Habitat Monitoring in Marra Sea Country

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Why monitor Marra Sea Country?

Marra Sea Country has significant biological diversity, containing habitats such as seagrass, corals, mangroves, macroalgae, and saltmarshes. These habitats support culturally important species including dugong, turtles, dolphins, whales, sea snakes, and diverse fish communities (Marra Traditional Owners, 2023).

Background

Marra Sea Country, located in the Northern Territory's Gulf of Carpentaria, stretches from the Roper River in the west to Warrawarda (Rosie Creek) in the east. It includes Kurrulinya (Maria Island) and Yumunkuni (Beatrice Island). The area is supported by two marine parks: the Limmen Marine Park (LMP, Commonwealth) and the Limmen Bight Marine Park (LBMP, NT), which encourage collaborative management of this region.

In 2021, a baseline survey mapped benthic habitats across more than 2,000 intertidal and subtidal sites in Marra Sea Country for the first time (Collier et al. 2023). A follow-up survey in 2023 began year one of ongoing habitat monitoring, allowing changes in habitat condition to be tracked over time (Smith et al. 2025).

That monitoring program continued in 2025, looking at changes in benthic habitats — focusing on seagrass — in Marra Sea Country.

This work is part of an ongoing collaboration between Marra Traditional Owners through Namultja Aboriginal Corporation, working with researchers from TropWATER James Cook University and the Northern Institute Charles Darwin University, the Northern Territory Parks and Wildlife Commission, and Parks Australia.







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How we monitor

Field work and data processing

Monitoring was conducted in September 2025. September was selected to coincide with northern Australia's peak seagrass growing time, and to ensure data are comparable with 2021 and 2023 surveys.

We used the NT Parks boats *Barranyi* and *Swamp Doggy* to survey inshore waters between Williyurru (Limmen Bight River) and Warrawarda (Rosie Creek). High winds and the use of small vessels meant our monitoring was mainly in inshore coastal waters within the LBMP and proposed LBMP extension.

62 sites were monitored using a spatially balanced design. At each site, GPS coordinates, depth and sediment type (mud, sand, rubble, rock) were recorded. Depth (metres) was recorded from the vessel sounder and converted to depth below mean sea level.

Benthic habitat data were collected using video drops as described in Smith et al. (2025). An underwater camera fitted with a 0.25 m^2 quadrat frame was lowered to the seafloor at each site, with 10 replicate drops filmed. A trained observer assessed habitat cover from still images captured during each drop, estimating seagrass biomass and percent cover of habitat types for each quadrat. These replicate drops were then averaged to produce mean seagrass biomass and percent cover of each habitat type for each site. Van Veen grab samples were taken where visibility was low or seagrass species identification was needed.

Habitats recorded included seagrass (and seagrass species), algae categories (erect macrophyte, filamentous, encrusting, turf mat, erect calcareous), and benthic macroinvertebrates including hard coral, soft coral, sponge, and other invertebrates.

All survey data were entered into a GIS using ArcPro (ESRI) to create a 2025 habitat spatial layer.



Barranyi



Camera drop



Van Veen grab

Data analysis

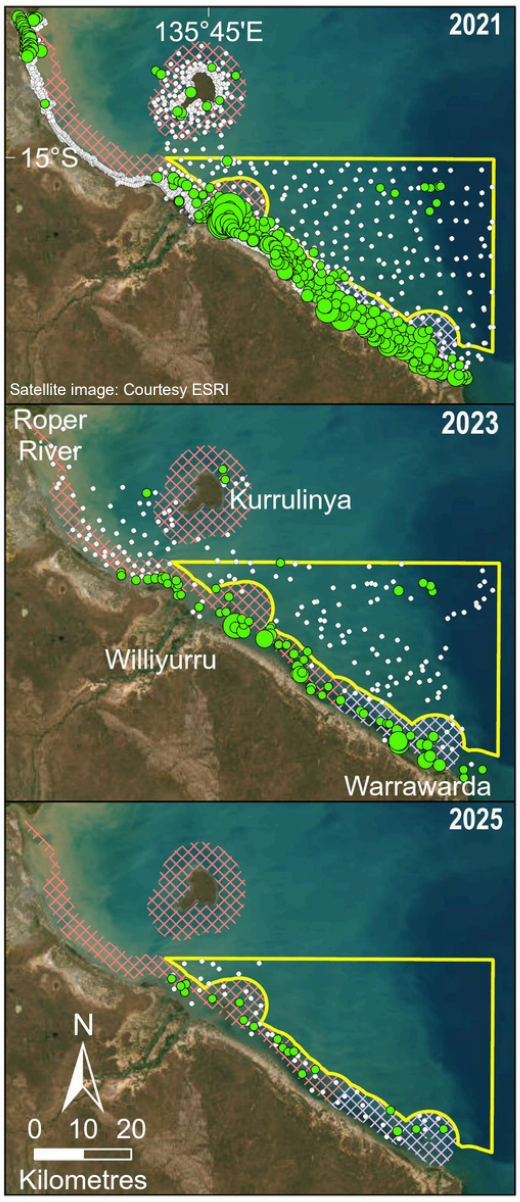
To examine changes over time, seagrass biomass was compared for 2021, 2023, and 2025 within two monitoring blocks: (1) the current LBMP from Williyurru (Limmen Bight River) to the eastern LBMP boundary, and (2) the proposed LBMP extension.

A Tweedie generalised linear model (GLM) was used to test for differences in seagrass biomass across years and monitoring blocks using the *mgcv* package in R, with pairwise post-hoc contrasts conducted using the *emmeans* package in R.

What we found

Seagrass presence and biomass

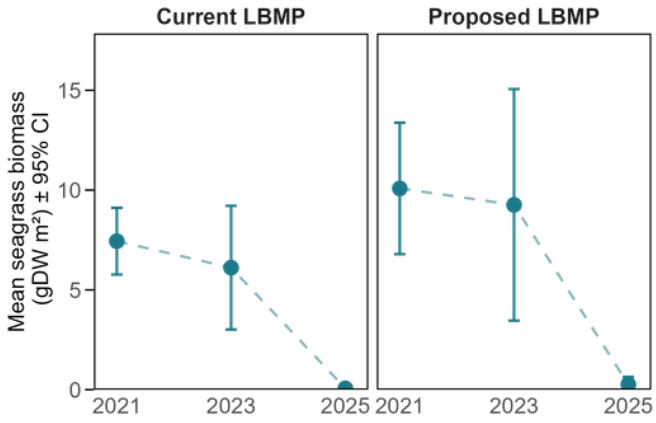
The maps below show seagrass presence (green circles), seagrass biomass (indicated by circle size), and seagrass absence (white dots) for each survey.



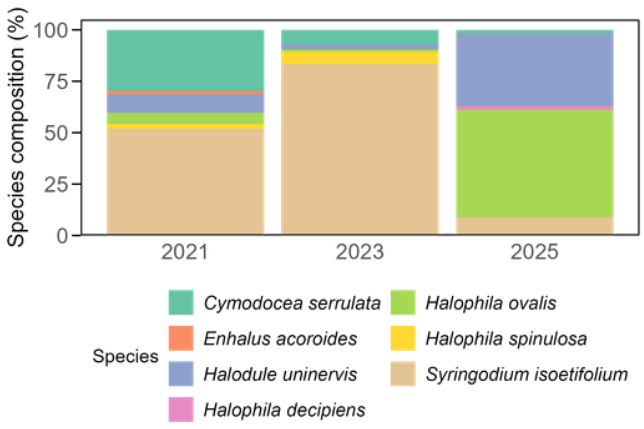
Within the inshore monitoring blocks (current LBMP and proposed LBMP extension), seagrass was detected at the majority of sites in 2021 and 2023 (63% and 81% of sites respectively), but only 32% of sites in 2025.

Seagrass biomass declined dramatically in 2025 to just 0.1 gDW m^2, a decline from 8.2 gDW m^2 in 2021 and 7.2 gDW m^2 in 2023. Pairwise comparisons confirmed that biomass in 2025 was significantly lower than both 2021 and 2023 (p-values < 0.0001). The figure below shows the loss of biomass in 2025 in each monitoring block.

The interaction between monitoring block and year in our model was not significant, and there was no overall significant difference in seagrass biomass between blocks (p > 0.05).



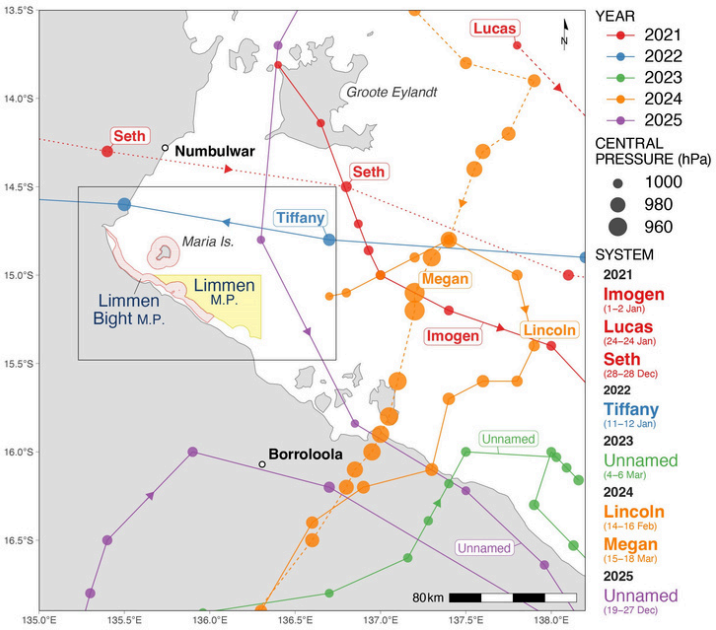
Species composition shifted from communities dominated by high-biomass *Syringodium isoetifolium* and *Cymodocea serrulata* in 2021 and 2023, to sparse, low-biomass patches of the small colonising species *Halodule uninervis* and *Halophila ovalis* in 2025 (see figure below). The species *Enhalus acoroides* and *Halophila spinulosa* were not recorded in 2025.



Environmental conditions

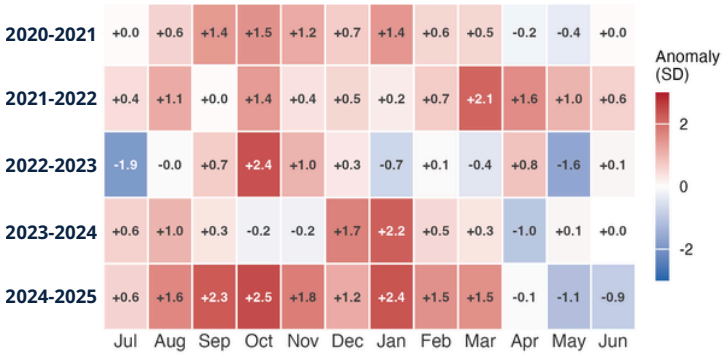
Tropical cyclones

Between 2021 and 2025, eight tropical cyclones or lows tracked through the south-western Gulf of Carpentaria (see map, right). The 2024 season brought Lincoln in February and severe tropical cyclone Megan in March — the period's strongest event, making landfall near Borroloola just east of the Limmen Marine Park. An unnamed tropical low crossed twice in late December 2025 — from the north, then the west — which may have further impacted seagrass. Most tracks passed east or south of Marra Sea Country, with severe winds limited to cyclone Megan.



Sea surface temperature

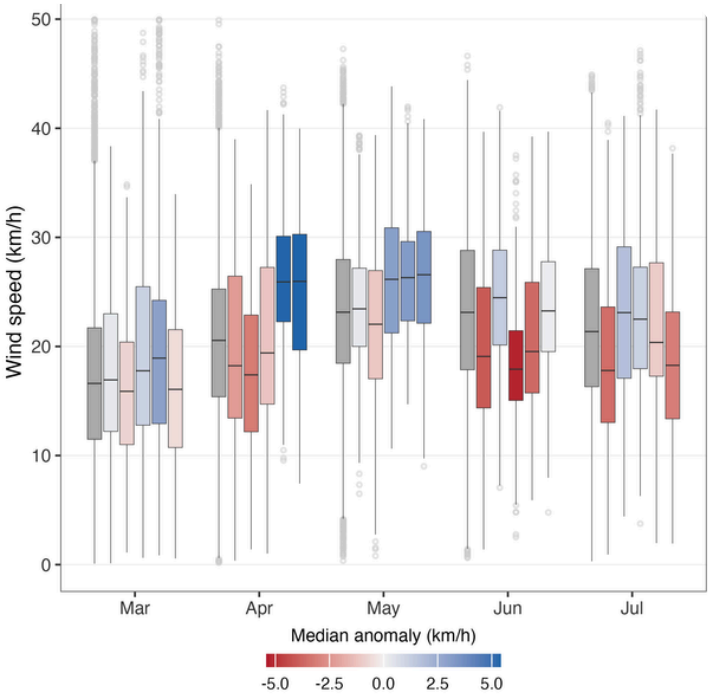
Marra Sea Country experienced an unusual eight-month warm water period from August 2024 to March 2025, peaking in October 2024 (29.9 °C, +2.5 SD) and January 2025 (31.8 °C, +2.4 SD), driven by La Niña conditions and calm winds. Sea surface temperatures (SST) returned to below average in April–May 2025 with increased wind and wave energy. The table (right) shows monthly SST anomalies from July 2020 to June 2025, with red months above average.



Wind and waves

Wind and wave conditions in Marra Sea Country in 2021–2025 were close to the 1991–2020 average, with two notable exceptions. April 2024 was the windiest April since 1950, and had the third-highest April wave height on record (1.04 m, ~+0.35 m above average), with extreme wind and waves co-occurring only twice before in the 86-year record (1947 and 1950). April 2025 was also above normal, with elevated waves continuing into May (1.14 m vs 0.89 m climatology), though anomalies were less extreme than 2024. Two consecutive energetic Aprils is unusual for this region.

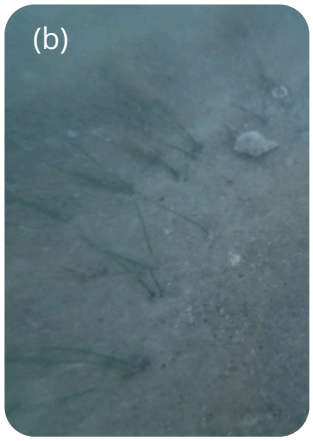
The figure (right) shows dry season median wind speeds for 2020–2025. The blue bars represent above average winds, and red bars are below average winds.



What this means for Country

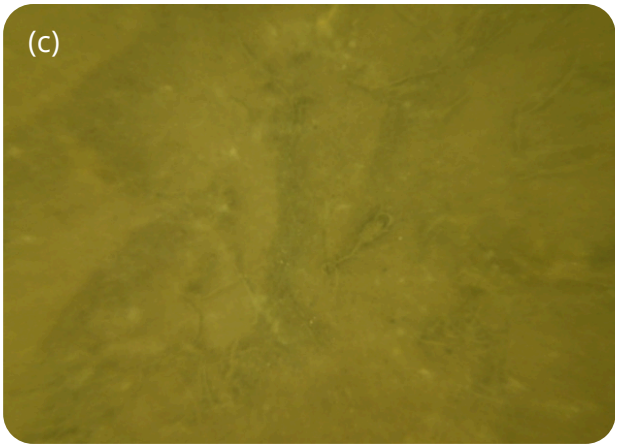
The inshore seagrass meadow of Marra Sea Country, largely within the Limmen Bight Marine Park, declined dramatically between 2023 and 2025. Within the meadow, seagrass biomass fell by 99%. Seagrass was found at only 32% of sites, down from 81% in 2023. The dense meadows of *Syringodium isoetifolium* (Figure a) and *Cymodocea serrulata* recorded in earlier surveys were replaced by sparse patches of small colonising species (Figure b).





This loss affects Sea Country directly. This meadow is an important feeding ground for dugong and turtles — species of deep cultural significance to Marra people — and supports the fish communities that Marra families rely on.

The likely drivers are compounding. Tropical Cyclone Megan (March 2024) delivered freshwater and sediment that reduced water clarity, followed by eight months of unusually warm water and two consecutive years of extreme wind and wave conditions in April. High levels of fine suspended material were still visible during the 2025 survey (Figure c).



Seagrass can recover. The presence of small, fast-growing colonising species *Halodule uninervis* and *Halophila ovalis* shows that life remains in these meadows. These species are nature's first step in rebuilding, and recovery is possible if water clarity improves and conditions return to normal.

The condition of deeper, offshore seagrass in the Commonwealth Limmen Marine Park remains unknown due to weather and access constraints in 2025, and those meadows may hold additional refuges that support seagrass recovery. Continued monitoring is essential to track how Sea Country responds, support management decisions across both parks, and ensure Marra knowledge and priorities remain central to the care of this Sea Country.

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Photos courtesy Sam Frederick and TropWATER JCU

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