Australian Government

Australian Institute of Marine Science

North West Shoals to Shore Research Program

Quantifying movement, distribution and important areas of pygmy blue whales on the North West Shelf

Michele Thums, Luciana Ferreira, Curt Jenner, Micheline Jenner, Danielle Harris, Andrew Davenport, Virginia Andrews-Goff, Mike Double, Luciana Moller, Rob McCauley

Michele Thums

September 2020

AIMS: Australia's tropical marine research agency.

Photo: Peter Gill

Acknowledgements

AIMS acknowledges the Traditional Owners of Country throughout the northern coast of Western Australia where this North West Shoals to Shore Research Program work was undertaken. We recognise these People's ongoing spiritual and physical connection to Country and pay our respects to their Aboriginal Elders past, present and emerging.

CANPASS & BART - Macquarie University, GeoScience Australia, ANSIR, Huaiyu Yuan, Garrick Paskos and Alexey Goncharov

Peter Farrell, Chris Teasdale, Libby Howitt, Mark Chinkin, Paul Thomson, Chari Pattiaratchi, Olwyn Hunt, Tiffany Klein, Nick Thake, Crew and staff of RV Whale Song

Margie Morrice, Natalie Kelly, Peter Gill, Brian Miller, Jason How


Nick Thake

Acknowledgements

This work was conducted as part of the North West Shoals to Shore Research Program which was proudly sponsored by Santos as part of the company's commitment to better understand WA's marine environment.

We acknowledge HESS, the INPEX-operated Ichthys LNG and Woodside Energy Ltd (Woodside) as Operator for and on behalf of the Browse Joint Venture (BJV) for making data available.

Santos

Curtin University

Centre for WHALE RESEARCH WESTERN AUSTRALIA

IAGC

Woodside

CREEM

INPEX

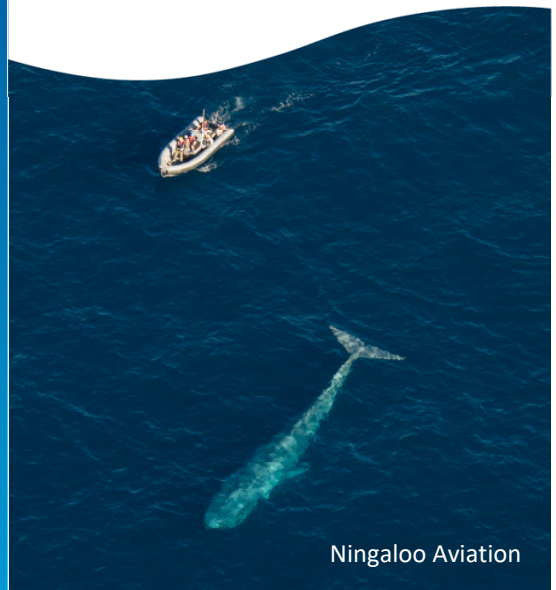
IMOS Integrated Marine Observing System

Background

Pygmy blue whale

Listed Endangered species under EPBC Act 1999

Blue whales are largest animal in the world (up to 30 m, 120 tonnes), pygmy blue whale is a sub-species



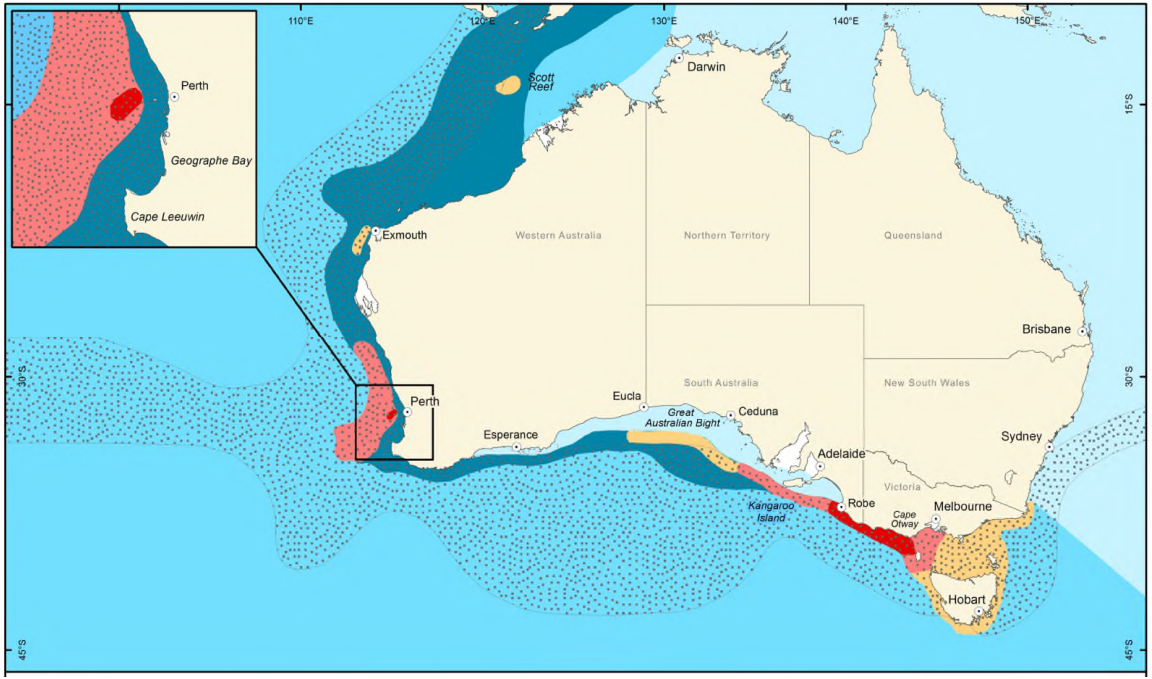
Ningaloo Aviation

- Found in the Southern Ocean, Indian Ocean and South Pacific Ocean
- Group which visits Western & southern Australia - Eastern Indian Ocean pygmy blue whale
- Migrate along the WA coastline to Indonesia
- Occur at low density, far from shore and spend much of their lives underwater
- These aspects make them difficult to study

Australian Government

Australian Institute of Marine Science

Pygmy blue whale distribution



Foraging area (annual high use area)

Known foraging area

Possible foraging area

Known to occur

Likely to occur

May to occur

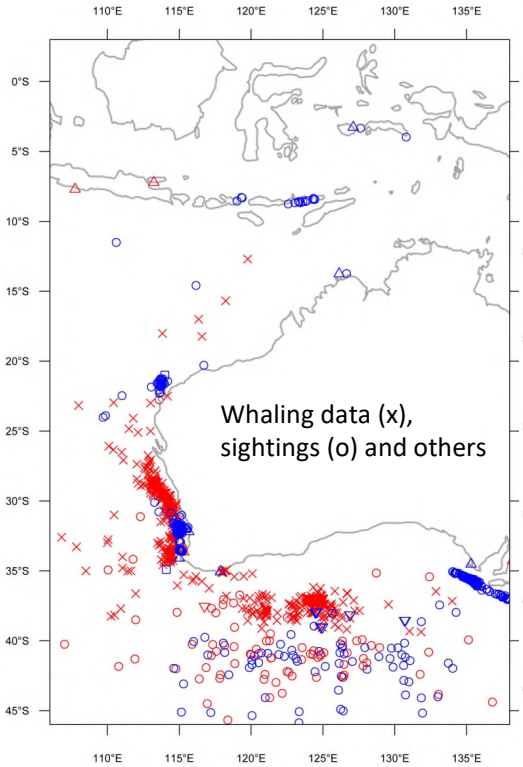
Historical catch area

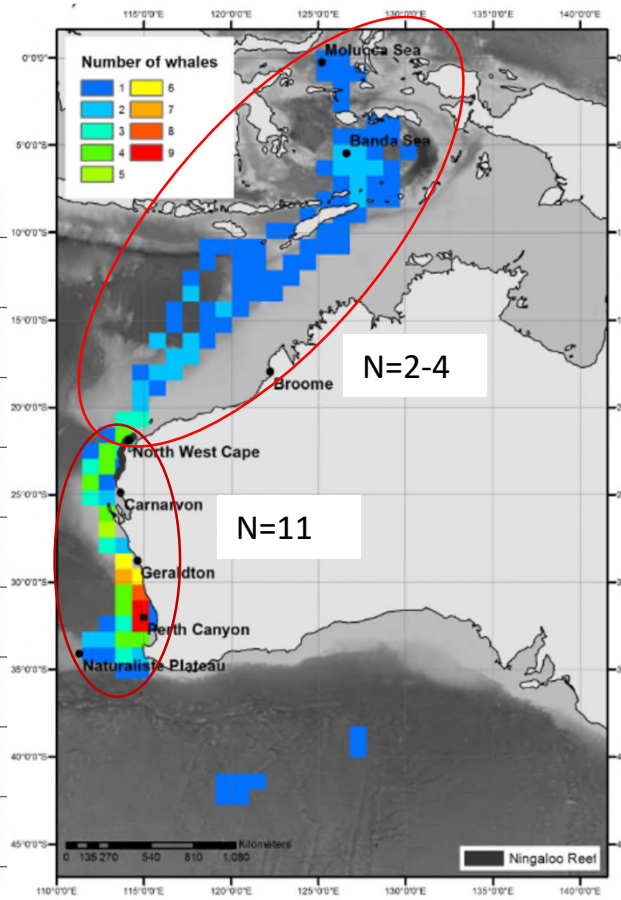
Background

Pygmy blue whale distribution and important areas

Data behind the maps

- Whaling data, sightings, strandings and acoustic detections
- Deployments of satellite transmitters
- Not many data points on the North West Shelf
- Designation of foraging areas on NWS based on satellite tracking data, and also, mostly unpublished passive acoustic detections and observations





Double et al. 2014

Aim and approach

Refine distribution and important areas

- Especially foraging areas and other areas of high use
- Deploy satellite tags and make use of existing deployments
- Passive acoustics – use new and archived data

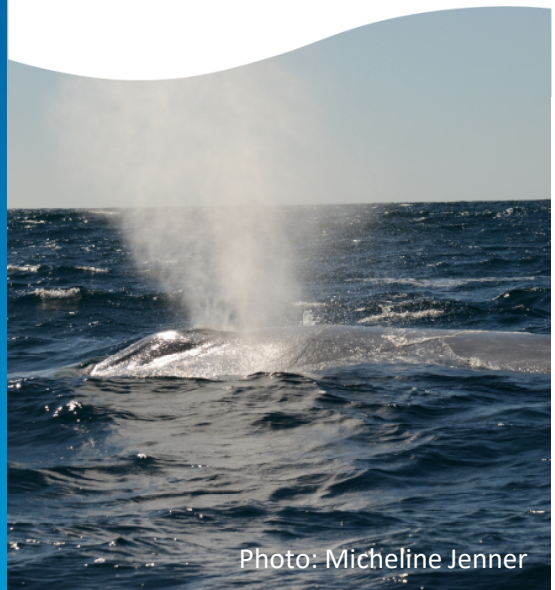


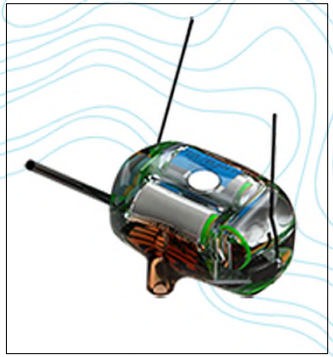
Photo: Micheline Jenner

Australian Government

Australian Institute of Marine Science

Satellite tracking

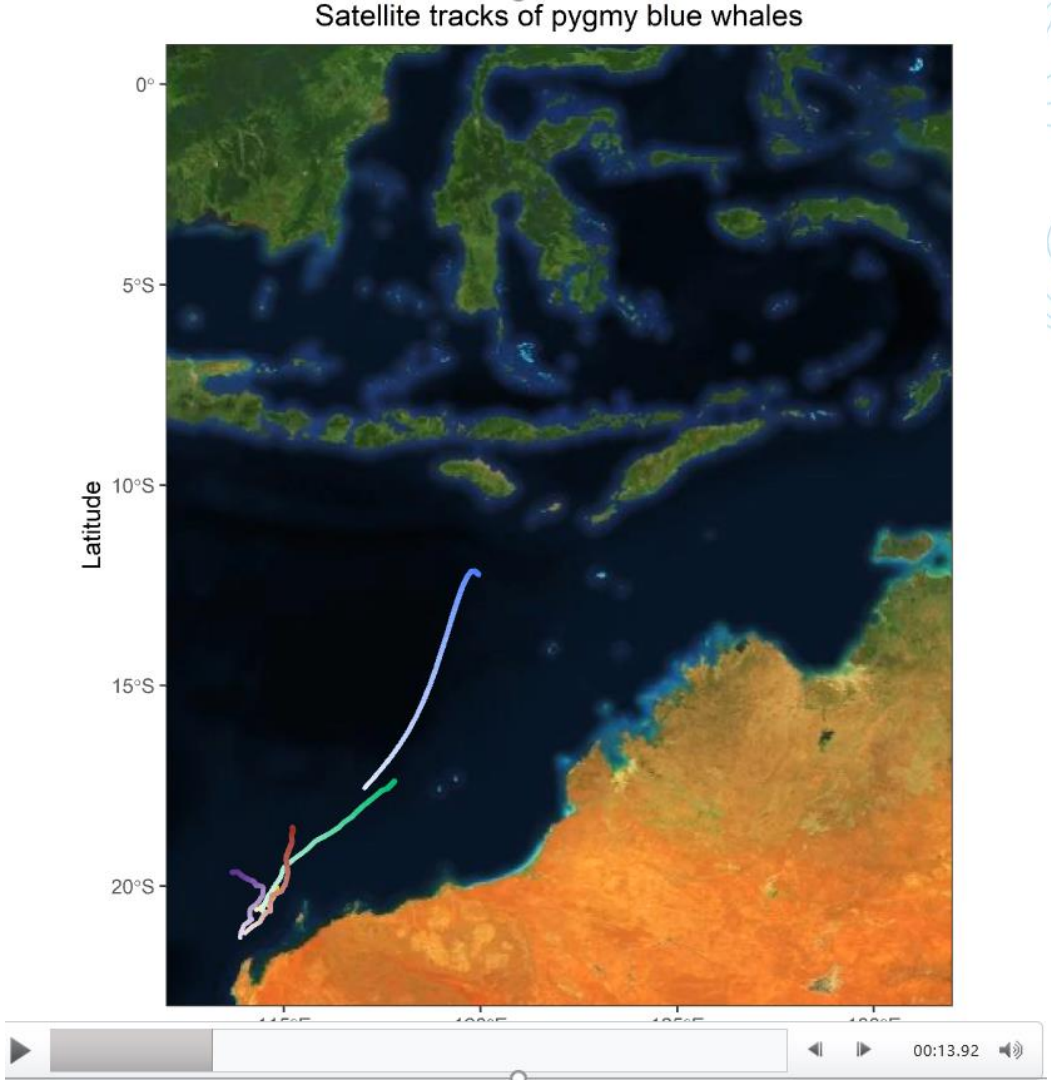
- Deployed WC limpet tags on 6 PBW at Ningaloo (2019-2020)
- Tags fitted with FASTLOC GPS
- Spotter plane and sonobuoys to find whales from RV Whale Song
- Deployed into rigid hull inflatable boat once whale found
- Spent many hours to get close enough to deploy the tag
- Tag deployed using a modified tranquiliser gun



Satellite tracking

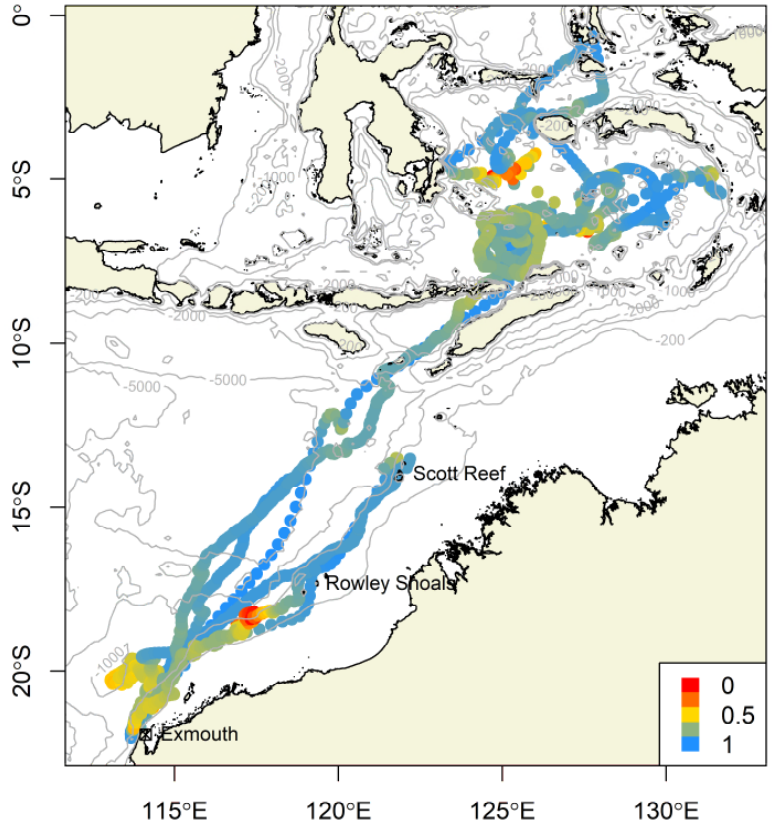
Analysis

- Combined our data with existing tag data
  - N = 11 from Perth Canyon (4 provided data on NWS) (2009 & 2011)
  - N = 1 from Bonney Coast (2015)
- State Space Model (SSM, Foiegras) to deal with location error and objectively identify movement behaviour
  - Continuum between fast and straight and slow with high turning angles
- Time in area analysis to determine most important areas
  - Gridded the whole area and calculated time spent in a grid cell and percentage of tagged whales using each grid cell and ranked the grid cells – top 25%, 50% and 75%
- Accounted for bias due to differences in deployment duration



ID	Duration
182671	17
182658	81
182665	14
182661	77
182657	110
182668	78

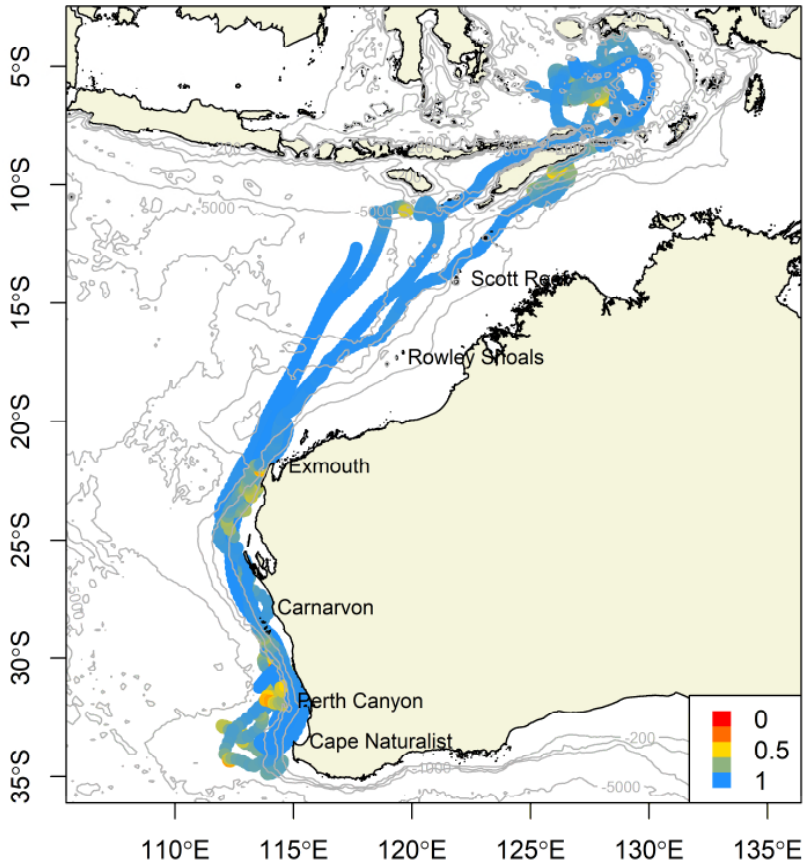
State Space Model AIMS satellite tag deployment, n=6



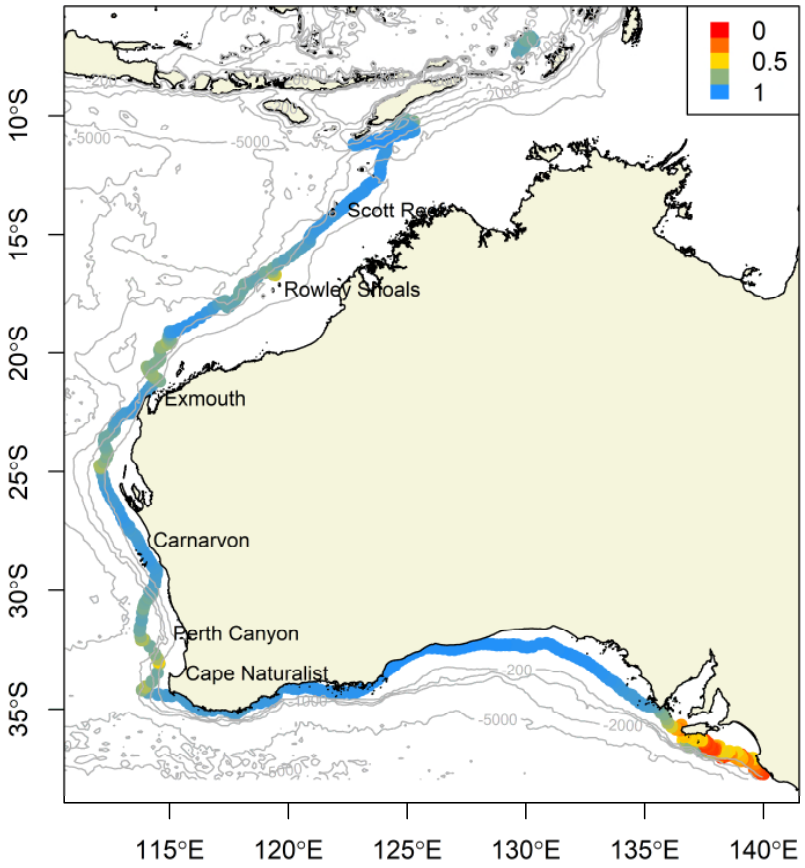
- Most tagged in Cape Range Canyon off Exmouth
- We interacted with 24 whales during the 10 days on site, 10 of these were feeding, 9 travelling and 5 singing

Warmer colours = more likely resident i.e. foraging or breeding
Cooler colours = more likely migrating

AAD deployments, n=9 Perth Canyon



Lu Moller et al. deployments, n=1, Bonney Coast, SA



Australian Government
Australian Institute of Marine Science

All, n= 16, (cropped to exclude south coast)

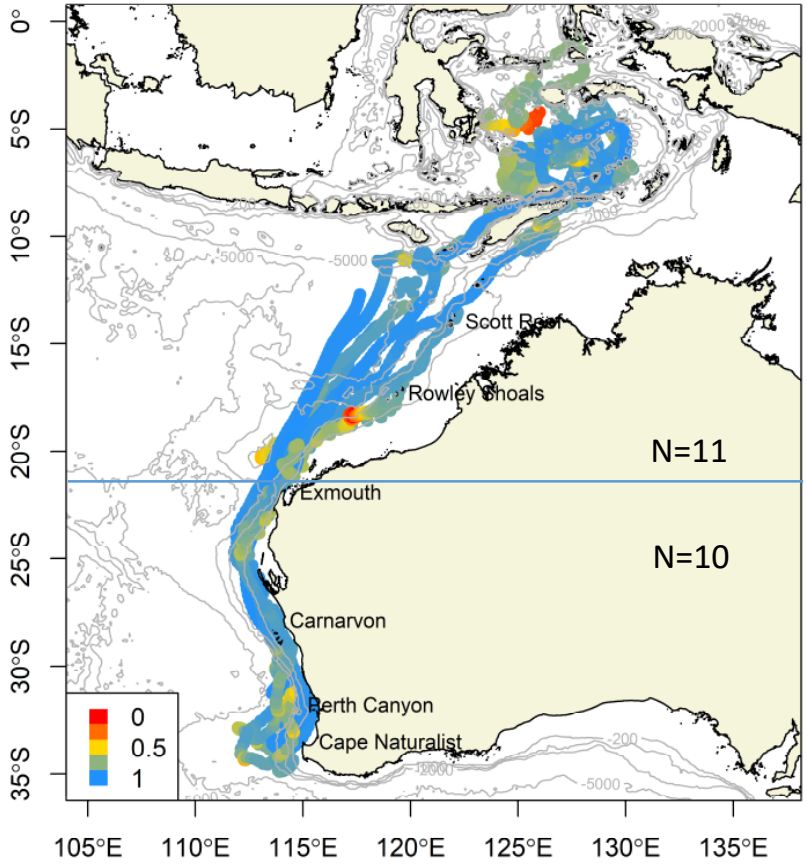
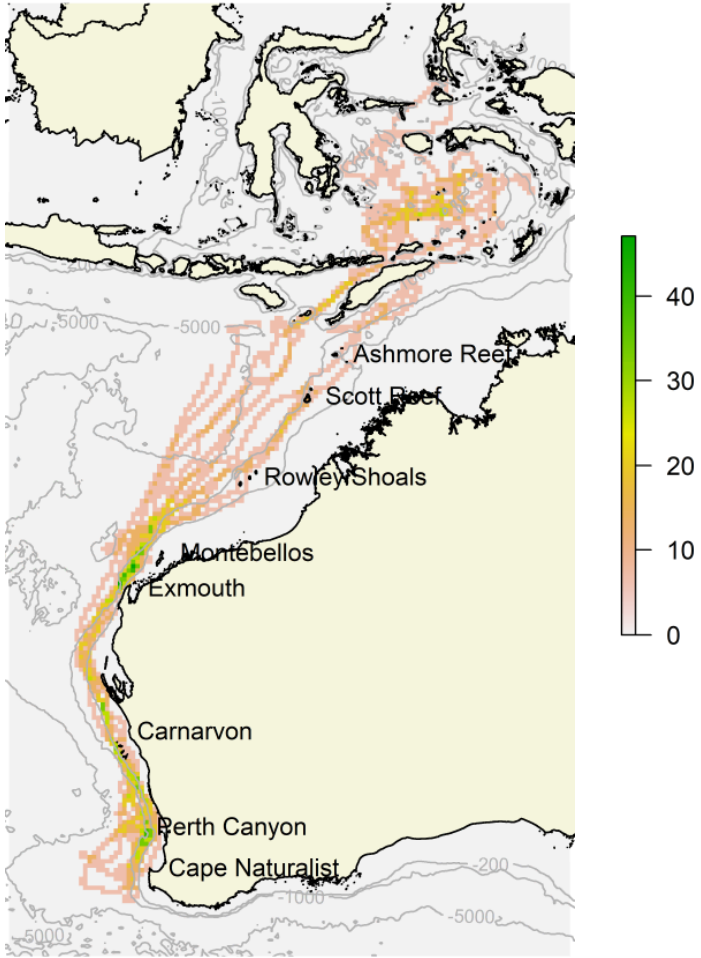
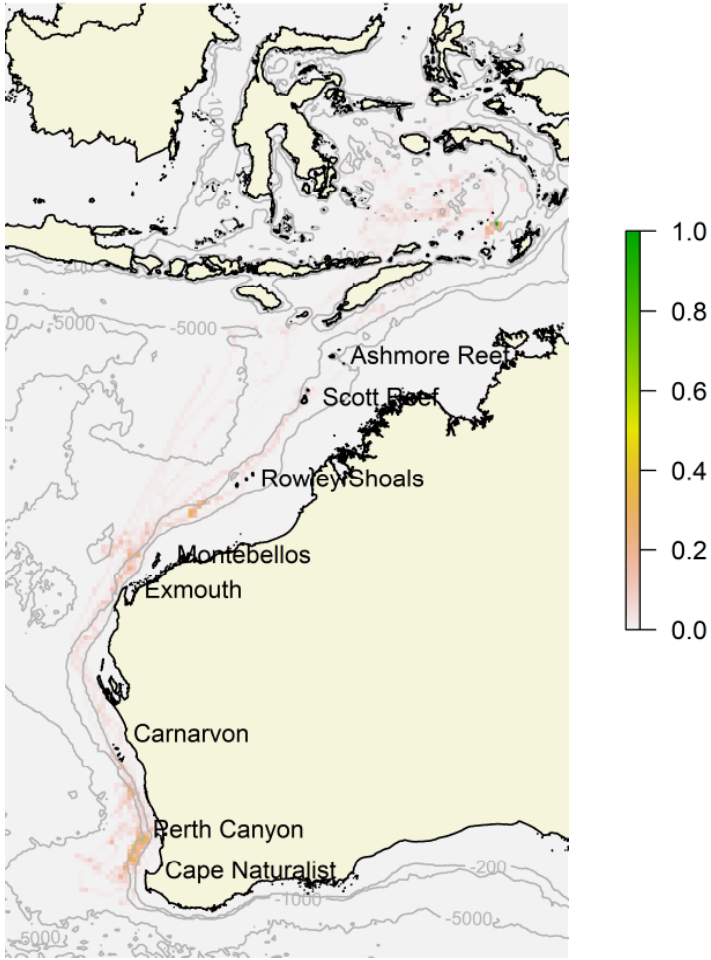


Photo: Micheline Jenner

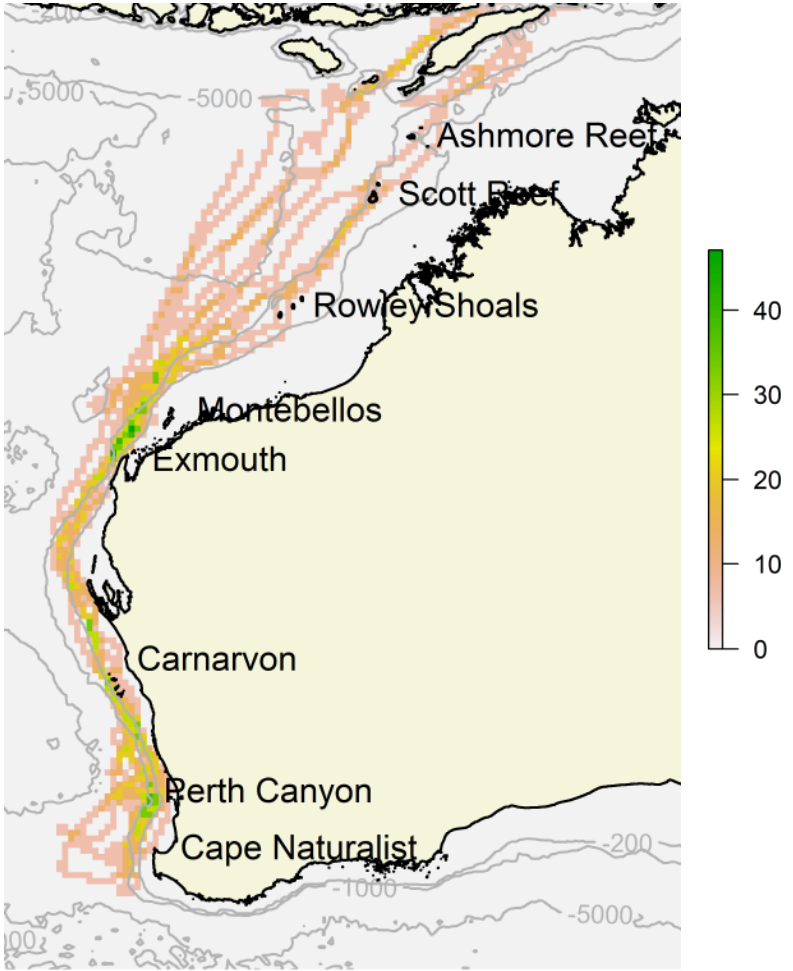
Percentage of whales



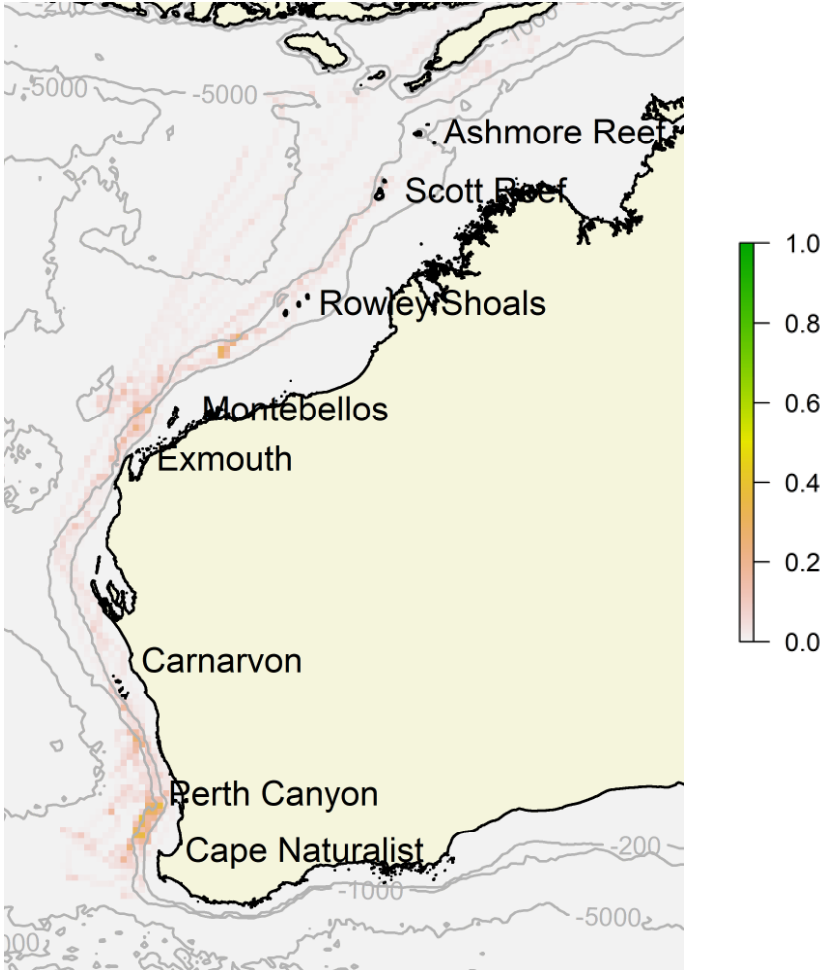
Index of occupancy (normalised time spent)



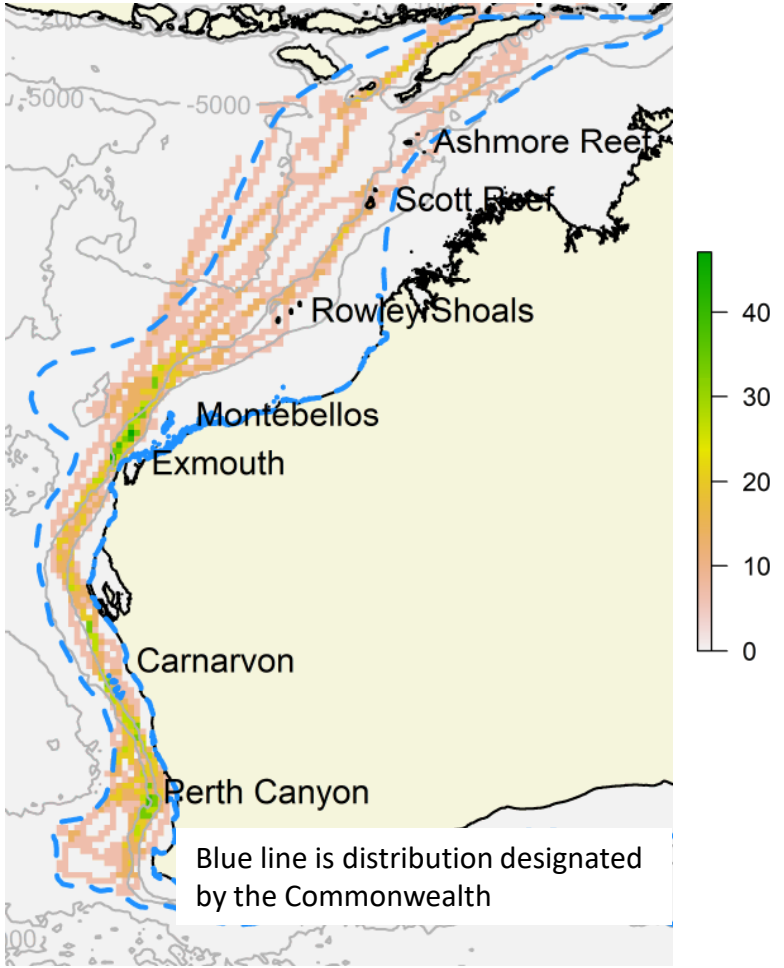
Percentage of whales



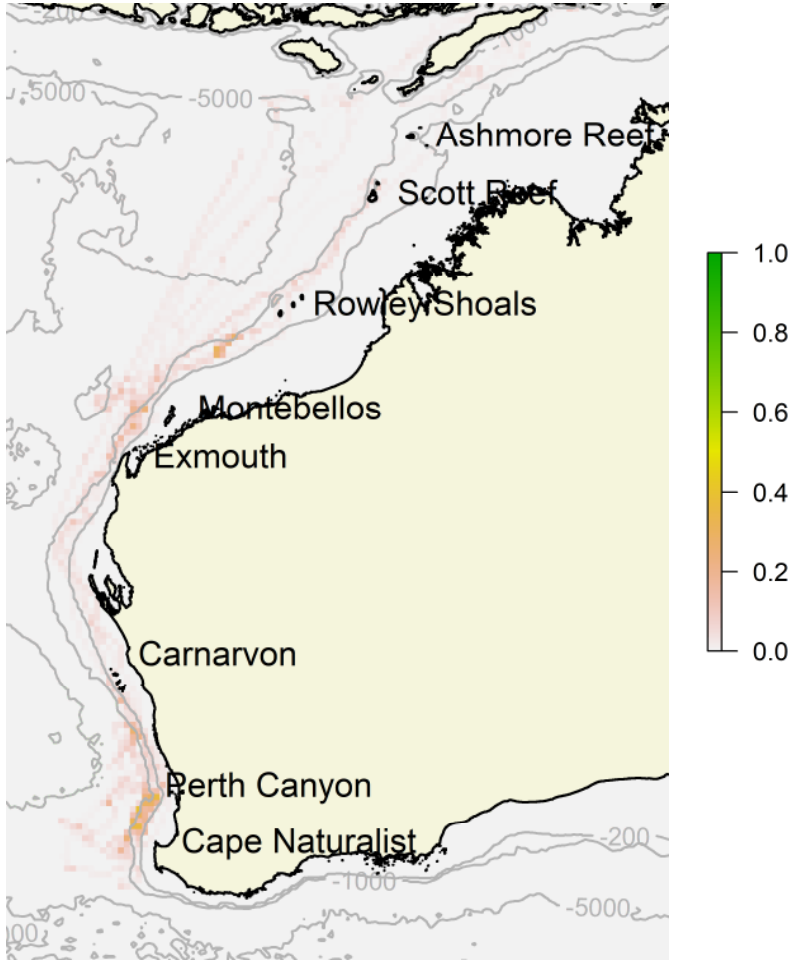
Index of occupancy (normalised time spent)



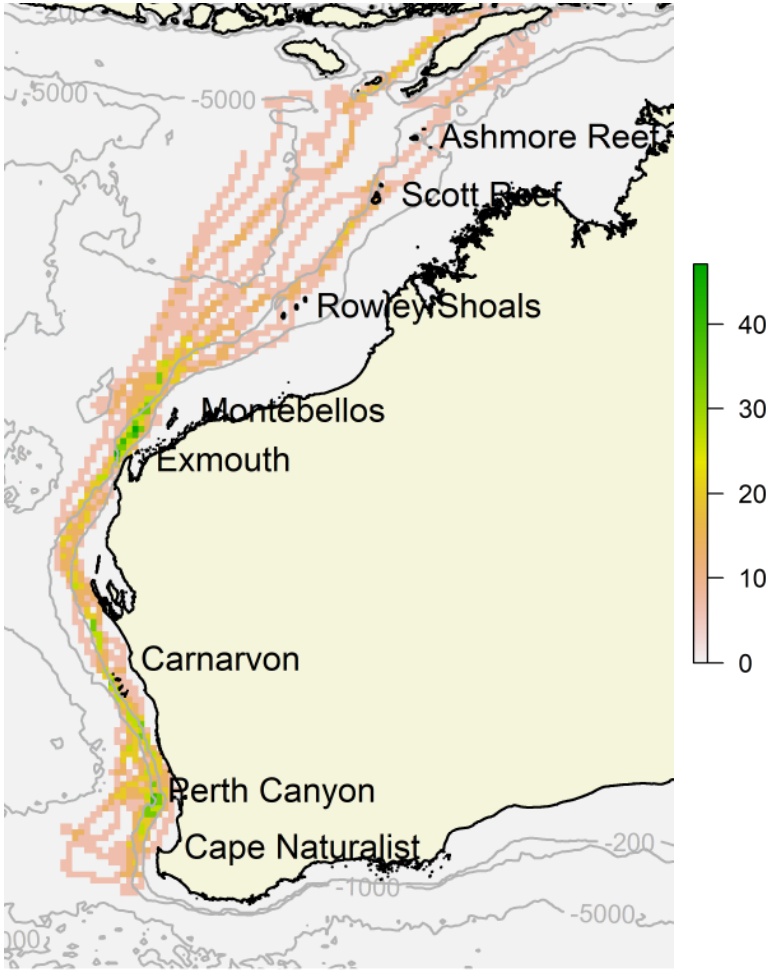
Percentage of whales with distribution BIA



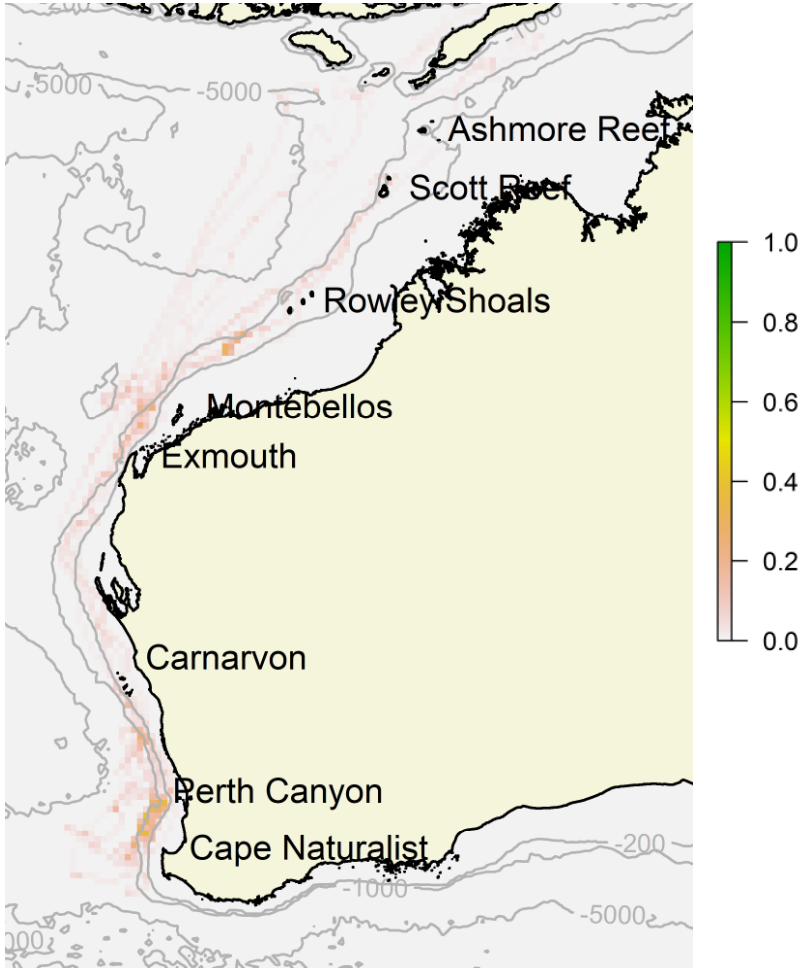
Index of occupancy (normalised time spent)



Percentage of whales

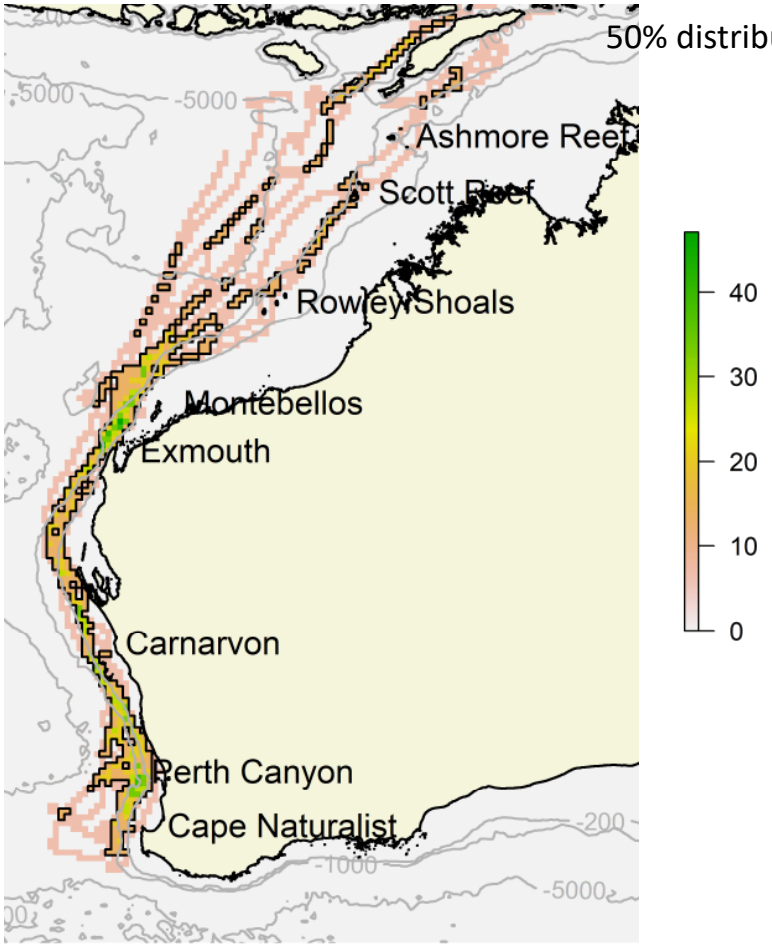


Index of occupancy (normalised time spent)

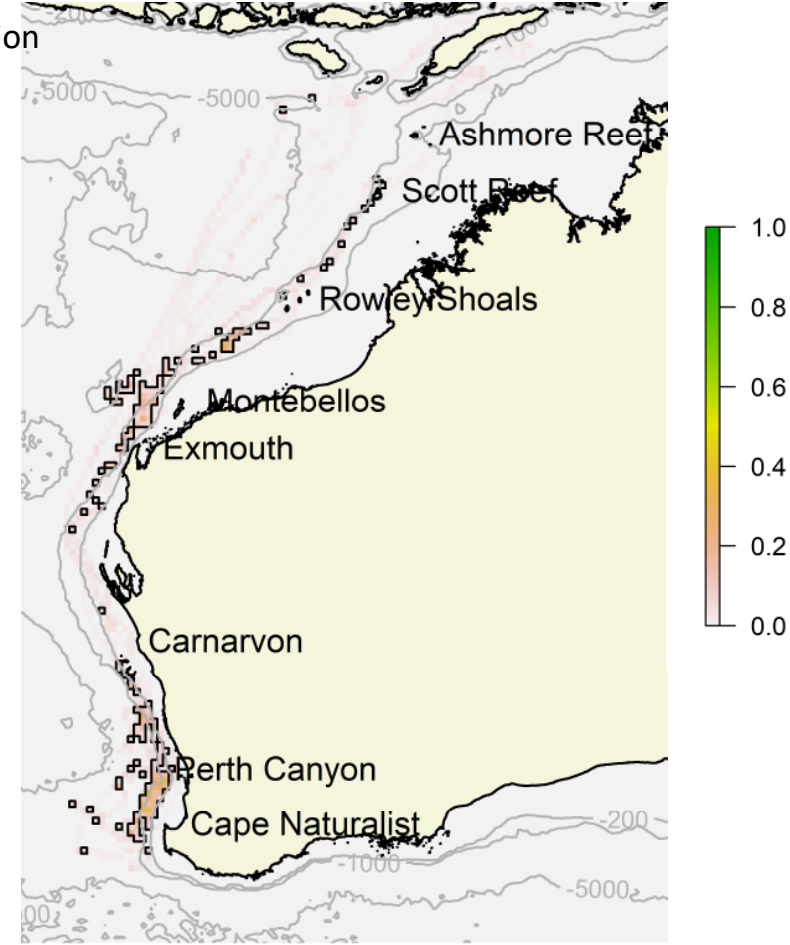


Percentage of whales

50% distribution



Index of occupancy (normalised time spent)



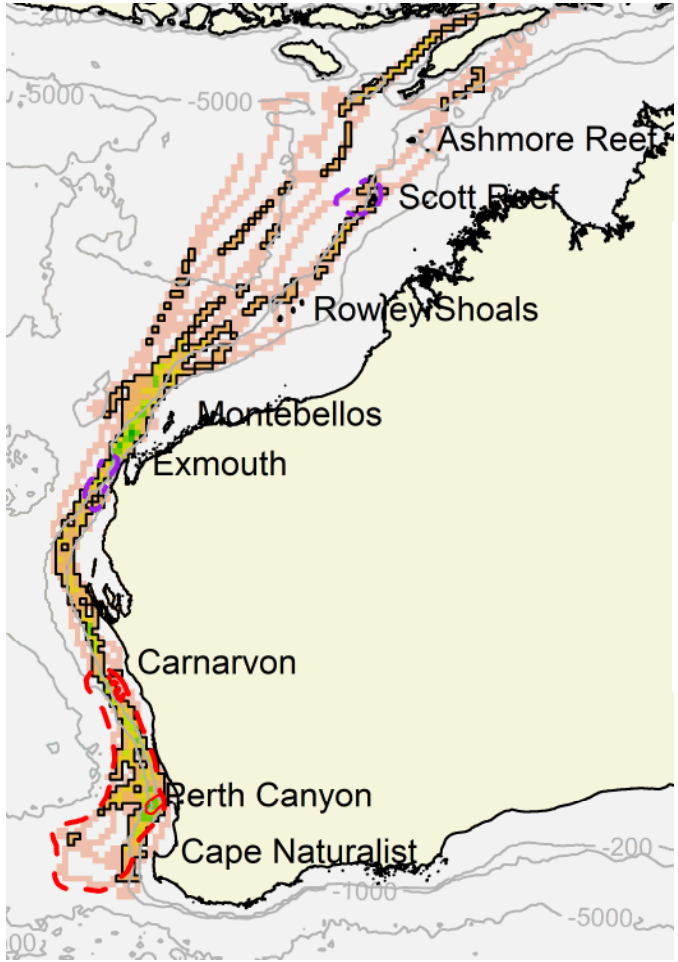
Australian Government

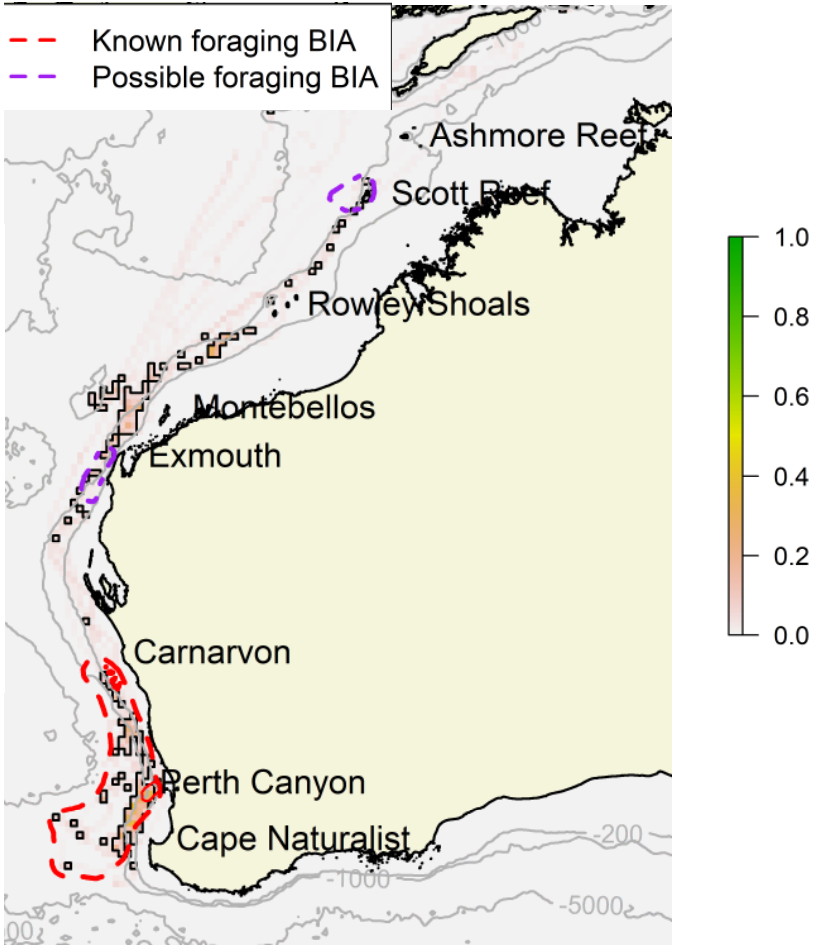
Australian Institute of Marine Science

Percentage of whales

50% distribution

Index of occupancy (normalised time spent)

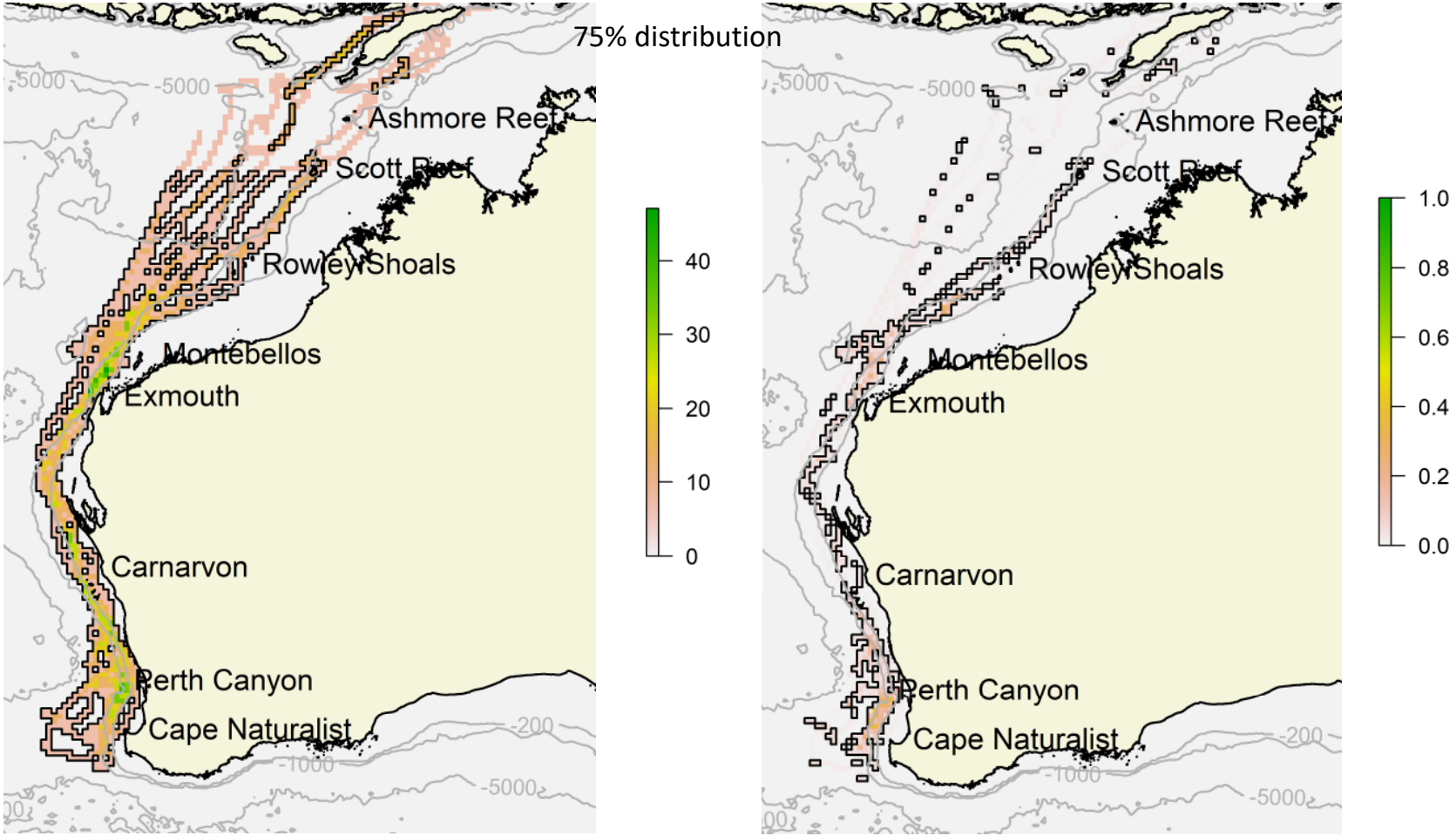




Percentage of whales

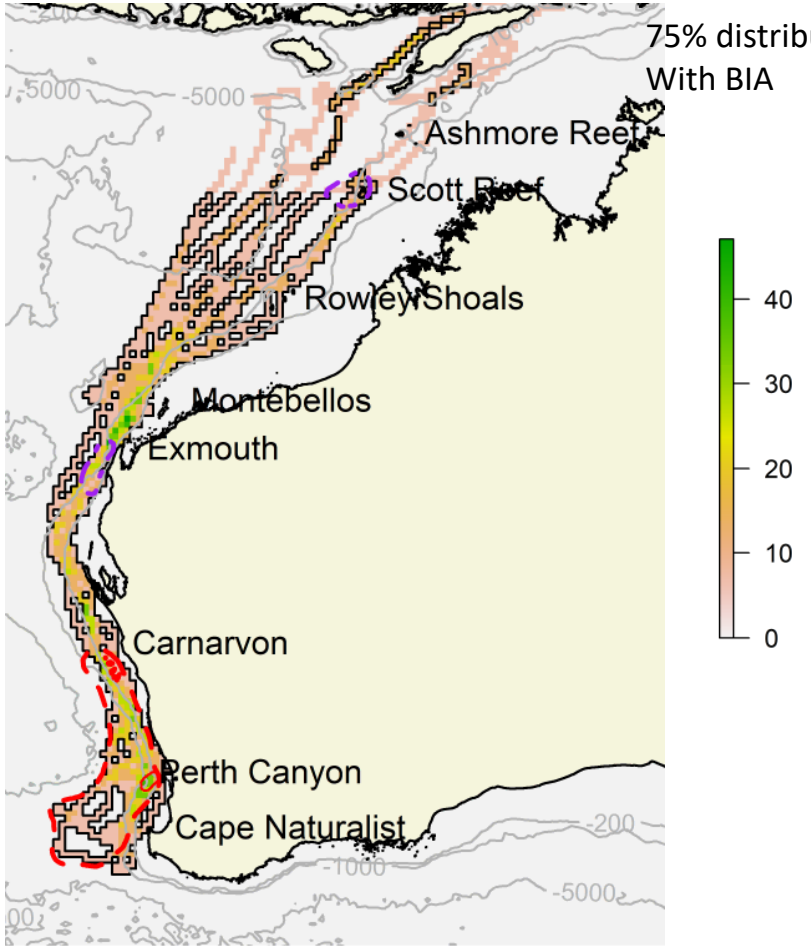
Index of occupancy (normalised time spent)

75% distribution

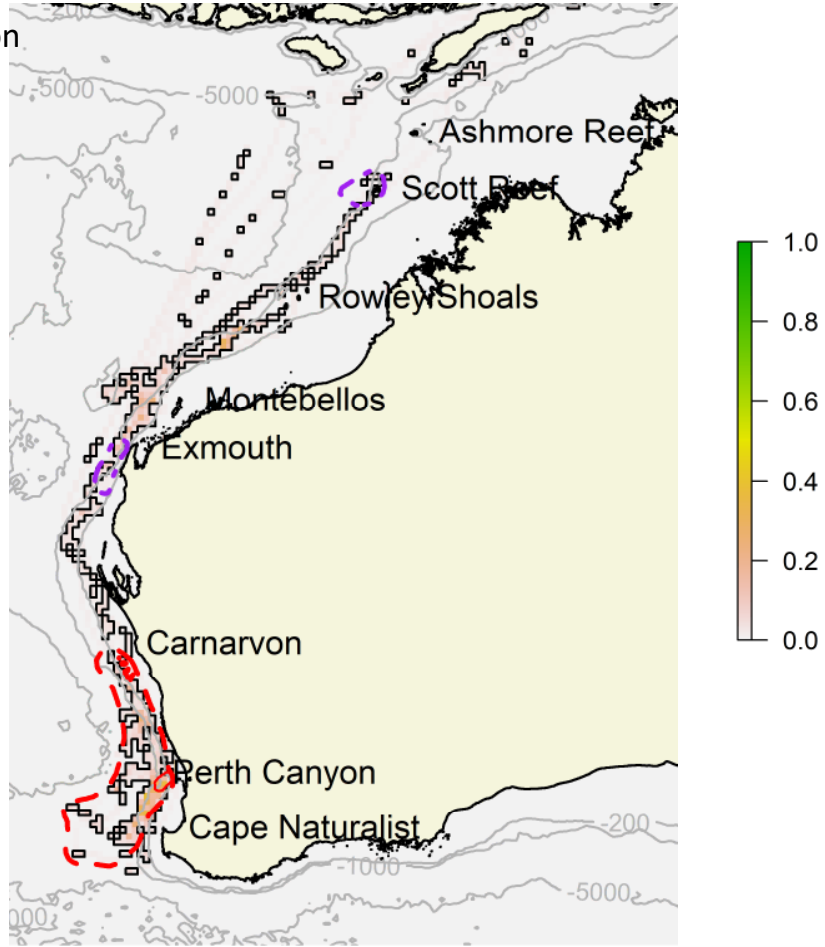


Percentage of whales

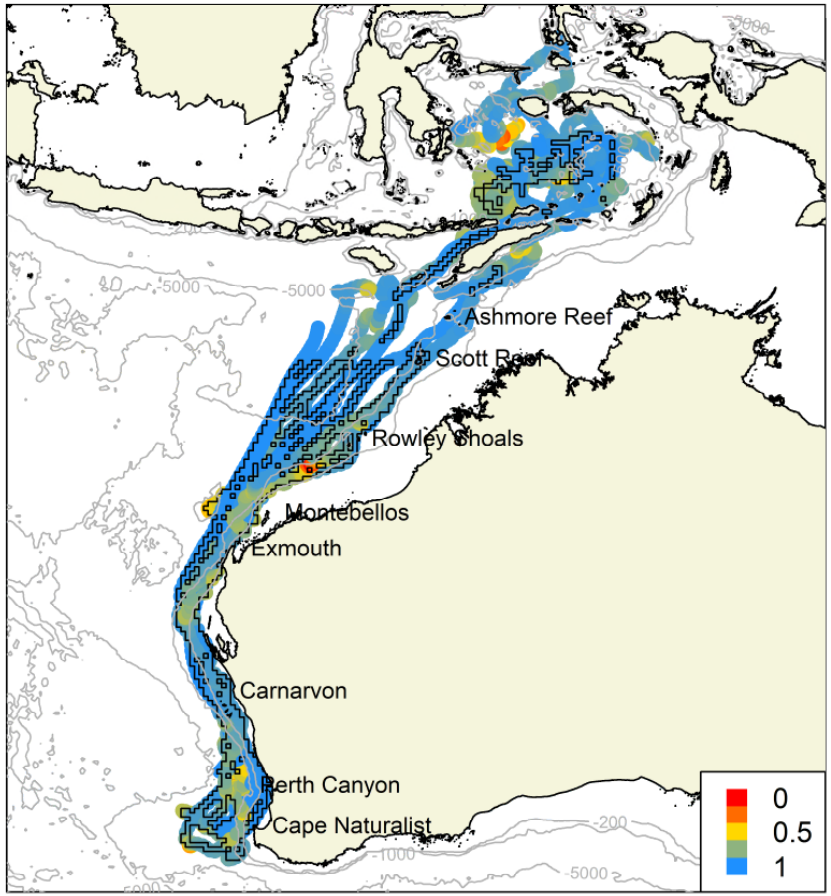
75% distribution
With BIA



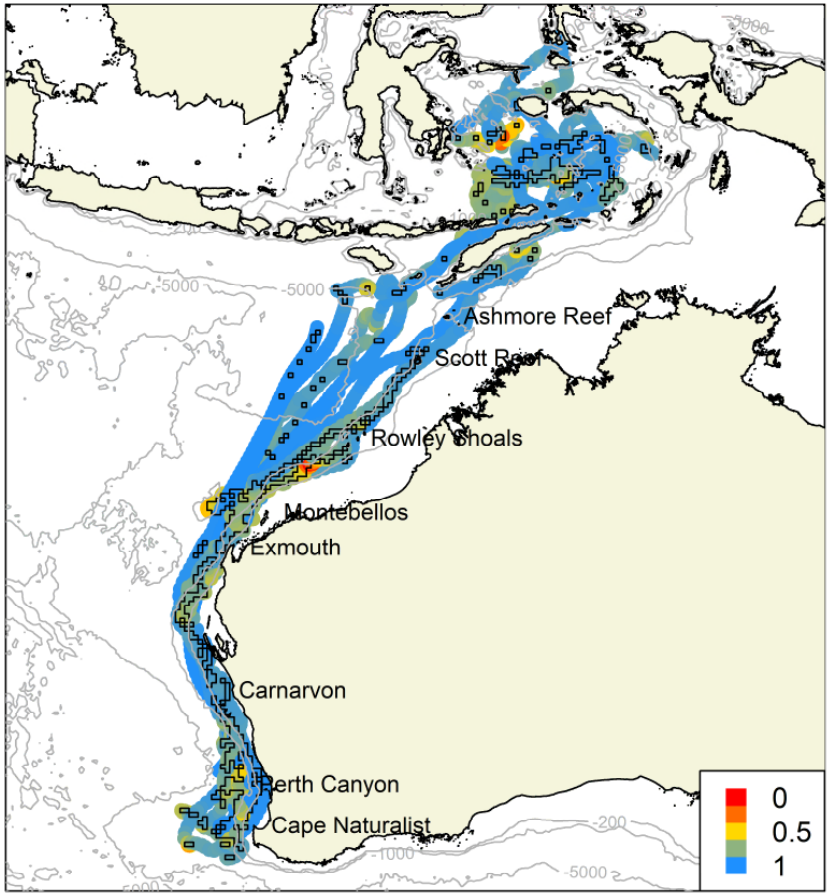
Index of occupancy (normalised time spent)



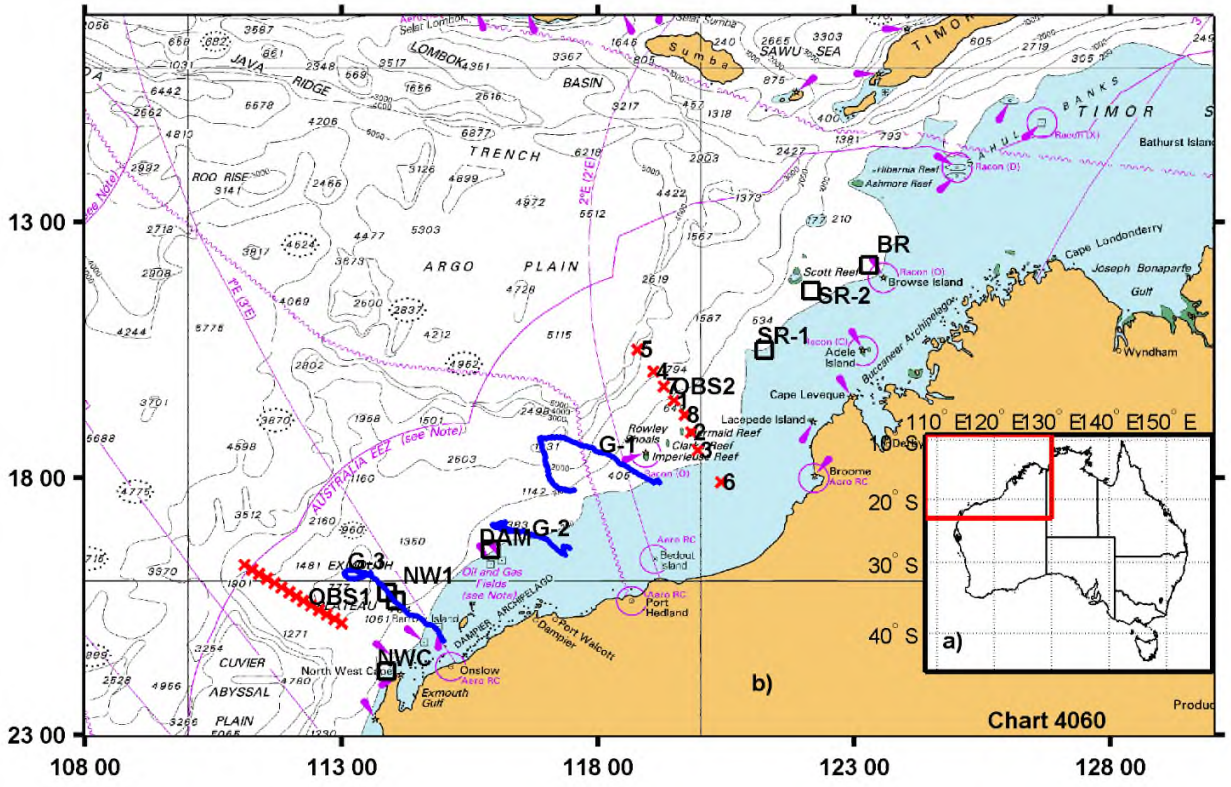
SSM locations & 75% distribution (% of whales)



SSM locations & 75% distribution (Index of occupancy)



Passive acoustics

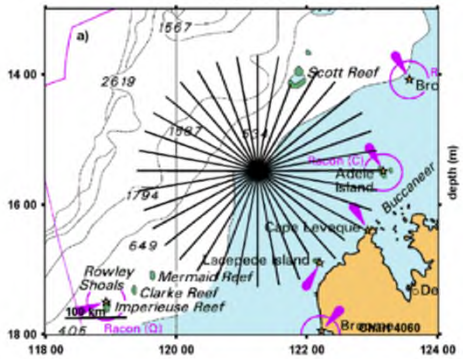


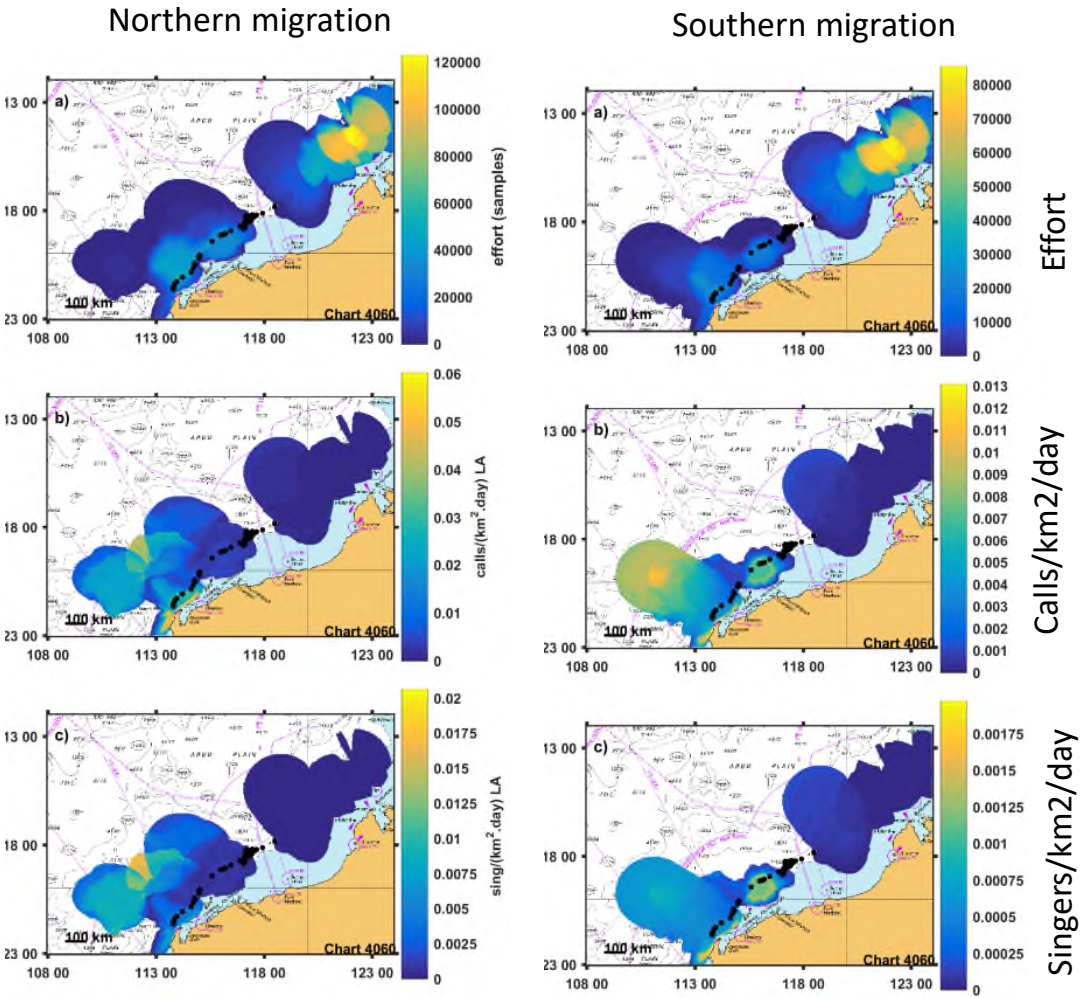
- Noise loggers deployed at NW Cape 2018 & 2019 (2 ~360 d ea)
- Loggers onboard sea gliders (3 deployments of 15-25 d) from 2018-2019
- These data were combined with archives of noise logger and OBS deployments collected by 41 instruments from 2006 to 2018

Black squares = fixed acoustic loggers, blue lines = glider deployments with sound traps attached, red crosses = line of ocean bottom seismometers (OBS)

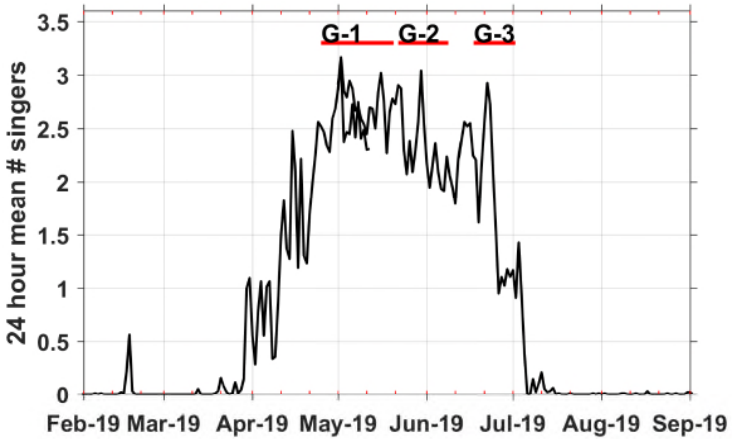
Methods

- Sound propagation modelling with assumed whale song source levels for each site to predict the listening range for an EIOPB call
- 10^{o} headings about receivers considering water sound speed profile; bathymetry; and substrate geoacoustic properties
- Sound propagation for gliders too: modelled multiple receiver locations and receiver depths for glider tracks, interpolated for actual glider location and receiver depth
- Counts of calls / km^2 and singers / km^2 summed across a spatial grid and corrected for sampling effort to give units of calls / (km^2·day) and singers / (km^2·day)





- Highest effort (top plots) near Scott Reef but lowest call (middle plots) and singer (bottom plots) density
- Highest density off the shelf, but closer in off Exmouth
- Hotspots off Exmouth, NW of Exmouth and off Dampier on Southern migration
- A lot of density way further west than tracking data, suggesting these whales may have a different migration pattern to whales that use Perth Canyon and off Exmouth



Left:

Singers vs time from NW Cape moorings

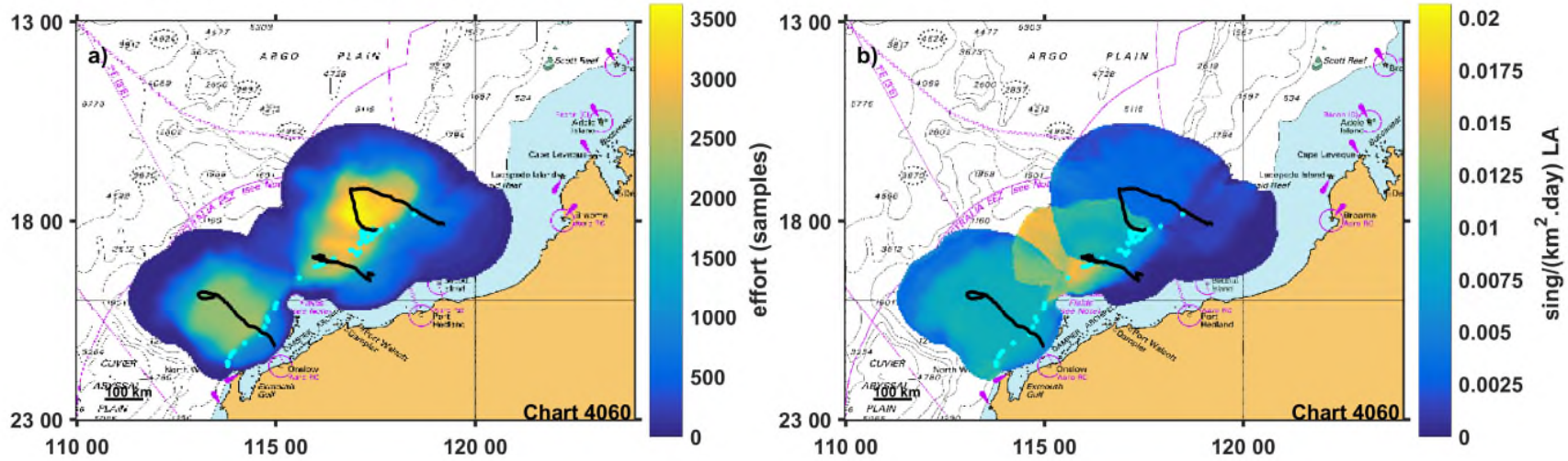
Times of glider missions shown by red bars

Below:

Left is effort sampled

Right is # singers / (km^2 · day)

Black lines are glider tracks, dotted track is 1 tagged whale



In progress: using acoustic data to model drivers of distribution

- Generalised additive mixed model (GAMM), tweedy distribution
- Two response variables corrected for survey area and effort:
    - Number of pygmy blue whale calls and number of calling pygmy blue whales
- Covariates:
    - bathymetry
    - sea surface temperature,
    - chlorophyll a,
    - distance to shelf (200 m), coast, canyon and along shore
    - depth of euphotic zone
    - current direction and magnitude,
    - month
- Random effects: Year and platform (glider, fixed loggers, OBS)
- Also in progress – overlap with threats

Outcomes and summary

Pygmy blue whale

Distribution and important areas on NWS

Not finished but…

- Quantified spatial distribution and provided data to assist in refining BIA's - high priority in Management Plan
- Distribution occurs at and beyond the shelf (200 m) so can consider reducing distribution extent designated in Management Plan
- Possible foraging BIA off Exmouth needs adjustment (extend to north west) and change from "possible" to "known"
- Although Scott Reef had lower occupancy & number of whales using it, it was included in the 50% and 75% distribution we calculated
- Banda Sea had high occupancy and number of whales using it – need coordination with Indonesia for protection
- While we can protect areas of highest use, tracking data suggest a continuum of foraging behaviour along the entire coast between 200m and 1000m contour

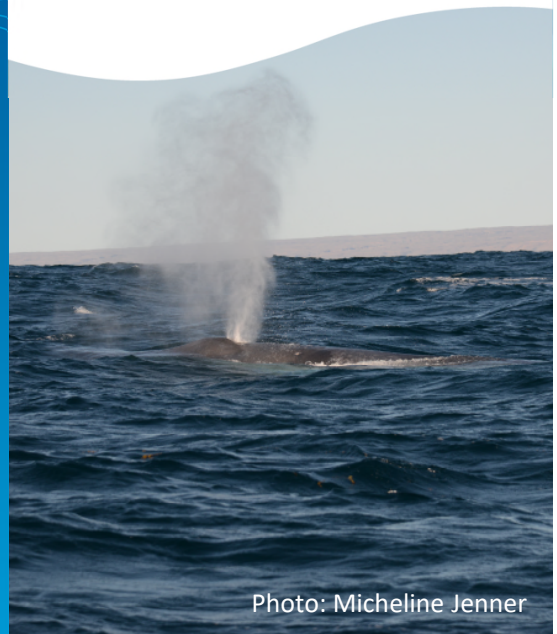


Photo: Micheline Jenner

Australian Government

Australian Institute of Marine Science

Australian Government

Australian Institute of Marine Science

AIMS: Australia's tropical marine research agency.

Michele Thums

m.thums@aims.gov.au

+61 (8) 63694020

@mthumsy

@aims_gov_au

@australianmarinescience

www.aims.gov.au

waadmin@aims.gov.au

+61 (8) 6369 4000