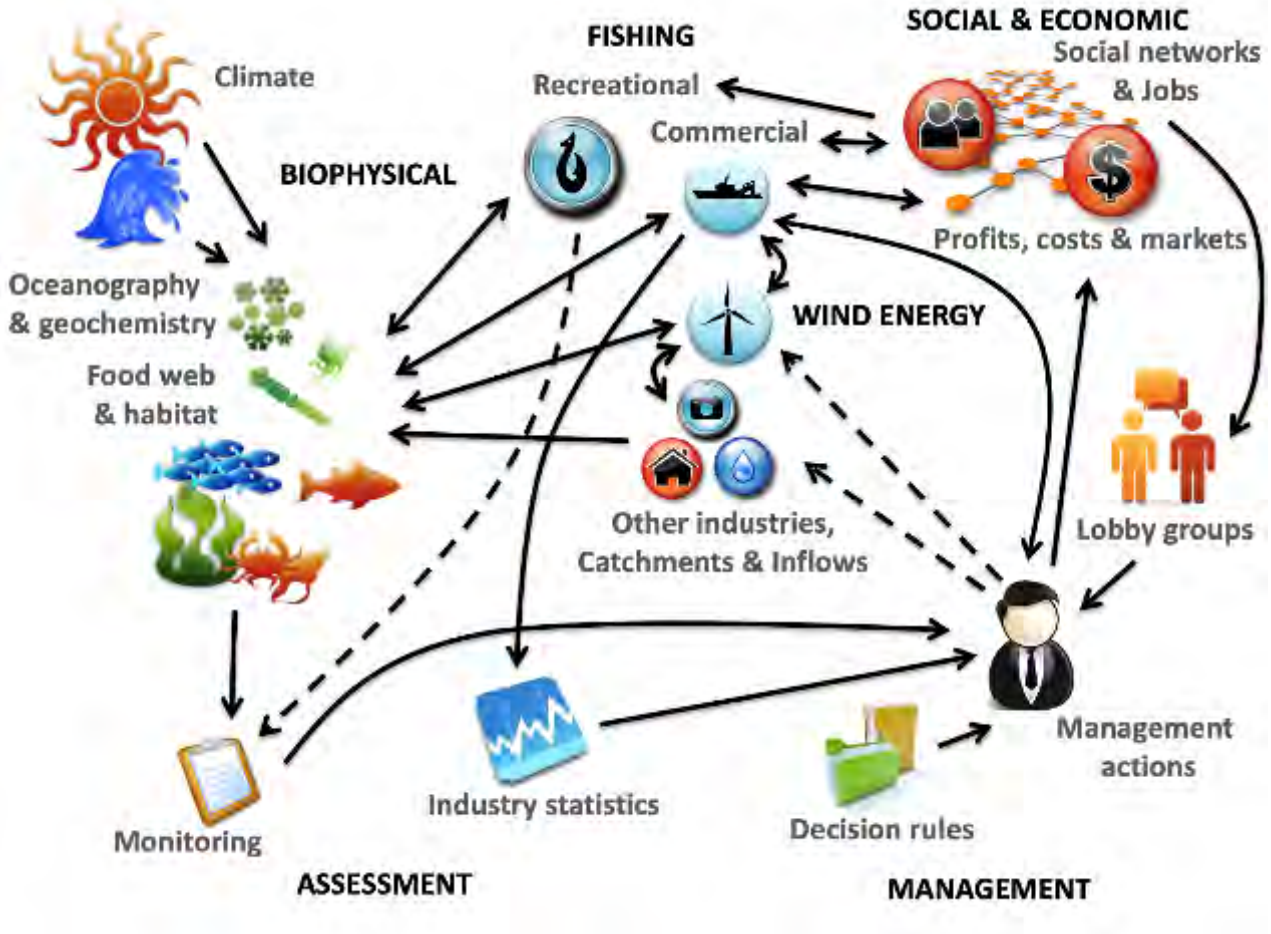
Conceptual (understanding)

Tactical (year-to-year)

Strategic (planning)

- Staged deployment (& interoperable)
- For: understanding, forecast/hindcast, management insights (testbed for options)

Model Content Concept (Simplistically)



- System perspective
- Fishery detail (dialled back a little in this model)
- Add/expanded wind energy. (non-fishery) relevant detail
- EwE = different way to look at same things

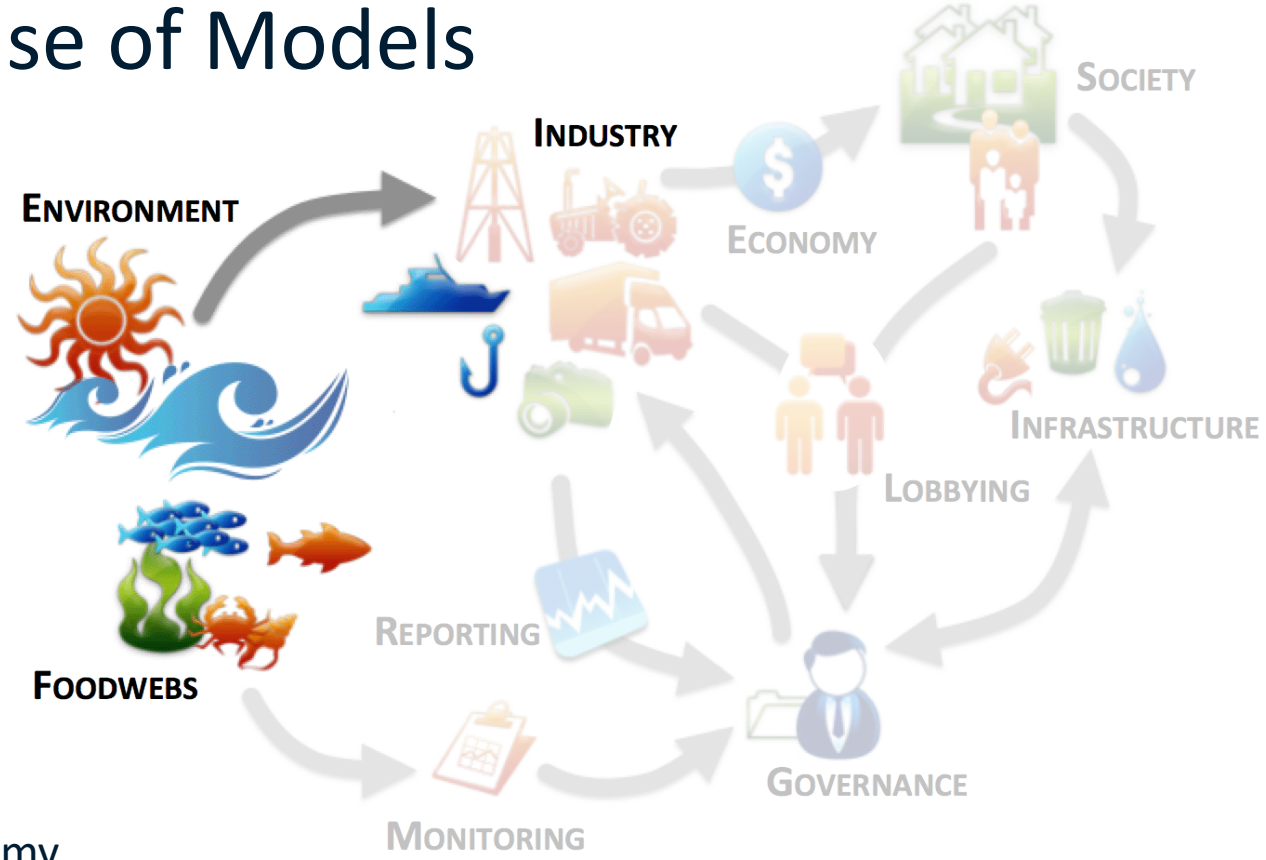
Expanding Use of Models

Focus through time

- Food web
- Simple fisheries

- Management loop
- Sustainable fisheries

- Climate impacts
- Socioecology
- More industries
- Ecotoxicology
- Multiple use EBM
- Sustainable Blue Economy



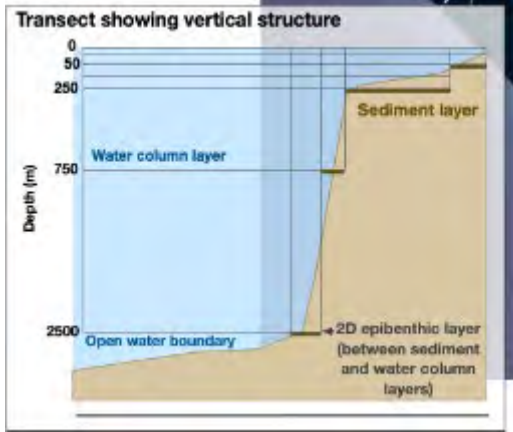
- Improved skill assessments & links to new empirical datasets

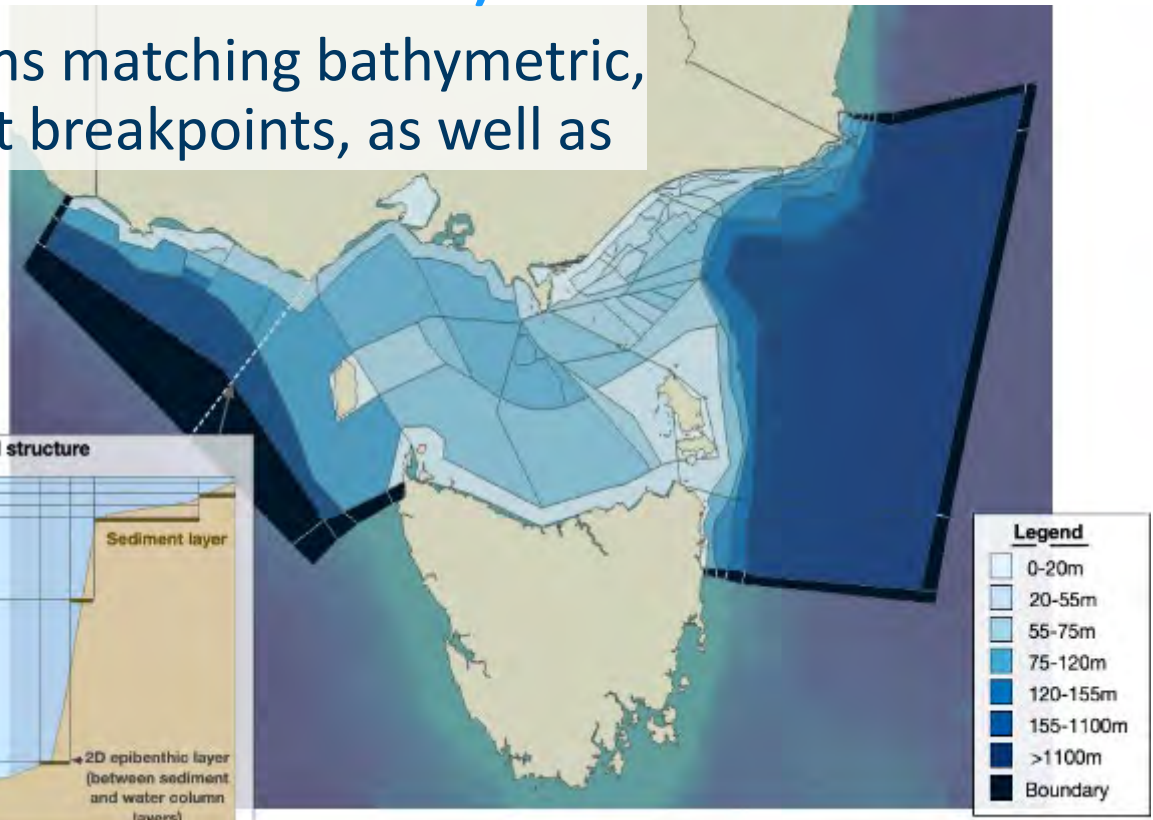
Ecosystem Modelling – Previous Use

- Atlantis
  - 25+ years
  - 45+ systems
  - Marine and large lake applications
- EwE = 7000+ applications globally
- Fisheries dominant more & more cumulative effects

Model Content – Map(s)

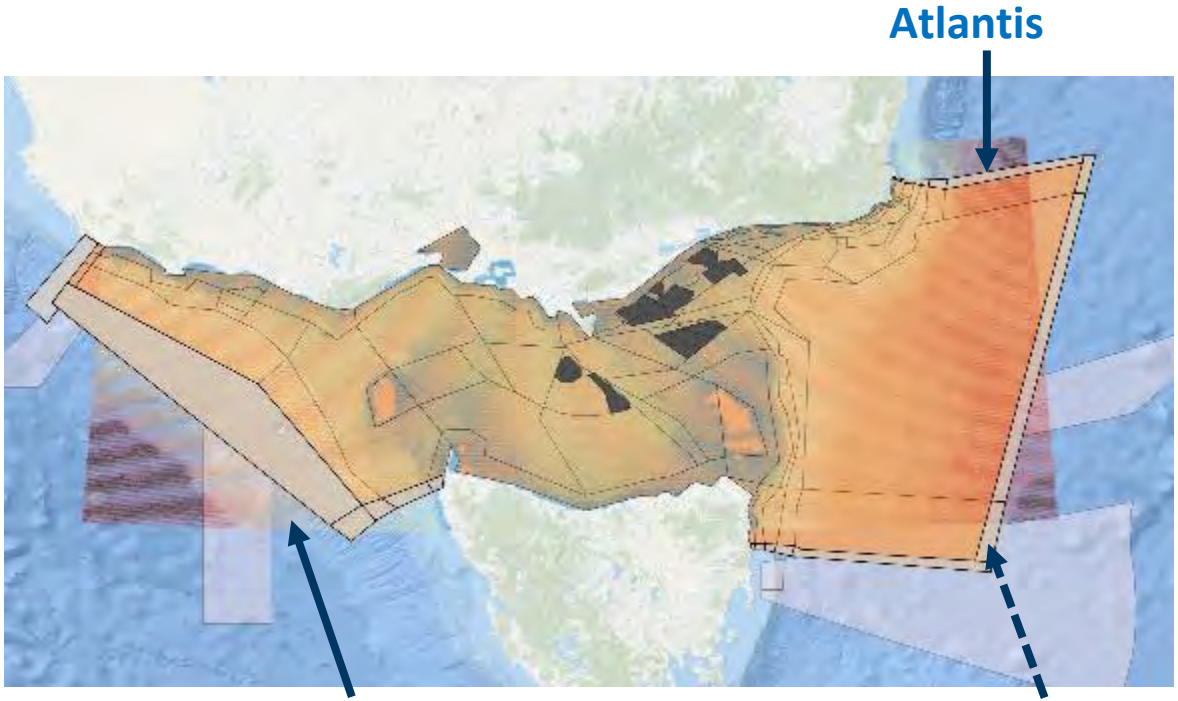
- EwE = regular grid **(how fine should this be?)**
- Atlantis = irregular polygons matching bathymetric, oceanographic and habitat breakpoints, as well as lease (and other zoning) boundaries





Model Content – Physics

- Physical environment
  - temperature
  - salinity
  - pH
  - current flow
  - suspended sediment
  - drawn from specialist hydrodynamic & climate models



Light grey = Atlantis bounding box (for model accounting purposes so doesn't matter if outside the oceanographic grid)

Model Content

Pelagic invertebrates & flora
- Large phytoplankton (diatoms)
- Small phytoplankton
- Microzooplankton
- Mesozooplankton
- Large zooplankton
- Gelatinous zooplankton
- Squid (inshore and deeper)

Benthic invertebrates & flora
- *Kelp*
- *Seagrass*
- Urchins
- Abalone
- Octopus
- Lobster
- Scallop
- *Other bivalves*
- *Sponges, corals (small & large)*
- *Other shallow filter feeders*
- Benthic deposit feeders
- Benthic carnivores (polychaetes)
- Crabs
- Prawns
- Other macrozoobenthos
- Other megabenthos

Sharks
- Demersal sharks
- Pelagic sharks
- Green eye dogfish
- Spikey dogshark
- Gulper sharks
- Gummy shark
- School shark
- Great white
- Grey Nurse
- Skates and rays

Iconic & Apex predators
- Gulls
- Shearwaters
- Australian Gannet
- Albatross & Petrels
- Little Penguin
- Fur seals (Longnose & Australian)
- Sea lions
- Baleen whales (Humpback, Right, Blue)
- Orcas
- Dolphins

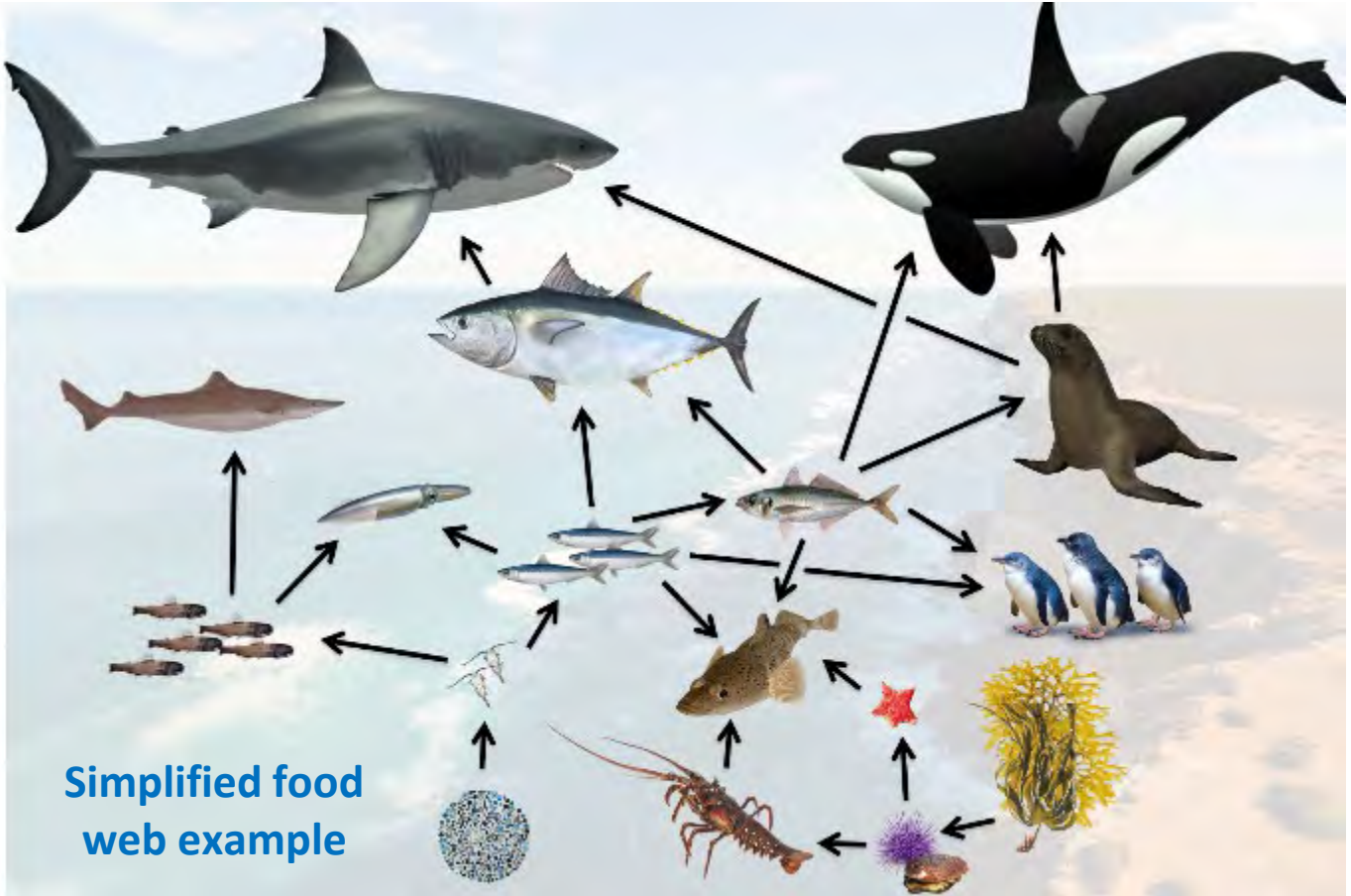
Fin-fish
- Small pelagics
- Mackerel
- Red bait
- Shallow piscivores
- Tuna and billfish (tropical; SBT)
- Myctophids
- Non-migratory mesopelagics
- Banded morwong
- Purple wrasse
- Shallow demersal reef fish
- Large piscivores
- School whiting
- Flatheads
- Shallow demersal fish
- Redfish
- Cardinalfish
- Gemfish
- Spotted Warehou
- Blue Warehou
- Redfish
- Other shallow demersal fish
- Shallow piscivores
- Blue-eye trevalla
- Blue grenadier
- Ribaldo
- Pink Ling
- Orange Roughy
- Dories and Oreos
- Deep demersal fish
- Magpie perch
- Territorial fish
- Herring cale
- Blue throat wrasse

Detritus
- Discards
- Labile (fast turnover)
- Refractory (slow turnover)

Microfauna
- Pelagic bacteria
- Benthic bacteria
- Meiobenthos

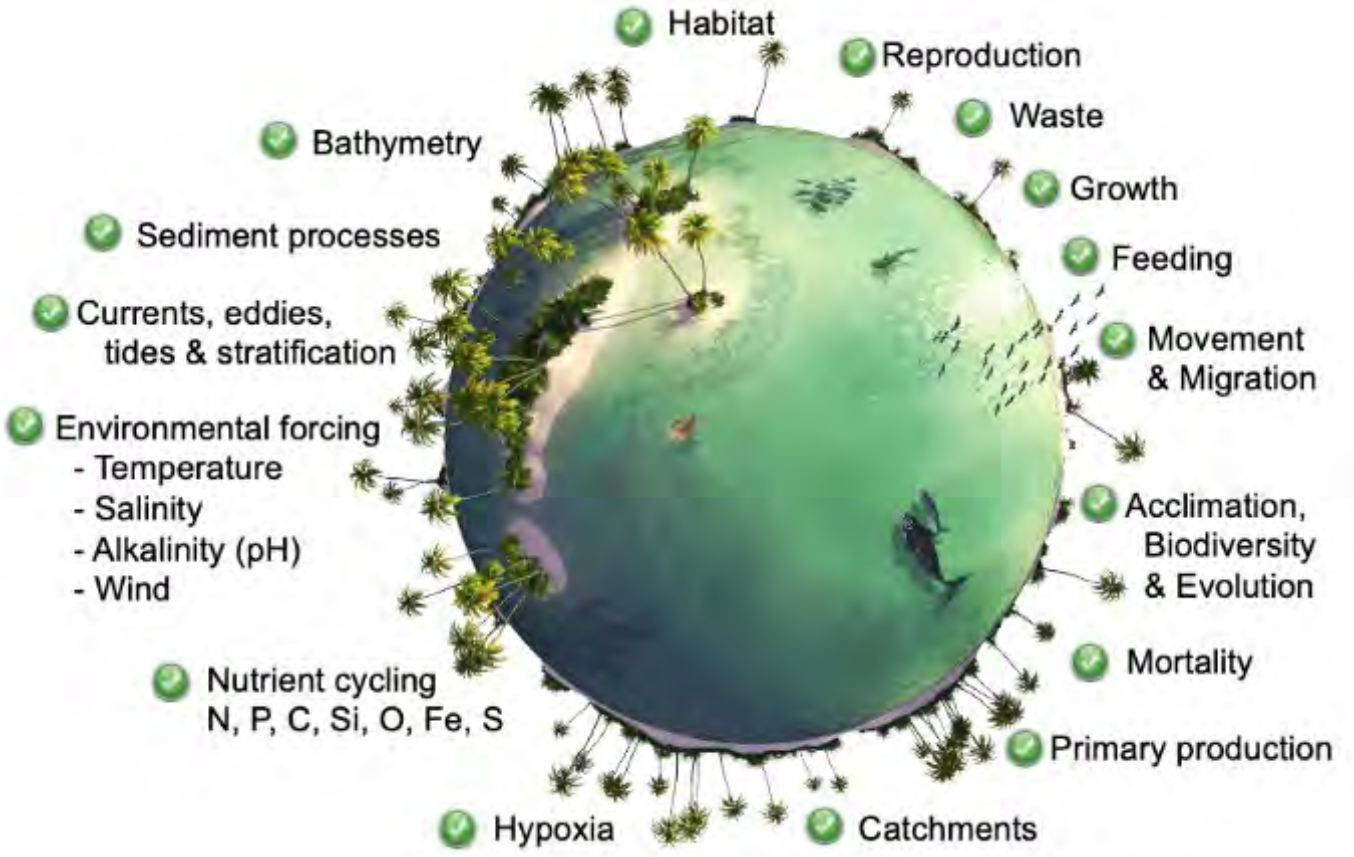
Range Extending Species
- Pink snapper
- Octopus
- Urchins
- Yellowtail Kingfish
- **Others?**

Model Content – Ecology (Example)



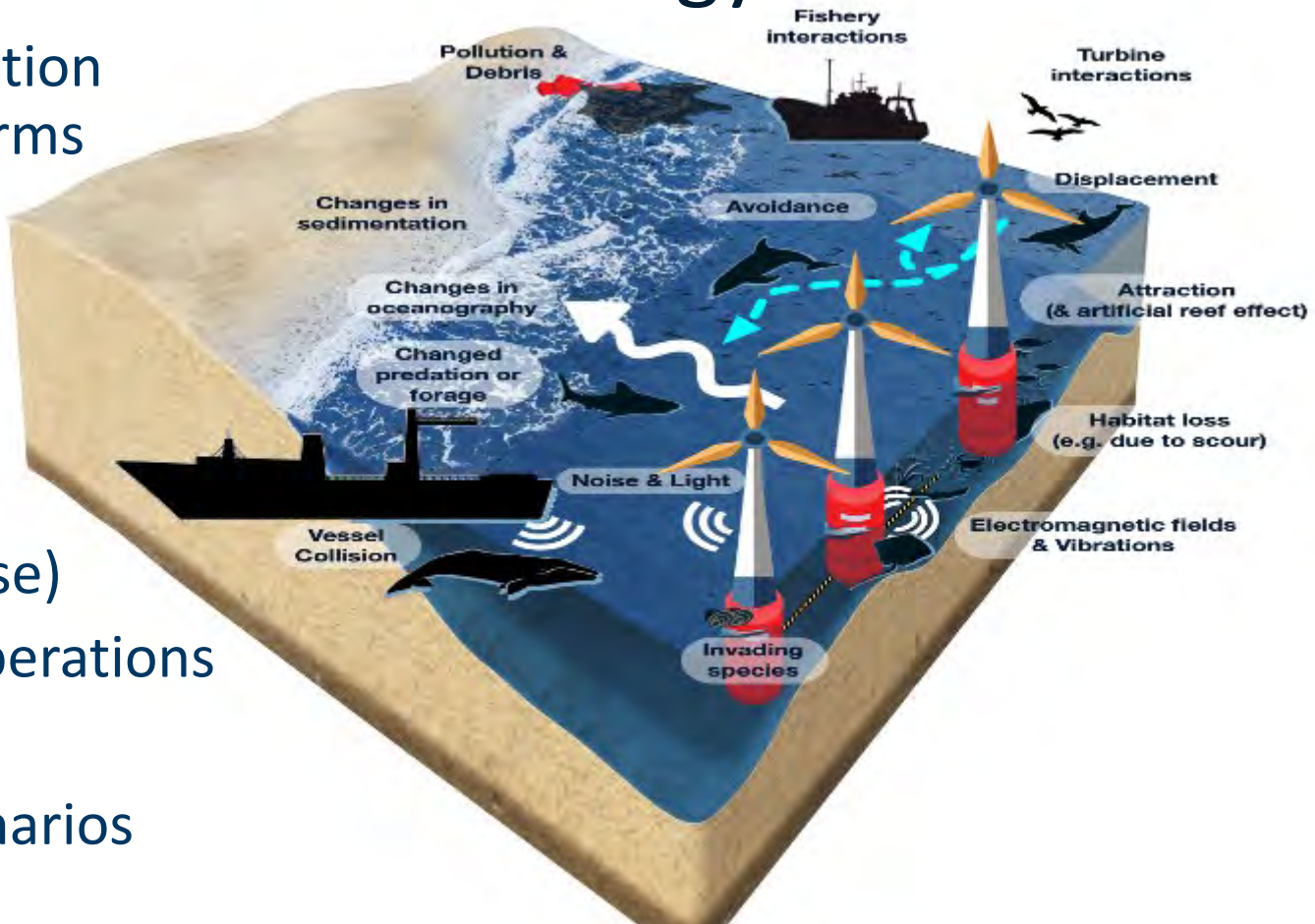
- Some at species level
- Some as functional groups
- Vertebrates & key invertebrates = size and age structured
- Others as biomass pools

Model Content – Ecological Processes



Model Content – Wind Energy

- Dynamic representation of all of the main forms of interaction
- Parameterised based on literature
- Using output form other models (e.g. hydrodynamics, noise)
- Construction and operations
- **Need help:**
  - development scenarios (timelines)



Model Content – Fisheries

- Fisheries in all the same detail as used for AFMA
  - metiers (different gears and what they target)
  - AFMA and State fleets
  - fleet dynamics (vessel sizes, targeting, spatial movement, home ports, economic drivers etc)
  - management rules
- **Zoning scenarios - begin defined** but as example:
  - exclusion from entire lease
  - exclusion from operational area
  - cables tracks (for some gears)

Model Content – Other Industries

- Shipping traffic (growth through time)
- Aquaculture leases
- **Other industries to consider?**

Status & Next Steps

- Now
  - Refining content based on feedback to date (if we are missing anything critical let us know now!)
  - Processing other model output as Atlantis input
- Coming (near future)
  - Validating model against latest available data
  - Simulations

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Australia's National Science Agency

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gov.au

Renewables Environmental Research Initiative (RERI)

Renewables Regulatory Practice Section
Nature Positive Regulation Division

Recent Australian Government support

The Government invested $22.7 billion over the next decade in the 2024-25 Budget for a Future Made in Australia (FMIA).

FMIA included $134.2 million to strengthen and streamline environment and heritage approvals, comprising:

- **improve understanding of the impacts of renewable energy projects on MNES and improve the management of these impacts.**
- develop, agree and maintain a national priority list of renewable energy and related projects; and increase regulatory capacity to support accelerated Commonwealth environment assessments for some projects on the list.
- increased regulatory capacity.
- more regional plans.
- Aboriginal and Torres Strait Islander Heritage Protection Act and cultural heritage reforms.

Renewables Environmental Research Initiative (RERI)

VISION: Enhance understanding of the impacts of renewable energy developments on MNES, and how best to manage these impacts to support faster, better decisions under the EPBC Act.

- Projects will **accelerate approval timeframes** by addressing critical scientific knowledge gaps.
- Projects will **reduce complexity**, **reduce uncertainty** and **reduce conflict** through clearer guidance.
- Note: RERI projects won't replace the need for proponents to collect their own targeted ecological information at a finer scale to support an environmental assessment.

1. Research

- Address scientific knowledge gaps about key species and determine best practice management of impacts.
- E.g., species' distribution, behaviour, flight height, flight speed, migration routes and timing etc.

2. Regulatory tools, templates & guidance

- Supplement existing guidance and develop new guidance.
- E.g., management plan templates, collision risk assessment framework, survey methodologies.

3. Data (EIA)

- Enable public access to contemporary and robust environmental data through the BDR.
- Develop new data standards to facilitate consistency.

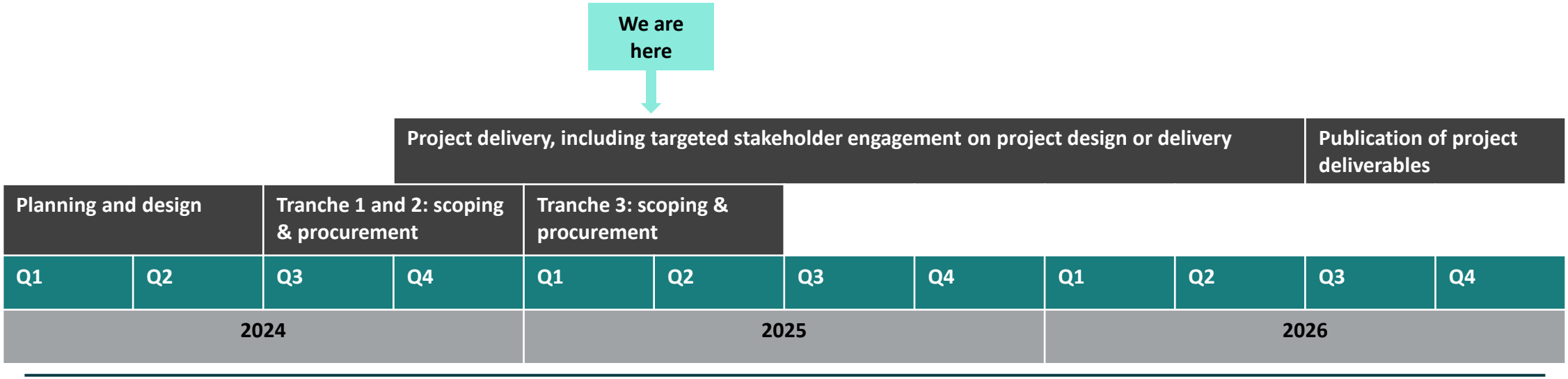
Collaborative design

How did we identify RERI projects?

- Discussions with state and territory environmental regulators.
- Feedback from proponents, environmental consultants and experts.
- 60+ members of DCCEEW Research Advisory Group, across 11 divisions.
  - 3x internal workshops with 100s of participants.
  - 450+ comments received on which projects to prioritise.

Delivery and engagement

- Procurement of projects has commenced and more will be rolled out over the coming months.
- Wherever possible, project deliverables will be available on the department's website.
- Each RERI project will undertake engagement activities to ensure both the quality and uptake of research outputs
- Delivery partners (external suppliers) will be responsible for identifying relevant stakeholders and designing and delivering appropriate engagement activities

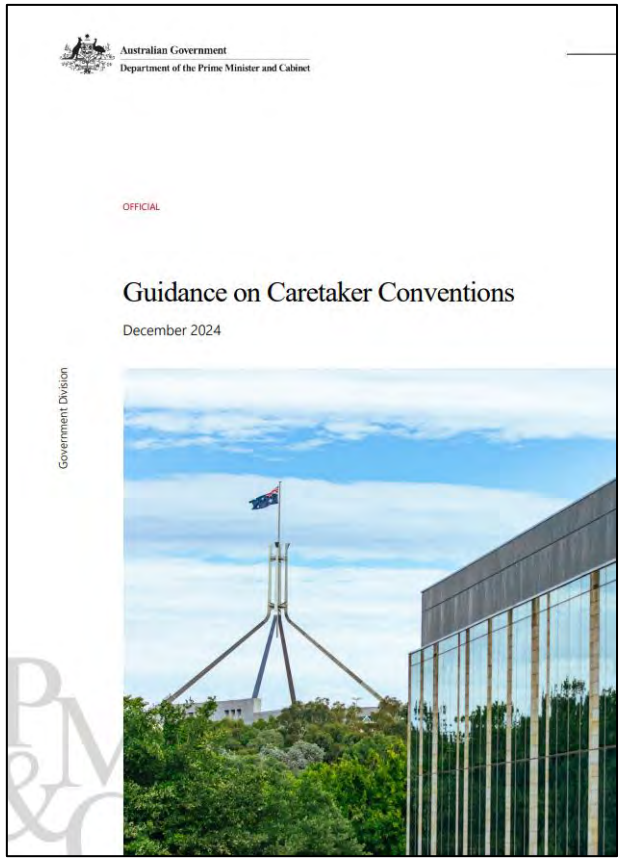


Recent progress to deliver the RERI

- 17 projects contracted to date, comprising over $12 million.
- A further 15+ projects identified for scoping and delivery.
- Most of these are subject to active procurement processes.

Caretaker

- The caretaker period has commenced.
- The government is now operating in accordance with the Guidance on Caretaker Conventions (https://www.pmc.gov.au/caretaker), pending the outcome of the 2025 federal election.
- No new RERI projects will be contracted during the caretaker period.
    - The department will continue to evaluate tender responses for projects that have already approached the market.
    - Contract negotiations may be undertaken, but contracts will not be signed.
    - Signing of any further contracts will be subject to advice of an incoming government.
- Projects already contracted will continue delivery as usual.
- The RERI website will be published after the caretaker period.



Contracted projects to date

(to be released on DCCEEW website soon)

Project title	Description	Delivery partner/s
Southern Bent-wing Bat: determining flight height and developing regulatory guidance	This project will summarise current knowledge about the Southern Bent-wing Bat and track their movements to better understand their movement patterns and flight height. This will inform regulatory guidance to help avoid and mitigate potential impacts from new wind farm developments.	Arthur Rylah Institute
Southern Black-throated Finch: population and habitat assessment in Townsville	The Townsville region is experiencing an expansion of renewable energy, urban and industrial developments. This project will assess the status of the Southern Black-Throated Finch population and deliver a local area plan for the species. This will better inform development and conservation activities and support the protection of key habitat areas across the region.	NQ Dry Tropics Ltd
Habitat quality assessment method for reptiles in the Brigalow Belt region	The project will identify key habitat attributes for the Yakka Skink and Dunmall's Snake. The project will also develop a habitat quality assessment method for the Ornamental Snake. Assessment of impacts to these cryptic reptiles is often required for developments in Queensland. The outcomes of the project will support robust and consistent environmental impact assessments to help protect these species.	CSIRO
Migratory shorebird population estimates and important habitat in Australia	This project will update population estimates and habitat mapping for 37 migratory shorebird species that visit Australia each year. The project will also create a user-friendly, online spatial interface for the Directory of Important Migratory Shorebird Habitat. This will provide a better understanding for proponents and decisions makers of where important habitat for migratory shorebirds are to inform avoidance and mitigation measures for renewable energy proposals under the EPBC Act.	BirdLife Australia
Updates to two reports about the impacts to birds and bats from onshore and offshore wind farms	This project will update two previous reports commissioned by the department: 1) Impacts on birds from offshore wind farms in Australia, and 2) Impacts to birds and bats from onshore wind farms. The project will: Provide more information about ecological traits of birds and bats (such as flight height) that contribute to risk of impacts from wind farms, Inform species-specific mitigation measures to reduce the impacts of proposals on birds and bats, Present data in a user-friendly format for easier use by proponents and decision makers.	Latitude 42

Continued …

Project title	Description	Delivery partner/s
A framework for delivery of regionally coordinated offsets in Queensland	Queensland is experiencing an expansion of renewable energy and critical mineral developments. This project will explore ways to coordinate restoration activities across multiple developments in a region. This project will include a pilot in north-west Queensland to support developments and deliver greater conservation outcomes for the Julia Creek Dunnart.	James Cook University
Literature review of interactions of marine mammals with light sources from offshore developments	The project will identify Australian species that may be affected by artificial light from offshore developments, such as wind farms. It will consider a range of marine mammals, including whales, dolphins, penguins, and seals that are not currently covered in the National Light Pollution Guidelines for Wildlife (2023). The Guidelines provide best practice management measures to mitigate the impacts of artificial lighting on wildlife. The project will summarise existing international and domestic research and provide recommendations about the development of additional guidance under the current Guidelines. This will support efficient and effective decision making under the EPBC Act.	Convention on Migratory Species (CMS) Energy Task Force
Review of international environmental regulatory approaches for onshore wind farms for consideration in the Australian context	This project will provide case studies from other countries about how environmental impacts from onshore wind farms are managed and regulated. This includes consideration of: best practice mitigations and management approaches, conditions of approval, technological innovations to help minimise environmental impacts from projects. We will use this information to consider how these approaches could be applied in Australia to support best practice environmental protections, whilst supporting an efficient transition to renewable energy.	Convention on Migratory Species (CMS) Energy Task Force
Ground truthing the effectiveness of environmental offsets	For a proposed development, after all efforts have been taken to avoid and mitigate environmental impacts, we may include offsets as a condition of approval to manage residual significant impacts. We commissioned the Ground-truthing of EPBC Act offset site information summary report (2024). This project will complement previous findings. It will evaluate over 20 offset sites and over 15 indirect offsets to understand if they are achieving their intended outcomes. The project will contribute to an ongoing body of work to assist EPBC Act approval holders to understand and meet their offset obligations. This will: Improve confidence in integrity of offsets to ensure better environmental protections; Support industry with clearer, implementable, streamlined conditions of approval; and, Inform guidance on offset management plans.	Jacobs Group (Australia) Pty Ltd
South-West Renewable Energy Zone NSW	The project will develop a regional scale conservation strategy and digital platform for the South-West Renewable Energy Zone. This will cover development linked to both renewable energy and critical mineral projects. This region is undergoing rapid development in renewable energy and early detailed conservation planning will help ensure that new renewable energy investments are contributing to regional conservation and not causing local extinction. The project will support faster approval timeframes for new projects in tandem with conservation benefits.	DCCEEW (NSW Government)

Continued …

Project title	Description	Delivery partner/s
Mapping seabed geomorphology and marine benthic habitat values in the Bass Strait region	This project will provide information about the marine environment in the Bass Strait, covering the Gippsland and Northern Tasmania Declaration Areas. This includes information about seabed features, marine processes and biological values. This will improve our understanding of potential habitat for a range of marine species to better inform proposed offshore renewable energy developments. The project will support both proponents and regulators to conduct efficient and high-quality environmental impact assessments. This will help ensure that new developments can safeguard biodiversity while contributing to the net zero transition.	Geoscience Australia
Survey guidelines and data standards for marine benthic habitats	This project will review a range of national and international survey methods, guidelines and data standards that are used to characterise and monitor marine benthic habitats. It will identify those that are best practice and fit-for-purpose for the development of high-quality environmental impact assessments for offshore wind developments. This will support consistency in the collection, classification, regulation, and management of benthic information. The project will provide related guidance for proponents and decision makers to support efficient and robust assessments.	Geoscience Australia
Developing standardised methods for assessing habitat quality (Queensland)	This project will develop standardised methods for assessing habitat quality in key areas of Queensland for up to 10 species. Standardised methods will facilitate consistent and robust approaches to developing offsets, helping to ensure that the impacts of new renewable energy developments are adequately compensated. This work will support both proponents designing new projects and the regulators assessing them. It will support shorter assessment timeframes.	Eco Logical Australia
Developing a regulatory guidance framework for protected matters	This project will develop a consistent regulatory guidance framework. It will populate this framework for 8 threatened species. The framework will include: • Contemporary ecological science. • Impact assessment methods. • Mitigation measures according to the mitigation hierarchy. • Significant impacts and methods to quantity impacts. • Offset suitability assessment and offset delivery measures. This will support best-practice assessment of environmental impacts using robust and science-based methods.	2Rog Consulting
Filling information gaps for parrots	This project will fill knowledge gaps for 5 parrot species: • Orange-bellied Parrot • Swift Parrot • Blue-winged Parrot • Regent Parrot • Superb Parrot The research focus will vary for each species, ranging from desktop studies to fieldwork. This will include investigation of movement patterns, flight heights, flight speed, and identify key habitat such as nesting sites. This information will help to identify best practice mitigation measures to support more efficient and effective environmental assessments for proposed onshore and offshore wind farms.	ANU

Continued …

Project title	Description	Delivery partner/s
Threatened Glider Regulatory Guidance Project	This project will undertake targeted research to address key knowledge and information gaps for three species of threatened Gliders: • Greater Glider (southern and central) • Greater Glider (northern) • Yellow-bellied Glider (south-eastern) Research outputs from the project will inform the development of regulatory guidance products which will help communicate the department's regulatory expectations for glider assessments, leading to more robust, effective regulation.	ANU
Best practice guidance for regulating impacts to cetaceans (whales, dolphins, porpoises)	Drawing on international literature and a review of other nations' environmental regulatory frameworks for assessing and managing potential impacts to cetaceans from offshore wind developments, the project will develop: • Guidance for assessing, mitigating, and managing potential impacts on cetaceans. • Population assessments and a risk framework, focusing on the southern right whale and blue whale. • A long-term cetacean monitoring framework.	Convention on Migratory Species (CMS) Energy Task Force

Data management

- Guidance on offshore environmental data standards to support EPBC assessments is important to the industry.
- We intend to address this gap through the RERI.
- This includes:
    - what data is expected from proponents (anonymised, aggregated, or shared publicly)
    - where data will be stored.
    - how to manage the data.
- We are working with stakeholders, including Environment Information Australia (EIA), to ensure that the data produced by RERI will be publicly accessible.

Links to the NESP MaC Hub

- **RERI design phase**
  - RERI was informed by NESP's early work in both the onshore and offshore space
    - For example, NESP projects 4.7, 4.8 and 4.9 informed the design of RERI's offshore projects.
- **RERI delivery phase**
  - RERI and NESP work programs are complementary
    - RERI projects run in parallel to NESP projects
  - The RERI team will engage with NESP MaC Hub on an ongoing basis to ensure projects from both programs can inform each other

Links between RERI & NESP MaC Hub projects

**** Note: due to probity constraints, only contracted RERI projects have been listed here.***

RERI projects relevant to offshore wind farm development *	Delivery partner	Potential links to NESP projects to be explored	Links to NESP MaC Hub 4.7 priority species list
Mapping seabed geomorphology and marine benthic habitat values in the Bass Strait region	Geoscience Australia	**4.7** – Development of regional modelling and risk assessments to inform offshore renewable decision-making (and completed projects: 2.1, 2.2, 3.21, 3.3)	n/a
Survey guidelines and data standards for marine benthic habitats	Geoscience Australia	**4.7** – Development of regional modelling and risk assessments to inform offshore renewable decision-making (and completed projects: 2.1, 2.2, 3.21, 3.3)	n/a
Literature review of interactions of marine mammals with light sources from offshore developments	Convention on Migratory Species (CMS) Energy Task Force	**4.8** - Potential impacts of offshore wind developments on eastern Indian Ocean pygmy blue whales **4.9** - Assessing the vulnerability of southern right whale and blue whale populations to disturbance from windfarm developments	Cetaceans listed – tbc *(ie. Blue whale, southern right whale, humpback whale)*
Best practice guidance for regulating impacts to cetaceans	Convention on Migratory Species (CMS) Energy Task Force	**4.8** - Potential impacts of offshore wind developments on eastern Indian Ocean pygmy blue whales **4.9** - Assessing the vulnerability of southern right whale and blue whale populations to disturbance from windfarm developments	Cetaceans listed – tbc *(ie. Blue whale, southern right whale, humpback whale)*
Filling information gaps for parrots	ANU	**4.17** – Migratory shorebird populations: research for management and recovery 4.26? – Modelling shorebird migration to assess disease risk amid global change	Parrots listed – tbc *(ie. orange-bellied parrot, swift parrot)*
Updates to 2 reports about the impacts to birds and bats from onshore and offshore wind farms	Latitude42	**4.17** – Migratory shorebird populations: research for management and recovery 4.26? – Modelling shorebird migration to assess disease risk amid global change	Parrots listed – tbc *(ie. orange-bellied parrot, swift parrot)*

Moving forward …

- RERI team will continue to work closely with the NESP MaC Hub.
- We are keen to feed into the excellent work being done by the Hub.

dcceew
gov.au

Questions?

Thank you for your interest in RERI.
We look forward to providing further updates as projects progress.

Marine and Coastal

National Environmental Science Program

NESP Project 4.7
Cumulative risk assessment for OWF in the Gippsland Declared Area

Keith Hayes, CSIRO Data61

9th April 2025, Hobart

Project overview and background

- Duration: 32 months
  - commenced May 2024, final report due December 2026
- Composition
  - Project team: CSIRO, AIMS, UTAS, Curtin University
  - Project advisory group (PAG): federal (DCCEEW, AFMA, NOPSEMA, GA), state (VIC, TAS), Industry and other invited experts
- Objective
  - Develop a methodology for cumulative risk assessment of OWF and apply it to the Gippsland Declared Area
  - Understand potential effects of OWF within the broader context of existing (and future) maritime activities and their potential effects on MNES
- Approach
  - Quantitative, probabilistic, risk assessment based on whole of ecosystem models and species-specific impact models
- Priority species
  - prioritisation commissioned by DCCEEW and NOPSEMA (NESP 3.21)
  - PAG: species with *a priori* high exposure such as Australasian gannet (*Morus serrator*) and Short-tailed Shearwater (*Ardenna tenuirostris*)?

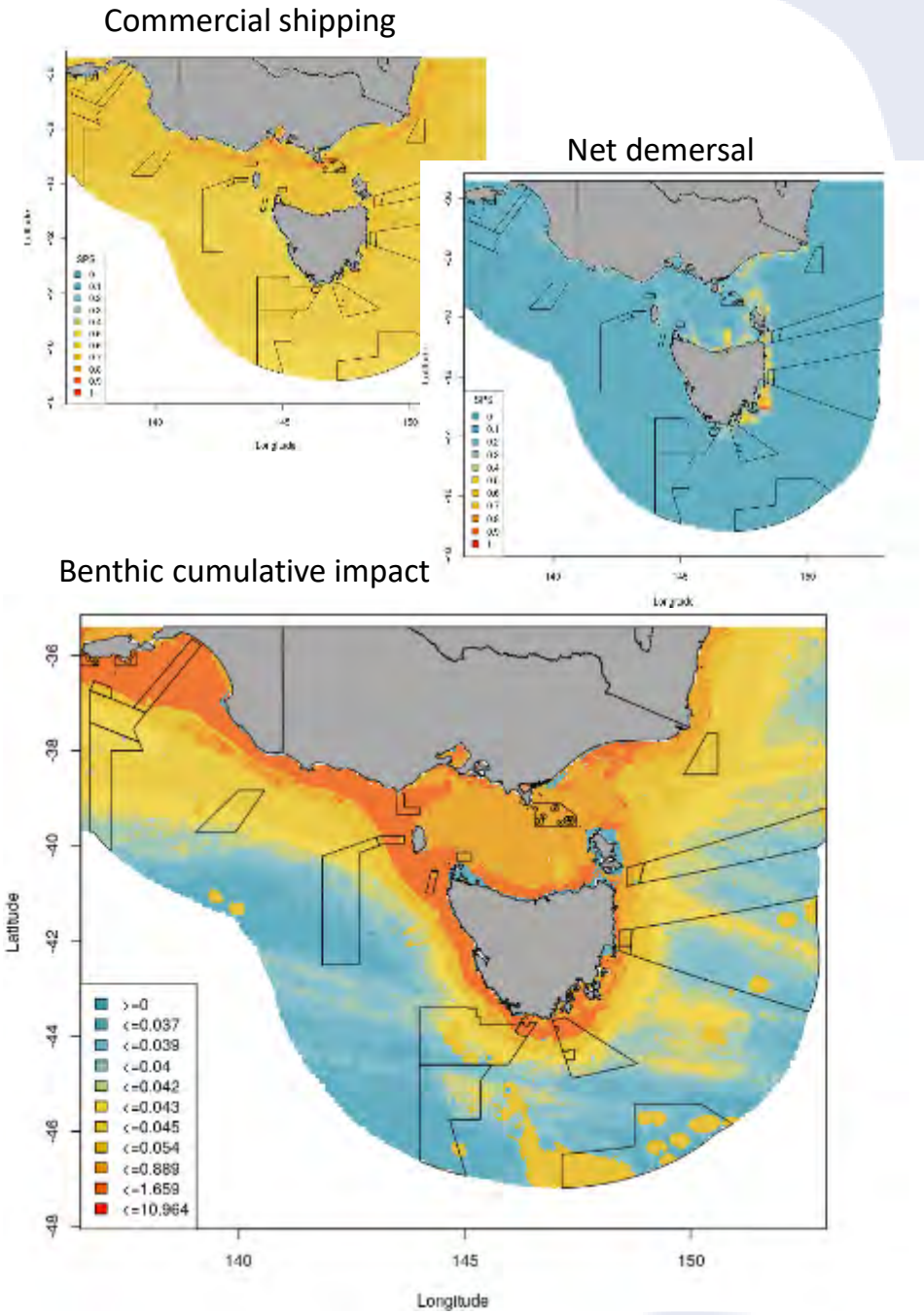
Common Name	Scientific Name
Birds, shorebirds and seabirds	
Amsterdam Albatross	*Diomedea amsterdamensis*
Australian Gould's Petrel	*Pterodroma leucoptera leucoptera*
Curlew Sandpiper	*Calidris ferruginea*
Far Eastern Curlew	*Numenius madagascariensis*
Grey-headed Albatross	*Thalassarche chrysostoma*
Mongolian Lesser Sand Plover	*Charadrius mongolus mongolus*
New Siberian Islands Red Knot	*Calidris canutus piersmai*
North-eastern Siberian Red Knot	*Calidris canutus rogersi*
Northern Royal Albatross	*Diomedea sanfordi*
Orange-bellied Parrot	*Neophema chrysogaster*
Swift Parrot	*Lathamus discolor*
Shy Albatross	*Thalassarche cauta*
Southern Giant-Petrel	*Macronectes giganteus*
~~Tasmanian Wedge-tailed Eagle~~	~~*Aquila audax fleayi*~~
~~Yakutian Bar-tailed Godwit~~	~~*Limosa lapponica menzbieri*~~
Cetaceans	
Blue whale	*Balaenoptera musculus sp.*
Southern right whale	*Eubalaena australis*
Humpback whale	*Megaptera novaeangliae*

Risk and cumulative risk

- Risk assessments come in three flavours
  - Qualitative (ordinal scale): “high”, “medium”, “low”
  - Semi-quantitative (interval scale): 5,6,7…
  - Quantitative (ratio scale): Pr(extinction)

- Cumulative risk assessment
  - Not possible with ordinal scale: no coherent calculus for adding “low” , “medium”, etc. risks
  - Interval scale possible but assumes additive effect and scale is not calibrated to measurable outcomes
  - Ratio scale estimates can be invalidated with observations (hence amenable to the scientific process)

- OWF risk assessment precedence
  - Not cumulative, qualitative: Copping and Hemery (2020)
  - Cumulative, semi-quantitative: Goodale and Milman (2019); Abramic *et al*. (2022); Reid et al. (2022); Gusatu *et al*. (2021)
  - Not cumulative, quantitative: Masden et al (2021) ; Copping *et al*. (2023); Busch and Garthe (2016); Booth *et al*. (2017); Bastos et al. (2016)

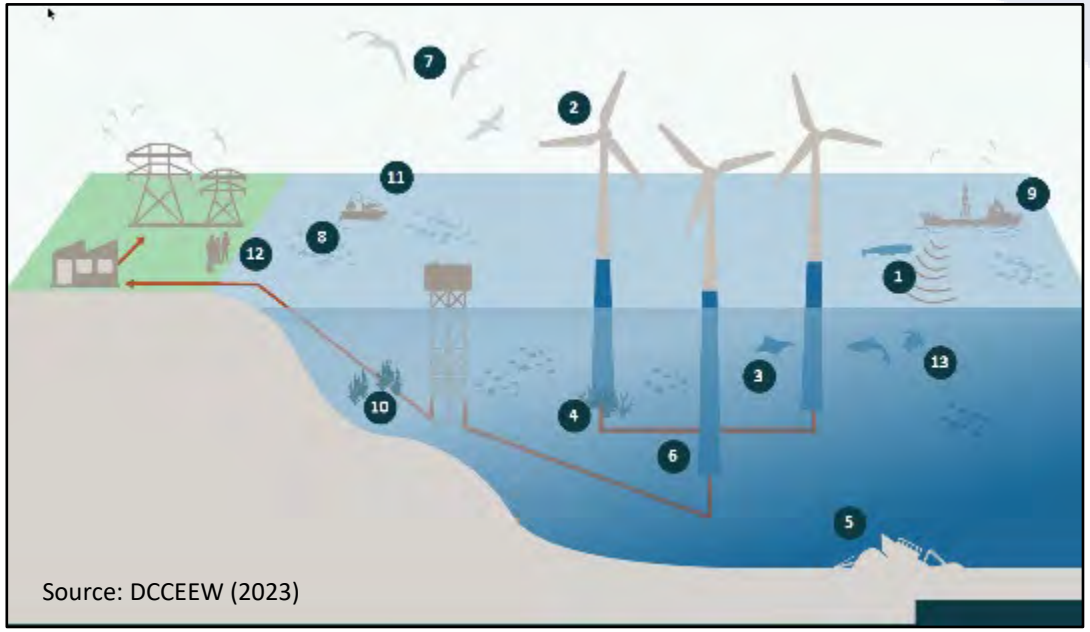


Problem formulation

- Protection goals and risk assessment endpoints
  - Extinction risk for priority species
  - Impacts on other marine natural values

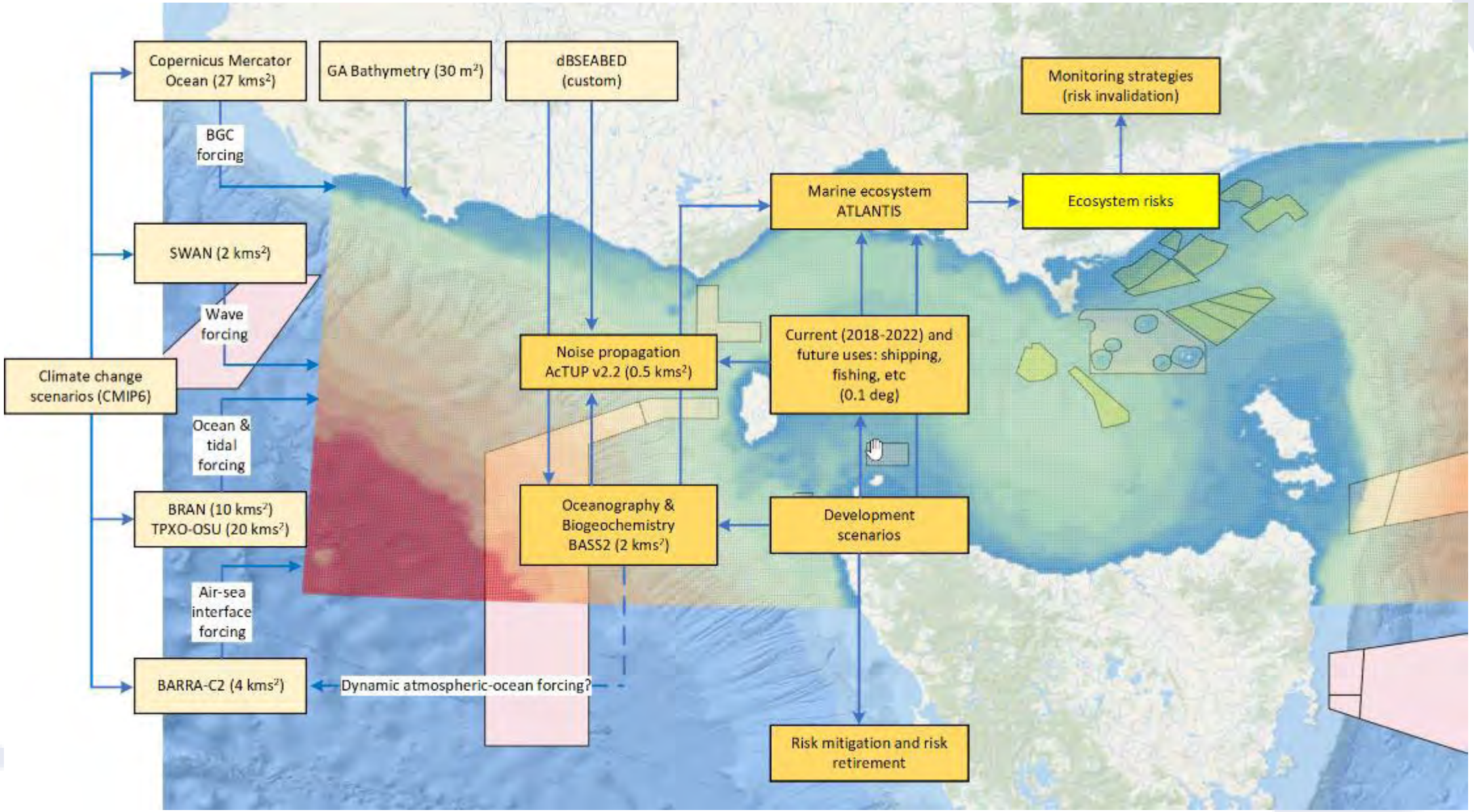
- Within scope impact pathways
  - Underwater noise (1)
  - Turbine interactions (2)
  - Electromagnetic fields (3)
  - Seabed disturbance (4)
  - Physical presence (hydrodynamics + barrier) (6 & 7)
  - Light (8)
  - Vessel interactions (9)
  - Invasive marine species (10)
  - Physical presence (interference/displacement) (11)
  - Multiple pathways (AMP natural values) (13)

- Identification of new and existing threats
  - Management plans and background papers
  - NESP Project 3.3
  - Expert interviews and elicitation

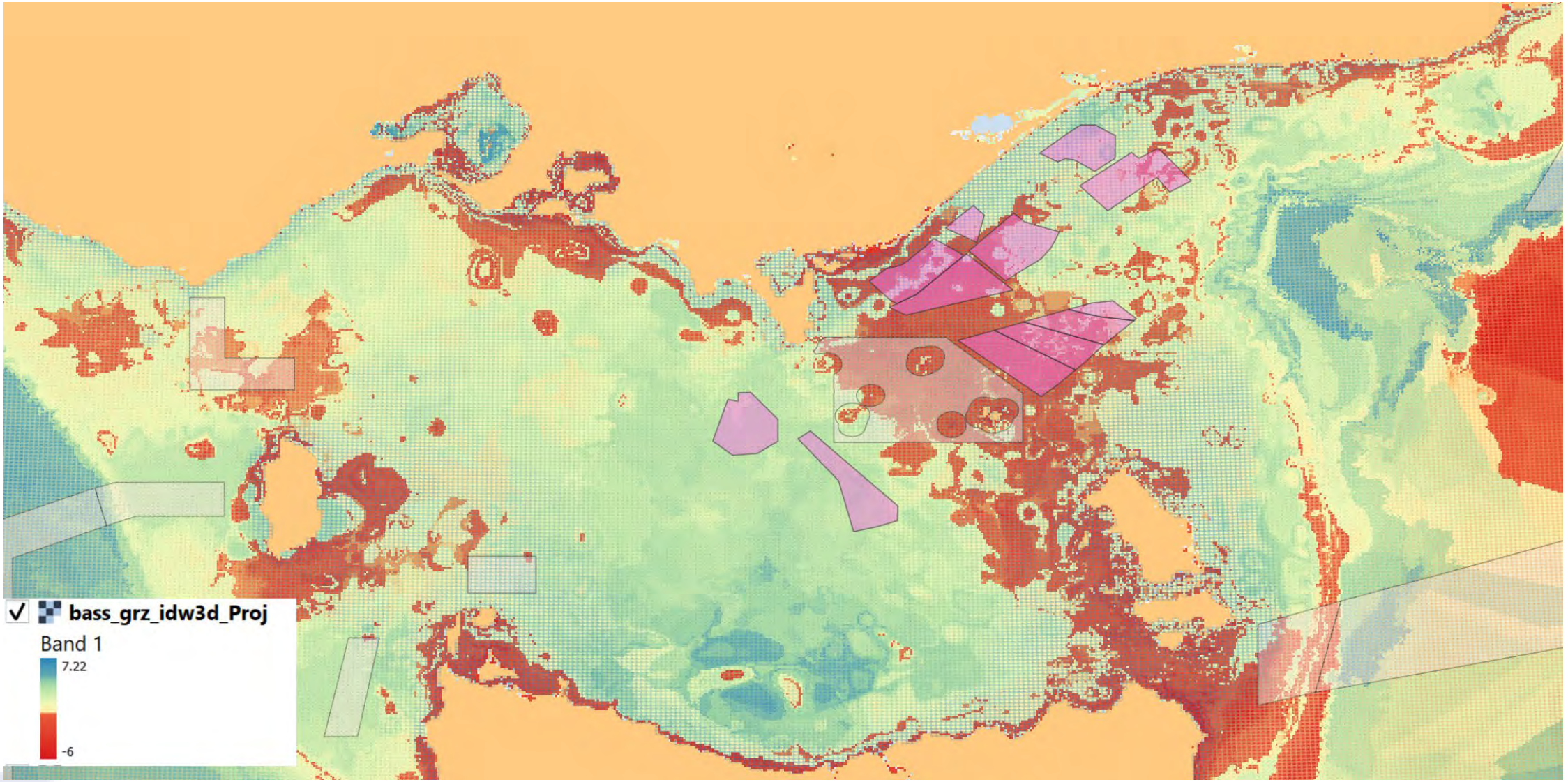


Source: DCCEEW (2023)

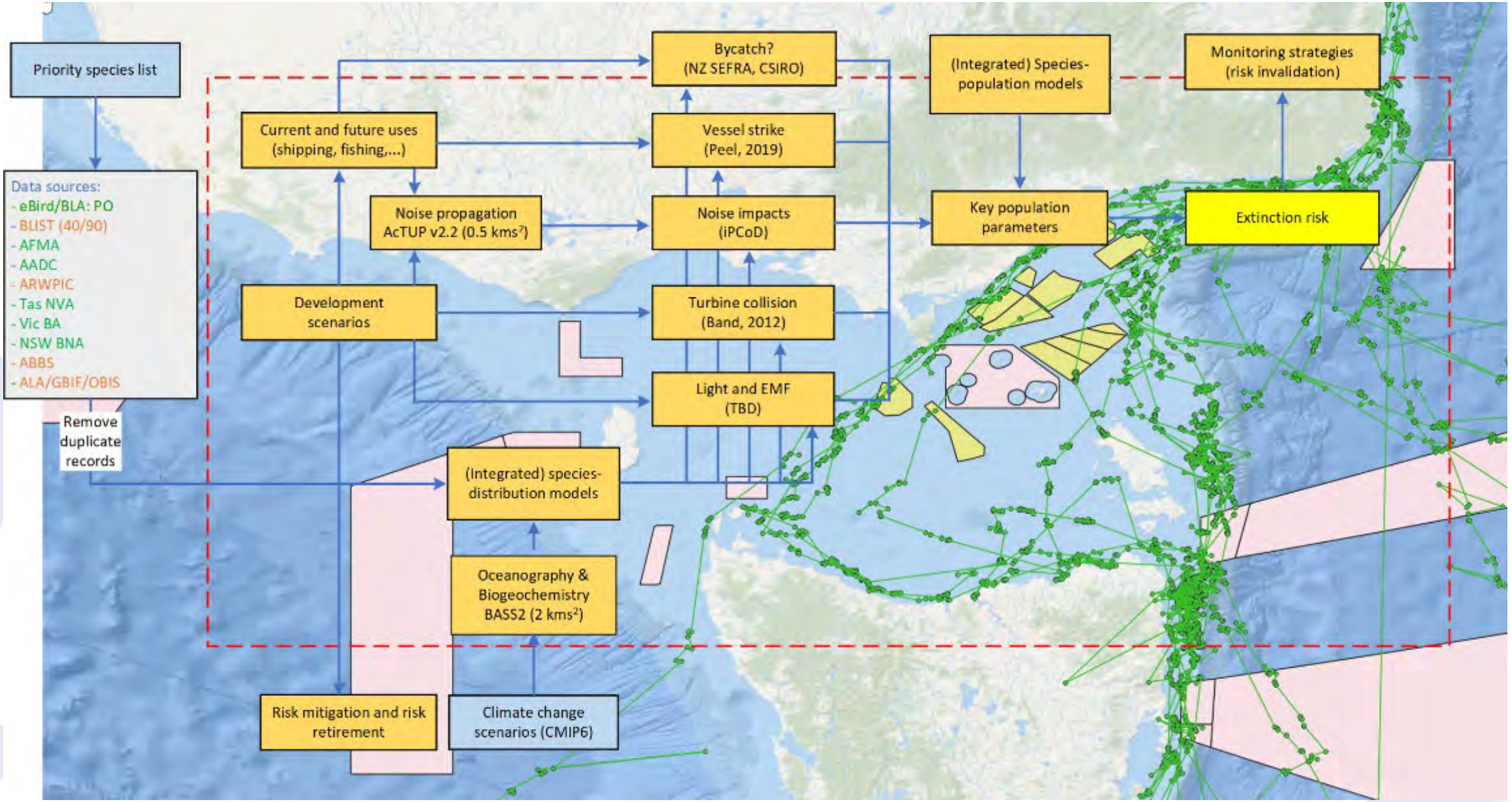
Impacts on marine natural values: ecosystem modelling



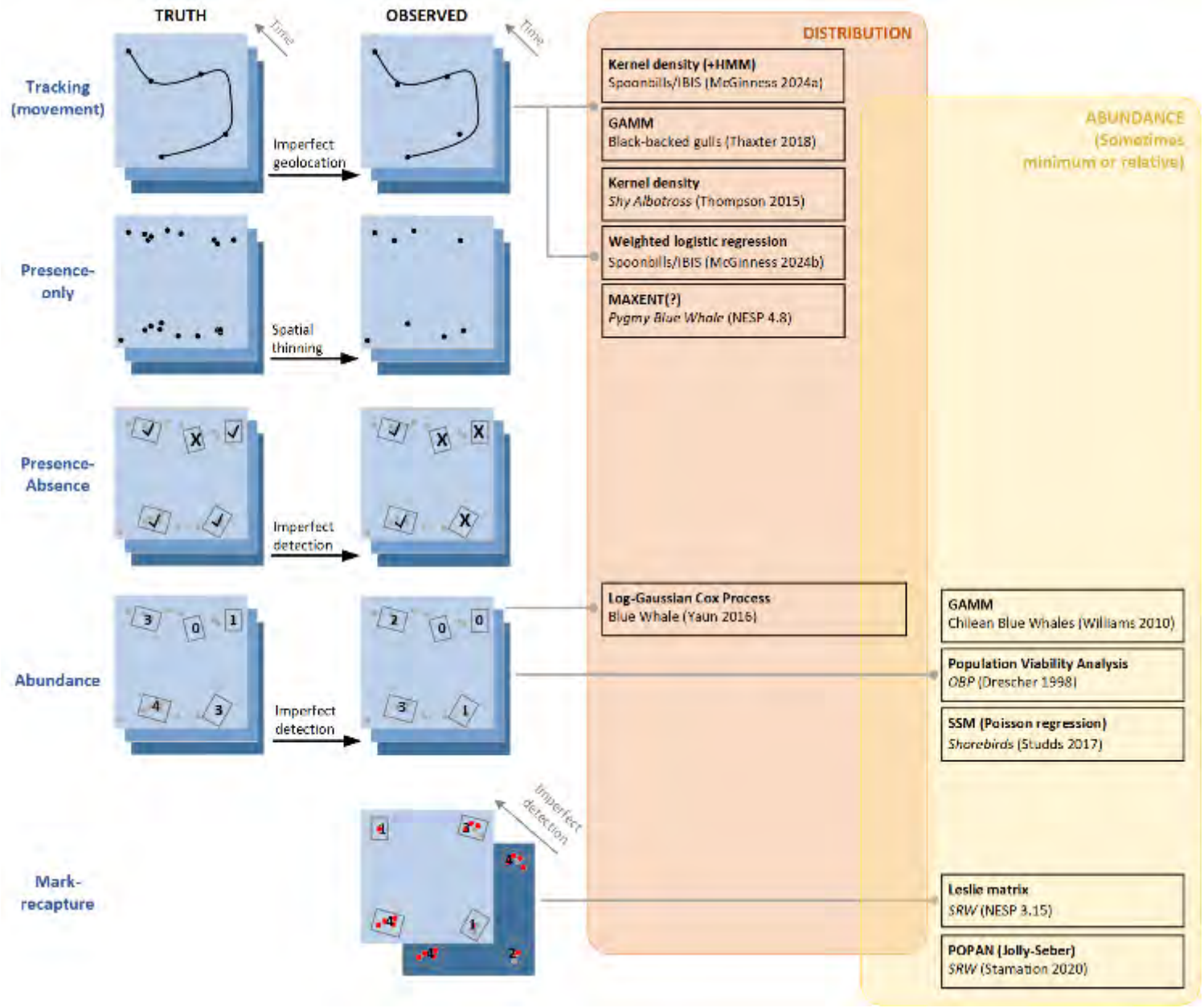
dBSEABED grainsize (Krumbein phi scale)



Extinction risk for priority species



Data and models (scope for integration)



Data accessibility

Data access and data sharing agreements in place

- dsSEABED: Bass Strait seabed characteristics
- AFMA: Commonwealth fisheries wildlife observations and interactions
- VIC DEECA: Right Whale Picture Information Catalogue (Vic)

Data requests and access agreements in negotiation

- TAS NRE: Mutual data sharing agreement
- ARWPIC: CSIRO legal review recommends a new agreement
- ABBBS: Currently considering data request

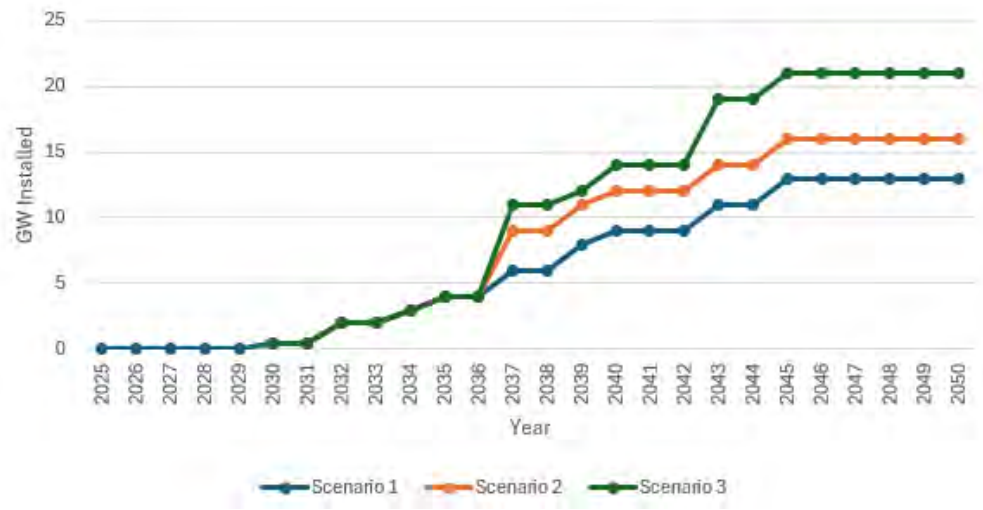
Further discussions required

- DCCEEW RERI projects
- Offshore Wind Industry
- Oil and Gas Industry

Development scenarios

- Describe plausible development up to 2040
  - GDA: Sawyer (2024) Scenario 1
  - First generation 2028, 2GW by 2032, 4GW by 2035, 9GW by 2040
  - Expected turbine yield 12 - 18MWs each
  - 56 - 84 turbines required for each GW
  - Turbines 1 - 2km apart in their feasibility area
  - Towers 160– 200m tall, rotor diameter 200 - 300m
  - Fixed (no floating) structures
- Additional wind farm details needed
  - Typical pile driving schedule
  - Standard risk mitigation strategies (e.g. bubble curtain)
  - Typical vessel operations during construction and operation
  - Other turbine details (e.g. blade pitch, rotor velocity)
  - Associated substructure details
  - Associated transmission infrastructure
- Changes in other activities
  - Commercial fishing and shipping activity
  - Decommissioning of offshore oil and gas infrastructure

Australian offshore wind installation scenarios (Sawyer, 2024)



Wrap up and key next steps

Data access, collation and aggregation

- Significant resources expenditure on this and significant progress has been made
- Difficult to decide on model approaches until this step is resolved
- Would like to finalise and complete this step this FY
- Hurdles remain – most significant project risk currently

Next steps

- Agree on modelling approaches
- Identify parameters, information sources and elicitation targets (if deemed necessary)
- Complete problem formulation (including elicitation)
- Document detailed research plan: confirm endpoints and analysis method
- FY25/26: implement and where possible share early results
- Seek closer liaison and collaboration with RERI projects

Marine and Coastal

National Environmental Science Program

Thank you

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Priority species and data sources

Myriam Lacharité
Eloise Wilson-Mayne

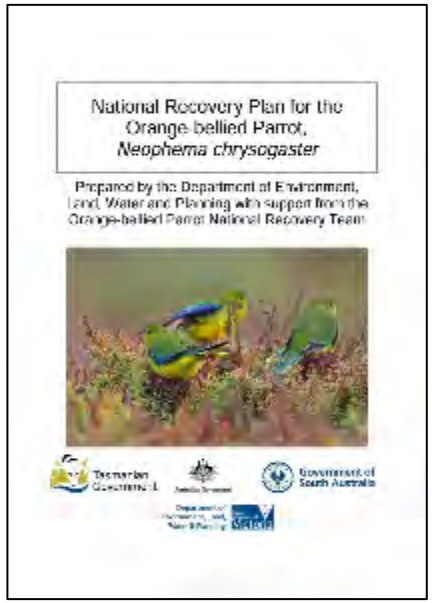
UNIVERSITY of TASMANIA
IMAS
Institute for Marine and Antarctic Studies

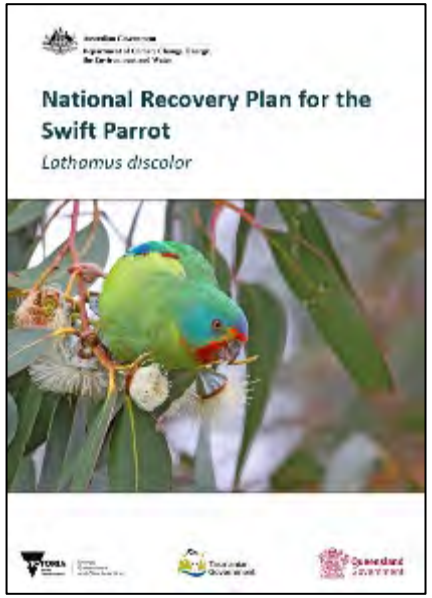
NESP 4.7 Bass Strait Workshop April 9-10 2025

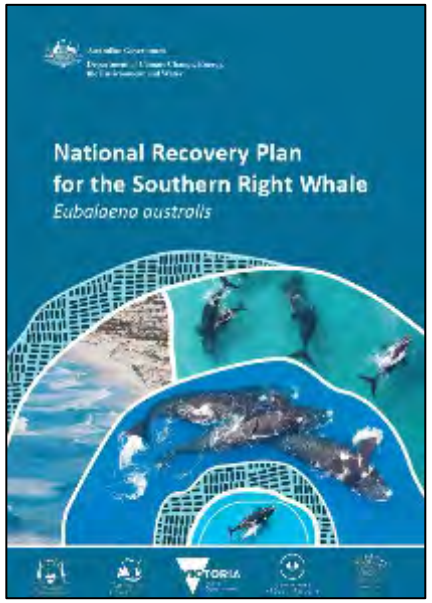
Shy albatross *Thalassarche cauta* (Photo credit: eBird.org)

Identifying priority species

- Listed in the *EPBC Act 1999* under Migratory Species, Threatened Seabirds, or Threatened Fauna
- Some with Recovery Plans; others with enough direction for action in the Conservation Advice[1]







1. Species Profile and Threats Database

Priority species

			EPBC Listing
Shorebirds and terrestrial parrots	North-eastern Siberian Red Knot	*Calidris (Calidris) canutus rogersi*	VU
	New Siberian Islands Red Knot	*Calidris (Calidris) canutus piersmai*	
	Curlew Sandpiper	*Calidris ferruginea*	CE
	(Mongolian) Lesser Sand Plover	*Charadrius (Charadrius) mongolus mongolus*	EN
	(Far) Eastern Curlew	*Numenius madagascariensis*	CE
	Orange-bellied Parrot	*Neophema chrysogaster*	CE
	Swift Parrot	*Lathamus discolor*	CE
Seabirds	Southern Giant Petrel	*Macronectes giganteus*	EN
	(Australian) Gould's Petrel	*Pterodroma leucoptera leucoptera*	EN
	Northern Royal Albatross	*Diomedea sanfordi*	EN
	Amsterdam Albatross	*Diomedea amsterdamsis*	EN
	Shy Albatross	*Thalassarche cauta*	EN
	Grey-headed Albatross	*Thalassarche chrysostoma*	EN
Whales	Blue whale	*Balaenoptera musculus* sp.	EN
	Southern right whale	*Eubalaena australis*	EN
	Humpback whale	*Megaptera novaeangliae*	--

Red Knot (*Calidris canutus*)

Pygmy and Antarctic Blue Whales

VU = Vulnerable; E = Endangered; CE = Critically Endangered

Objectives

- Collate available data from discoverable sources

- Categorize available data for downstream modelling:

  - Presence-only
  - Presence-absence
  - Abundance (counts)
  - Abundance (mark-recapture)
  - Movement (tracking)

Publicly available data sources

eBird

birdlife AUSTRALIA

MOVEBANK for animal tracking data

BirdLife INTERNATIONAL

Seabird Tracking Database
Tracking Ocean Wanderers

AUSTRALIAN ANTARCTIC DATA CENTRE | AUSTRALIAN ANTARCTIC PROGRAM

NESP 2.7

Tasmanian Government

Natural Values Atlas
Authoritative, comprehensive information on Tasmania's natural values
Version 3.12.10

VICTORIA State Government

Victorian Biodiversity Atlas

NSW GOVERNMENT

Access BioNet Atlas

In progress

Australian Government
Department of Climate Change, Energy, the Environment and Water

Bird and Bat Banding Scheme

Australian Government
Australian Fisheries Management Authority

Observer Program

Australian Government | AUSTRALIAN ANTARCTIC PROGRAM | AUSTRALIAN ANTARCTIC DATA CENTRE

Whale observations and surveys

AUSTRALASIAN RIGHT WHALE PHOTO-IDENTIFICATION CATALOGUE

iNaturalistAU

Atlas of Living Australia
ala.org.au

OBIS
OCEAN BIODIVERSITY INFORMATION SYSTEM

GBIF
Global Biodiversity Information Facility

Data processing workflow (and QA/QC)

IN PROGRESS

Locating the raw data

Public and directly accessible

Public and requires the creation of a (free) account

Discoverable but not directly accessible

Obtaining the raw data

Is it a sensitive species?

Requires a data sharing agreement?

Limitations on availability and use in place?

Keep a record of acknowledgements and credit

Days, or weeks, or months (and ongoing)

Data types

Sightings

Surveys

Presence/absence

Satellite/GPS tracking

Video tracking

VHF Tracking

Key considerations

Type of observation: sightings (visual), audible, captured, dead/alive, beached, carcass, etc.

Is the geolocation accurate (e.g., within 1000m)?

What is the temporal range?

Is the record duplicated from another source?

Survey/sighting type and effort

Is there a count?

Is there a standardized sampling effort?

Were all species recorded?

Presence-only: No standardized sampling effort

Presence-absence: All species recorded, standardized sampling effort

Abundance: Count, standardized sampling effort

Current data inventory: Sightings and surveys

In Australia (Rest of the world)

From State Atlases, eBird, BirdLife Australia, NESP 2.7		Presence only	Presence-absence	Abundance (counts)	Abundance (Mark-recapture)
Red Knot	*Calidris canutus*	4,314 (26,092)	1,420 (13,845)	14,587 (175,106)	-
Curlew Sandpiper	*Calidris ferruginea*	11,837 (11,268)	4,657 (7,330)	29,592 (82,380)	-
(Mongolian) Lesser Sand Plover	*Charadrius (Charadrius) mongolus mongolus*	3,356 (714)	1,423 (977)	15,581 (11,367)	-
(Far) Eastern Curlew	*Numenius madagascariensis*	14,228 (482)	2,480 (850)	64,987 (9,321)	-
Orange-bellied Parrot	*Neophema chrysogaster*	3,409 (0)	15 (0)	754 (0)	-
Swift Parrot	*Lathamus discolor*	16,590 (0)	184 (0)	6,862 (0)	-
Southern Giant Petrel	*Macronectes giganteus*	951 (3,229)	86 (3147)	1,057 (32,197)	-
Australian Gould's Petrel	*Pterodroma leucoptera leucoptera*	376 (0)	0 (0)	0 (2)	-
Northern Royal Albatross	*Diomedea sanfordi*	71 (377)	8 (152)	375 (6,781)	-
Amsterdam Albatross	*Diomedea amsterdamsis*	0 (66)	0 (0)	3 (8)	-
Shy Albatross	*Thalassarche cauta*	4,636 (1,248)	479 (509)	7,347 (15,042)	-
Grey-headed Albatross	*Thalassarche chrysostoma*	709 (542)	10 (159)	228 (3,602)	-
Blue whale	*Balaenoptera musculus* sp.	173	0	*Ongoing*	-
Southern right whale	*Eubalaena australis*	5,712	0	8	-
Humpback whale	*Megaptera novaeangliae*	3,970	0	*Ongoing*	-

Individual events or surveys

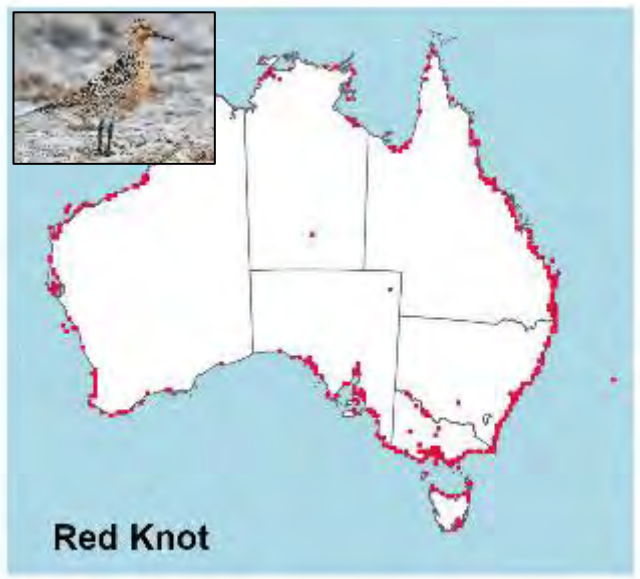
Current data inventory: Tracking

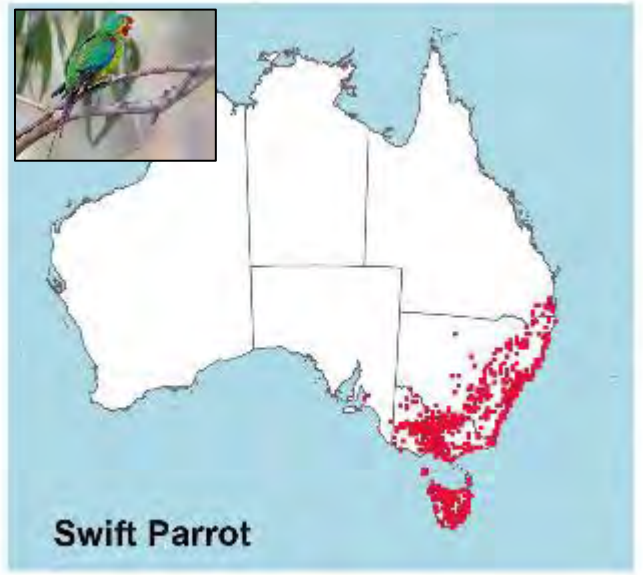
From State Atlases, Movebank, BirdlLife Seabird Tracking Database, and exploring AAD data holdings		Movement (Satellite tracking)	Movement (Radio Tracking Signal)
Red Knot	*Calidris canutus*	--	-
Curlew Sandpiper	*Calidris ferruginea*	*Ongoing*	-
(Mongolian) Lesser Sand Plover	*Charadrius (Charadrius) mongolus mongolus*	--	-
(Far) Eastern Curlew	*Numenius madagascariensis*	21	-
Orange-bellied Parrot	*Neophema chrysogaster*	--	51
Swift Parrot	*Lathamus discolor*	--	-
Southern Giant Petrel	*Macronectes giganteus*	217	-
Australian Gould's Petrel	*Pterodroma leucoptera leucoptera*	62	-
Northern Royal Albatross	*Diomedea sanfordi*	120	-
Amsterdam Albatross	*Diomedea amsterdamsis*	345	-
Shy Albatross	*Thalassarche cauta*	*N/A*	-
Grey-headed Albatross	*Thalassarche chrysostoma*	333	-
Blue whale	*Balaenoptera musculus* sp.	*Ongoing*	-
Southern right whale	*Eubalaena australis*	*Ongoing*	-
Humpback whale	*Megaptera novaeangliae*	24 (and *ongoing*)	-

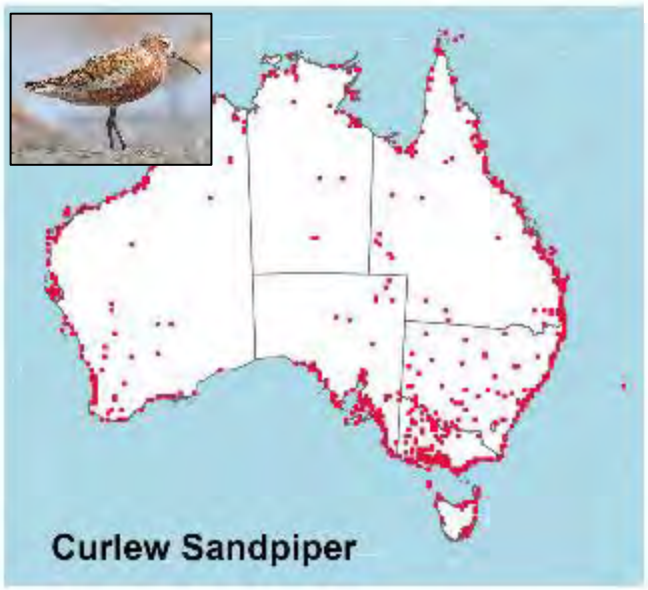
Number of tracks

Distribution: Shorebirds and terrestrial parrots

Sightings and surveys
(eBird, BirdLife Australia, States Atlases)





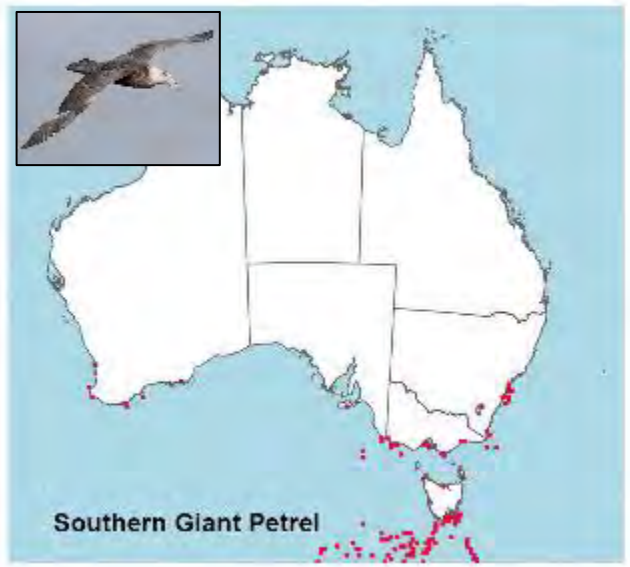


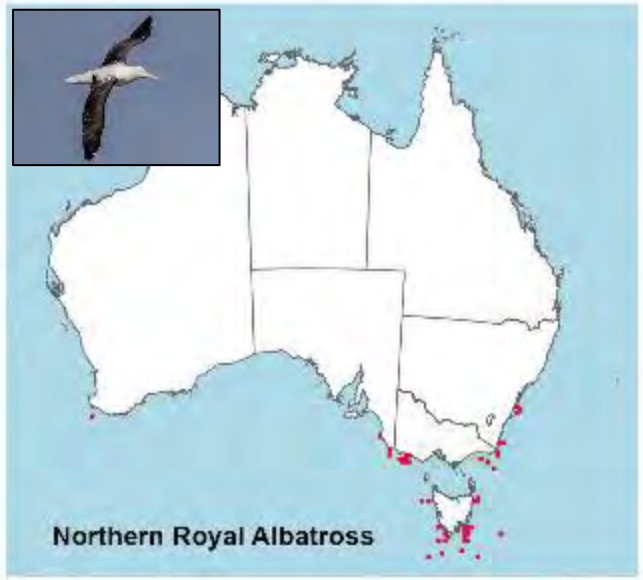
■ ≥ 1 Presence-only, Presence-absence, or abundance sampling event (25 km x 25 km grid)

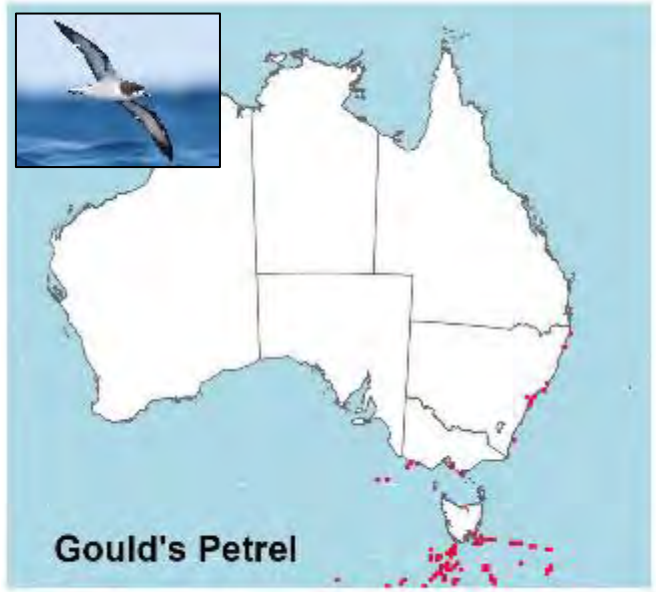
Photo credit: eBird.org; Queensland Government

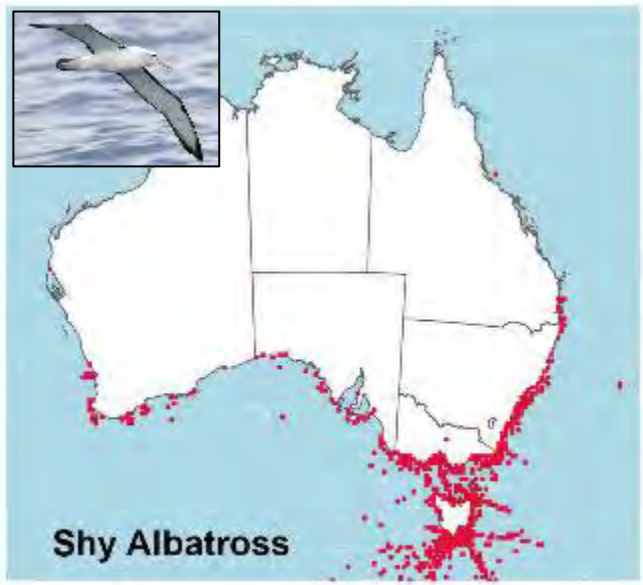
Distribution: Seabirds

Sightings and surveys
(eBird, BirdLife Australia, State Atlases)







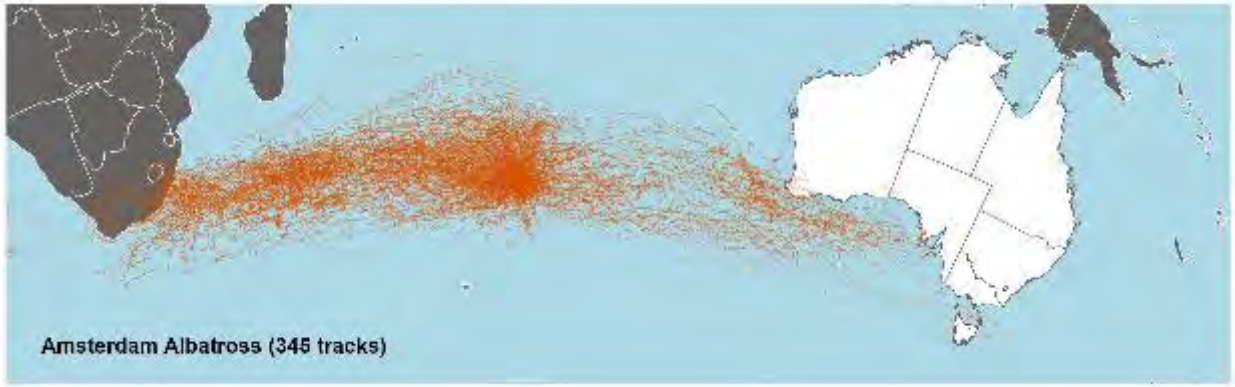


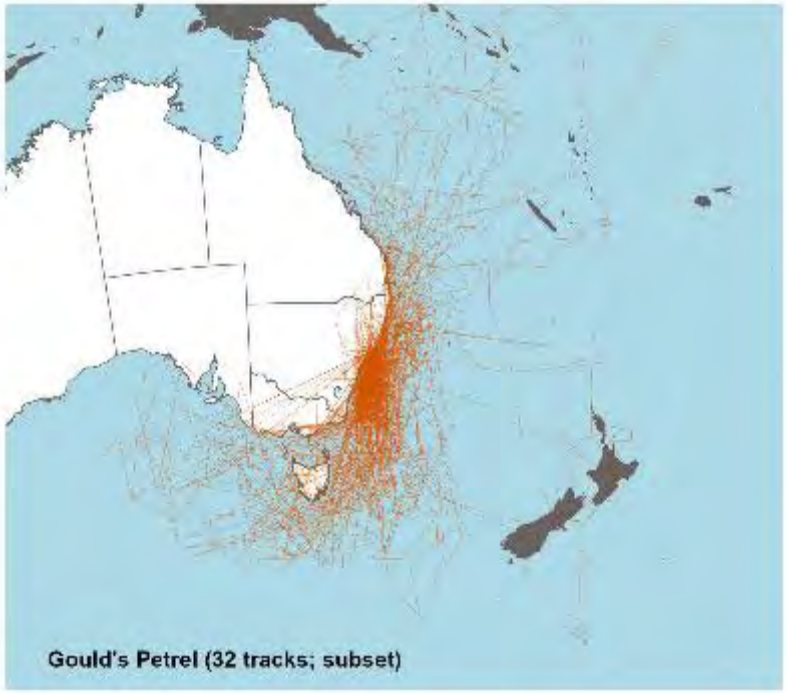
■ ≥ 1 Presence-only, Presence-absence, or abundance sampling event (25 km x 25 km grid)

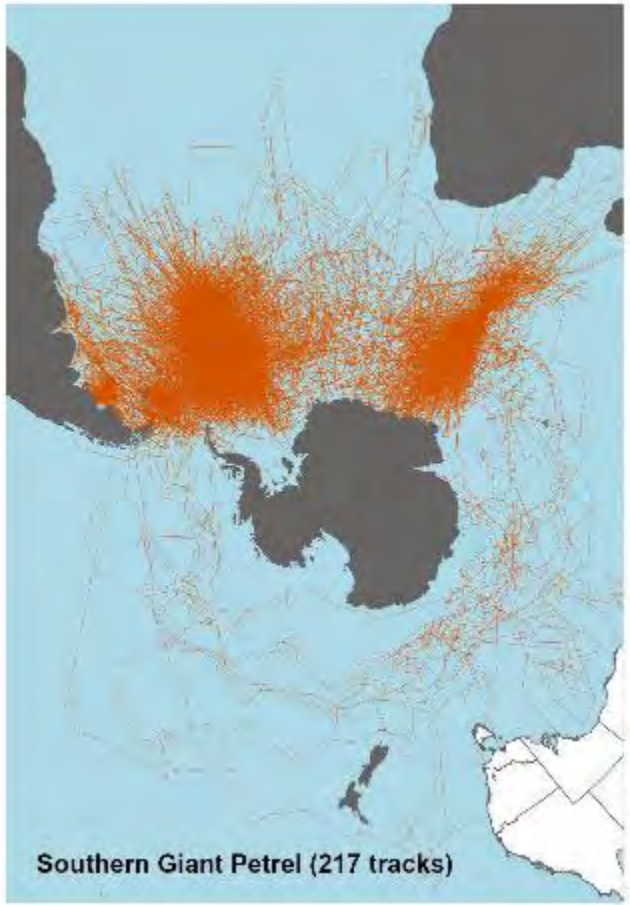
Photo credit: eBird.org

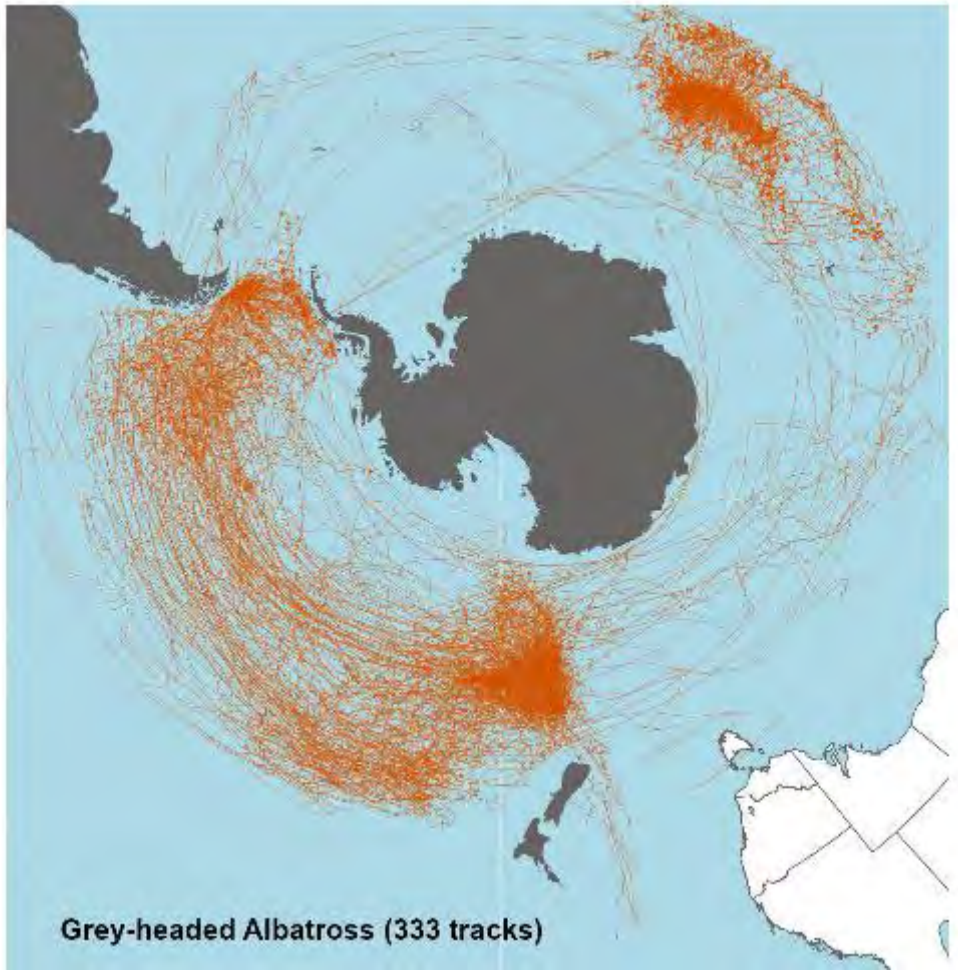
Distribution: Seabirds

Tracking
(BirdLife Seabird Tracking Database)









Data providers: Lorna Deppe, Leigh Torres, Paul Scofield, Yuna Kim, Flavio Quintana, Conservation Services Programme (NZ), Graham Robertson, David Thompson, Bindi Thomas, Peter Ryan, Ben Dilley, Susan Waugh, Javier Arata, Nicholas Carlile, Pierre Pistorius, Matt J Rayner, Christopher Robertson, David Nicholls, Henri Weimerskirch, Jacob Gonzalez-Solis.

Distribution: Whales

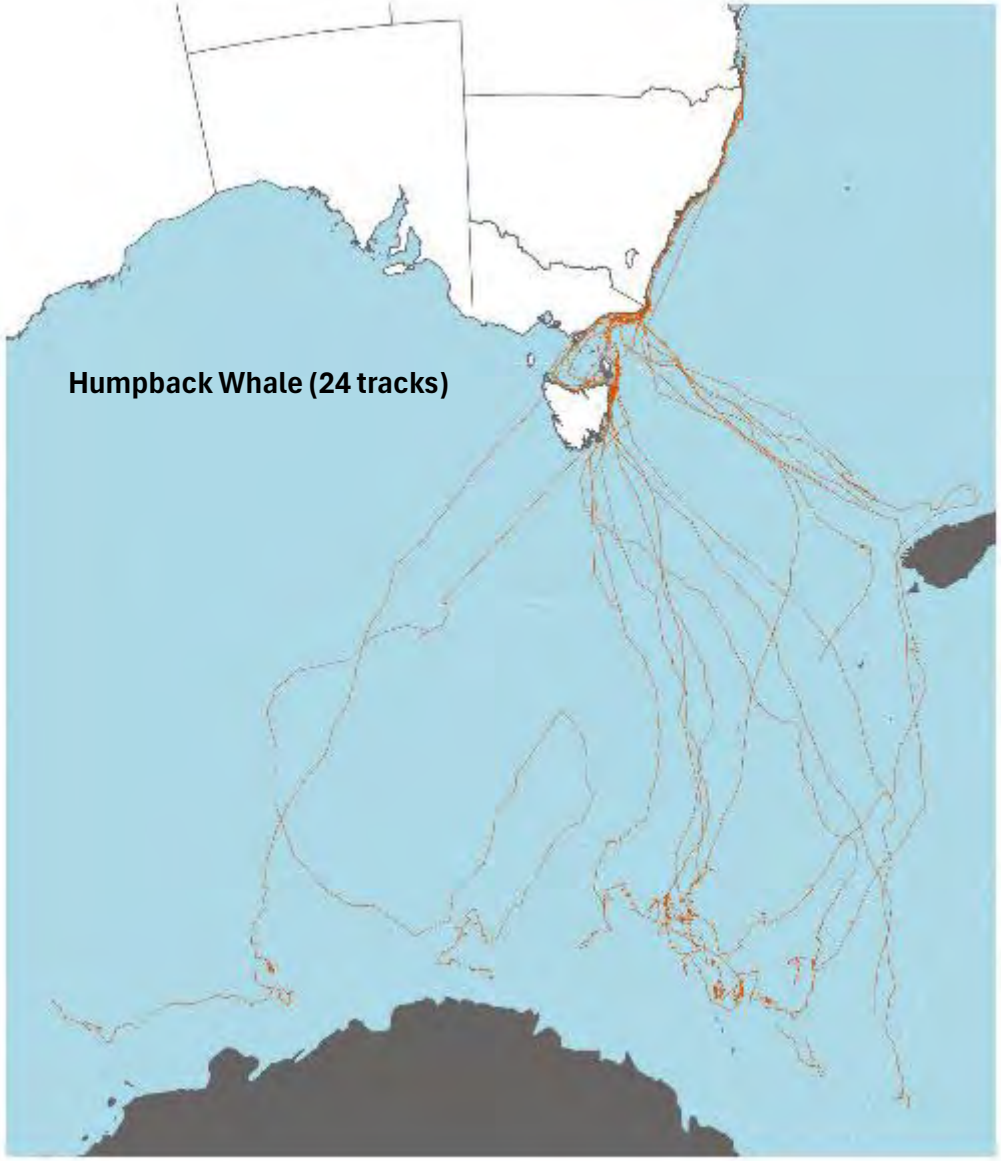
Sightings and surveys
(State Atlases, NESP 2.7)

■ ≥ 1 Presence-only, Presence-absence, or abundance sampling event (25 km x 25 km grid)

Photo credit: Australian Antarctic Program

Distribution: Whales

Tracking
(Australian Antarctic Data Centre)



Challenges

- Access to data
- Accuracy and reliability of metadata
- Significant processing time for inclusion in modelling

Expert Identification Methodology

NESP Marine and Coastal Hub Workshop
Bass Strait Ecosystem and Offshore Renewable Energy

Geoff Hosack | 9 April 2025

NOAA http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/bluewhale.htm

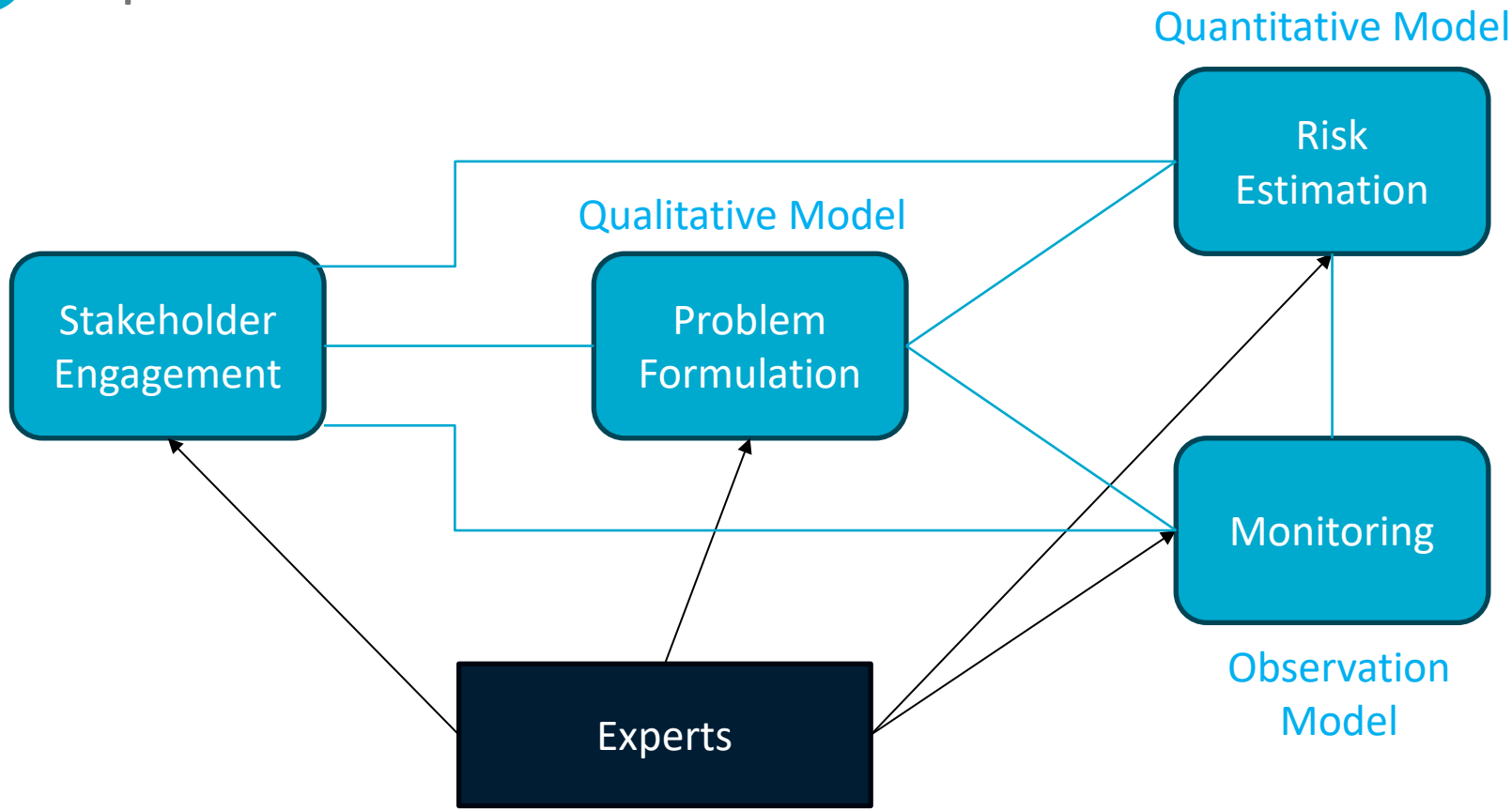
I would like to begin by acknowledging the Nipaluna People as the Traditional Owners of the land/s that we're meeting on today, and pay my respect to their Elders past and present.

'Eternal Wisdom, Infinite Innovation'
artwork by Rachael Sarra, working with Gilimbaa.

Experts in ORE environmental impact assessment

- Role of expertise in environmental risk assessment models
- Expert input into ORE environmental impact assessments
- Expert identification methodology
  - Goals: Relevancy, representativeness, and transparency
- Example for Bass Strait Ecosystem ORE

Experts and models in ERA



Stakeholder engagement

National Research Council (1996) definition:

"*A risk characterization must address what the **interested and affected parties** believe to be at risk in the particular situation, and it must incorporate their perspectives and specialized knowledge*"

National Research Council (2009) clarifies SE as process:

"*Many stakeholders believe that the current process for developing and applying risk assessments lacks credibility and transparency. That may be partly because of failure to involve stakeholders adequately as **active participants** at appropriate points in the risk assessment and decision-making process rather than as passive recipients of the results*"

Problem Formulation

NRC (1996):

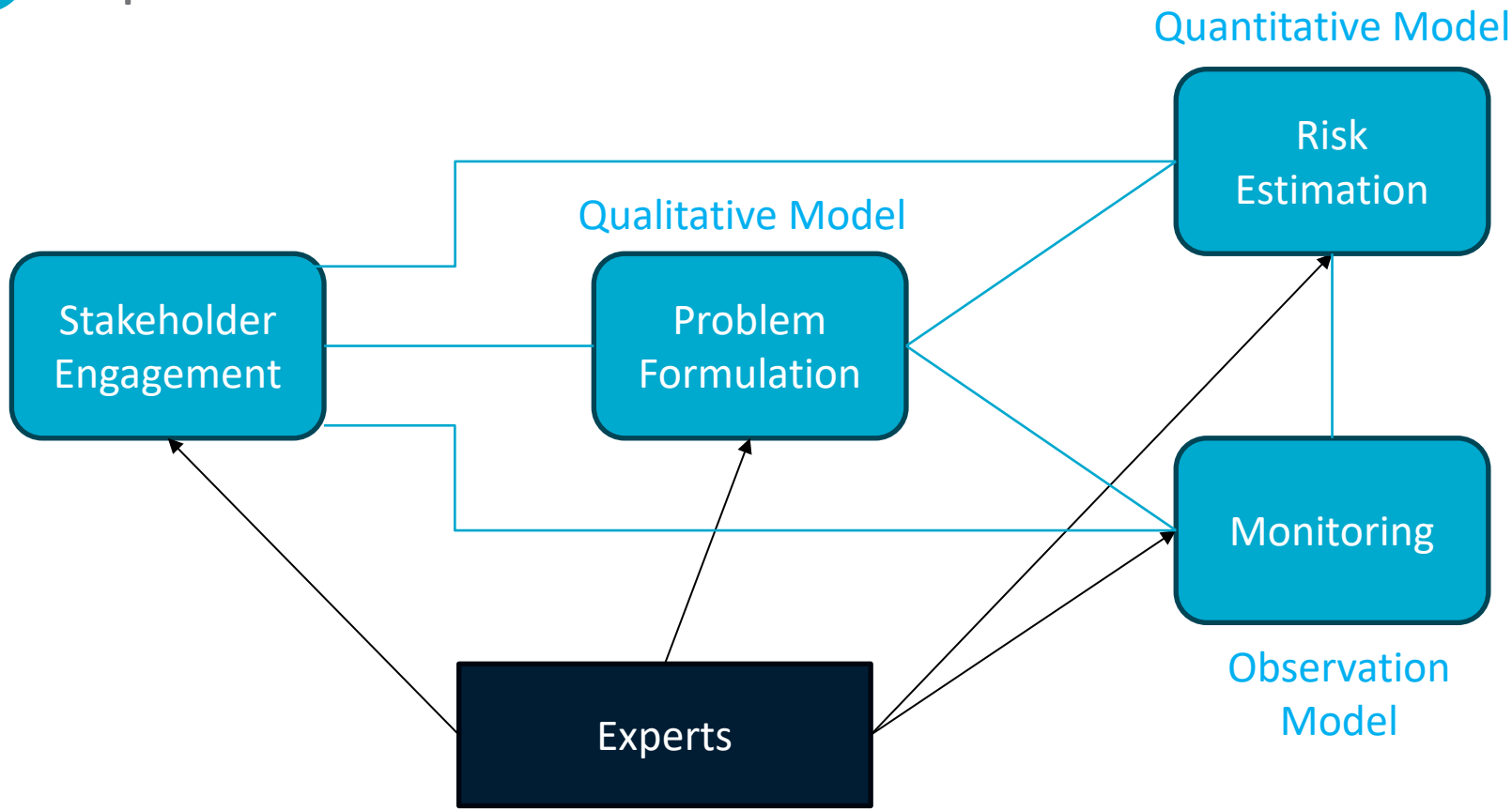
An activity in which **public officials, scientists, and interested and affected parties** clarify the nature of the choices to be considered, the attendant hazards and risks, and the knowledge needed to inform the choices.

"Five steps" The Presidential/Congressional Commission on Risk Assessment and Risk Management (1997):

1. Identifying and characterizing [the problem caused by] situations
2. Putting the problem into its public health and ecological context.
3. Determining risk management goals.
4. Identifying risk managers with the authority or responsibility to take the necessary actions.
5. Implementing a process for engaging **stakeholders**.

→ Stakeholder engagement continues *throughout* risk assessment

Experts and models in ERA



Risk estimation and monitoring

Choose action *a* with maximum expected utility:

Utility (or loss) function

$$\max_a \bar{u}(a \mid y) = \int u(\theta, y, a) F(d\theta \mid y)$$

State of World *Observations*

Posterior distribution proportional to likelihood times prior:

$$f(\theta|y) \propto f(y \mid \theta) f(\theta)$$

Updated beliefs *Data model* *Prior assumptions*

What is a model? Do models need experts?

$$\text{Model} = \text{Data} + \text{Assumptions}$$

Expert input and ORE environmental impact assessment

Stakeholder engagement and problem formulation informs guidance.

- Table 1. Summary of relevant engagement activities: Conservation advice, wildlife conservation plans, management and bioregional plans, etc.
- Table 2. Problem formulation: Key risk pathways for receptor groups

	Key impact pathways (stressors)/sources of impact													
Receptor groups/specific protected matters	**Underwater noise – mortality, injury and behavioural effects**	**Turbine interactions – injury and mortality to birds and bats**	**Electro-magnetic fields**	**Seabed disturbance – loss of/ harm to benthic habitats**	**Disturbance of underwater cultural heritage**	**Physical presence –effects on hydro-dynamic and sediment transport processes**	**Physical presence – barrier effects and displace-ment of marine fauna**	**Light emissions**	**Vessel interactions – injury and mortality to marine fauna**	**Invasive marine species**	**Physical presence – socioeconomic: interference/ displacement of existing uses**	**Physical presence – socioeconomic: seascapes and visual amenity**	**Multiple impact pathways – Australian Marine Parks and their values**	**Cumulative impacts** Applies to all receptor groups/ specific matters protected but should be considered only where these are relevant to a particular action in the context of existing and approved actions
Baleen whales (listed threatened, migratory and marine) *Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015) *Conservation Management Plan for the Southern Right Whale (Commonwealth of Australia 2012) *Conservation advices (e.g. Sei and Fin whales)	x					x	x		x				x	x

Guidance requires expert input into assessment

- Cumulative impact assessment:

  "*When there are multiple proposals within a region, where possible, proponents should take into account the potential impacts of each project. This supports maximising the utility of a declared area for renewable generation while managing the cumulative environmental impacts of the individual and collective projects upon the region.*"

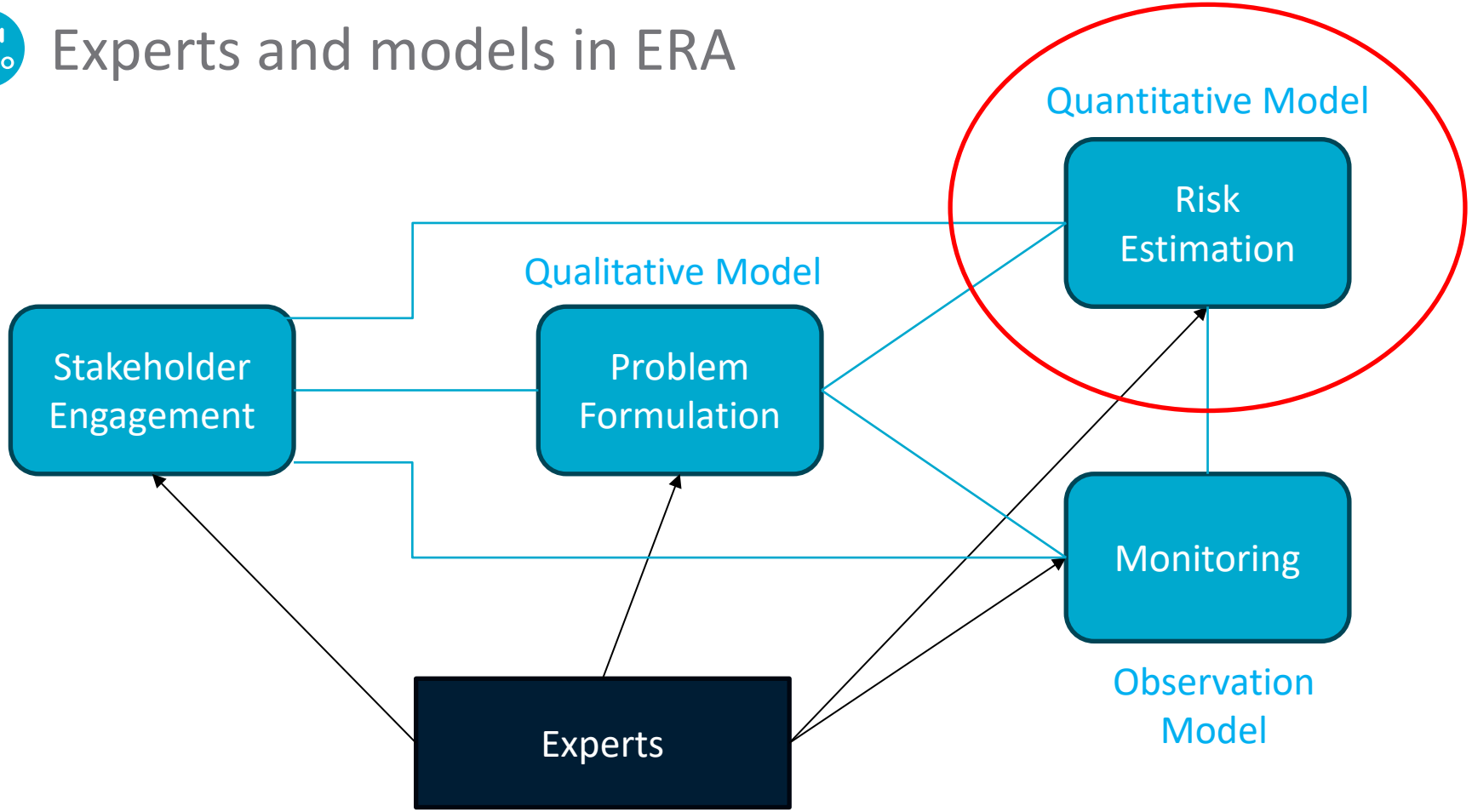
- Focus on estimation of risk: Uncertainty is a recognised feature of assessment process
- Focus on monitoring: Uncertainty reduction and evaluation of mitigation measures

Scientific expertise is required to ensure fit-for-purpose models

- Bayesian approach begins with probabilistic expert elicitation (Hosack 2024)

$$\text{Model} = \text{Data} + \text{Assumptions}$$

Experts and models in ERA



Expert Identification Methodology

Incorporating scientific expertise into ORE

Expertise helps make an assessment robust to model criticism

- "*All models are wrong but some are useful*" (George E. P. Box)
- Defence is a *process* that incorporates diversity of scientific expertise

  → Expertise inputs depend on expert identification methodology

Goals of expert identification methodology:

- *Relevancy* – expertise clearly connected to identified risk areas
- *Representativeness* – sample of participating experts is similar to available pool
- *Transparency* – easy to show why expert included (or not)

Expert ID procedure for ERA

Method developed to ID scientific experts in genetic biotechnology

- Risk assessment for genetically modified mosquitoes (Hosack et al. 2023)

Simplified stepwise process:

1. Identify literature search terms for attributes (e.g., domains of expertise)
2. Bibliometric analysis for each attribute (e.g., *H*-index, number of cites)
3. Multiattribute value analysis integrates sets of expertise
4. Choose experts based on preferential ordering scheme

Example: Blue whale population impacts

Blue whale OR "Balaenoptera musculus" (Title) and **conservation OR status OR extinct* OR (risk AND assess*) OR distribution OR threat* OR migrat* OR abundance** (Abstract)

Filters:
Journal articles
Published 2000-Present
Australian affiliated author(s)

Pool of Candidate Experts

Preferential ordering for selection

- Example for blue whales used *H*-index and total citations
- Top 5 out of 46 experts based on analysis:

Author	Rank
ATTARD CRM	1
BEHEREGARAY LB	1
GILL PC	3
MORRICE MG	3
JENNER KCS	5

Conclusion

Expert identification methodology underpins robust assessment

- ✓ *Relevant*: search of published scientific literature
- ✓ *Representative*: experts selected from identified pool of candidates
- ✓ *Transparent*: declared stepwise procedure

Multiattribute approach allows structured inclusion of other criteria

- Backgrounds, geography, demographics etc.
- Scientific literature is not the only repository of relevant human knowledge

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Hosack, G. R., Beeton, N. J., Ickowicz, A., Peel, D., Wilkins, A., Dambacher, J. M., Wickramarachchi, A., McDonald, M., Tay, W. T., Wilson, L., Bauer, D., and Hayes, K. R. 2023. Risk Assessment for Controlling Mosquito Vectors with Engineered Nucleases: Paternal Male Bias Construct. Report No. EP2022-4945. Hobart, Australia: CSIRO. https://doi.org/10.25919/2t8h-5k81

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Thank you

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Research Scientist

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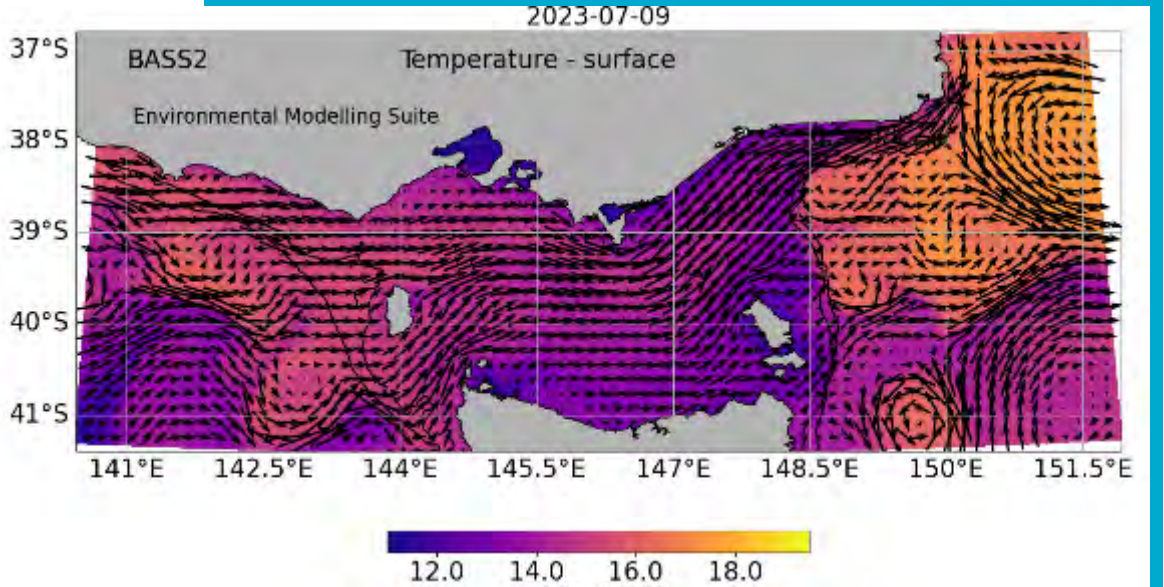
Development of regional modelling and risk assessments to inform offshore renewable decision-making

Current and future Oceanographic conditions in Bass Strait

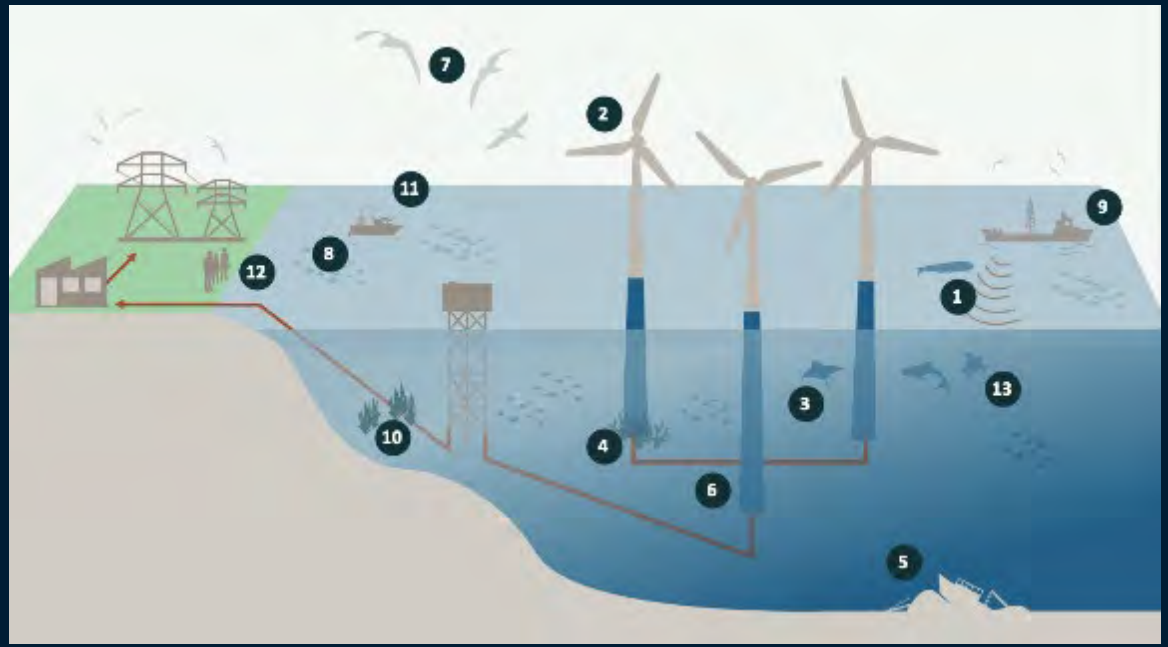
Dynamical modelling to support offshore wind industry development

Clothilde Langlais
Mathieu Mongin, Harris Anderson

9th April 2025
NESP Marine and Coastal Hub workshop



Sources of impact



Dynamical modelling is used to assess:

6. Physical presence –
Effects on hydrodynamics and sediment transport processes

and to provide environmental information to

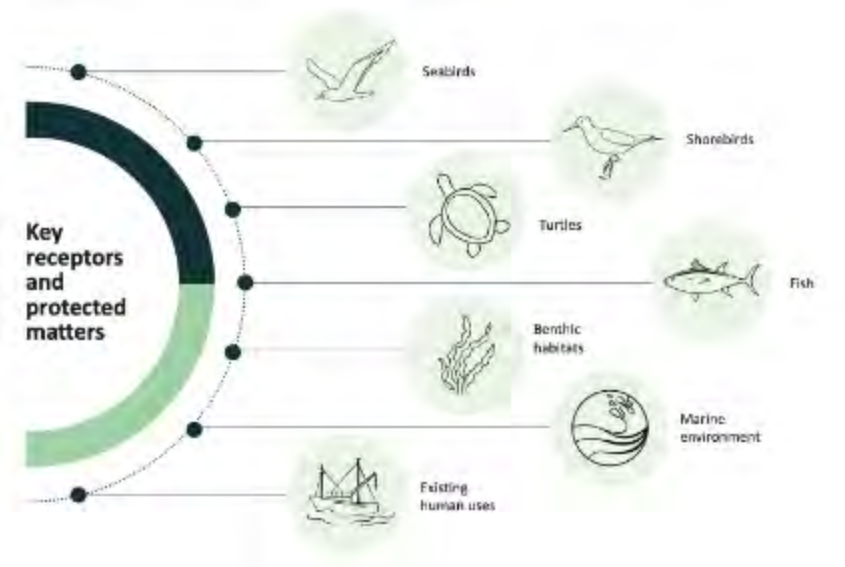
- **Noise modelling**
- **Ecosystem modelling**

Which are used to assess sources of impact 1., 4., 7. 10., 11. and 13.

DCCEEW 2023, GUIDANCE
KEY ENVIRONMENTAL FACTORS FOR OFFSHORE WINDFARM ENVIRONMENTAL IMPACT ASSESSMENT UNDER THE ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999, Department of Climate Change, Energy, the Environment and Water, Canberra, July. CC BY 4.0.

Key environmental factors for impact assessment

Source of impact 6. : Physical presence –
Effects on hydrodynamics and sediment transport processes



minimise modification to hydrodynamic processes and flow on ecological effects.

- Changes in ocean currents, mixed layer depth and upwellings
- Changes in nutrients supply and primary productivity

DCCEEW 2023, GUIDANCE
KEY ENVIRONMENTAL FACTORS FOR OFFSHORE WINDFARM ENVIRONMENTAL IMPACT ASSESSMENT UNDER THE ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999, Department of Climate Change, Energy, the Environment and Water, Canberra, July. CC BY 4.0.

Impact of wind-farm on hydrodynamics

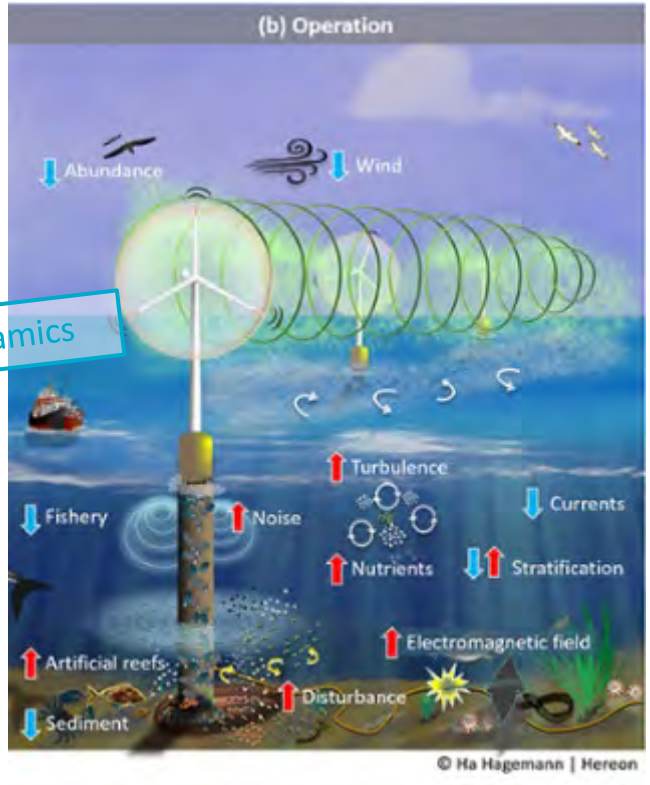
Modification of the atmospheric conditions

"Wind turbines extract kinetic energy from the mean atmospheric flow and convert a part of it into electric energy and the remaining part into turbulent kinetic energy (TKE) that drives wakes and a downwind wind speed deficit" Akhtar et al., 2022

vanBerkel et al., 2020 - Biggest flow on effect on hydrodynamics

Modification of oceanic conditions due to underwater infrastructure

"ocean currents are slower behind the turbines and surface friction at the foundations causes increased turbulent mixing of the water." Benkort et al., 2024



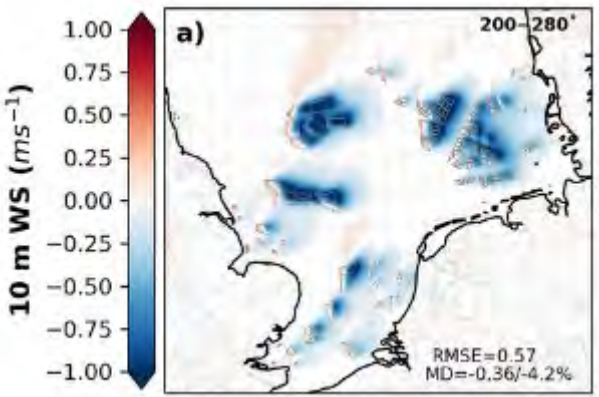
Benkort et al., 2024

Impact of wind-farm on hydrodynamics

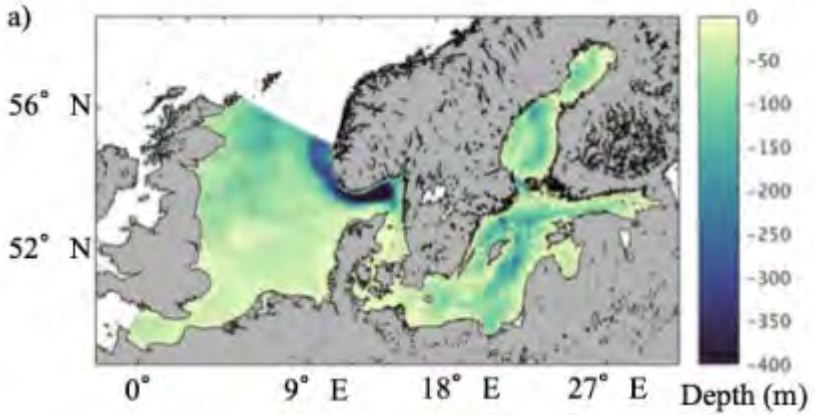
Modification of the wind – North-Sea example

- reduction of **4% of 10m wind**
- reduction of 22–14% of wind at hub height (90m)

10 m Wind speed reduction Akhtar et al., 2022



Daewel et al., 2022



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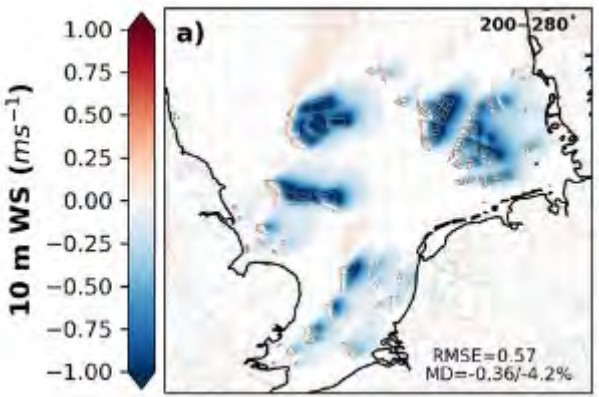
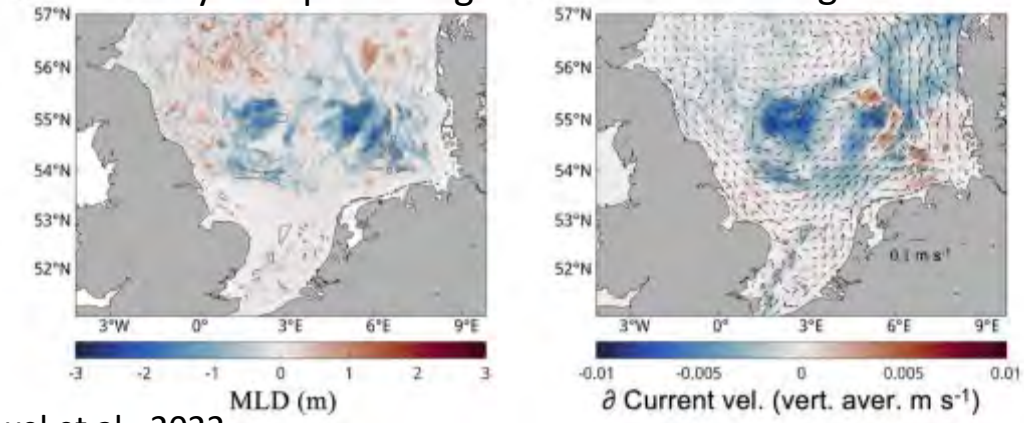


Impact on ocean circulation and mixed layer depth

a) Mixed layer depth changes b) Current changes



Daewel et al., 2022

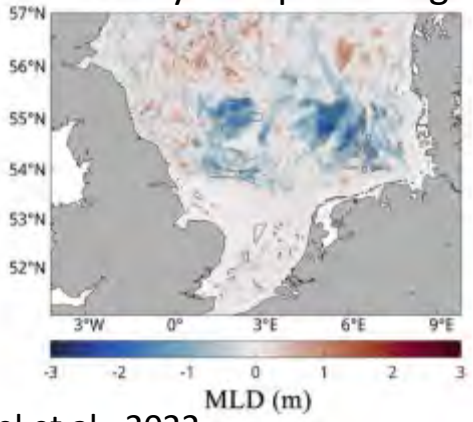
Impact of wind-farm on hydrodynamics

Modification of the wind – North Sea example

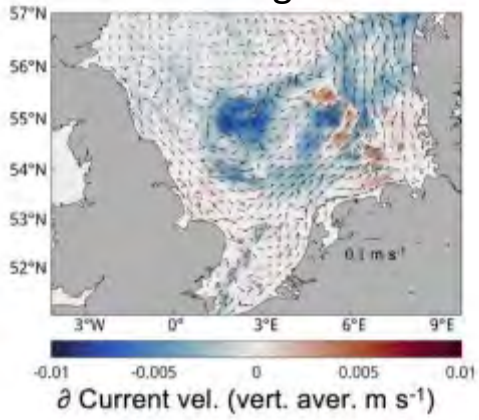
- reduction of **4% of 10m wind**
- reduction of 22–14% of wind at hub height (90m)

Impact on ocean circulation and mixed layer depth, and net primary productivity

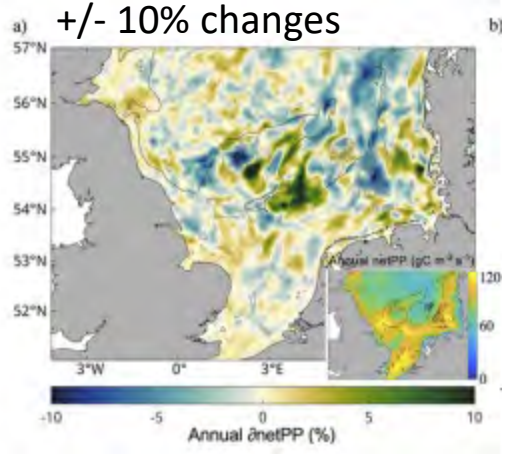
a) Mixed layer depth changes



b) Current changes



+/- 10% changes



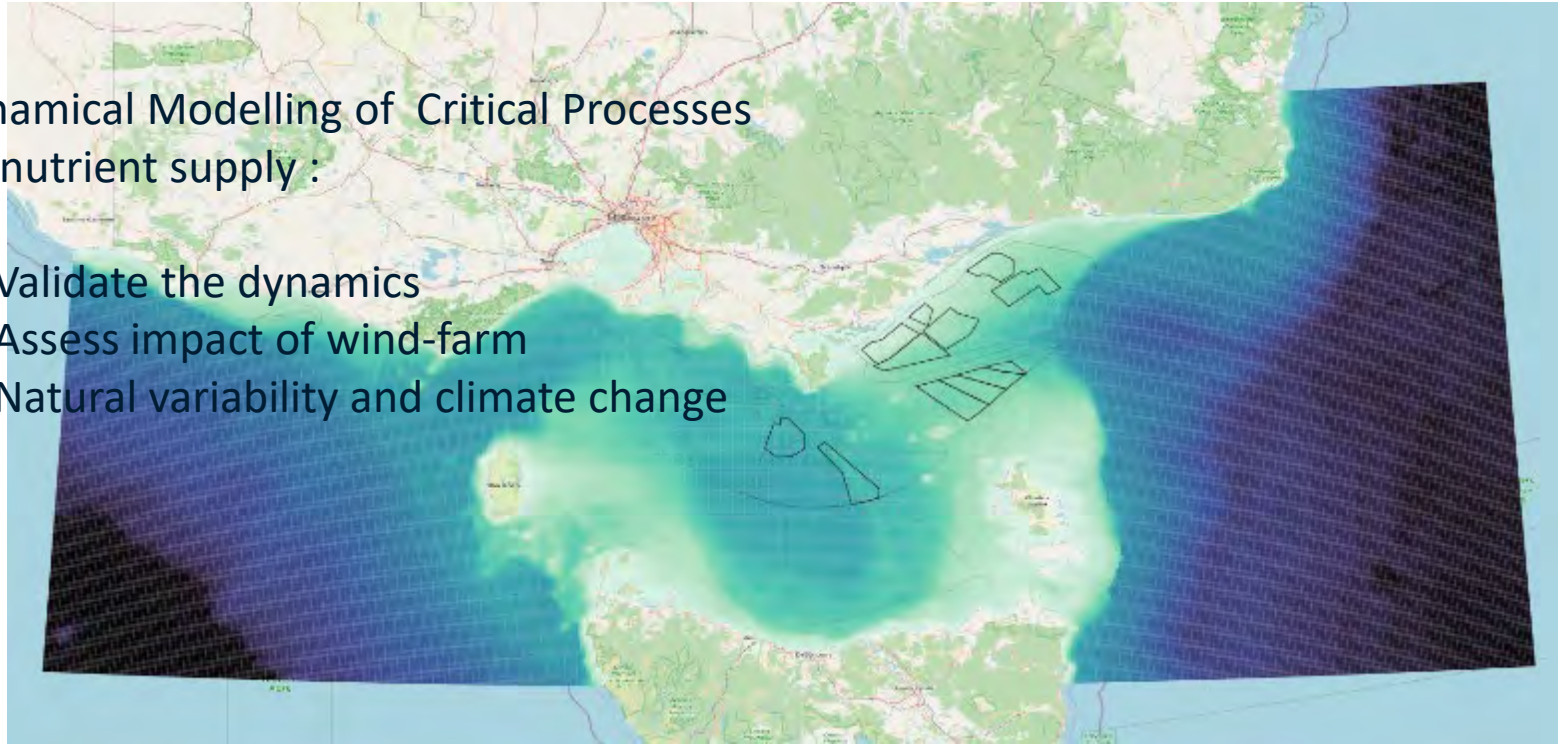
Daewel et al., 2022

Impact of wind-farm on Bass Strait circulation ?

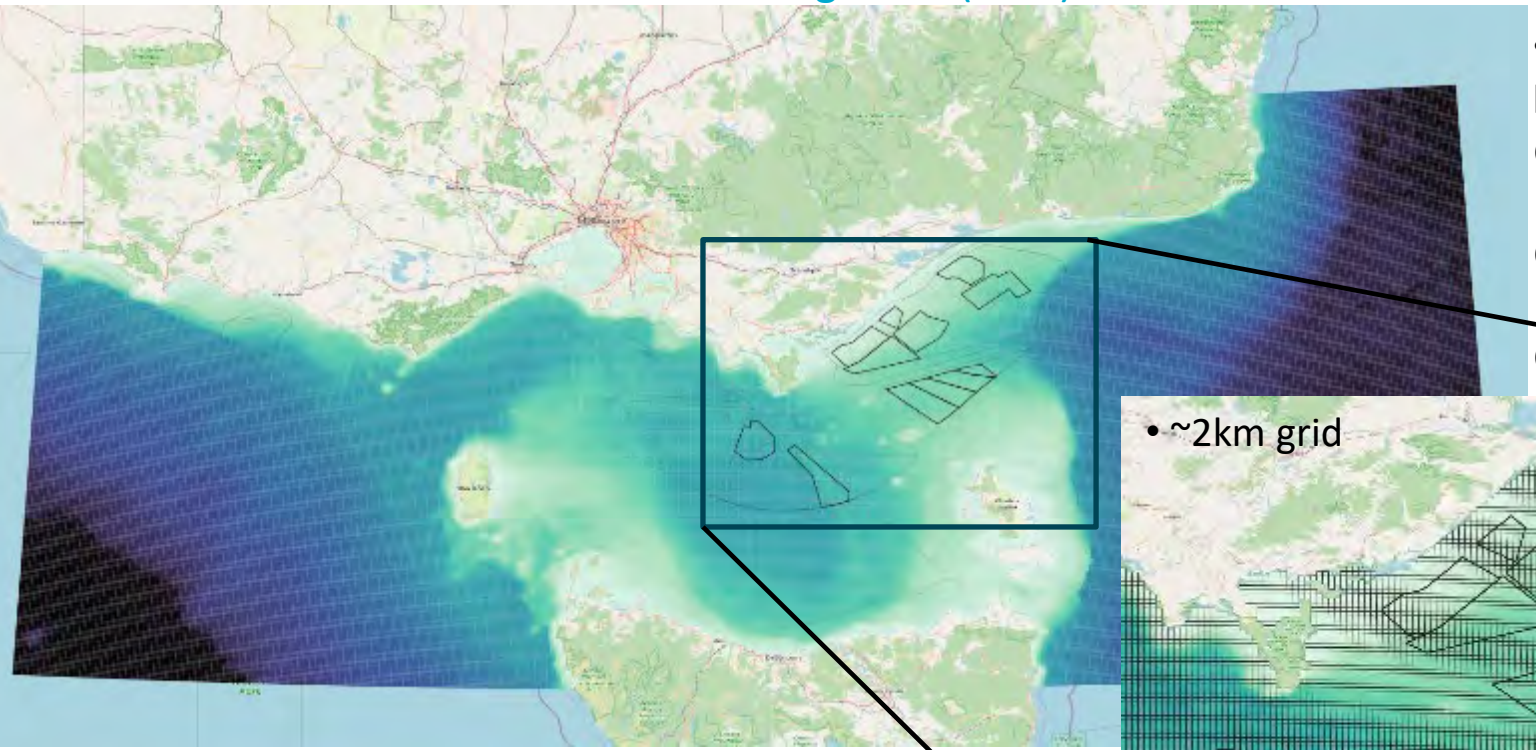
Changes in nutrients supply and primary productivity

Dynamical Modelling of Critical Processes for nutrient supply :

- Validate the dynamics
- Assess impact of wind-farm
- Natural variability and climate change

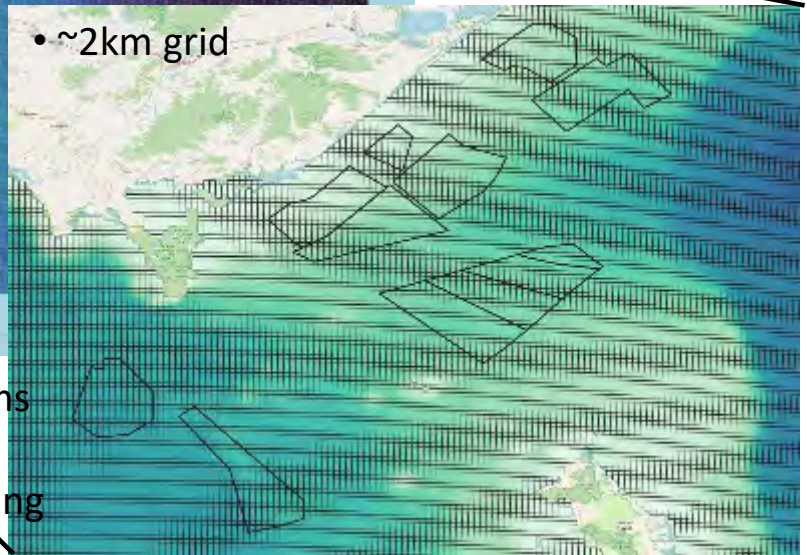


BASS2 2 km hydrodynamical model grid and Bathymetry
CSIRO Environmental Modelling Suite (EMS)



•Driven at boundaries by global reanalysis :

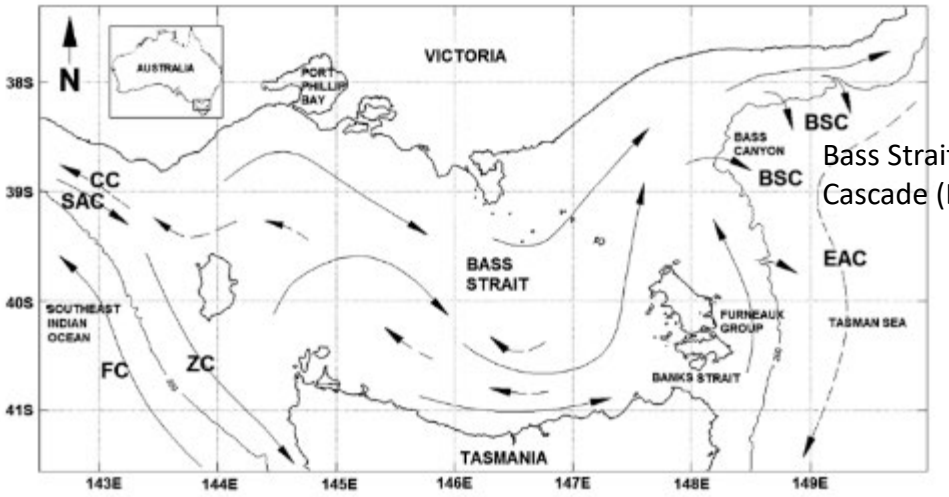
- Atmosphere : BARRA-C1,
- Ocean : BRAN2023,
- Tide : TPXO



• ~2km grid

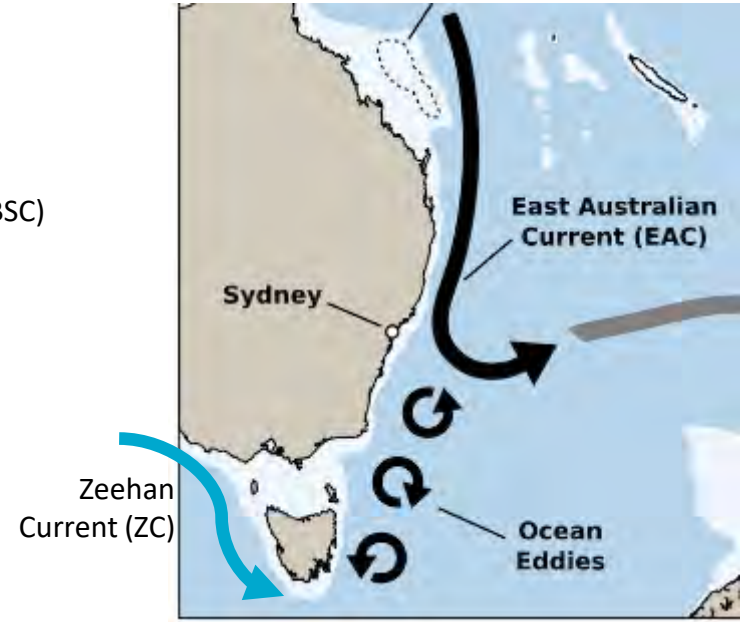
•open ocean boundaries capture the along-shelf current systems
•cover all the shelves areas - needed to simulate the tidal resonances inside the strait, as swell as the stratification in Spring

Circulation in Bass Strait



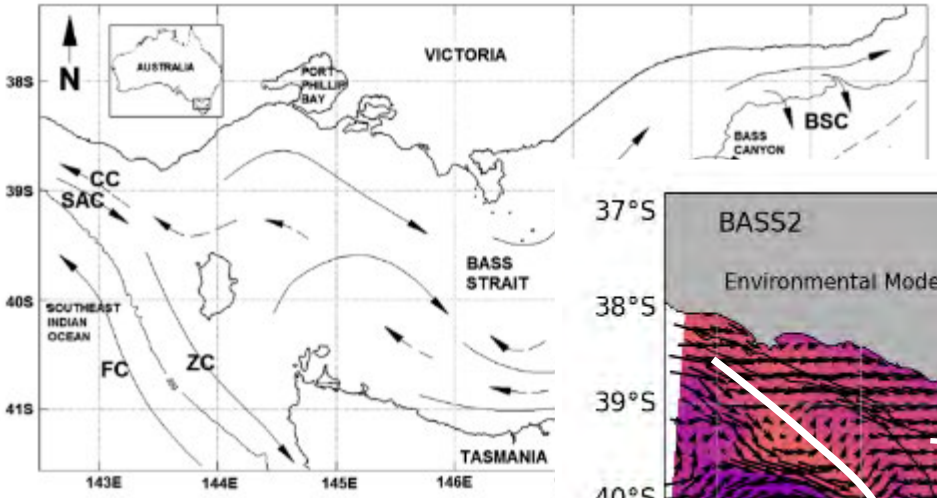
Bass Strait Cascade (BSC)

Sandery and Kampf 2007

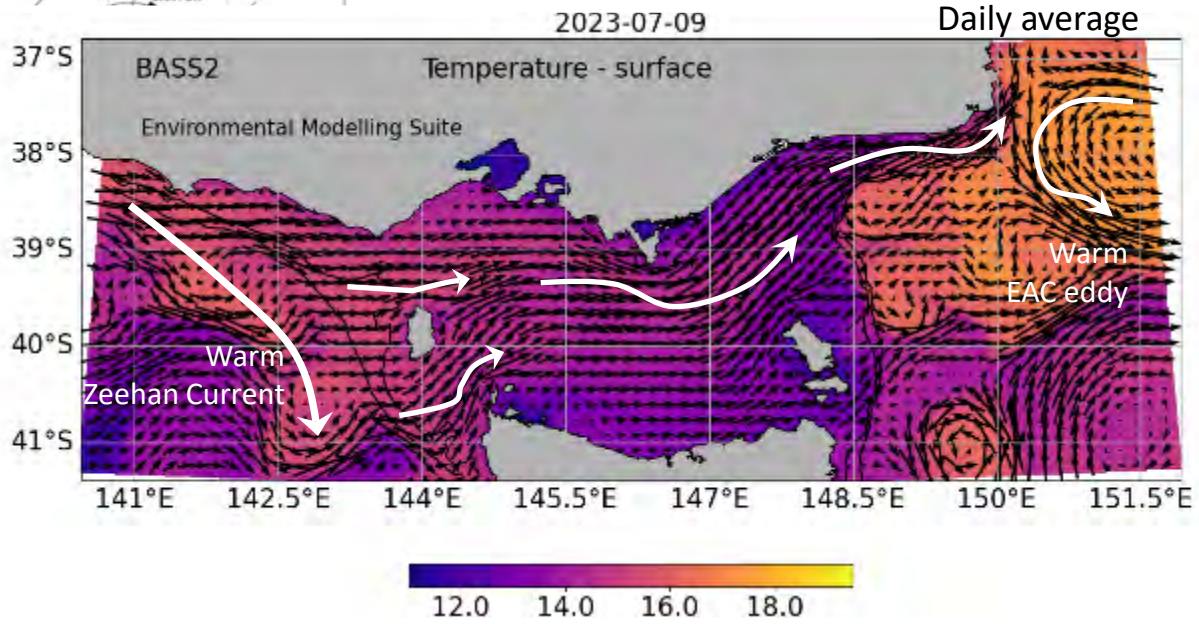


Source : Eric Oliver

Circulation in Bass Strait

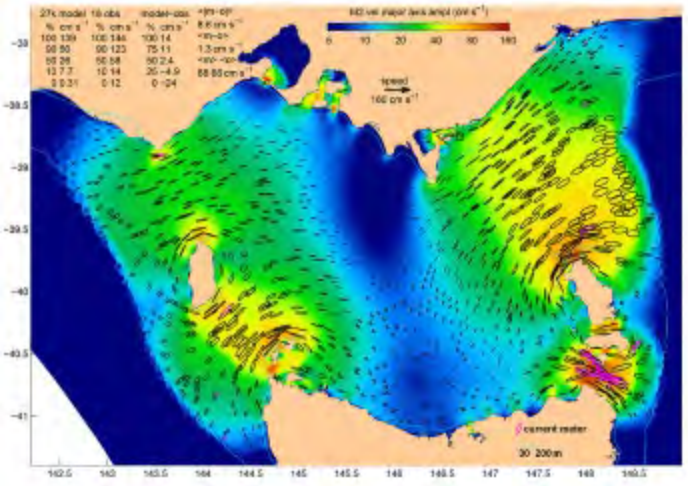


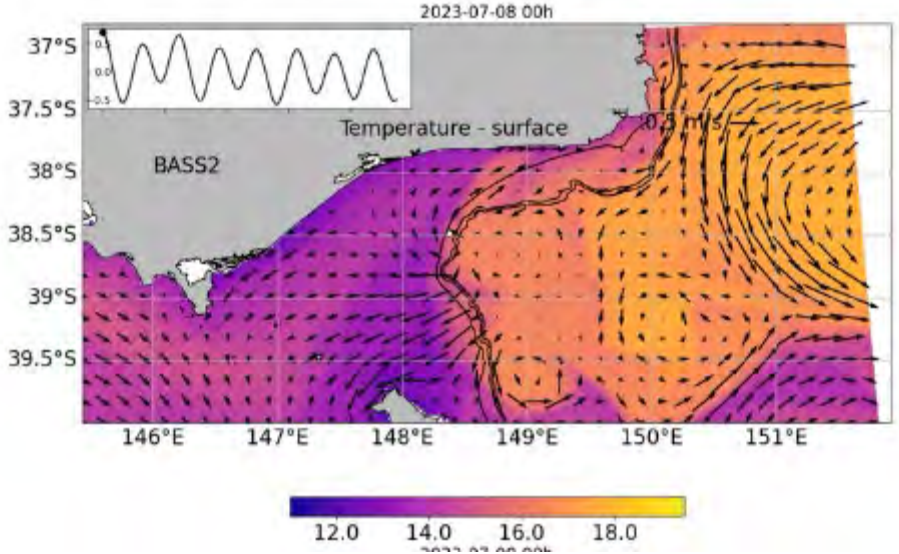
Sandery and Kampf 2007



Circulation in Bass Strait - Tides

Strong tidal currents



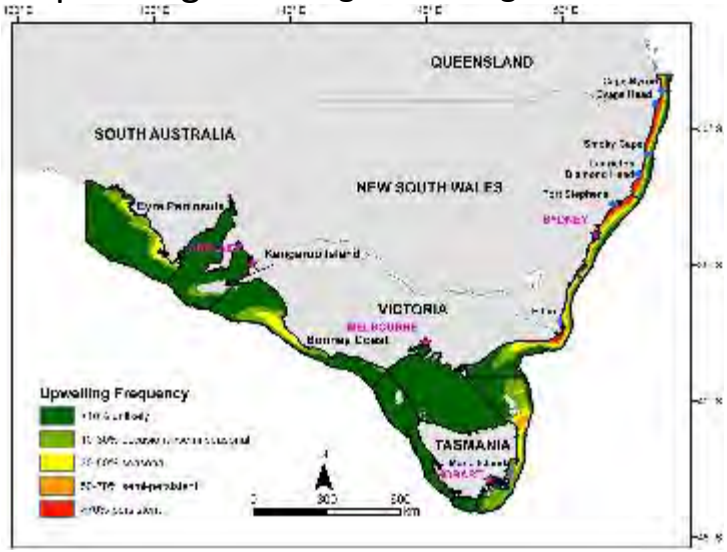


Griffin et al., 2021

4-days hourly animations

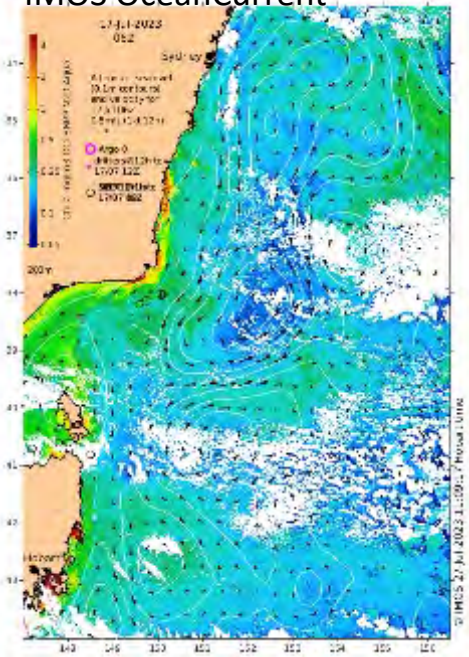
Circulation in Bass Strait - upwellings

Upwellings – Huang and Wang 2019

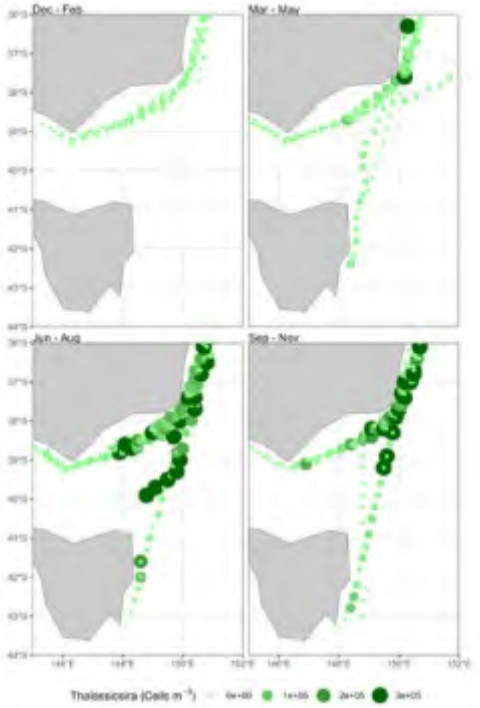


Surface Chl-a

IMOS OceanCurrent



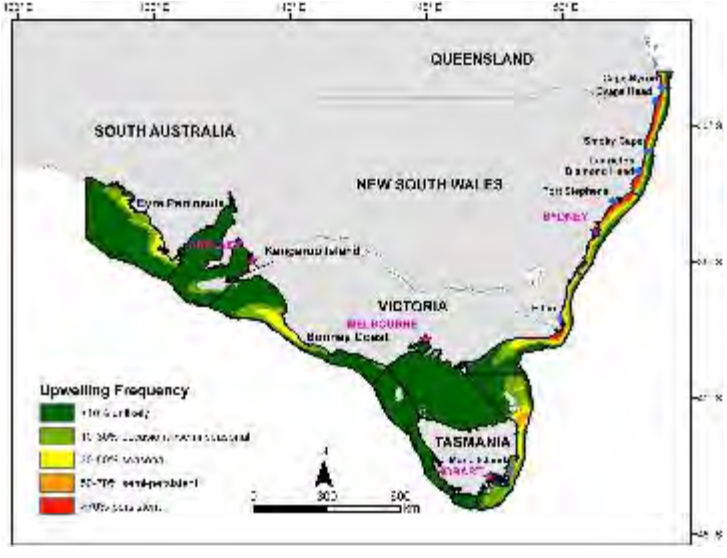
From Claire Davies



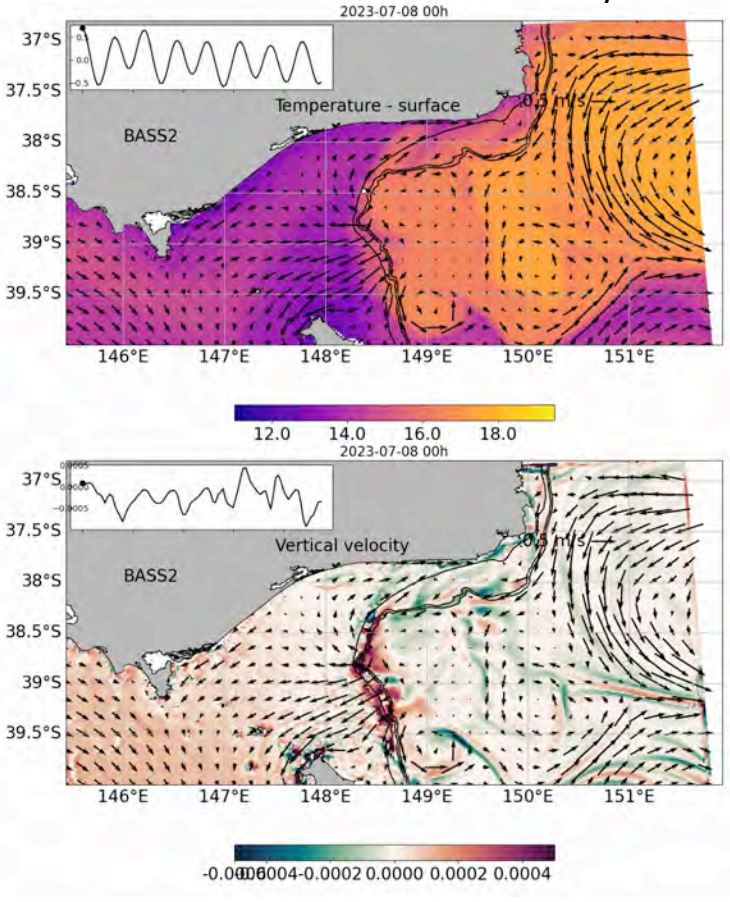
15-y climatology of Thalassiosira
IMOS Australian Continuous Plankton recorder Survey

Circulation in Bass Strait - upwellings

Upwellings – Huang and Wang 2019

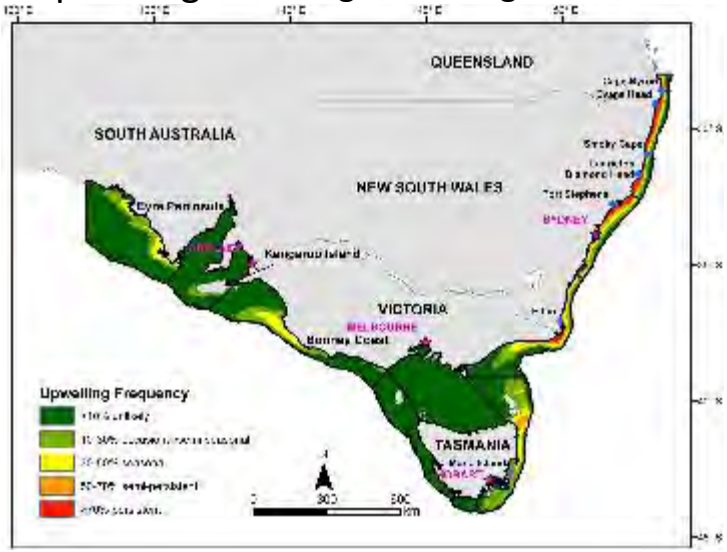


4 days animations



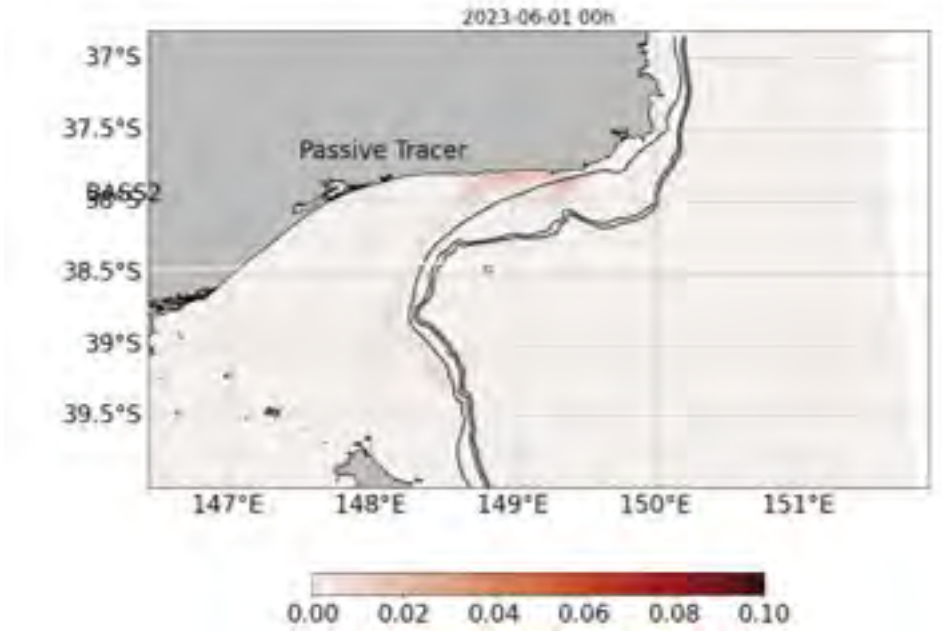
Circulation in Bass Strait - upwellings

Upwellings – Huang and Wang 2019



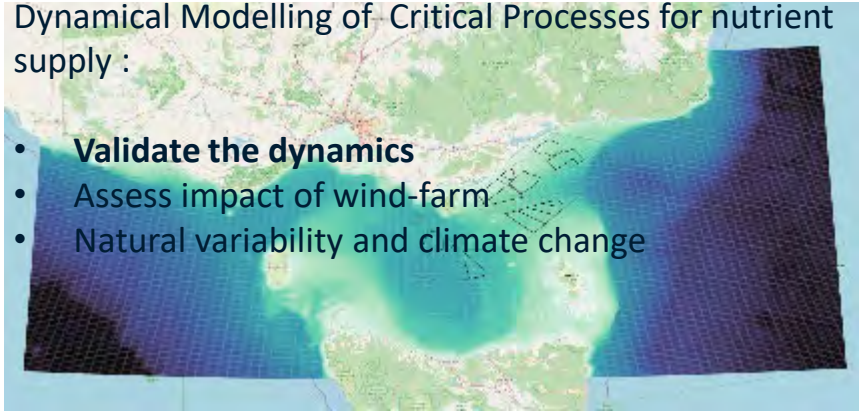
Tracking upwelling pathways

2 months animation



Passive tracer initialized below 400m
Upwelled at the surface

BASS2 dynamical modelling to support offshore wind industry development



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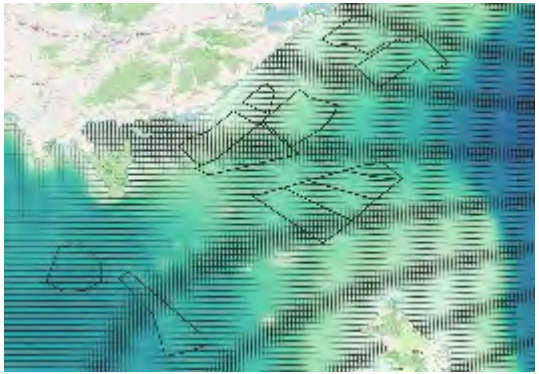


Wind-farm scenarios in development

Wind field:
reduction of **4% of 10m wind**
over the lease areas

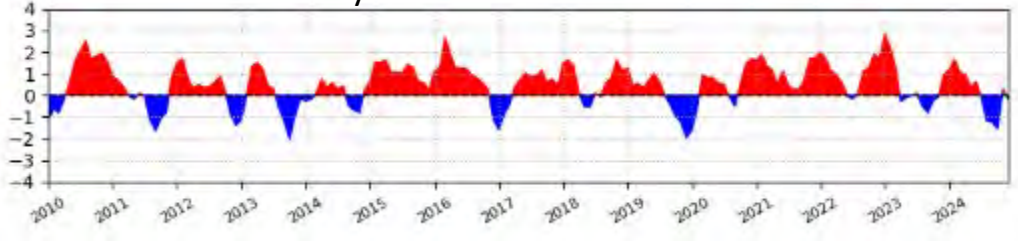
Interannual variability

Southern Annular Mode (SAM) modulates the westerly winds

Southern Annular Mode (SAM): **Negative phase (winter)**

Southern Annular Mode (SAM): **Positive phase (winter)**

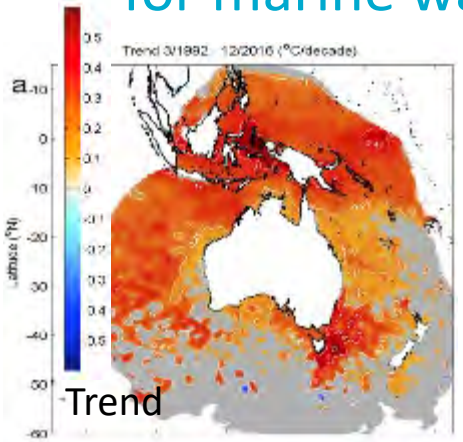
SAM index variability



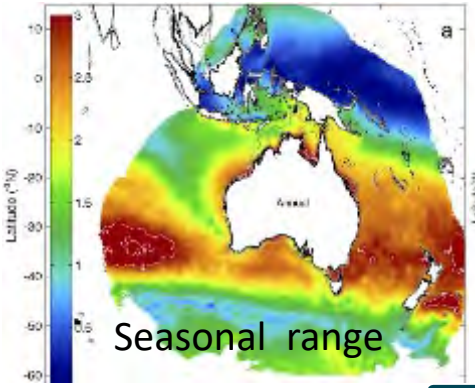
http://www.bom.gov.au/climate/sam/

https://www.cpc.ncep.noaa.gov/products/precip/CWlink/daily_ao_index/aao/month_aao_index.shtml

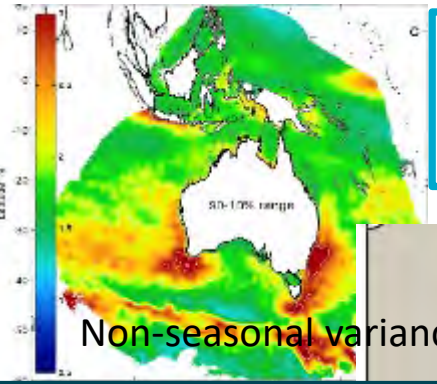
A hotspot of changes and extremes for marine waters and marine ecosystems – role of EAC eddies



Trend



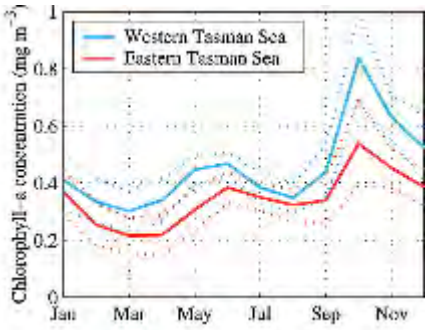
Seasonal range



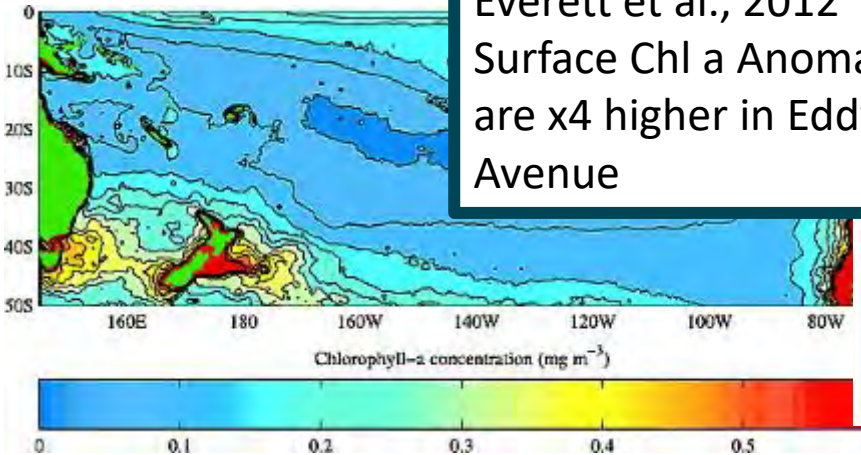
Non-seasonal variance

- 0.5 °C/decade
- 3 °C seasonal
- 3 °C non-seasonal

Wijffels et al., 2018 SSTAARS



Tilburg et al., 2002

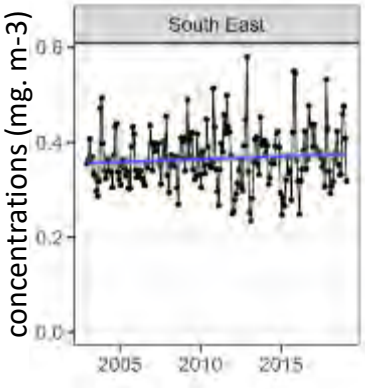


Everett et al., 2012
Surface Chl a Anomalies are x4 higher in Eddy Avenue

Source : Eric Oliver

A hotspot of changes and extremes for marine waters and marine ecosystems – role of EAC eddies

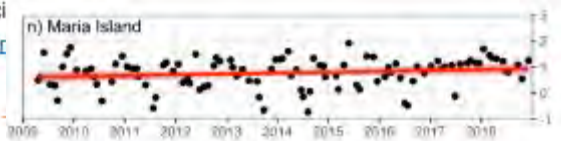
Richardson et al., 2020 - IMOS State and Trend of Australia's ocean report



Mean monthly chlorophyll a

South-east Marine Region

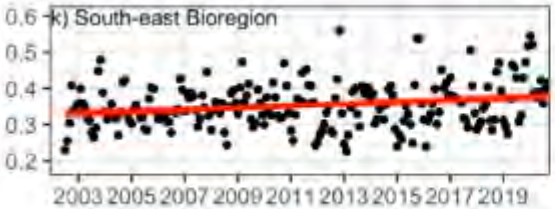
- Fast warming (~1.1°C century⁻¹) with up to ~2°C at Maria Island, Tasmania (Time Series 1.1)
- At Maria Island, surface nitrate is rising, contrary to warming trend, and due to winter mixing and incursion of sub-Antarctic surface waters; surface phosphorous and surface silicon is declining (Time Series 1.5)
- Relatively low net primary production (423 mg C m⁻² d⁻¹) (Time Series 2.2)
- Zooplankton abundance and biomass increasing at Maria Island (Time Series 2.3)
- Summer peaks of tropical *Prochlorococcus* and sub-tropical *Synechococcus* at Maria Island indicate prolonged exposure to warmer waters via EAC extension (Time Series 2.6)
- Low water transparency (Time Series 3.1)
- Presence of warm-water *Tripos paradoxides* increases in winter (Time Series 3.3)
- Abundance of HABs is typically below trigger levels, with some exceptions. There is however evidence that abundance is increasing (Time Series 3.4)
- Range expansion of *Noctiluca scintillans* into Tasmania (1994) and the Southern Ocean (2010, 2013) (Time Series 3.6)
- Warm water copepod species increased in abundance at Maria Island, while cold water speci
- Some evidence that calcifying zooplankton may be sensitive to falling aragonite saturation (Tir
- North/south shift in latitudinal trend of larval fish assemblages below 35°S (Time Series 4.6)



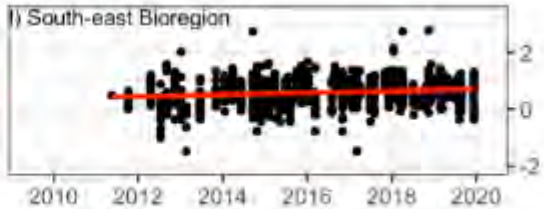
Zooplankton Biomass (log10 mg m-3)

Richardson et al., 2021 -Water column (epipelagic, 0-200m)

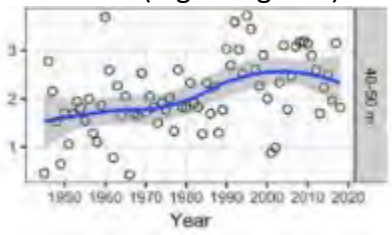
IMOS Australian Continuous Plankton Recorder (AusCPR) survey.



Chla Biomass (mg m-3)

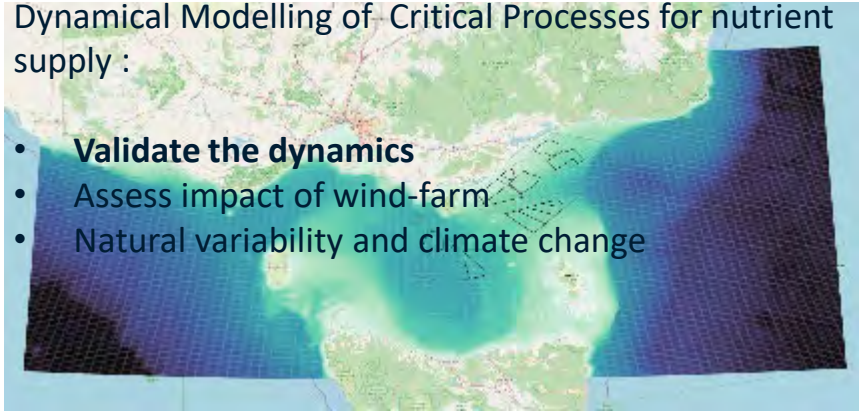


Zooplankton Biomass (log10 mg m-3)



Annual time series of nitrate

BASS2 dynamical modelling to support offshore wind industry development



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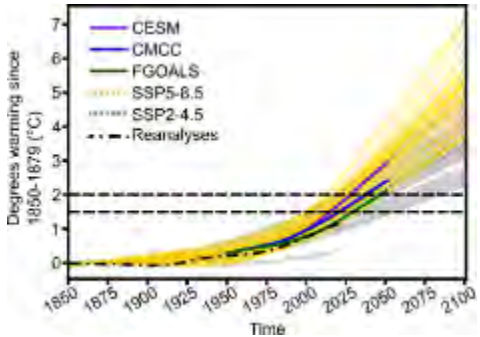
Full BGC in development

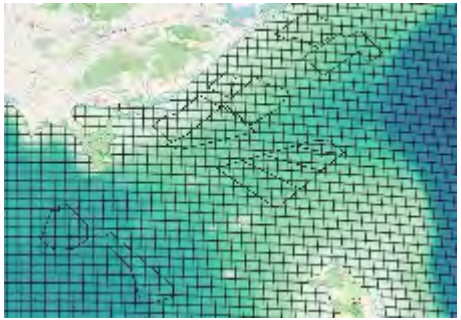
Future conditions in development

2024-2040



Wind-farm scenarios in development

Wind field:
reduction of **4% of 10m wind** over the lease areas

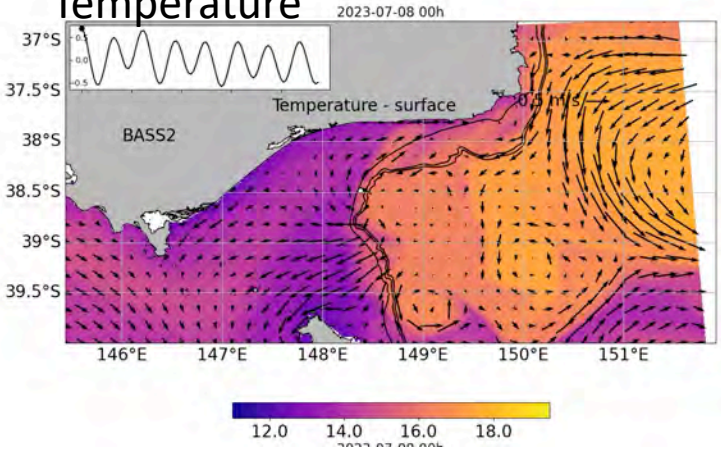


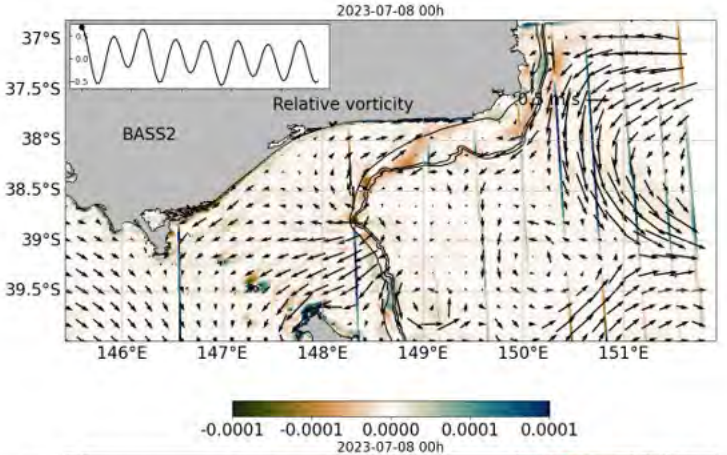
CSIRO

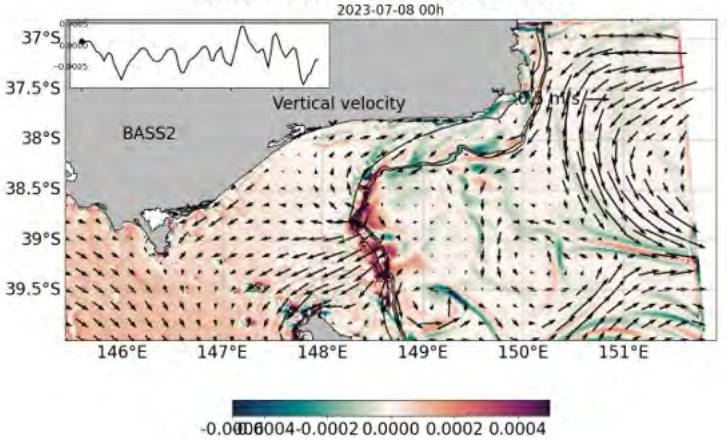
Australia’s National Science Agency

Winter 2023 during SEA-MES1

Temperature







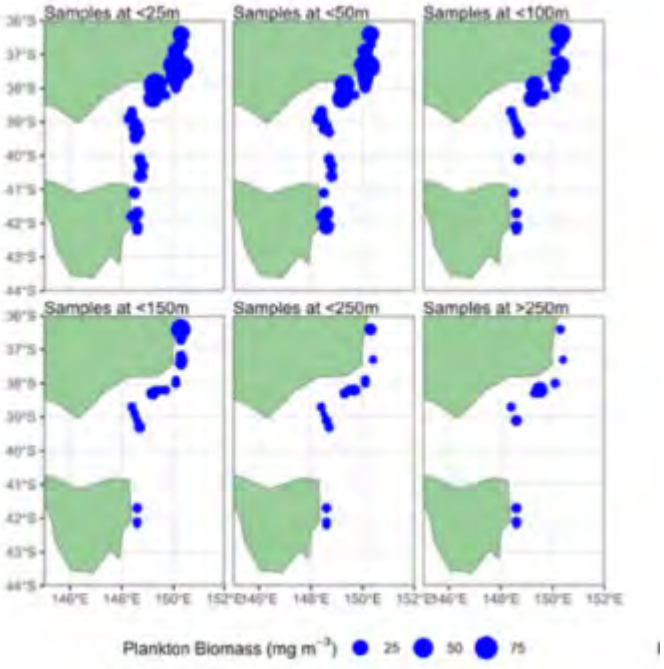
- Warm EAC eddy – MHW
- Eastward Bass Strait jet
- Frontal instabilities – curvature vorticity
- Horizontal shear – shear vorticity

  → vertical velocities
- Strong Tidal current – divergence of the flow

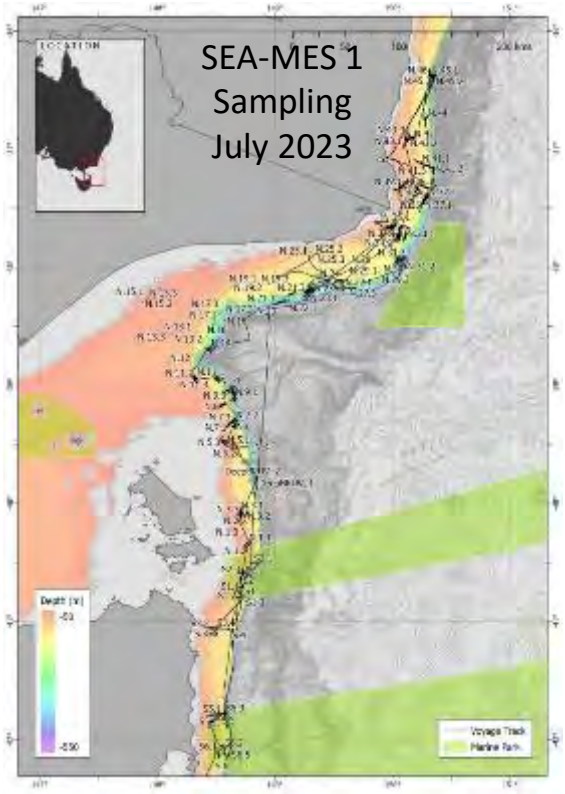
  → Vertical velocities

Observations of Winter bloom and nutrient pathways

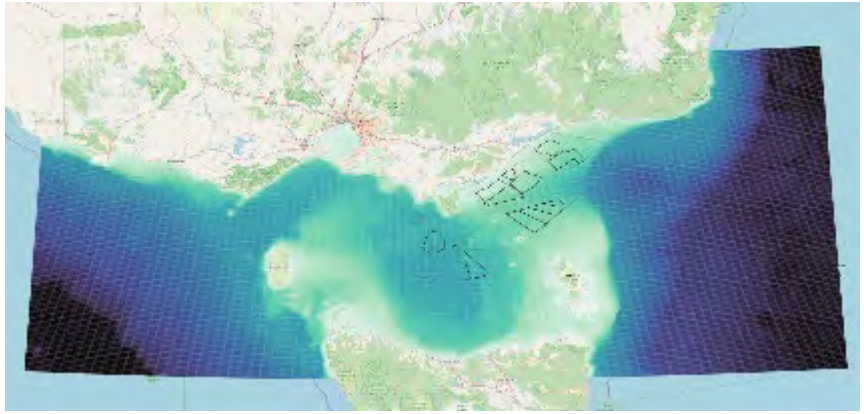
From Claire Davies



SEA-MES 1 plankton biomass:
combination of the phytoplankton bloom and the target zooplankton



BASS2 dynamical modelling to support offshore wind industry development



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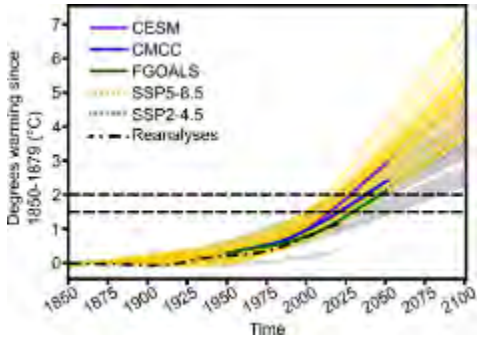
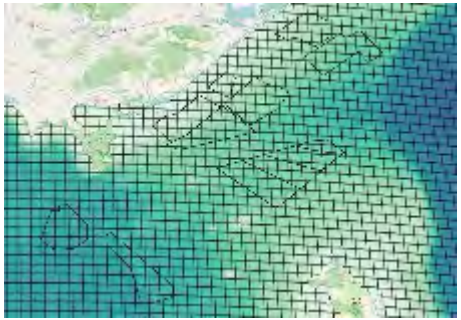


Wind-farm scenarios in development

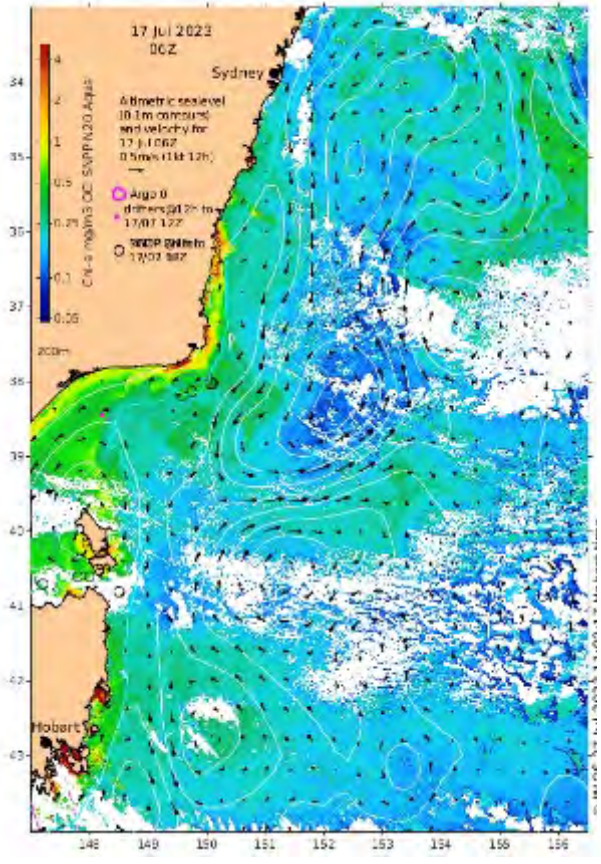
Wind field:
reduction of **4% of 10m wind** over the lease areas

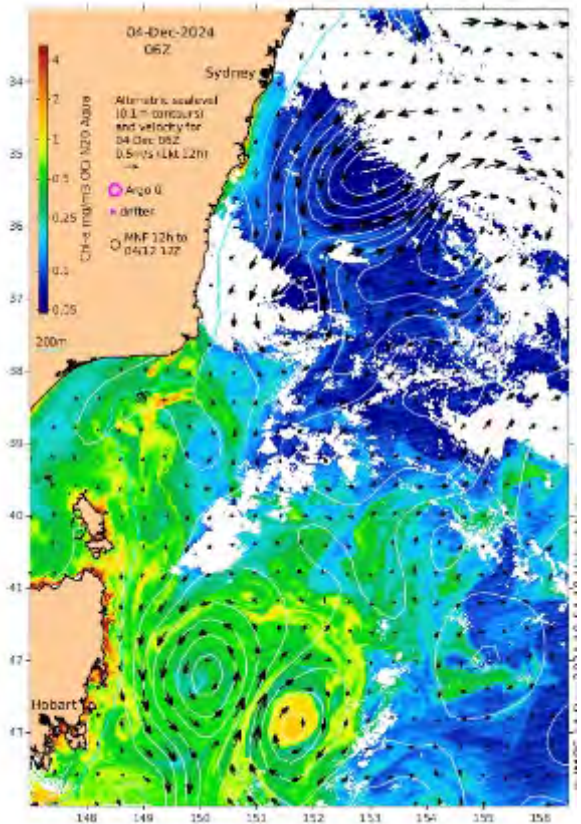
In-water obstruction:
increased mixing (4–20% of the bottom friction Carpenter et al., 2016) resulting in reduced stratification.



Circulation in Bass Strait – upwellings and Chla

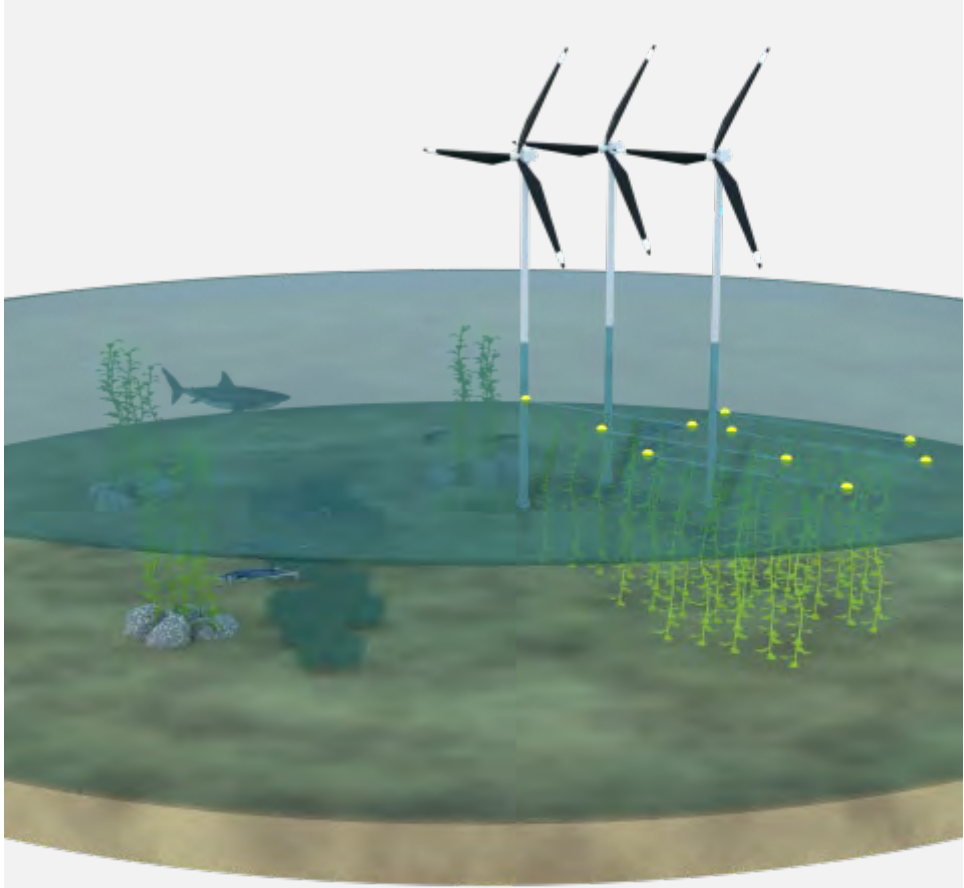
Upwellings – Huang and Wang 2019





Modelling cumulative effects

Beth Fulton | 2025



Ecosystem Modelling - Roadmap

- What are ecosystem models
- Model map
- Model ecology
- Human components

- **Text like this indicates points where input from you would be VERY helpful**

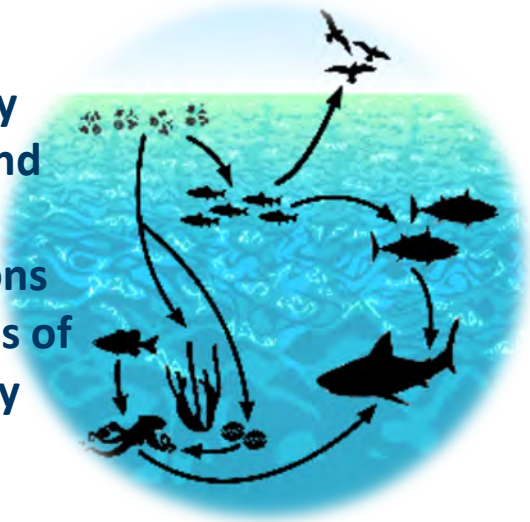
Marine Model Roadmap

Ecosystem Modelling - Ensemble

- Ensemble approach
  - 2 different model types (so we can cover structural uncertainty)
  - Do they come to same answers? If yes more confident

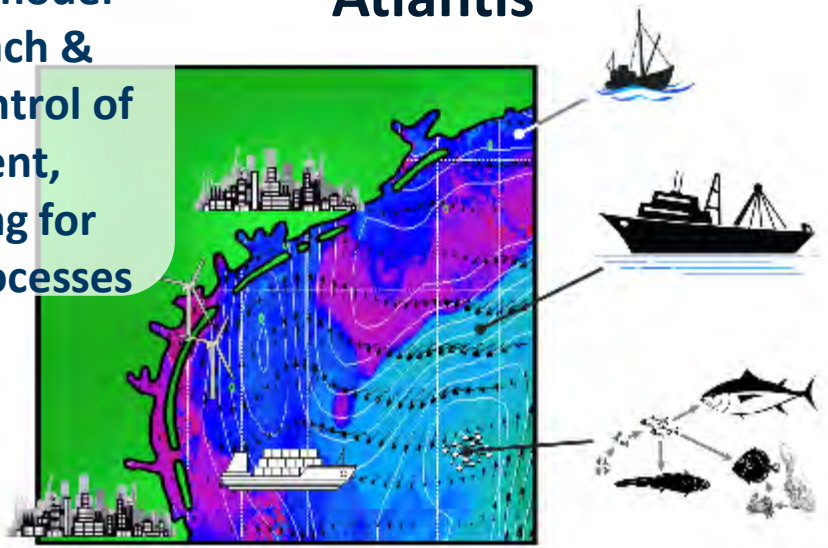
Ecopath with Ecosim

Primarily trophic and habitat connections and sources of mortality



Hybrid model approach & more control of content, allowing for more processes

Atlantis



Use of Models

Our use

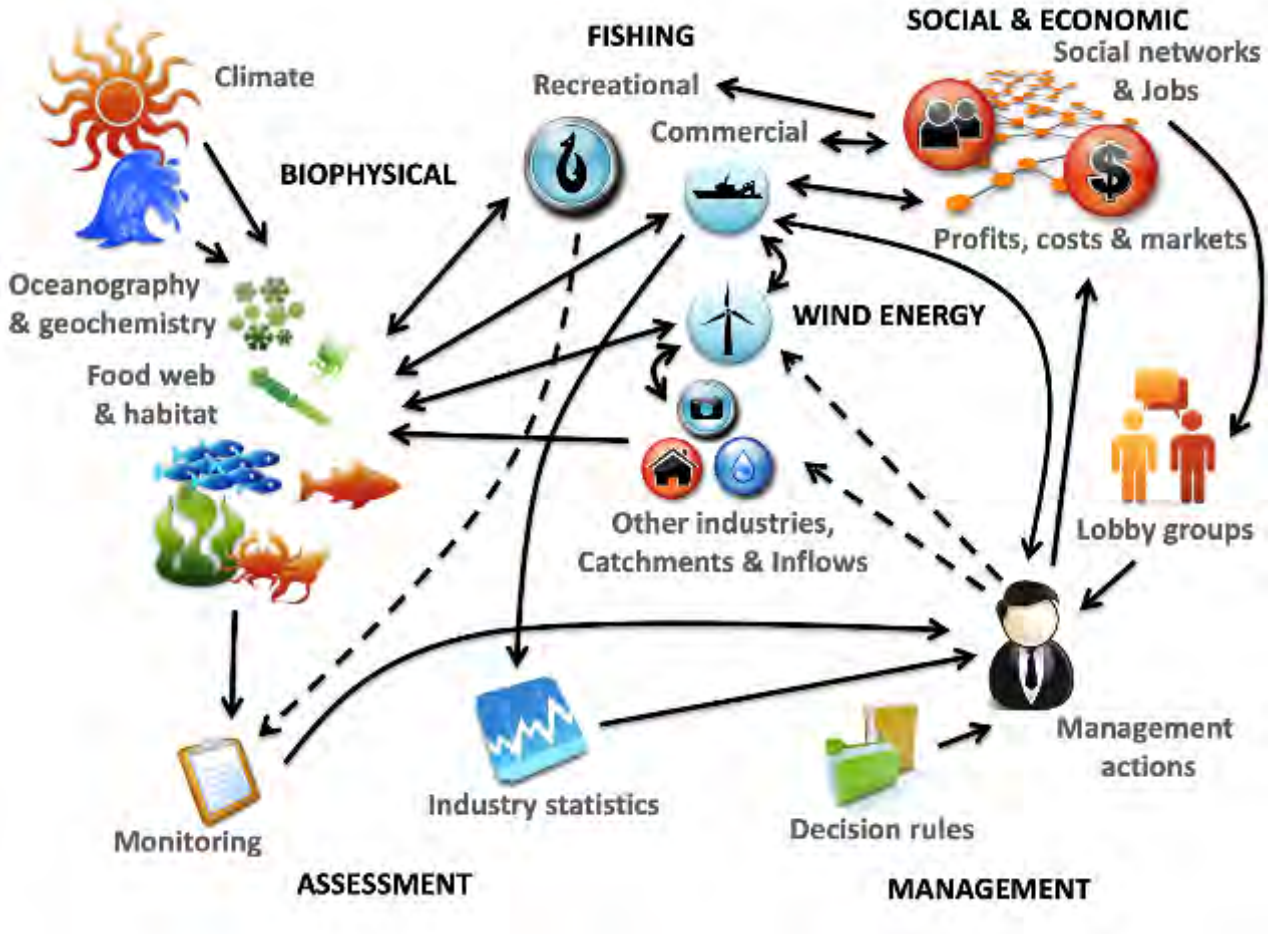
Conceptual (understanding)

Tactical (year-to-year)

Strategic (planning)

- Staged deployment (& interoperable)
- For: understanding, forecast/hindcast, management insights (testbed for options)

Model Content Concept (Simplistically)



- System perspective
- Fishery detail (dialled back a little in this model)
- Add/expanded wind energy. (non-fishery) relevant detail
- EwE = different way to look at same things

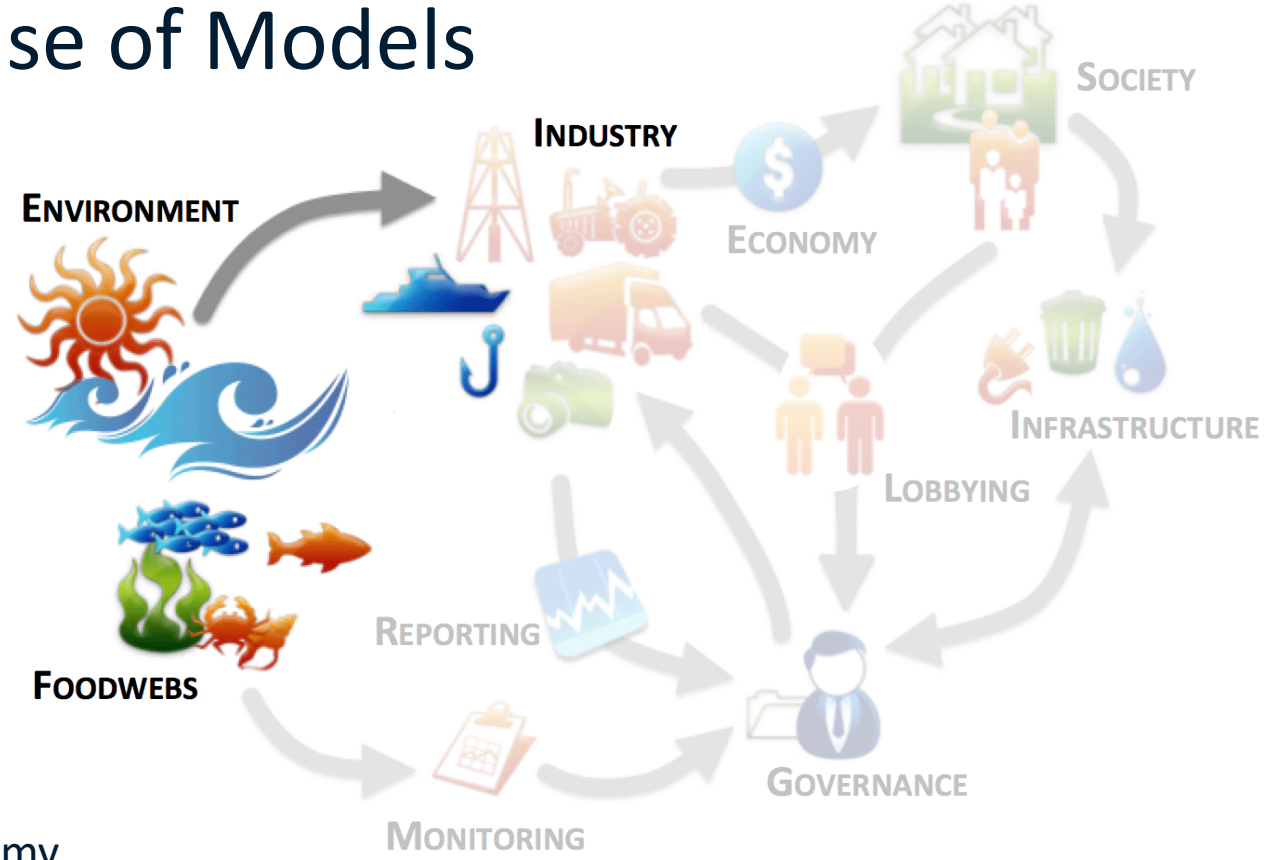
Expanding Use of Models

Focus through time

- Food web
- Simple fisheries

- Management loop
- Sustainable fisheries

- Climate impacts
- Socioecology
- More industries
- Ecotoxicology
- Multiple use EBM
- Sustainable Blue Economy



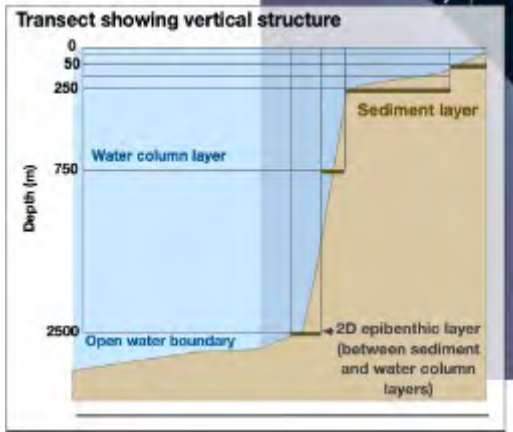
- Improved skill assessments & links to new empirical datasets

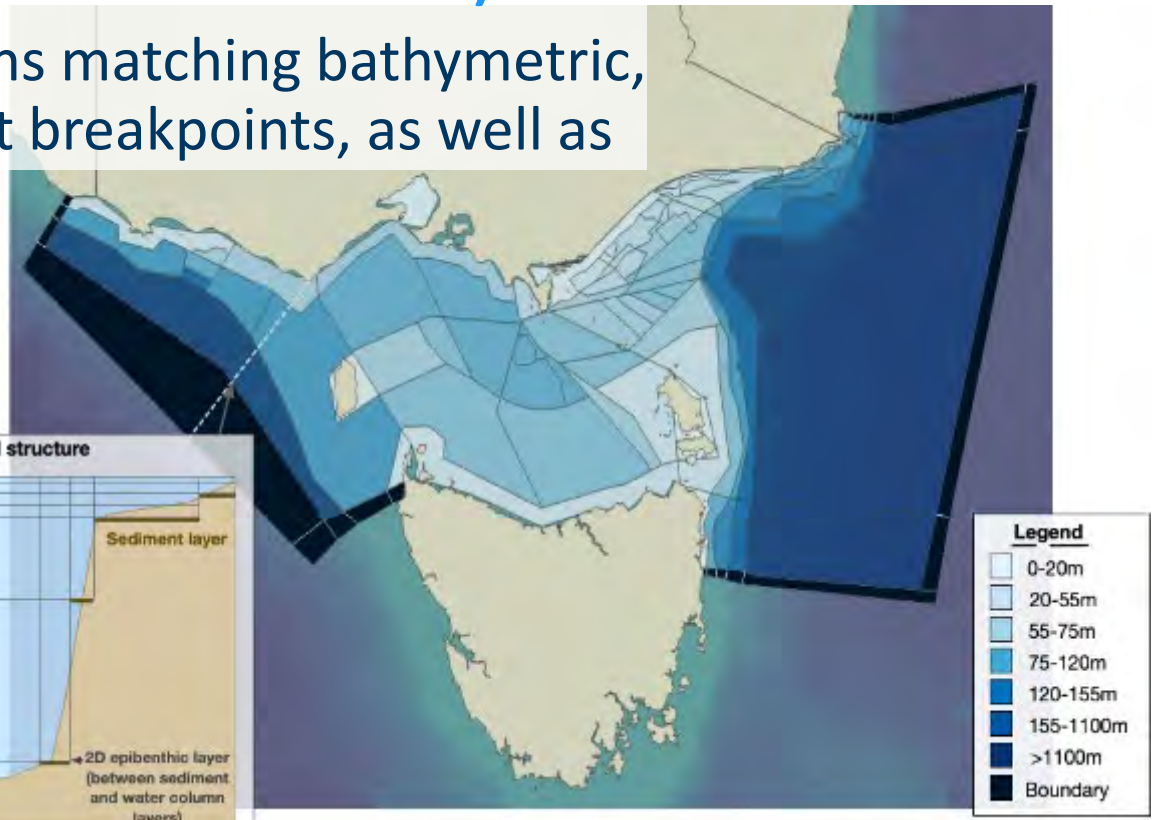
Ecosystem Modelling – Previous Use

- Atlantis
  - 25+ years
  - 45+ systems
  - Marine and large lake applications
- EwE = 7000+ applications globally
- Fisheries dominant more & more cumulative effects

Model Content – Map(s)

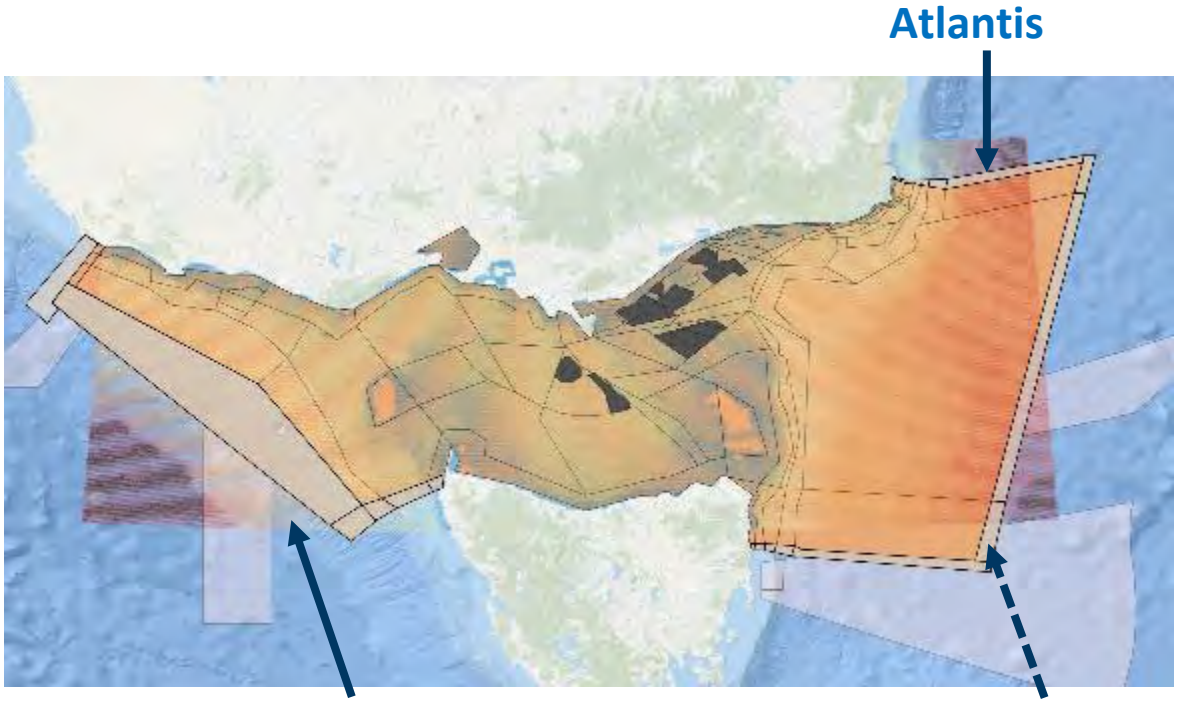
- EwE = regular grid **(how fine should this be?)**
- Atlantis = irregular polygons matching bathymetric, oceanographic and habitat breakpoints, as well as lease (and other zoning) boundaries





Model Content – Physics

- Physical environment
  - temperature
  - salinity
  - pH
  - current flow
  - suspended sediment
  - drawn from specialist hydrodynamic & climate models



Light grey = Atlantis bounding box (for model accounting purposes so doesn't matter if outside the oceanographic grid)

Model Content

Pelagic invertebrates & flora
- Large phytoplankton (diatoms)
- Small phytoplankton
- Microzooplankton
- Mesozooplankton
- Large zooplankton
- Gelatinous zooplankton
- Squid (inshore and deeper)

Benthic invertebrates & flora
- *Kelp*
- *Seagrass*
- Urchins
- Abalone
- Octopus
- Lobster
- Scallop
- *Other bivalves*
- *Sponges, corals (small & large)*
- *Other shallow filter feeders*
- Benthic deposit feeders
- Benthic carnivores (polychaetes)
- Crabs
- Prawns
- Other macrozoobenthos
- Other megabenthos

Sharks
- Demersal sharks
- Pelagic sharks
- Green eye dogfish
- Spikey dogshark
- Gulper sharks
- Gummy shark
- School shark
- Great white
- Grey Nurse
- Skates and rays

Iconic & Apex predators
- Gulls
- Shearwaters
- Australian Gannet
- Albatross & Petrels
- Little Penguin
- Fur seals (Longnose & Australian)
- Sea lions
- Baleen whales (Humpback, Right, Blue)
- Orcas
- Dolphins

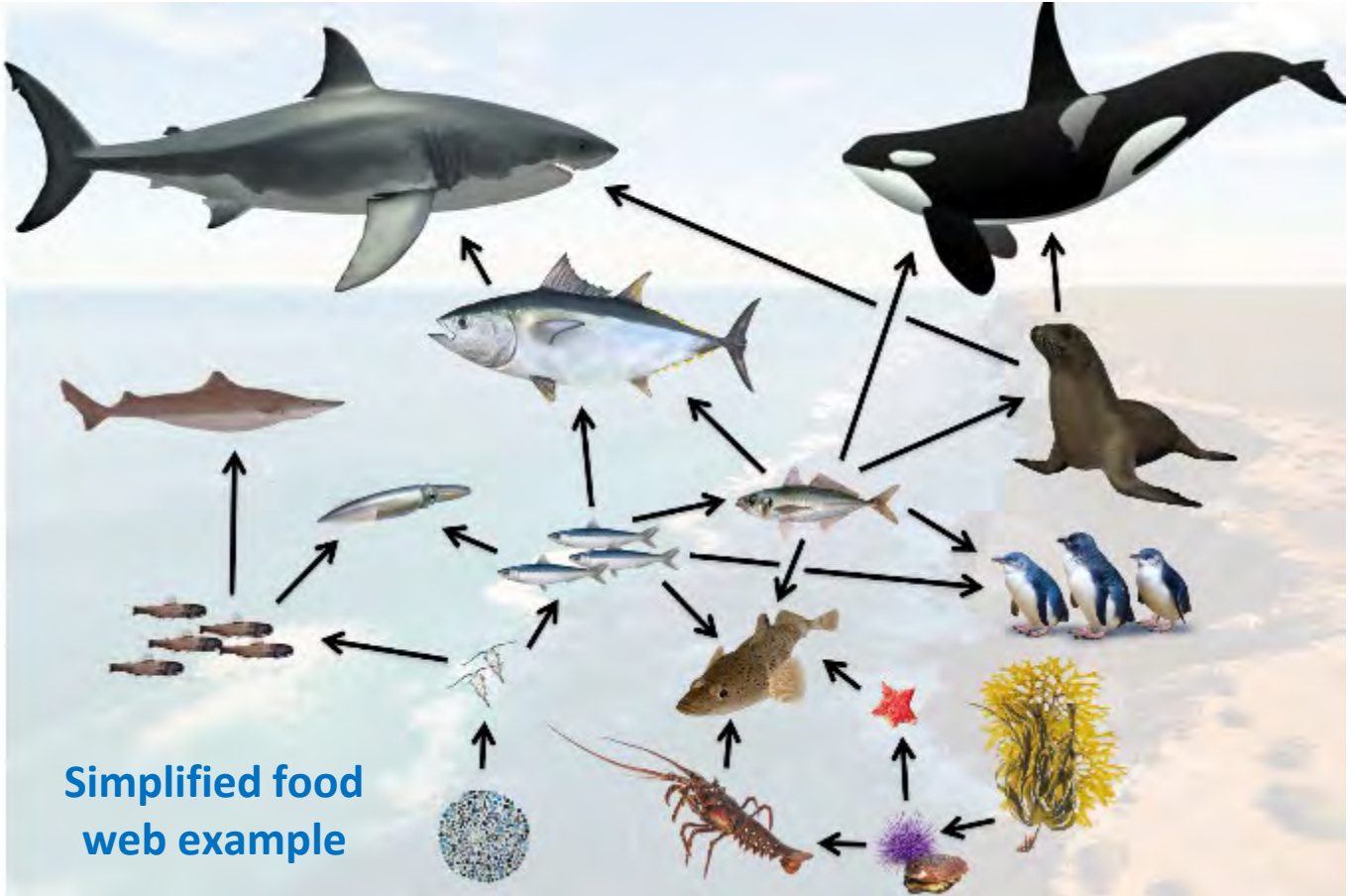
Fin-fish
- Small pelagics
- Mackerel
- Red bait
- Shallow piscivores
- Tuna and billfish (tropical; SBT)
- Myctophids
- Non-migratory mesopelagics
- Banded morwong
- Purple wrasse
- Shallow demersal reef fish
- Large piscivores
- School whiting
- Flatheads
- Shallow demersal fish
- Redfish
- Cardinalfish
- Gemfish
- Spotted Warehou
- Blue Warehou
- Redfish
- Other shallow demersal fish
- Shallow piscivores
- Blue-eye trevalla
- Blue grenadier
- Ribaldo
- Pink Ling
- Orange Roughy
- Dories and Oreos
- Deep demersal fish
- Magpie perch
- Territorial fish
- Herring cale
- Blue throat wrasse

Detritus
- Discards
- Labile (fast turnover)
- Refractory (slow turnover)

Microfauna
- Pelagic bacteria
- Benthic bacteria
- Meiobenthos

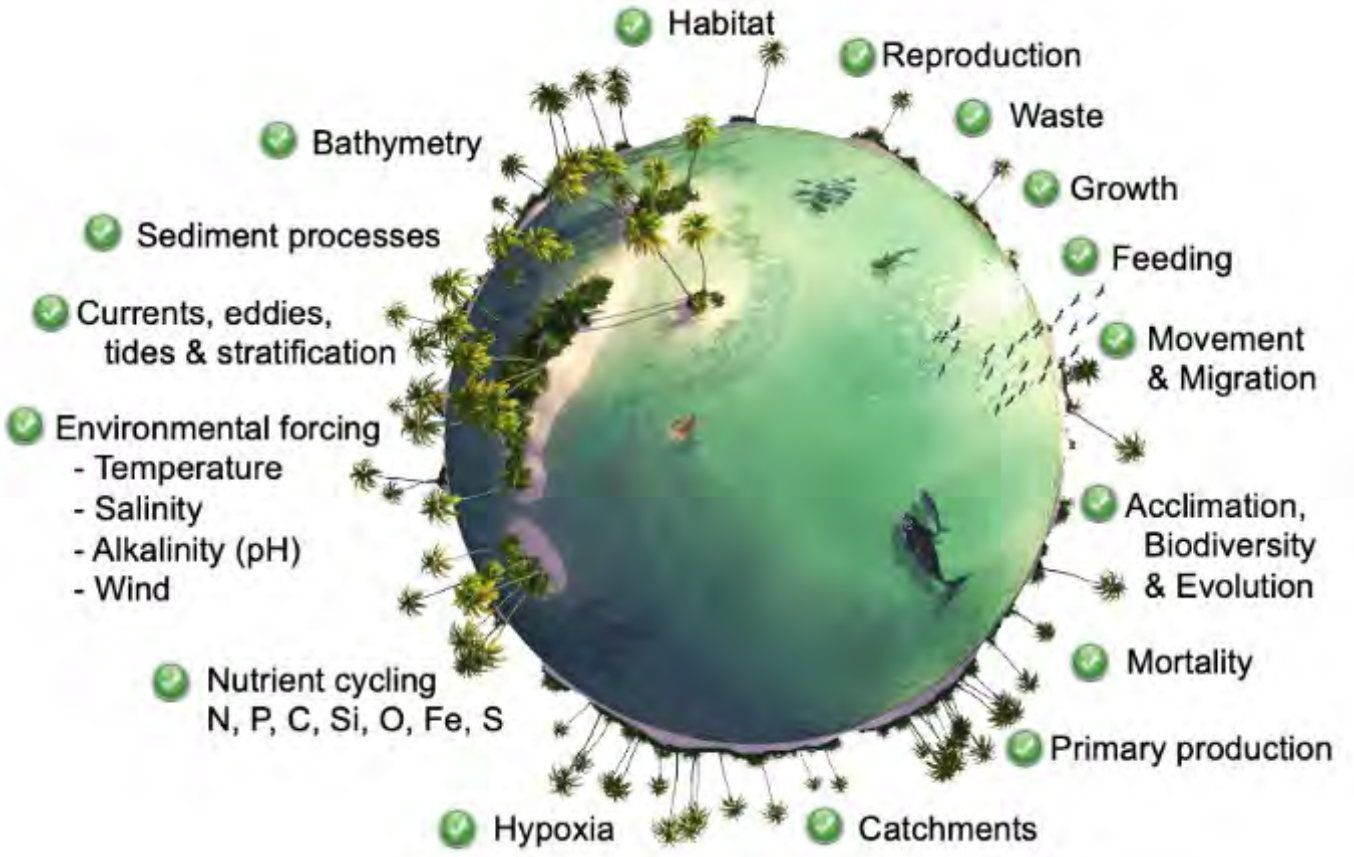
Range Extending Species
- Pink snapper
- Octopus
- Urchins
- Yellowtail Kingfish
- **Others?**

Model Content – Ecology (Example)



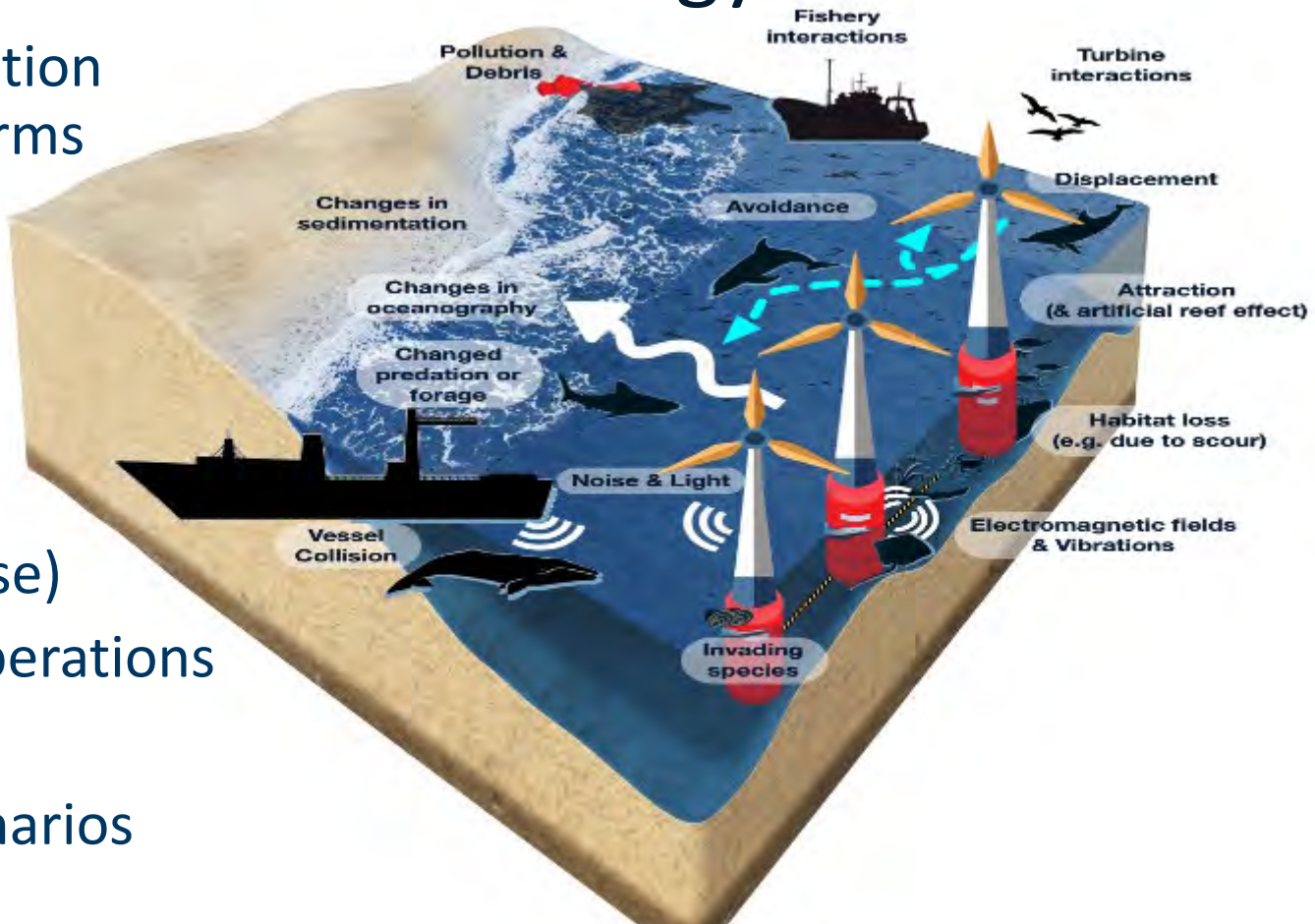
- Some at species level
- Some as functional groups
- Vertebrates & key invertebrates = size and age structured
- Others as biomass pools

Model Content – Ecological Processes



Model Content – Wind Energy

- Dynamic representation of all of the main forms of interaction
- Parameterised based on literature
- Using output form other models (e.g. hydrodynamics, noise)
- Construction and operations
- **Need help:**
  - development scenarios (timelines)



Model Content – Fisheries

- Fisheries in all the same detail as used for AFMA
  - metiers (different gears and what they target)
  - AFMA and State fleets
  - fleet dynamics (vessel sizes, targeting, spatial movement, home ports, economic drivers etc)
  - management rules
- **Zoning scenarios - begin defined** but as example:
  - exclusion from entire lease
  - exclusion from operational area
  - cables tracks (for some gears)

Model Content – Other Industries

- Shipping traffic (growth through time)
- Aquaculture leases
- **Other industries to consider?**

Status & Next Steps

- Now
  - Refining content based on feedback to date (if we are missing anything critical let us know now!)
  - Processing other model output as Atlantis input
- Coming (near future)
  - Validating model against latest available data
  - Simulations

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Australia's National Science Agency