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AUSTRALIAN INSTITUTE
OF MARINE SCIENCE

North West Shoals to Shore Research Program

Multiple satellite tracking
datasets inform marine
turtle conservation on
the North west Shelf

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AIMS: Australia's tropical marine research agency.

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Protected and Iconic Species Movement, Distribution and Threats

Collaborators

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Pendoley Environmental - Kellie Pendoley

ERM Vietnam - David Waayers

Charles Darwin University - Michael Guinea

Conservation International Timor-Leste



Photo: Nick Thake



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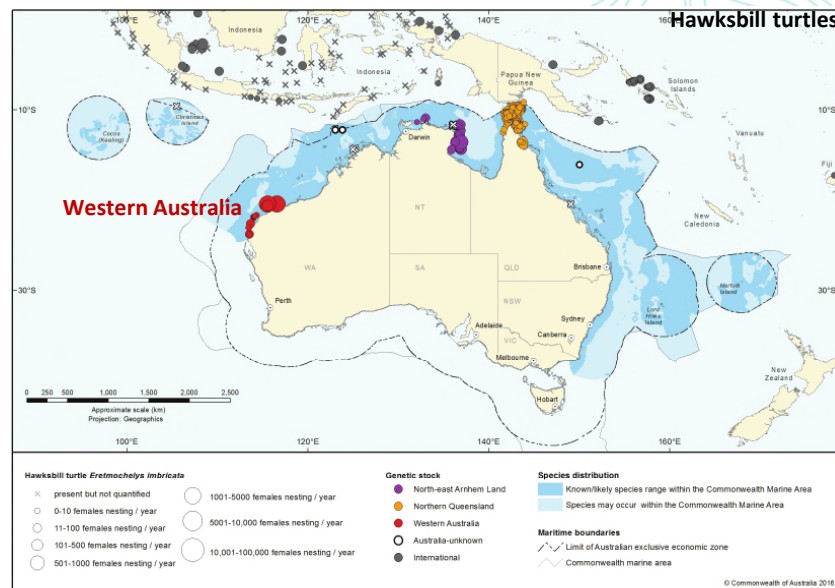
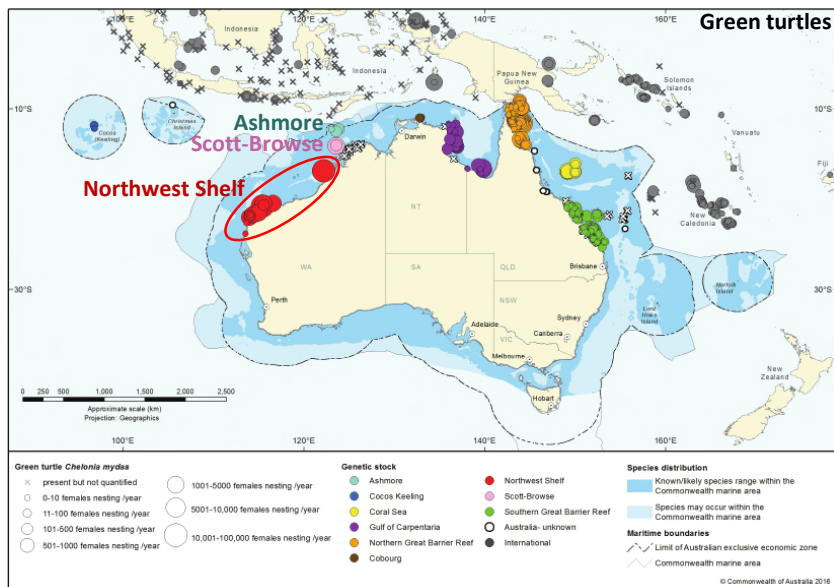
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Background

Listed by IUCN as Endangered and Critically Endangered; and Vulnerable by EPBC Act

Limited understanding of movement, distribution and important areas

Populations potentially overlap with industry activities

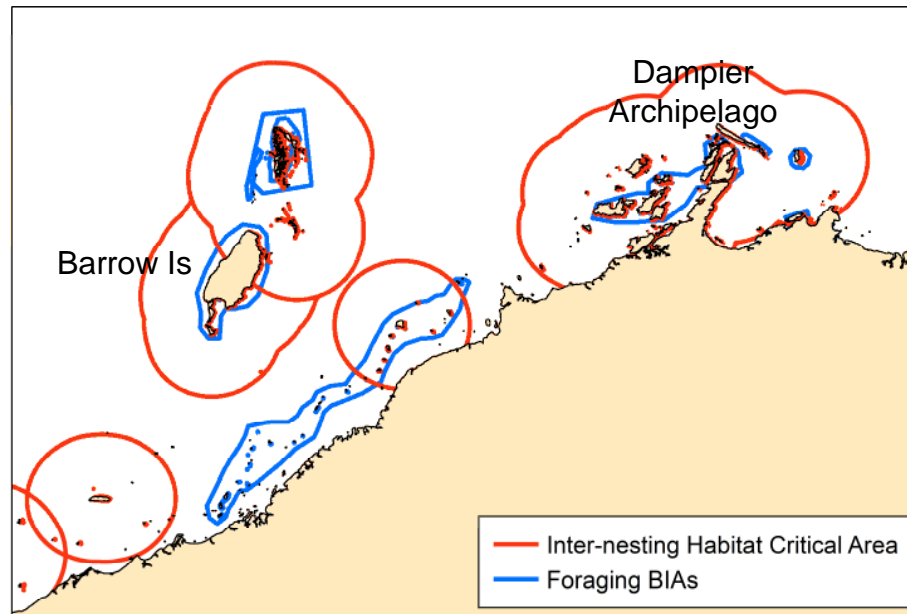


Background

Need to identify important areas and exposure to pressures for conservation and management

In the absence of quantitative data, Critical Habitat and Biologically Important Areas (BIAs) were created based on expert knowledge

A number of individual projects have deployed satellite tags to assist with industry impact assessments



Green and hawksbill turtles

Aim



Here we compiled satellite telemetry data to quantify the important areas within green and hawksbill distribution and assess exposure risk to pressures to assist with turtle conservation and management



Photo: Nick Thake

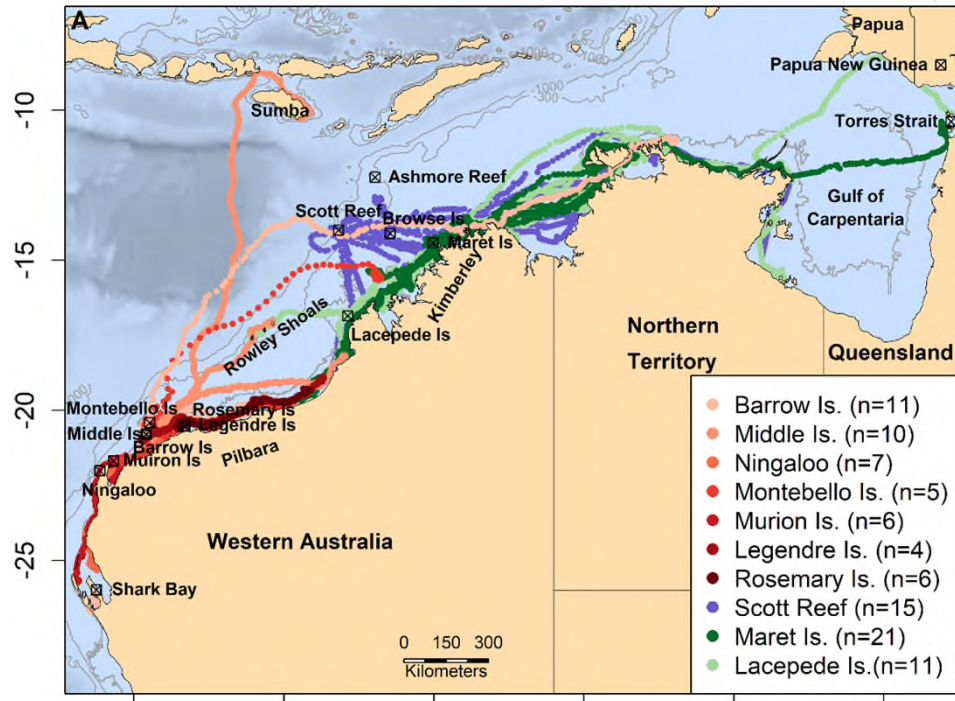


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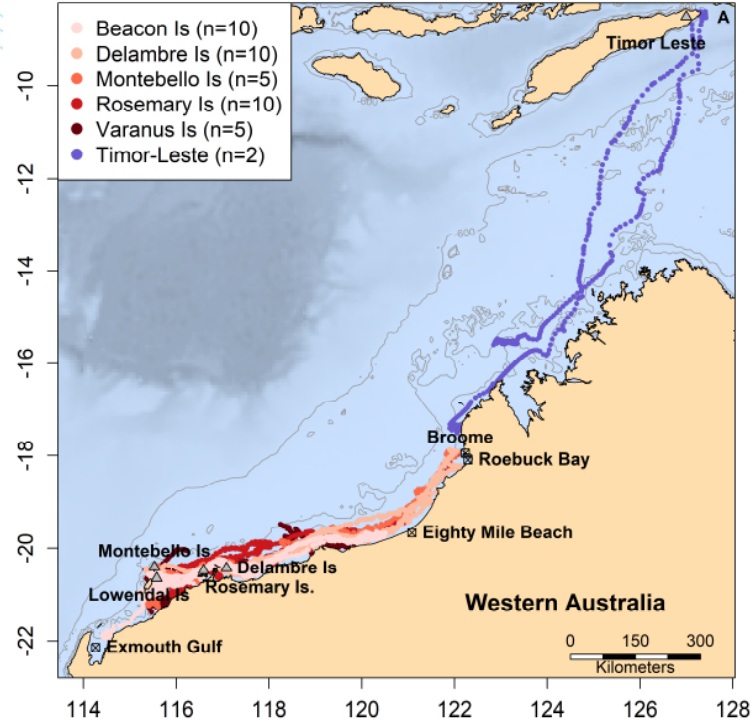
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Green turtles



96 tracks from adult female green turtles

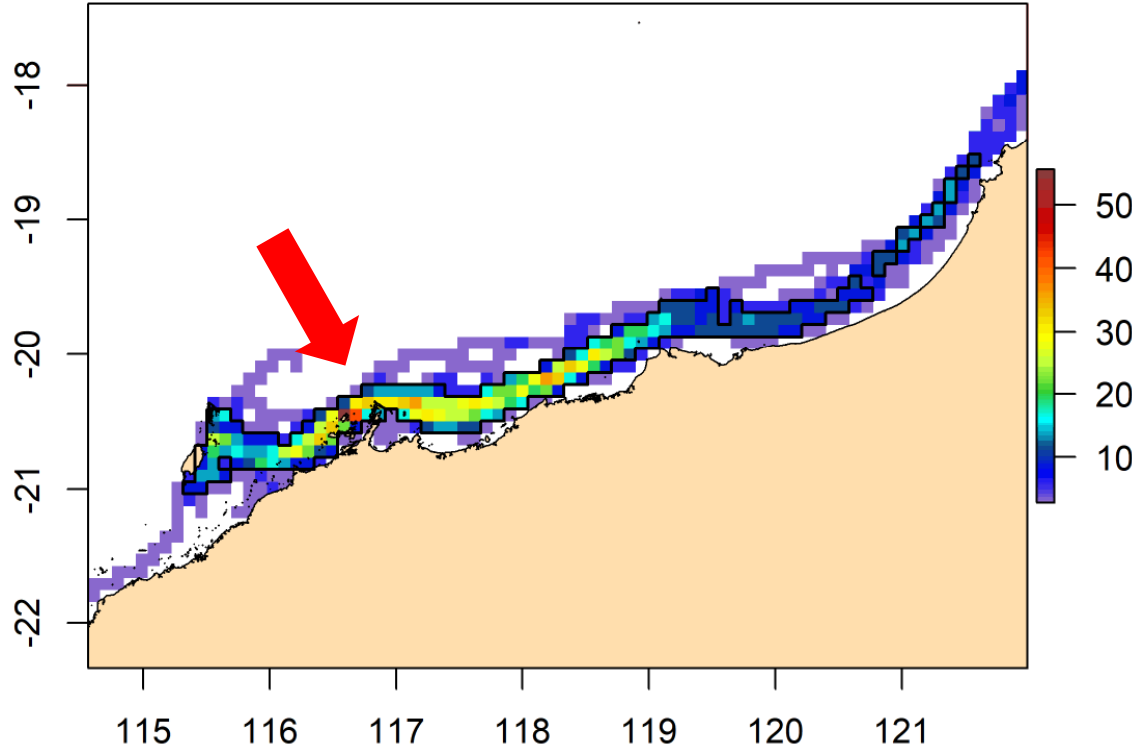
Hawksbill turtles



42 tracks from adult female hawksbill turtles

Methods

All turtles combine – Number of turtles



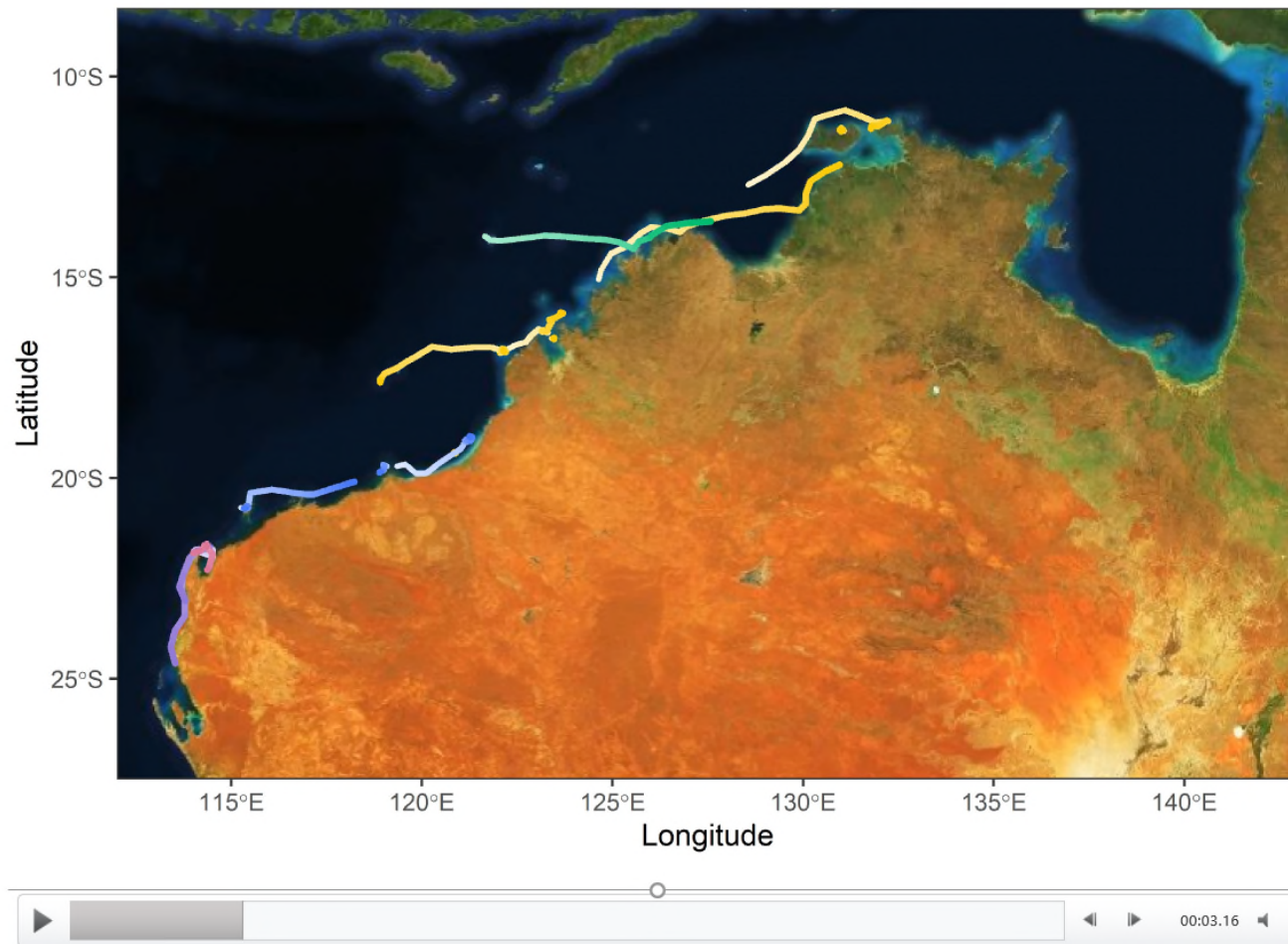
We classified each track into: Inter-nesting, Migration and Foraging

We gridded the whole area and calculated time spent for each turtle and each behaviour.

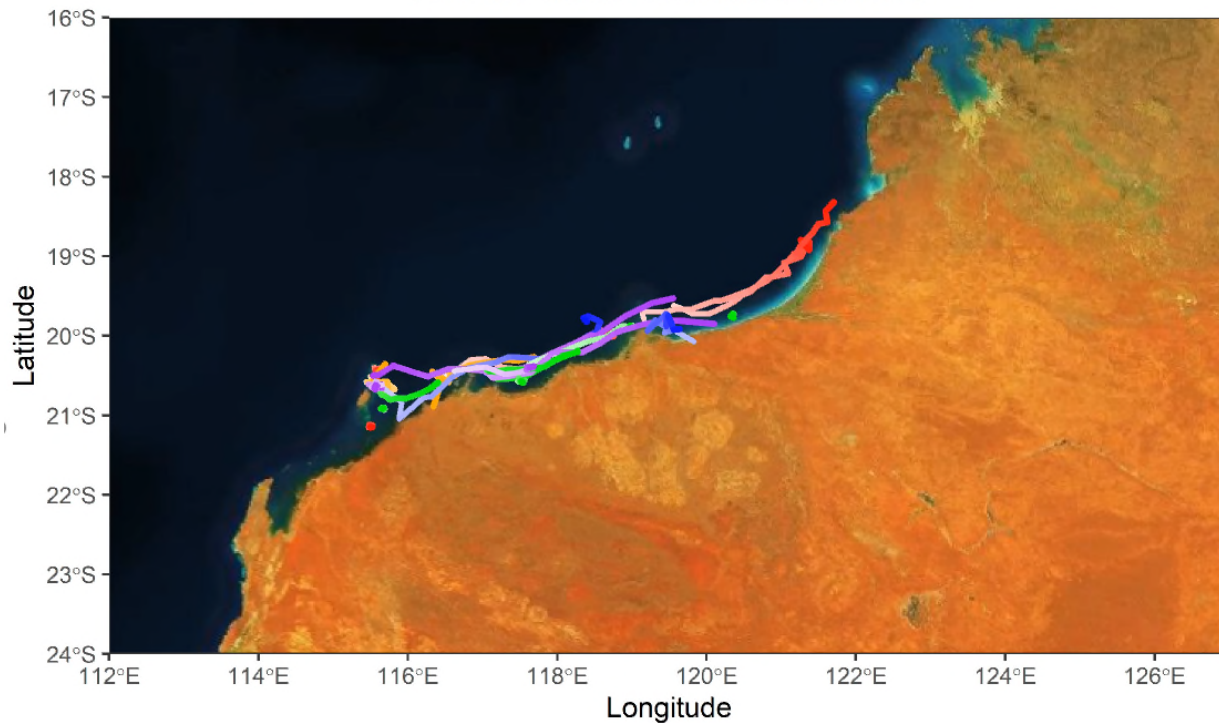
We combined all individual time spent distributions and calculated occupancy index and number of turtles in each grid cell

We then ranked all grid cells to define the top 75% and 95% as the most important areas

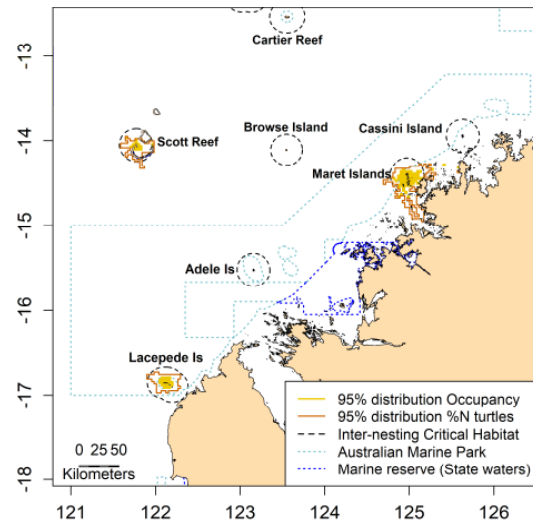
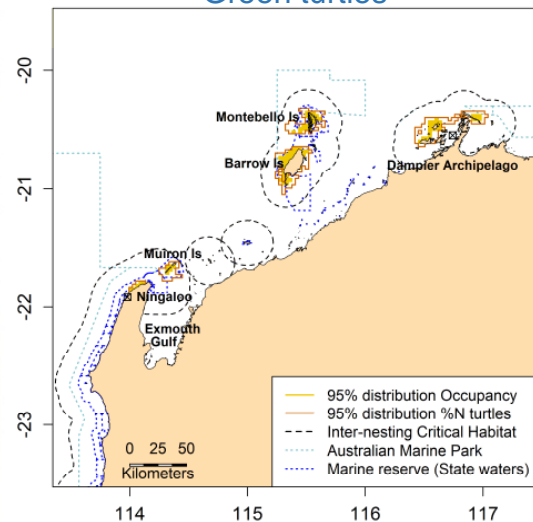
Satellite tracks of green turtles



Satellite tracks of hawksbill turtles



Green turtles



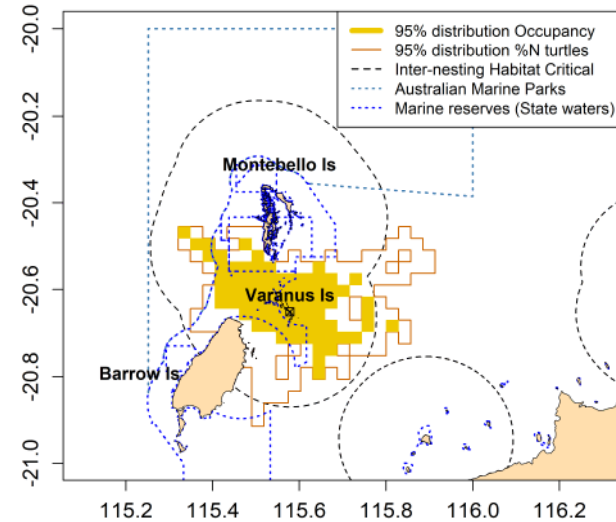
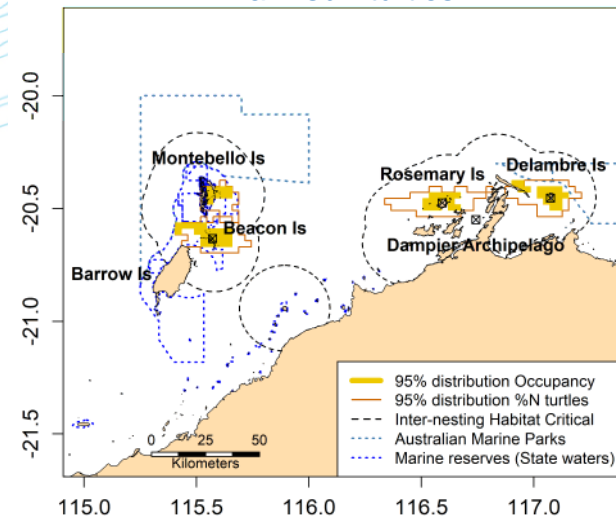
Inter-nesting

High values of occupancy and overlap of turtles adjacent to nesting beach

The 95% inter-nesting distribution of most rookeries matched the Inter-nesting Habitat Critical Area (20km)

High overlap with marine protected areas ~40%

Hawksbill turtles

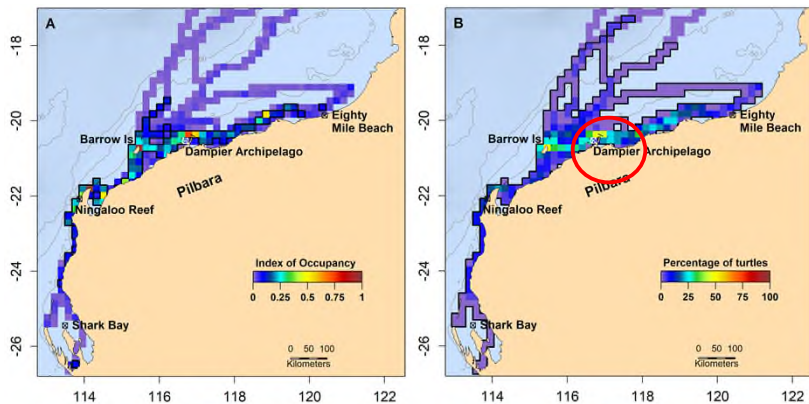


Migration

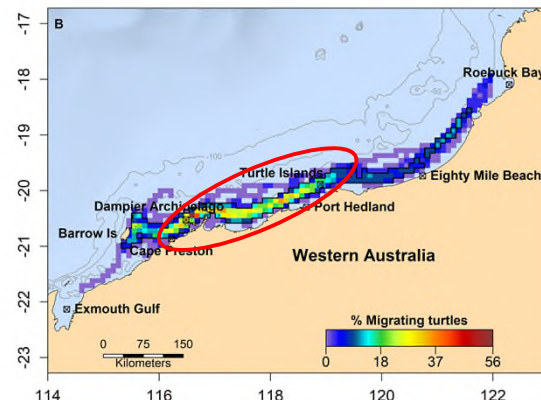
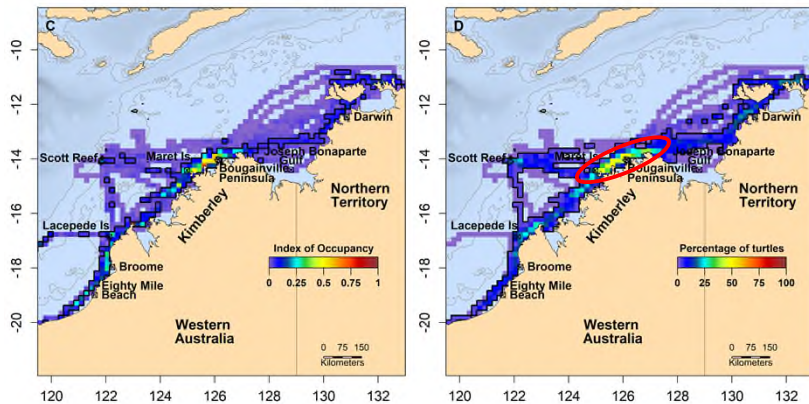
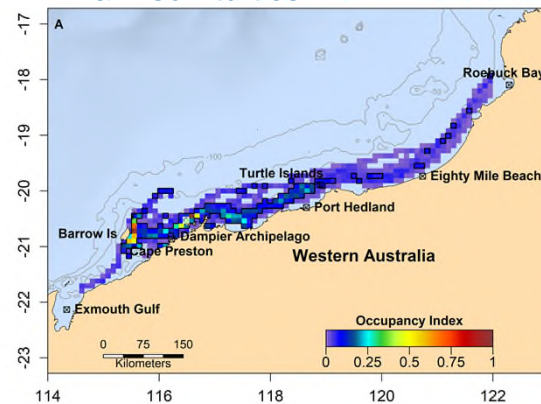
Low occupancy due to fast swimming during migratory movements

Number of turtles overlapping highlighted hotspots: >40% of greens and 56% of hawksbills

Green turtles



Hawksbill turtles



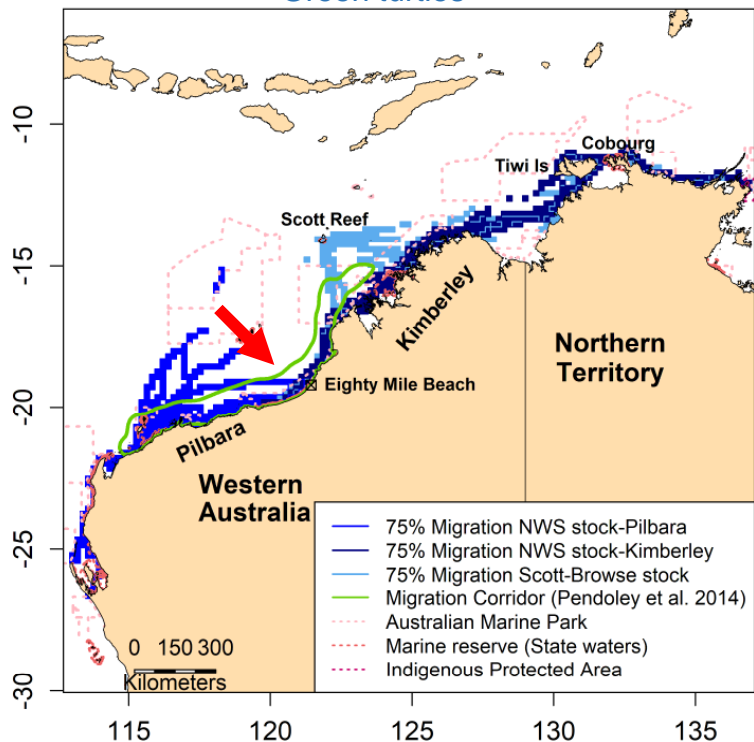
Migration

Large overlap (>40%) between the migration distribution and a migratory corridor (Pendoley et al. 2014)

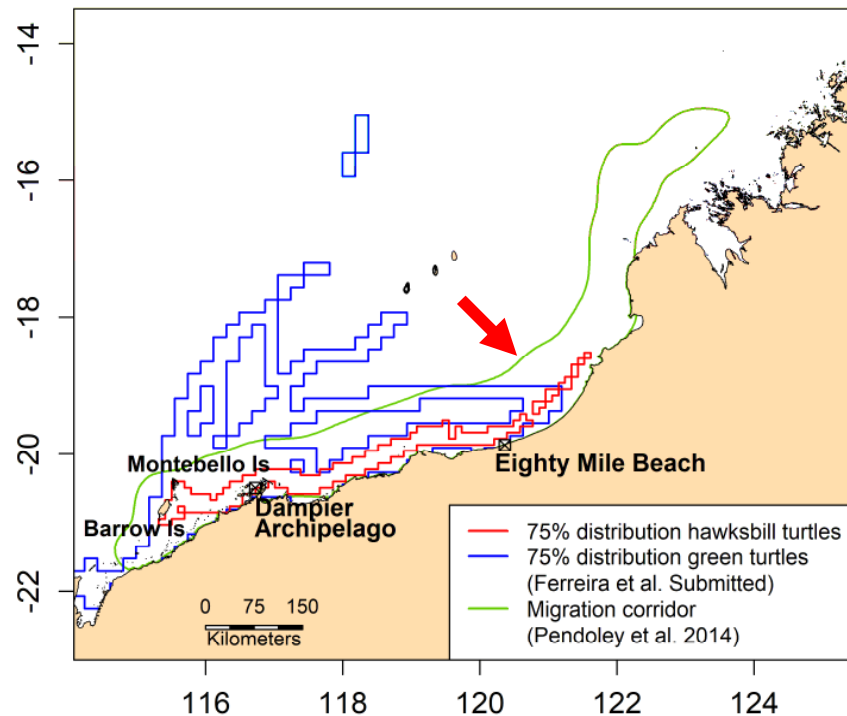
22.2% and 34.4% overlap with protected areas for green turtles

36% overlap with protected areas for hawksbill turtles

Green turtles



Hawksbill turtles

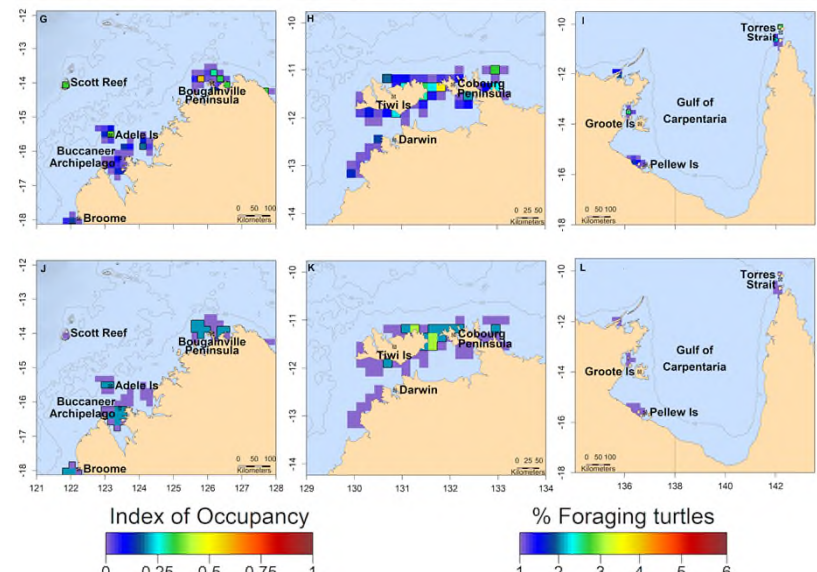
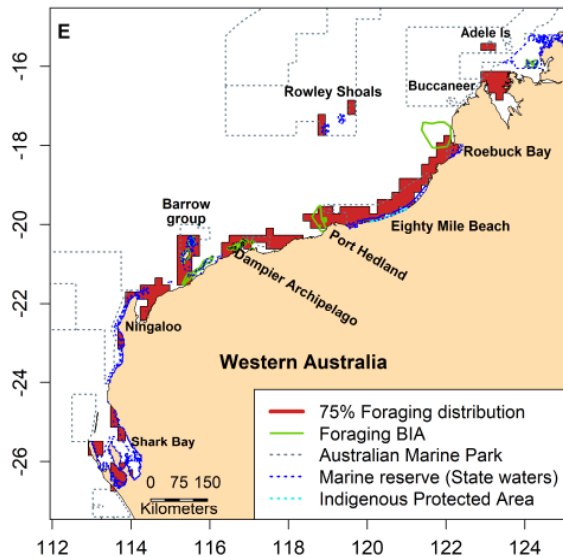
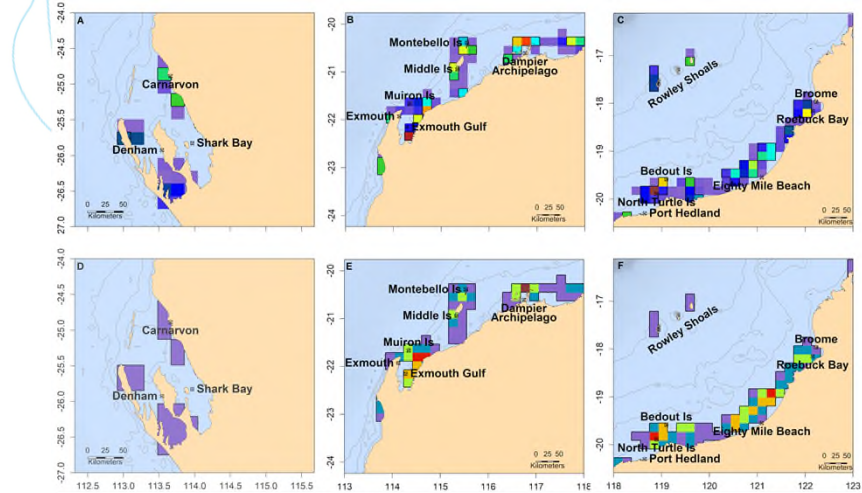


Foraging green turtles

Discrete foraging distribution from Shark Bay to Torres Strait

We identified 13 foraging areas where turtles from multiple stocks co-occurred

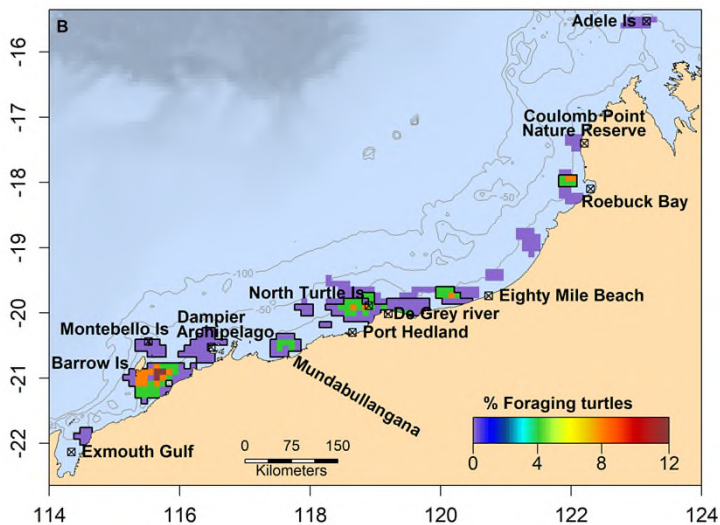
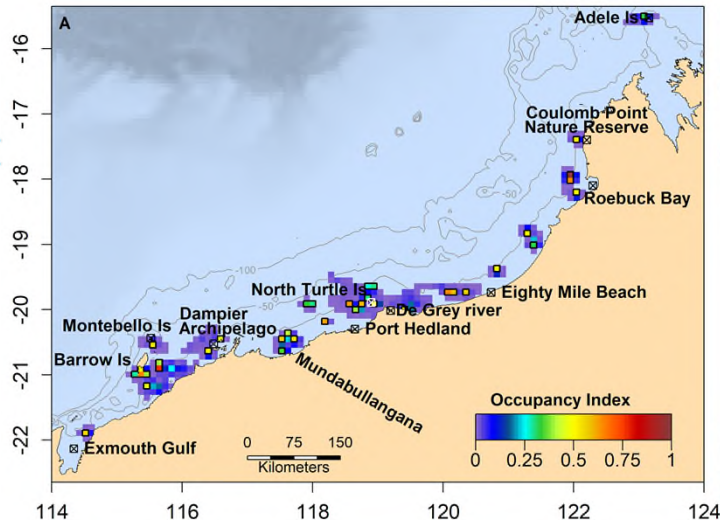
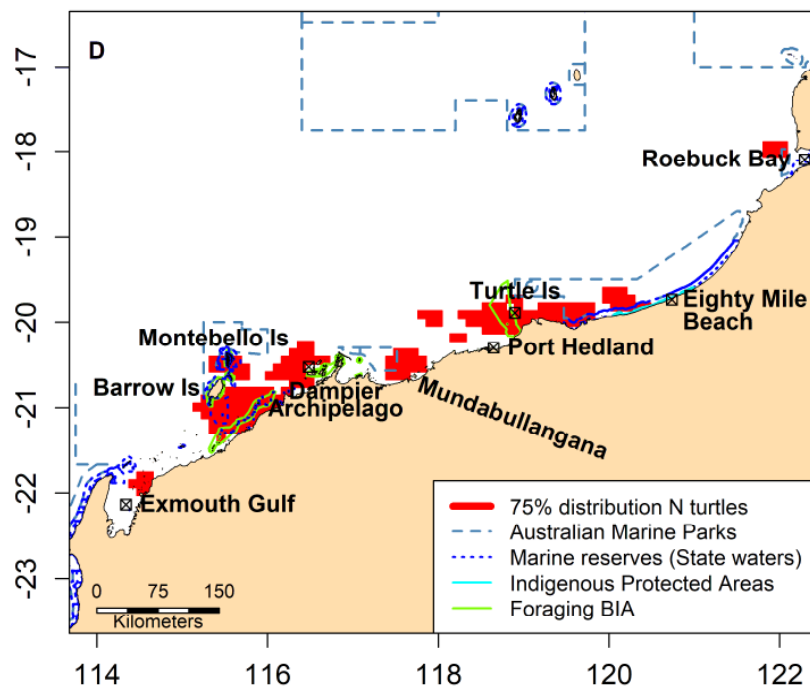
Foraging distribution overlapped with foraging BIAs, but indicated many areas not formally recognised as BIAs



Foraging hawksbill turtles

Discrete foraging distribution from Exmouth to Kimberley

Low overlap between foraging distribution and BIAs or protected areas



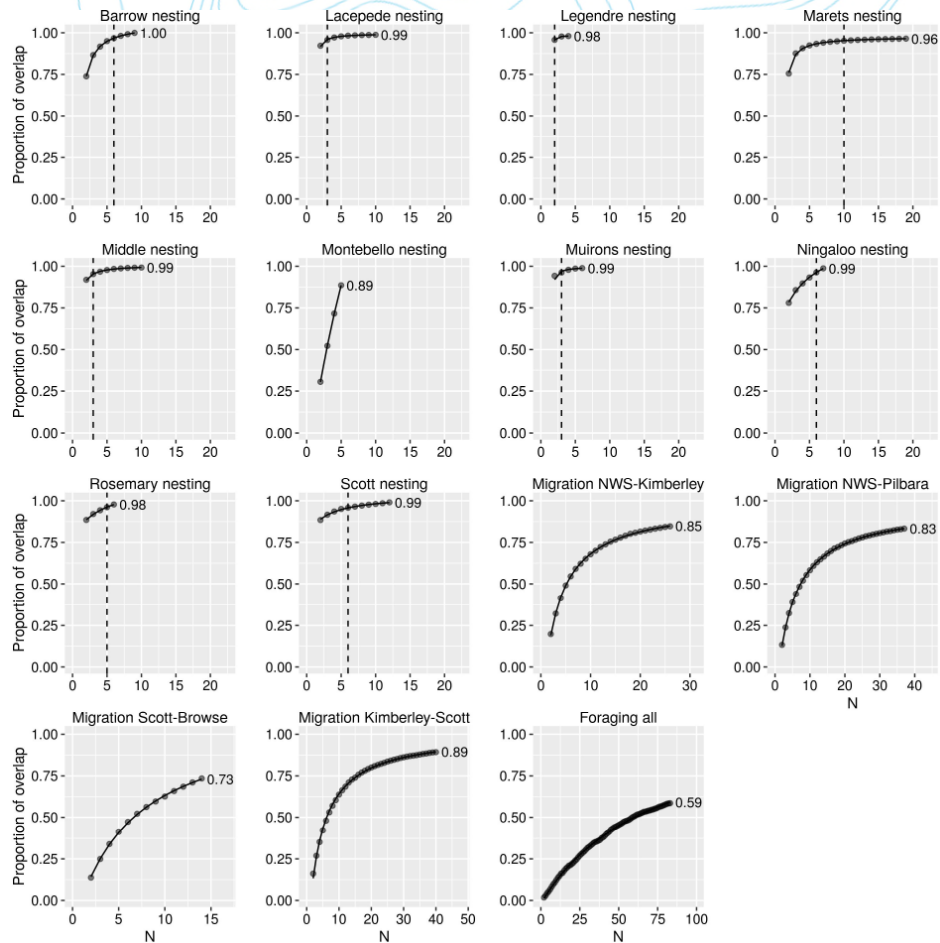
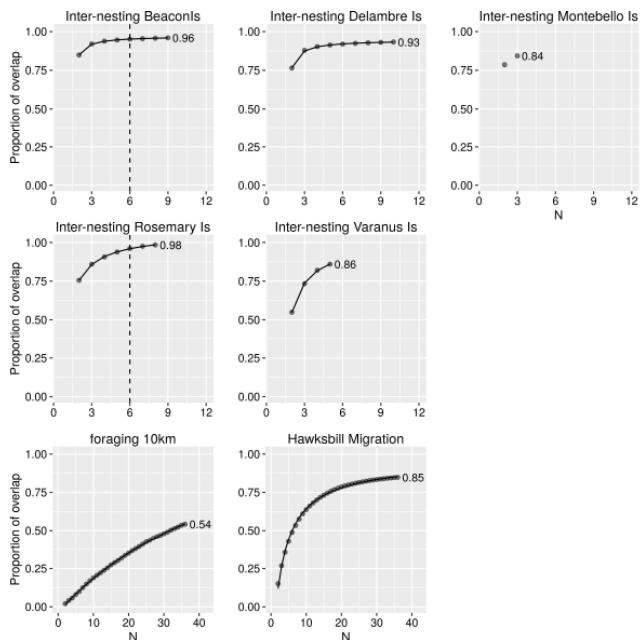
Sample size

Effect of sample size was assessed by calculating cumulative overlap over 1000 permutations

Sample size was adequate to describe inter-nesting distribution

Migration distribution was near the asymptote

Foraging distribution did not reach asymptote indicating sample size is still not large enough to quantify the entire extent



Exposure of threatened megafauna to pressures on the North west Shelf



Michele Thums, Scott Whiting, Sabrina Fossette, Tony Tucker, Graham Loewenthal, Marissa Speirs, Joanne King, Dani Rob, Mark Meekan, Phillipa Wilson, Kellie Pendoley, David Waayers, Michael Guinea, Samantha Reynolds, Brad Norman, Mike Double, Robert McCauley, Curt Jenner, Micheline Jenner, Andre Davenport, Virginia Andrews-Goff, Luciana Moller, Danielle Harries

Threat mapping overlaid with information on species distribution is a powerful tool for prioritising areas for conservation management

We compiled spatial data on threatened marine megafauna and human activities in the North West Shelf to calculate the overlap between species distributions and pressures

Exposure risk = high occupancy of taxa overlapped with high cumulative pressure



Photo: Michele Thums

Threatened species layers

Marine turtle distribution

- Green turtle
- Hawksbill turtles
- Flatbacks turtles

Whale distribution

- Blue whales
- Humpback whales

Shark distribution

- Whale sharks

Pressures

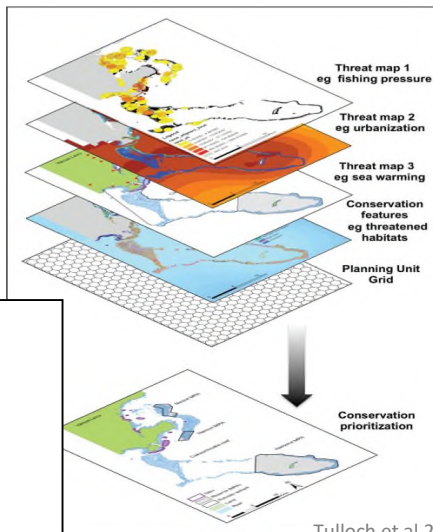
- O&G wells
- Offshore production facilities
- Onshore O&G facilities
- Pipelines
- Petroleum titles
- 2D seismic lines
- 3D survey areas
- Population density
- Shipping hotspots
- Artificial light at night

Individual Time spent



Distribution for each taxa

- Turtles: nesting, foraging, migration
- whales
- sharks



Pressure spatial data



Overlay with grid and extract

- presence(1)/absence(0)
- estimate of intensity



Cumulative threat maps

Spatial Overlap and Exposure Risk



Conclusion

Turtle distribution and important areas



- This is the first time that the extent of the distributions has been quantified
- The distributions we defined can be directly used to inform marine spatial planning
- Sample size analysis provided support to the distributions we define, particularly for inter-nesting
- We show the value in compiling and analysing multiple tracking datasets for the delineation of distribution and important areas



Photo: Nick Thake

Outputs



Publications

Ferreira LC, Thums M, Fossette S, Wilson P, Shimada T, Tucker AD, Pendoley K, Waayers D, Guinea ML, Loewenthal G, King J, Speirs M, Rob D, Whiting SD. Multiple satellite tracking datasets inform green turtle conservation at a regional scale. *In review*. Diversity and Distribution

Fossette S[#], Ferreira LC[#], Whiting SD, ..., Thums M. Quantifying movement and distribution of the critically endangered hawksbill turtle in the Eastern Indian Ocean. Manuscript being prepared for Global ecology and conservation

Ferreira et al. Exposure of threatened megafauna to pressures on the Northwest Shelf – In prep



Photo: Luciana Ferreira



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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.

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.

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THANK YOU!