Reef Research on the Ningaloo Coast

Ningaloo Reef is the largest fringing coral reef in Australia. This diverse marine environment supports a wide range of critical ecological, economic, social and cultural values.

In 1987, the Ningaloo Marine Park and Muiron Islands Marine Management Areas were established to form a framework for a multi-use park that provides a wide range of activities. The Marine Park stretches 260km, encompassing 5,000 square kilometres of oceans. Sanctuary zones form 34% of the Marine Park. In 2011, The Ningaloo Coast World Heritage Area was declared to recognise the outstanding natural beauty and biological diversity of both the marine and terrestrial systems in the region. Ningaloo Reef is home to 300 documented coral species, more than 700 reef fish species, approximately 650 mollusc species and more than 1,000 species of marine algae.

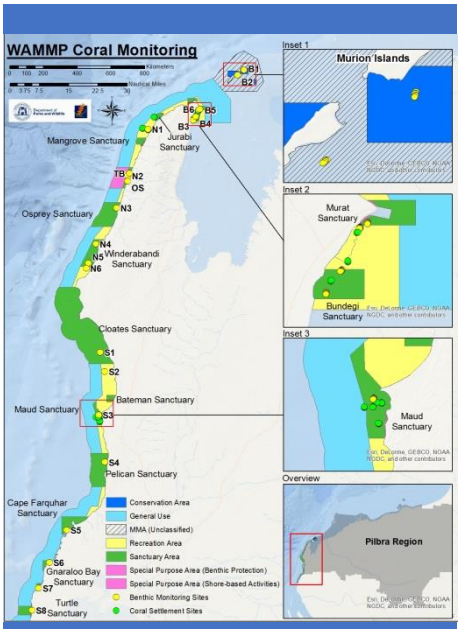
Corals within the Ningaloo Marine Park are exposed to pressures, including anomalously high water temperature, fresh water flooding and cyclone generated waves (Connell and Keough 1985; Moore et al. 2012; Speed et al. 2013).

Coordinated research and monitoring activities from numerous organisations collect information to monitor and manage Ningaloo Reef. The combined efforts of researchers, managers and citizen scientists have and will continue to play vital roles in understanding and protecting Ningaloo Reef. There has been specific interest in using citizen science as an opportunity to grow site-specific datasets to explore human-use impacts and act as an early warning system for reef health impacts such as coral bleaching.

REEF CHECK AUSTRALIA

Western Australia Department of Parks and Wildlife

by George Shedrawi



- The Department of Parks and Wildlife manages Western Australia's marine parks and reserves and has been monitoring the condition of corals within the Ningaloo marine reserves and the Ningaloo Coast World Heritage Area since 1991.
- Corals of the Ningaloo region have been exposed to successive impacts in recent years, including broad-scale, anomalously high water temperatures in the summers of 2011 and 2013, fresh water flooding and cyclone-generated wave action (Moore et al. 2012; Speed et al. 2013). Since 2010, average coral cover has declined significantly at 12 of the 22 permanent coral monitoring sites in the Ningaloo marine reserves. This loss of coral cover has been most pronounced around the Muiron Islands (50% decline at two sites), at Bundegi (85% decline at five sites) and south of Coral Bay (50% decline at five sites), all of which were areas that had previously supported high coral cover. The most commonly lost corals are those of the family Acroporidae which are highly susceptible to impacts of the kind (heating events and cyclones) experienced in this region of Western Australia since 2010.
- The Department also monitors the abundance of juvenile corals using terracotta tiles, which gives an indication of larval supply and recruitment potential. This information is used to inform managers of the recovery potential of a given reef after disturbances. To date, our work has shown that settlement rates at reefs near Bundegi are low. In contrast, the western reefs of the Ningaloo Marine Park remain stable from 2010 to 2015.
- While the recent loss of coral has been documented by measuring permanent monitoring sites over time, more generalised assessments of condition across the Ningaloo marine reserves are required to better understand the detailed spatial and temporal dynamics of coral loss and recovery.
- The continued detection of juvenile corals on western reefs indicates a certain resilience of these coral communities to the multiple disturbances that have occurred in recent years. However, more detailed surveys which consider the abundance of young colonies on the reef substratum will provide additional information on survival rates and how this will influence coral cover over time.

- The Department of Parks and Wildlife is working in collaboration with AIMS, CSIRO, universities, and not-for-profit organisations to better understand the pressures that impact Ningaloo Reef and to assess connectivity among reefs, patterns of recruitment and the potential for coral recovery. The recovery of heavily affected coral reefs will take years.
- Parks and Wildlife is also currently investigating additional methods that could complement the Department's existing monitoring program, such as using historical remote sensing data to provide a broader perspective on how the condition of coral has changed over time

References

- Moore JAY, Bellchambers LM, Depczynski M, Evans RD, Evans SN, Field SN, Friedman K, Gilmour JP, Holmes TH, Middlebrook R, Radford B, Ridgway T, Shedrawi G, Taylor H, Thomson DP, Wilson SK (2012) Unprecedented mass bleaching and loss of coral across 12° of latitude in Western Australia in 2010–11. PLoS ONE 7:e51807
- Speed CW, Babcock RC, Bancroft KP, Beckley LE, Bellchambers LM, Depczynski M, Field SN, Friedman KJ, Gilmour JP, Hobbs J-PA, Kobryn HT, Moore JAY, Nutt CD, Shedrawi G, Thomson DP, Wilson SK (2013) Dynamic Stability of Coral Reefs on the West Australian Coast. PLoS ONE 8:e69863

Additional information:
https://www.dpaw.wa.gov.au/management/marine/marine-research

CSIRO Ningaloo Reefs Shallow Reefs Project

by Damien Thompson

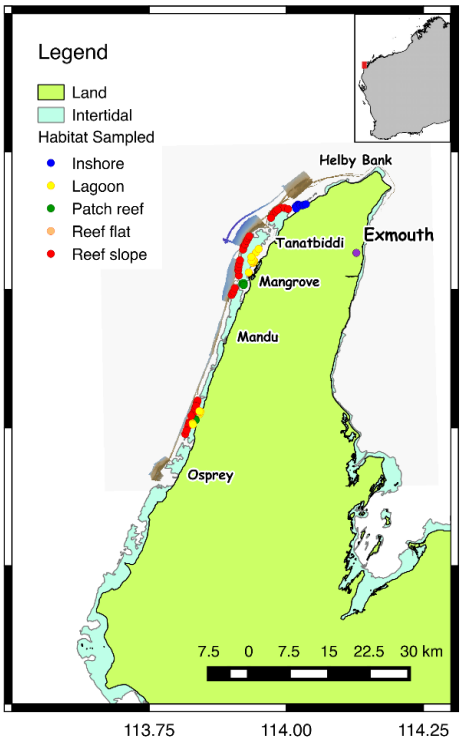


Figure ?

Figure ? Reef Slope at Osprey Reef Ningaloo

Ningaloo Outlook is a strategic research partnership between CSIRO and BHP Billiton that is developing new marine knowledge about Ningaloo Reef to inform the management of the Ningaloo Coast World Heritage Area. The program is a five-year research alliance, which aims to increase the understanding of Ningaloo's deep and shallow reefs and iconic megafauna (turtles, reef sharks and whale sharks).

Two key objectives of the shallow reefs program are:

(i) to provide annual assessments on the status of reef flat and reef slope habitats at Northern Ningaloo and

(ii) (ii) to form strong partnerships with local managers (Department of Parks and Wildlife) and communitiy groups (e.g. Cape Conservation Group).

The Ningaloo Shallow Reefs research theme theme will provide the data to support the management of coral and fish ecological values. The research will also gather new knowledge to better understand the ecological processes that are important in the structuring of reef flat and reef slope communities, and how this varies within the different management zones of the Ningaloo Marine Park. With the assistance of local community groups (e.g. Cape Conservation Group) the team are using a combination of diver based surveys and modelling techniques to assess the relative abundance and diversity of fishes, sharks and corals.

In the first year of the research program, the research team surveyed fish, benthos and marine debris at 72 locations between Osprey (south) and Jurabi (North). These assessments are providing information essential for understanding changes to fish and benthic communities over time.

CSIRO Ningaloo Reefs Shallow Reefs Project

by Damien Thompson

Figure ? Cape Conservation Group members learn about data entry and photo transect protocols

Citizen science programs, such as Reef Check, add enormous value to the formal research programs like Ningaloo Outlook. By improving the exchange of information between local community groups and researchers, we can improve our ability to respond and report on changes occurring in the marine environment e.g. such as the 2016 global coral bleaching event.

Cape Conservation Group (CCG) volunteers were trained in Reef Check methods in February 2016. This provides community members with the skills and materials to carry out benthic surveys using a similar method to what is used in the Ningaloo Outlook program. Reef Check and CCG members surveyed coral communities at Osprey Reef immediately before the predicted 2016 coral bleaching event (February 2016); a time when the CSIRO Ningaloo Outlook research team were unable to carry out surveys.

These inshore locations were subsequently re-surveyed in May 2016 and, by comparing our observations with those in March 2016, we were able to confirm that the global coral bleaching event of 2016 has had little to no impact on inshore coral communities at Osprey. Our involvement with Reef Check and CCG has helped us to meet our program objectives by (i) strengthening our partnerships with local community groups and marine managers and (ii) improving our ability to provide managers with up-to-date information on the impacts of events such as the 2016 global coral bleaching episode.

Additional information:
https://www.dpaw.wa.gov.au/management/marine/marine-research

Australian Institute of Marine Science

by Martial Depczynski

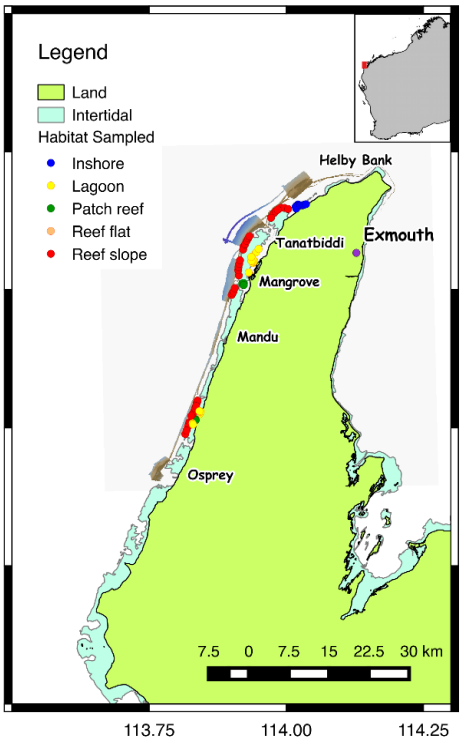


Figure ?

The Australian Institute of Marine Science (AIMS) research program has been underway on Ningaloo Reef since 2006. The focus of the research has been on improving understanding of the reef and the natural processes that support it so that managers may make well informed decisions about the management of the Ningaloo Marine Park and the region.

Surveys collect data on the percentage cover of different substrate types and benthic organisms (particularly corals), identified to benthic group or lifeform level.

AIMS continue their close involvement with Ningaloo through a number of science projects. In collaboration with the Department of Parks and Wildlife (DPaW) and the Australian National University, annual surveys of newly recruited fishes continue along the length of Ningaloo. The program is now in its 8th year and aims to identify long-term trends in fish recruitment to assist management of fish stocks within the Ningaloo Marine Park.

The data set is also being used to answer more specific questions such as which habitats act as important fish nursery grounds and what factors are important in maintaining fish diversity and abundance in seasonal algal meadows (Wilson et al. 2014). AIMS, in collaboration with the DPaW, have also recently completed extensive baseline surveys of fish and benthos in the Ningaloo Marine Park on behalf of Woodside Energy Limited which covered over 300km of reef habitat from the Muirons to Red Bluff.

Ningaloo weather station at Milyering Visitor Centre offers the latest weather and oceanographic observations.

AIMS also continue their whale shark research through satellite tagging and photo-identification techniques at Ningaloo. These techniques allow us to document the movements and seasonal reoccurrence of individual whale sharks to Ningaloo.

Additional information:

- Ningaloo Atlas http://ningaloo-atlas.org.au/
- Ningaloo weather station data http://weather.aims.gov.au/#/station/8.

Extreme events on the Reef

In 2013, RCA helped to implement five monitoring sites, since this time the area has been exposed to several severe weather events. Long-term monitoring is important to document impacts and recovery from disturbance events.

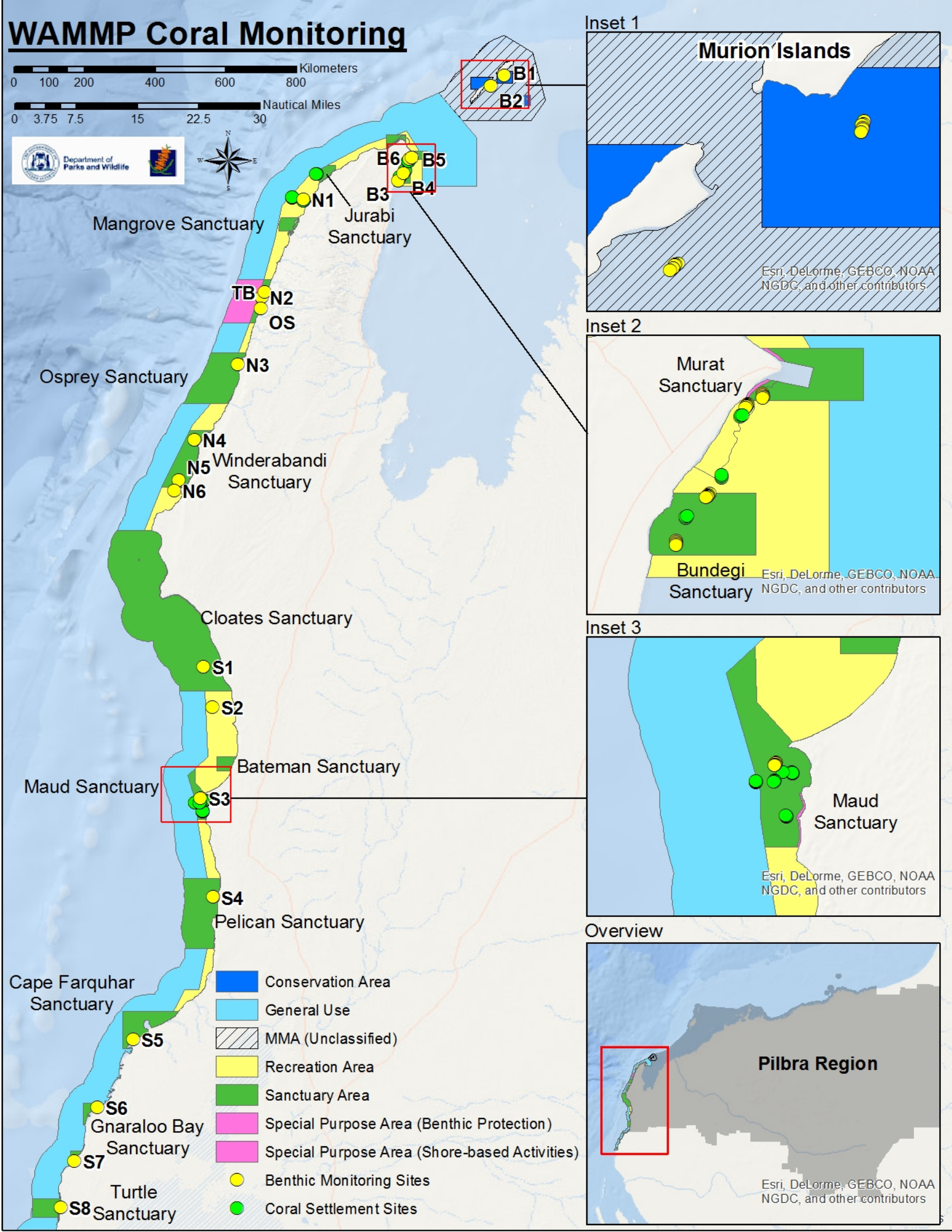
In April 2014 severe flooding occurred in the Exmouth area. More than 250mm, almost the average annual rainfall for the region, fell over a weekend and caused severed flooding and washed away roads and scoured the riverbeds. A plume of silt and sediment was observed around nearshore areas of Cape Range National Park.

In 2011, a category two cyclone Bianca tracked along the coastline and passed through the Ningaloo region. In March 2015 another category three cyclone (Olwyn) also tracked through the Montebello Islands and within three km of the Ningaloo fringing reef. Less than 6 weeks later Tropical Cyclone Quang, Category 2 cyclone impact just north of the North West Cape.

Cyclones and flooding both have the potential to impact reefs through direct physical damage from intensified water movement, exposure to fresh water and sediment loading.

Other monitoring considerations

- A recent study of historical data has demonstrated coral cover within the Ningaloo Marine Park is dynamic undergoing decline and recovery over long periods (Speed et al 2013).
- In the mid 1980s-90s coral-eating *Drupella* snails caused extensive damage to more than 100 km of reef area across Ningaloo. Monitoring indicates that *Drupella* abundance has been low to moderate since 1994. Observations suggest that *Drupella* may be attracted to broken coral. Ongoing monitoring is an important consideration for Ningaloo Reef.
- Corals within the Ningaloo Marine Park and Muiron Islands Marine Management Area (NMPA) have recently been exposed to successive pressures, including broad-scale, anomalously high water temperatures in the summer of 2011 and 2013, fresh water flooding and cyclone-generated waves (Moore et al. 2012; Speed et al. 2013). No change in coral cover was detected at sites monitored by the Department as a result of Cyclone Olwyn.
- Fringing reefs in Ningaloo Marine Park appear to have been unaffected by the third global coral bleaching event that began in Australia in early 2016.


WAMMP Coral Monitoring
Kilometers
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Nautical Miles
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Department of Parks and Wildlife
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S8
Mangrove Sanctuary
Jurabi Sanctuary
Osprey Sanctuary
Winderabandi Sanctuary
Cloates Sanctuary
Bateman Sanctuary
Maud Sanctuary
Pelican Sanctuary
Cape Farquhar Sanctuary
Gnaraloo Bay Sanctuary
Turtle Sanctuary
Conservation Area
General Use
MMA (Unclassified)
Recreation Area
Sanctuary Area
Special Purpose Area (Benthic Protection)
Special Purpose Area (Shore-based Activities)
Benthic Monitoring Sites
Coral Settlement Sites
Inset 1
Murion Islands
Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors
Inset 2
Murat Sanctuary
Bundegi Sanctuary
Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors
Inset 3
Maud Sanctuary
Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors
Overview
Pilbra Region
Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors