National Environmental Science Program

RESEARCH REPORT
Project 3.5

MARINE HABITATS OF KURTIJAR INDIGENOUS PROTECTED AREA

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Cover images

Front and back: Aerial view of Kurtijar Sea Country. Credit: JCU TropWATER.

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Acknowledgement of Country

The Marine and Coastal Hub acknowledges Aboriginal and Torres Strait Islander people as the First Peoples and Traditional Owners and custodians of the land and waterways on which we live and work. This research was conducted in Kurtijar Sea Country. We honour the Kurtijar Traditional Owners and pay our respects to Elders past, present and future.

Aboriginal and Torres Strait Islander peoples represent the world's oldest living culture. We celebrate and respect this continuing culture and strive to empower Aboriginal and Torres Strait Islander peoples.

Executive summary

Seagrass meadows across remote northern Australia provide critical habitat for dugongs, turtles, fish, prawns, and other key species, yet data on their extent and condition remain limited. Few large-scale or long-term monitoring programs exist, meaning regional planning often proceeds with minimal understanding of potential impacts on these ecosystems.

NESP Marine and Coastal Hub Project 3.5 – Partnerships for Seagrass Research and Protection – addresses these gaps by consolidating existing data, identifying priorities for new surveys, generating new datasets, and improving access to seagrass information to support better management and sustainable development. Within this broader program, the Kurtijar Sea Country Indigenous Protected Area (IPA) in the southeast Gulf of Carpentaria, Queensland, was identified as a priority area for assessment. The IPA extends from the Norman River near Karumba to the Staaten River and includes the Staaten–Gilbert Fish Habitat Area, supporting diverse marine habitats, endangered species, and fisheries that are commercially, recreationally, and culturally important.

The survey of intertidal and subtidal habitats within Kurtijar Sea Country was a collaborative effort involving researchers from TropWATER (James Cook University), the Northern Institute (Charles Darwin University), and Edith Cowan University, working in partnership with the Carpentaria Land Council Aboriginal Corporation and Normanton Rangers. The study provides the first comprehensive baseline data on benthic habitats across the IPA, contributing to a larger regional effort to map and monitor seagrass across northern Australia and strengthen Indigenous-led management of Sea Country.

Intertidal surveys were conducted by helicopter at 380 sites from 27 to 28 August 2023 and 23 October 2023. Subtidal surveys were undertaken on the live-aboard MV Eclipse from 4–6 October 2023. Fifty-one subtidal sites were surveyed using a towed video and sled net, drop camera, and grab sampling. The area was highly turbid with mud as the dominant sediment type and low cover of seagrass, algae, and macroinvertebrates. Two seagrass species were recorded: *Halodule uninervis* in the intertidal area between Karumba and Smithburne River, and *Halophila ovalis* at three sites between the Gilbert River and Staaten River at a depth of 11–14m. Benthic macroinvertebrates, including sea pens, whips, sponges and hydroids, were found at only 22% of sites in the subtidal area. Filamentous algae were present at 2% of intertidal sites, and erect macrophyte algae were present at 4% of subtidal sites.

This project delivers essential baseline data and maps to support Kurtijar people and the QLD Government in the planning and management of Kurtijar Sea Country and the IPA. Spatial data such as this enables communities to identify key areas for monitoring and management, particularly those with cultural significance, ecological importance, or resource management priorities.

1. Introduction

The Kurtijar Sea Country Indigenous Protected Area (IPA) in Queensland lies between the Norman and Staaten Rivers in the south-east Gulf of Carpentaria, Queensland. Kurtijar People are the Traditional Owners of the saltwater Country in this IPA and the land and rivers extending inland approximately 100km. The Carpentaria Land Council Aboriginal Corporation (CLCAC), formed in 1982, represents the Traditional Owners from nine Aboriginal Language Groups in the lower Gulf of Carpentaria, including the Kurtijar people (Carpentaria Land Council Aboriginal Corporation, 2025a). The Kurtijar Aboriginal Corporation was formed in 1994 and consists of 17 clan groups (Kurtijar Aboriginal Corporation, 2020).

The Normanton Land and Sea Rangers include Kurtijar, Kukatj and Gkuthaarn Traditional Owners undertaking conservation and land management activities in this region. These activities are in alignment with the aspirations of the community, focusing on wetland and biodiversity monitoring, weed control, fire management, feral animal management, and cultural activities (Carpentaria Land Council Aboriginal Corporation, 2025b).

The Gulf of Carpentaria is a large, shallow bay (<70m) with muddy sediments and a tidal range of 2–4 m (Poiner et al., 1987; Somers & Long, 1994; Torgersen et al., 1983). It has a seasonal monsoon cycle with a wet season (December–February) characterised by north-westerly winds and occasional cyclones, and a dry season (May–October) with south-easterly winds (Somers & Long, 1994). Previous studies have shown that the south-east coastal region has the highest biodiversity of benthic communities in the Gulf, associated with the muddy sandy sediments and riverine flows (Long & Poiner, 1994). Kurtijar Sea Country in the south-eastern Gulf is influenced by the Staaten and Gilbert Rivers, which extend from the Great Dividing Range about 400 km inland and flow north-west into the Gulf of Carpentaria with catchments that cover ~73,000 square kilometres. A third of the Gilbert River catchment is a broad estuarine delta of winding creeks, tidal flats and mangrove swamps that reach 100km in width (Bureau of Meteorology, 2017; Burford et al., 2020). These remote and largely unaltered rivers with their seasonal monsoonal flows create critical and extensive wetland habitats (Burford et al., 2020; Carpentaria Land Council Aboriginal Corporation, 2014). However, there are plans to alter the river flow (Etheridge Shire Council, 2020) and concerns about the influence of this on coastal ecosystems (O'Mara et al., 2025).

The Kurtijar Land and Saltwater Country Plan, developed by the Kurtijar people, sets out the values and management priorities for Kurtijar land and saltwater country (Carpentaria Land Council Aboriginal Corporation, 2014). The Kurtijar IPA has significant conservation and biodiversity values with diverse mangrove, seagrass and saltmarsh habitats that support a wide range of threatened and endangered species, including dugong and nesting sea turtles (Carpentaria Land Council Aboriginal Corporation, 2014). It is one of the last strongholds for the largetooth (*Pristis pristis*), green (*Pristis zijsron*) and dwarf (*Pristis clavate*) sawfish species (Department of the Environment, 2025). These species are critically endangered on the IUCN Red List and vulnerable under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. The largetooth sawfish prefers muddy bottom sediments, and juveniles migrate from freshwater rivers and estuaries to coastal and offshore waters as adults (Allen, 1997; Commonwealth of Australia, 2015; Giles et al., 2006; Stevens et al., 2005). Connectivity between the riverine freshwater, estuarine and marine environments is essential to maintaining the health of this ecosystem. Life history data on sawfish in Australia are limited, but populations are suspected to have declined by at least 50% (Kyne et al., 2021) as a result of fishing pressures (overfishing and bycatch, including gillnetting and trawling) and habitat loss (Commonwealth of Australia, 2015; Kyne & Pillans, 2017; Yan et al., 2021).

The coastline from the Gilbert River to just north of the Staaten River, extending 4 km offshore, is a Declared Fish Habitat Area (FHA) (Carpentaria Land Council Aboriginal Corporation, 2014; Queensland Government, 2025). Queensland's FHAs aim to protect high-quality fish habitats, especially those critical in sustaining fish stocks for recreational, commercial, and Indigenous fishing. The Staaten–Gilbert FHA safeguards mangroves, estuarine salt flats and extensive sand bank habitats as well as critical nursery areas for prawn, barramundi and other marine species (Burford et al., 2020; Queensland Government, 2025). The Northern Prawn Fishery (NPF) operates across northern Australia and generates the most revenue of all Australian fisheries (Commonwealth of Australia, 2020) and the waters of the south-east Gulf of Carpentaria are the most productive banana prawn fishing grounds (Smart et al., 2021). Juvenile banana prawns and barramundi use these estuaries as feeding and refuge areas (Broadley et al., 2020). Increased river flows during the wet season bring substantial nutrients into these Gulf wetlands, increasing coastal productivity. This seasonal flush is critical to maintaining primary productivity, and any alteration to river flows is likely to have detrimental impacts on fisheries (Broadley et al., 2020; Burford et al., 2020; O'Mara et al., 2025; Smart et al., 2021).

Key industries in the region are based around its natural resources, including commercial fishing, mining, shipping, pastoralism and a growing tourism sector. The Kurtijar Land and Saltwater Country Plan expresses the Kurtijar people's desire to ensure the demands on these resources, especially by tourism and fishing, are sustainable and balanced with traditional uses. It also conveys their aspiration that impacts on Country, culture and local livelihoods are considered in future management and development decisions.

There are plans for development in the Kurtijar Sea Country IPA catchment; the Gilbert River has been identified as an area for agricultural expansion in North Queensland. To facilitate the irrigation required for this development, there is a proposal to build a 31-metre-high dam with a 323 GL capacity located on the Gilbert River, 30 km southwest of Georgetown (Etheridge Shire Council, 2020). While a dam could facilitate irrigation demands, a CSIRO assessment found the significant water use would impact downstream environments, and further investigations would be required to quantify impacts on commercial and recreational fisheries (Commonwealth Scientific and Industrial Research Organisation, 2013). Variable freshwater flows between wet and dry seasons are critical to the life histories of many commercial, recreational and culturally important species like prawns, barramundi, sawfish and mud crabs (O'Mara et al., 2025). They have a high dependence on productive coastal estuaries for spawning, recruitment, nurseries, habitat, and food, with many moving between freshwater and offshore coastal environments throughout their lives (Broadley et al., 2020; O'Mara et al., 2025; Smart et al., 2021). Alterations to free-flowing rivers for water development threaten the habitat connectivity essential for growth, recruitment and movement of these key species – such as sawfish – as well as lesser-studied species, including mangrove jack, mullet and catfish (O'Mara et al., 2025). Traditional Owners have expressed concerns about the proposed water developments and the damage they will have on these important cultural and natural environmental systems (Carpentaria Land Council Aboriginal Corporation, 2014).

Despite its ecological and cultural significance, there remains a critical lack of baseline data on benthic habitats across Kurtijar Sea Country. In particular, seagrass – the foundation of many coastal food webs and a vital habitat for important species such as dugong, turtles, prawns and fish – has not been comprehensively mapped in this region since limited subtidal surveys were conducted in 1986 and aerial surveys in 2004 (Figure 1). This knowledge gap restricts the ability of Traditional Owners and environmental managers to make informed decisions about resource use and habitat and species protection. To address this, a marine benthic habitat survey was undertaken in 2023 covering intertidal and subtidal waters from the Norman River to the Staaten River, as part of a larger project mapping seagrass across Northern Australia (Figure 1). Funded by the National Environmental Science Program (NESP) Marine and Coastal Hub, this work is part of Project 3.5 – Partnerships for Seagrass Research and Protection – which aims to generate bilingual habitat maps, spatial datasets, and a report to support informed decision-making by the Kurtijar people, government and environmental managers.

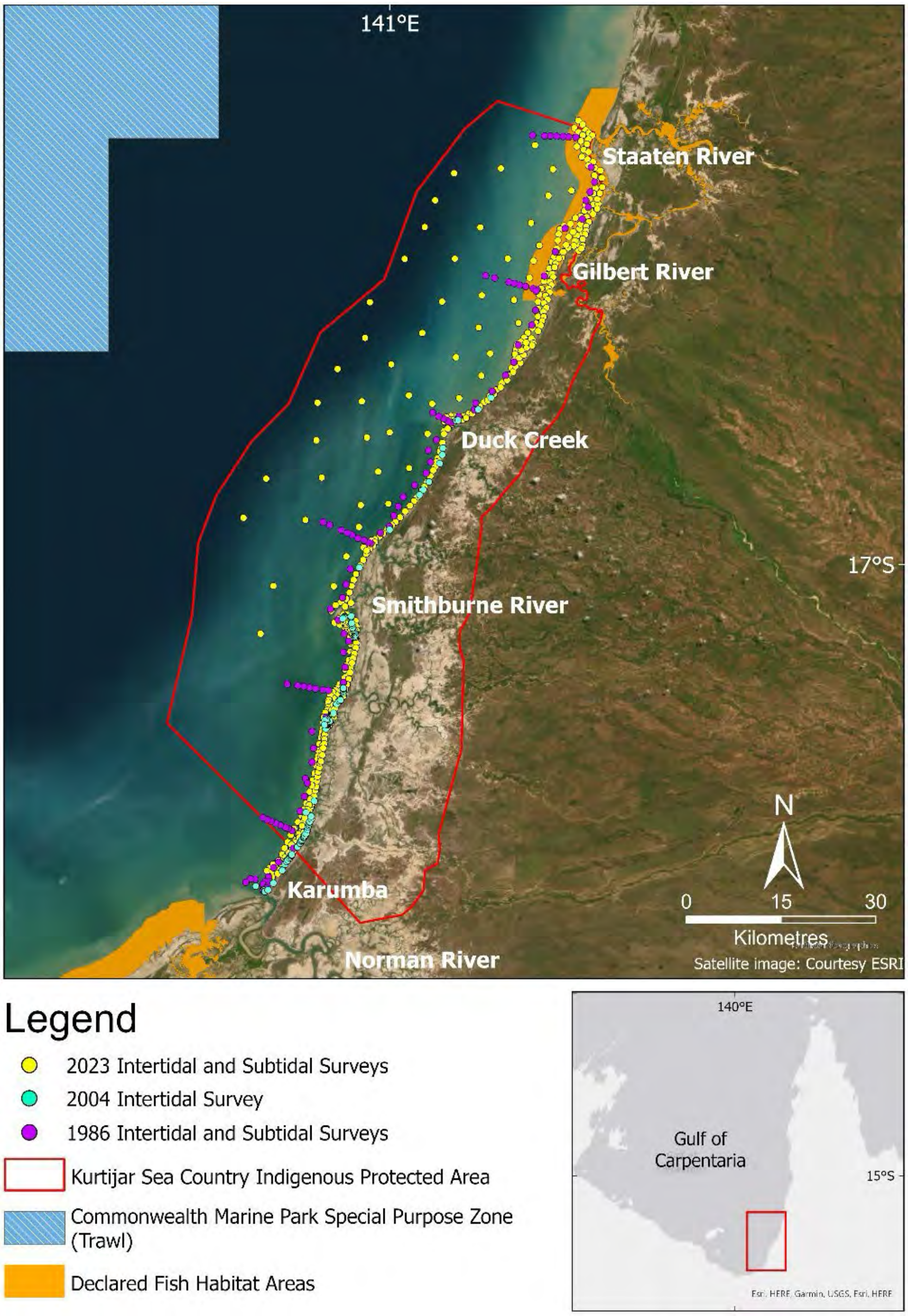

Figure 1: Kurtijar Sea Country (Norman River to Staaten River) and protected areas, including the Staaten-Gilbert Fish Habitat Area. Surveys in Kurtijar Sea Country: Intertidal and subtidal surveys in 1986 and intertidal surveys in 2004 (Coles et al., 2004; Roelofs et al., 2005), and Intertidal and subtidal habitat surveys in 2023 (this survey).

2. Methods

2.1. Survey area

The survey was conducted as a collaboration between TropWATER James Cook University, Northern Institute Charles Darwin University, Edith Cowan University, Normanton Rangers and Carpentaria Land Council Aboriginal Corporation. The survey focused on the intertidal and subtidal waters in the south-east Gulf of Carpentaria between the Norman and the Staaten Rivers in the Kurtijar Sea Country IPA (Figure 1). The intertidal surveys were undertaken from August 27–28, 2023 and October 23, 2023. Subtidal waters were surveyed from October 4–6, 2023. Survey dates were selected to coincide with northern Australia's peak seagrass growing period in spring and early summer (Carter et al., 2022). This ensures data is comparable amongst years and with other adjacent survey locations.

2.2. Benthic habitat

2.2.1. Observations and sampling

Helicopter

Exposed intertidal banks were surveyed by helicopter, which allows for rapid surveys across large areas. Intertidal sites were surveyed while the helicopter maintained a low hover (Figure 2a, b). At each site, a visual estimate was made of benthic habitat within three 0.25 m^2 replicate quadrats within an approximate 10 m^2 circular site.

Drop video

Benthic habitat data were collected from the MV Eclipse tender (Figure 2d) using a drop camera consisting of an underwater CCTV camera (SpotX) (field of view: 0.25m^2) attached to a metal frame with cable relaying to a computer screen on board, allowing for real-time observation. The camera and frame were deployed and lowered to the seafloor three times with a 1–2 metre drift between each replicate drop, with each video deployment recorded.

Information, including site number, time, depth and sediment type, was recorded for each site. Videos were processed after the field trip. A still image was captured for each site's three drops. Habitat assessments were conducted by a trained observer on each still image.

Van Veen grab

When habitat could not be easily identified by video on MV Eclipse’s tender, a van Veen grab (grab area 0.0625 m^2) was used to collect a small sample to confirm sediment type, seagrass presence, and to identify seagrass species (Figure 2i–j).

Towed video

This method was used on MV Eclipse and is designed for detailed assessments using larger vessels with towing capability. An underwater CCTV camera (SpotX) was winched at each site from the vessel to the sea floor (Figure 2e). A GoPro was also attached to the camera sled frame as a back-up camera system. The camera was towed at drift speed (< 1 knot) for approximately 100 m for each transect. Benthic habitat was observed on a monitor and digitally recorded (Figure 2f).

For habitat assessments, a trained observer captured a still image at 10 random time points along the transect.

Sled net

For the sites sampled from MV Eclipse, a small net was attached to the back of the sled to collect a benthic sample at each site and confirm sediment type (Figure 2e, g, h). Sled net contents, including mobile and sessile invertebrates, were photographed for species identification purposes before returning them to the sea.

Figure 2: (a, b) Intertidal sites were surveyed by helicopter. (c, e) Subtidal sites were surveyed by sled tows with video and sled net from Eclipse or (d) from the Eclipse tender by drop camera and van Veen grab. (f) Benthic habitat observed in real time using the towed video, (g) contents of the sled net were rinsed to separate sediment and (h) invertebrates were put into a collection bin for identification. (i, j) When visibility was too low to see the seafloor, a van Veen grab was used, and its contents were emptied and identified.

2.2.2. Seagrass biomass and percent cover

Seagrass above-ground biomass and percent cover were estimated for each 0.25 m^2 replicate quadrat within each intertidal site and in each still subtidal image. Seagrass biomass was determined for each quadrat using the 'visual estimates of biomass' technique (Mellors, 1991). This involves ranking seagrass biomass while referring to a series of quadrat photographs of similar seagrass habitats for which the above-ground biomass has been previously measured. A low biomass scale was used for this survey. The percentage of each seagrass species contributing to the total above-ground biomass within each quadrat was also estimated. After video analysis, each observer ranked a series of calibration quadrats. A linear regression was then calculated for the relationship between observer ranks and the harvested values and used to calibrate above-ground biomass estimates for all ranks made by that observer. Biomass ranks were converted to above-ground biomass in grams dry weight per square metre (g DW m^2) and averaged among replicates to provide mean total seagrass above-ground biomass and contribution to total above-ground biomass for each species for each site. Similarly, seagrass cover and seagrass species percent cover were also estimated for each quadrat using a series of quadrat photographs for which percent cover was previously estimated using image analysis software.

2.2.3. Algae communities

The percent cover of algae was estimated for each quadrat according to five functional groups:

- **Erect macrophyte**: Macrophytic algae with an erect growth form and a high level of cellular differentiation, e.g. Sargassum, Caulerpa and Galaxaura species (Figure 3a).
- **Filamentous**: Thin, thread-like algae with little cellular differentiation (Figure 3b).
- **Encrusting**: Algae that grow in a sheet-like form attached to the substrate or benthos, e.g. coralline algae (Figure 3c).
- **Turf mat**: Algae that form a dense mat on the substrate (Figure 3d).
- **Erect calcareous**: Algae with erect growth form and high level of cellular differentiation containing calcified segments, e.g. Halimeda species (Figure 3e).

2.2.4. Benthic macroinvertebrate communities

The percent cover of habitat-forming benthic macroinvertebrates (BMI) was estimated for each quadrat according to broad taxonomic groups:

- **Hard coral**: All scleractinian corals, including massive, branching, tabular, digitate and mushroom.
- **Soft coral**: All alcyonarian corals, i.e. corals lacking a hard calcareous skeleton.
- **Sponge**
- **Other BMI**: e.g., hydroids, ascidians, barnacles, oysters, and habitat-forming molluscs such as clams. Other BMI categories are listed in the 'comments' column of the GIS site layer.

Sessile and mobile invertebrates photographed in the sled net contents were identified to the lowest taxonomic level.

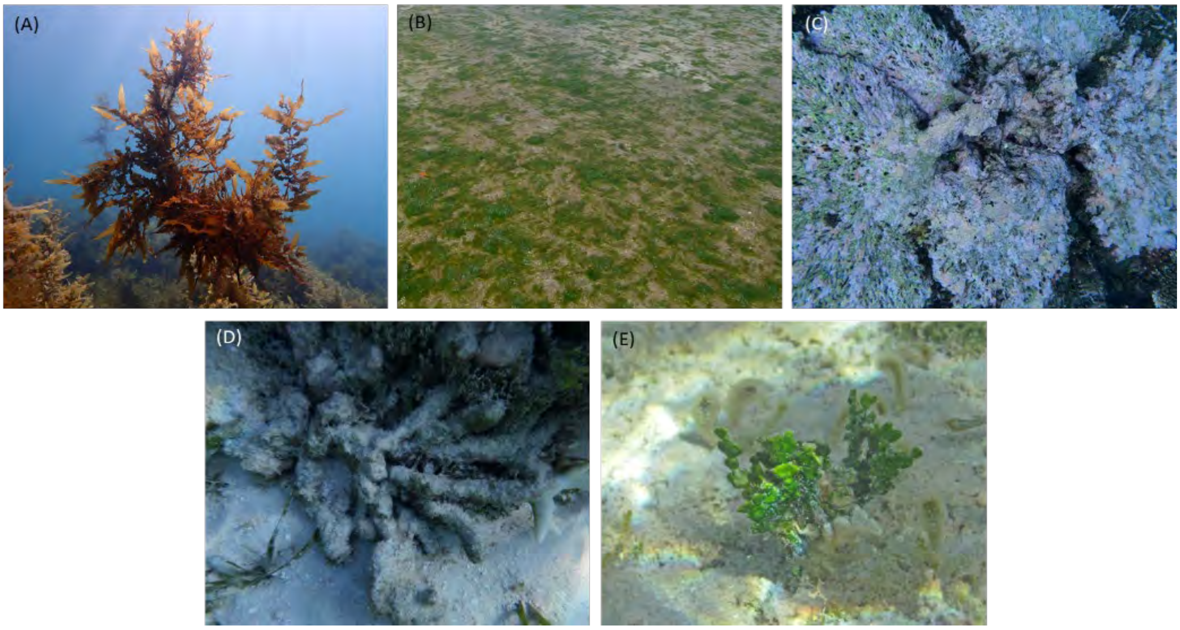

Figure 3: Examples of functional algae groups are (a) erect macrophytes, (b) filamentous, (c) encrusting, (d) turf mat, and (e) erect calcareous.

2.3. Geographic Information System (GIS)

All survey data were entered into a Geographic Information System (GIS) using ArcGIS Pro 3.5.2 (Environmental Systems Research Institute, ESRI). Three spatial layers were created to describe habitats in the region:

2.3.1. Habitat (site) layer

This shapefile contains point data collected at each survey site and includes:

- Temporal details of survey i.e. date and time
- Spatial details of location, tidal zone, latitude/longitude and depth below mean sea level (dbMSL)
- Sediment type
- Seagrass-specific information of seagrass presence/absence, mean total above-ground biomass ± standard error (SE), mean biomass for each species, mean total percent cover seagrass, and mean percent cover for each species
- Percent cover of algae and algal types, BMI and BMI types, and bare substrate
- Sampling method
- The presence of sea cucumbers, turtles, dugongs or dolphins observed at the site
- Survey vessel name
- Data custodians
- Comments

2.3.2. Meadow (polygon) layer

This polygon shapefile contains meadow information and includes:

- Temporal details of survey i.e. date and time
- Seagrass meadow information, including meadow identification (ID) code, seagrass species present, meadow community type, meadow density, mean meadow above-ground biomass ± standard error (SE), mapping precision, meadow area ± reliability estimate (r) in hectares, persistence, dominant species, and number of total and biomass sites within the meadow
- Sampling method
- Data custodians
- Comments

Intertidal seagrass meadows (polygon) were constructed using seagrass presence/absence site data and meadow boundaries mapped using GPS points recorded while flying along the intertidal meadow edge. Rectified colour satellite imagery of the survey region sourced from ESRI, the intertidal extent model (Bishop-Taylor et al., 2019), field notes and photographs taken during the survey were used to identify geographical features such as reef tops, channels and deep-water drop-offs to assist in determining seagrass meadow boundaries. The mapping precision estimate was used to calculate an error buffer around each meadow. The area of this buffer is expressed as a meadow reliability estimate (R) in hectares (Table 1). Subtidal seagrass meadows (polygon) were constructed using seagrass presence/absence site data. A circle polygon 50m in diameter was drawn around sites where seagrass was present, but the large spacing between subtidal sites with seagrass meant we had low confidence to draw meadow boundaries. Polygons are indicative of seagrass presence only and does not represent the extent of the meadow itself.

Table 1: Mapping precision and methods for seagrass meadows.

Mapping precision	Mapping method
0.5–10 m	Meadow boundaries mapped in detail by GPS from helicopter. Intertidal meadows completely exposed or visible at low tide. Relatively high density of mapping and survey sites. Recent aerial photography and satellite imagery aided in mapping.

Meadow community type was determined according to seagrass species composition. Species composition was based on the percent each species' biomass contributed to mean meadow biomass. A standard nomenclature system was used to categorise each meadow (Table 2). This nomenclature also included a measure of meadow density categories (light, moderate, dense) determined by mean biomass of the dominant species within the meadow (Table 3).

Table 2: Nomenclature for intertidal seagrass meadow community types.

Community type	Species composition
Species A	Species A is 90–100% of composition
Species A with Species B	Species A is 60–90% of composition
Species A with Species B/Species C	Species A is 50% of composition
Species A/Species B	Species A is 40–60% of composition

Table 3: Density categories and mean above-ground biomass ranges (gDW m^2 for each species used in determining intertidal seagrass meadow community density.

Density	*H. uninervis*	*H. ovalis*
Light	< 1	< 1
Moderate	1–4	1–5
Dense	> 4	> 5

2.3.3. Biomass interpolation raster

This raster shows an inverse distance weighted (IDW) interpolation applied to seagrass above-ground biomass point data (using the site layer) to describe spatial variation in biomass across seagrass meadows.

3. Results

The Kurtijar IPA supports diverse marine and coastal habitats, ranging from seagrass meadows and algal beds to benthic invertebrate communities and deeper subtidal ecosystems that sustain a variety of marine life (Figure 4). The dominant sediment across the intertidal and subtidal survey area was a combination of mud, sand and shell. The water was highly turbid, so a van Veen grab was used at 24 subtidal sites with no visibility to confirm sediment type and habitat. Rough weather meant we could not survey subtidal waters south of the Smithburne River. During the subtidal survey, the team recorded a dugong, a turtle feeding on a jellyfish, and a sea snake was captured on towed video at two sites.

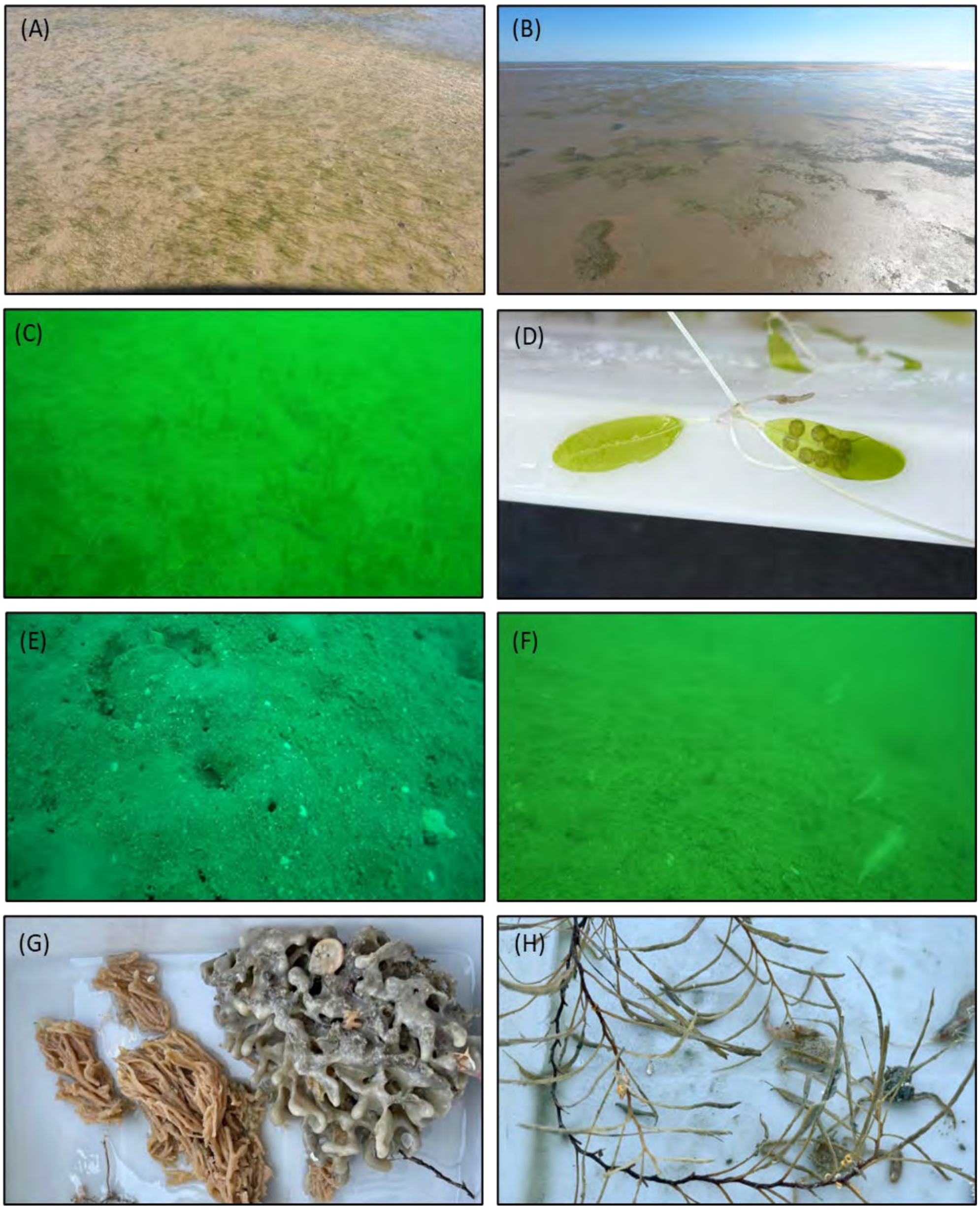

Figure 4: Habitats observed during surveys included (a, b) intertidal *Halodule uninervis* seagrass meadows, (c) *Halophila ovalis* seagrass in deeper water, (d) *Halophila ovalis* fruiting, (e) muddy sediment with sand and shell, (f) sea pens (soft coral), (g) sponges, and (h) hydroids.

3.1. Seagrass

Two seagrass species from two families were identified in this survey: *Halodule uninervis* and *Halophila ovalis* (Figure 5). Seagrass was present at 40 (10%) of 380 intertidal sites and 3 (5%) of 51 subtidal sites (Figure 6).

Intertidal seagrass was concentrated between Karumba and the Smithburne River. All 40 intertidal sites with seagrass had *H. uninervis* present, and six sites also had small amounts (2–10%) of *H. ovalis* (Figure 4a, b, Figure 7). Mean percent cover ranged from 0.7–56.7%. Biomass of *H. uninervis* ranged from 0.03–10.8 g DW m^2 and *H. ovalis* biomass ranged from 0.03–1.2 g DW m^2 (Figure 8).

Subtidal seagrass was found between the Gilbert and Staaten Rivers at a depth of 11–14 m (Figure 4c, Figure 6). All three sites were composed of *H. ovalis* with a mean percent cover ranging from 0.1–3.7% and biomass ranging from 0.04–1.3 g DW m^2 (Figure 7). One of the sites with denser patches of H. *ovalis* was fruiting (Figure 4d).

A total of 1,122 ha of seagrass was mapped across five intertidal meadows (Figure 10a). The largest meadow was located at the southern end of the Kurtijar IPA near Karumba and accounted for > 60% of total seagrass area (Figure 10b). Mean meadow biomass ranged from 0.23 to 5.89 g DW m^2, with *H. uninervis* the dominant species in all meadows (Figure 7, Figure 8).

Dugong feeding trails were observed at 32 intertidal survey sites where the seagrass species *H. uninervis* was growing in meadows with moderate or dense biomass (Figure 9, Figure 10).

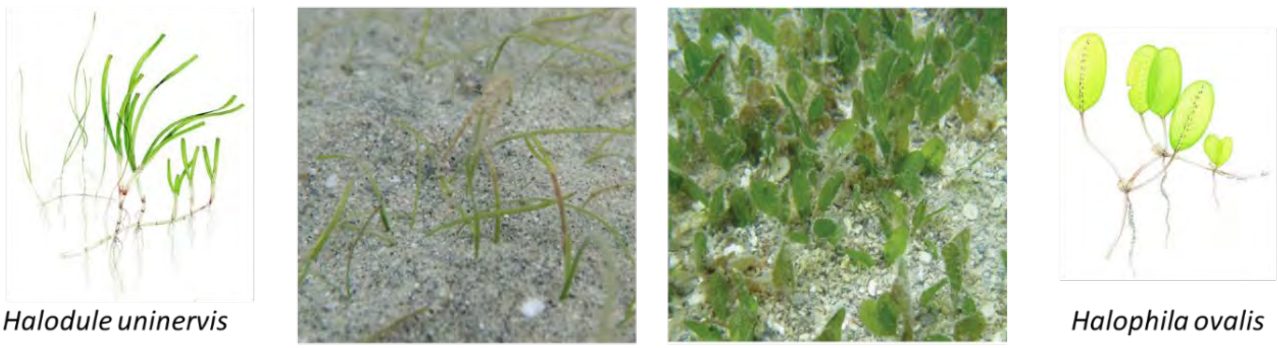

Figure 5: Seagrass species present during surveys.

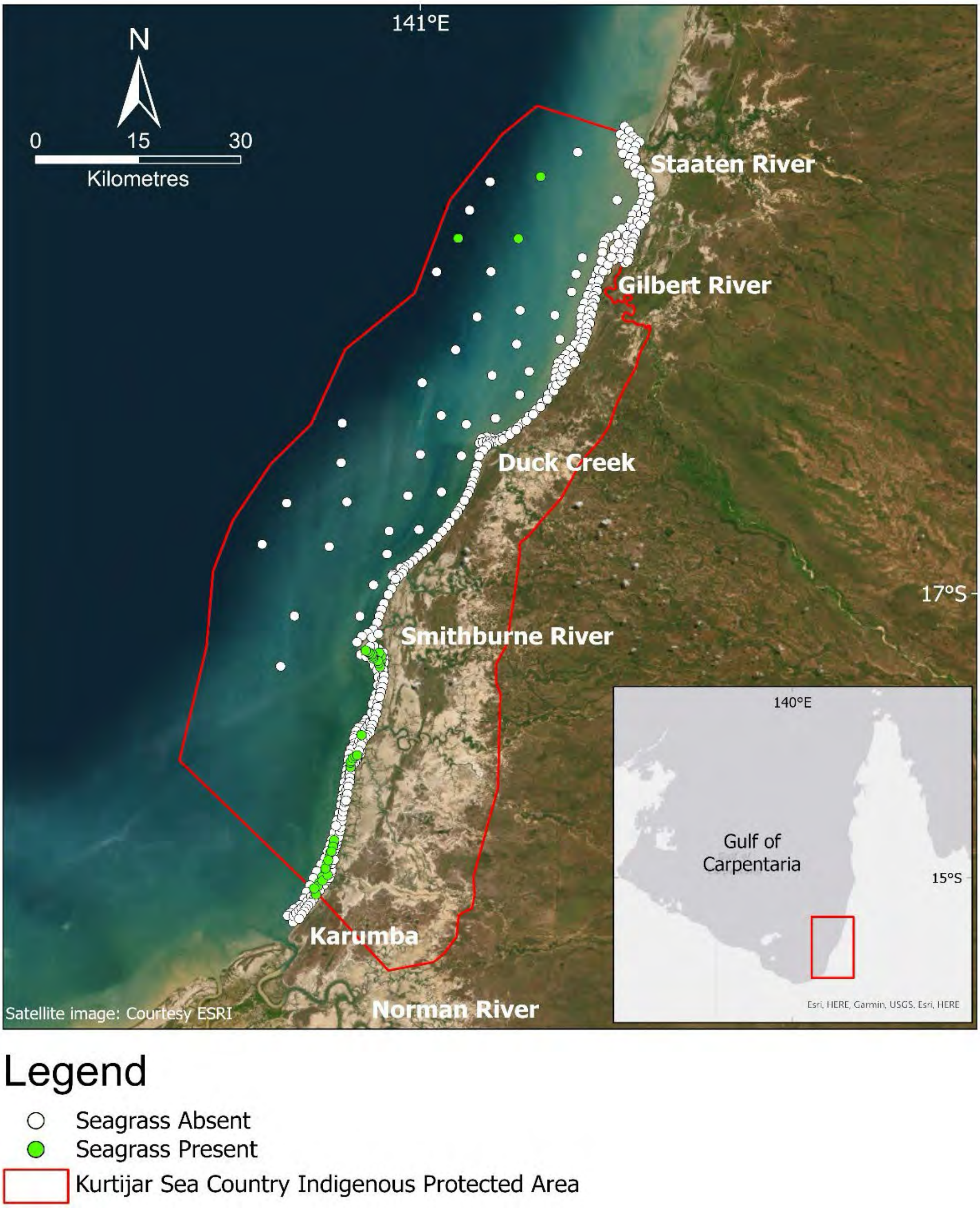

Figure 6: Seagrass presence and absence at survey sites.

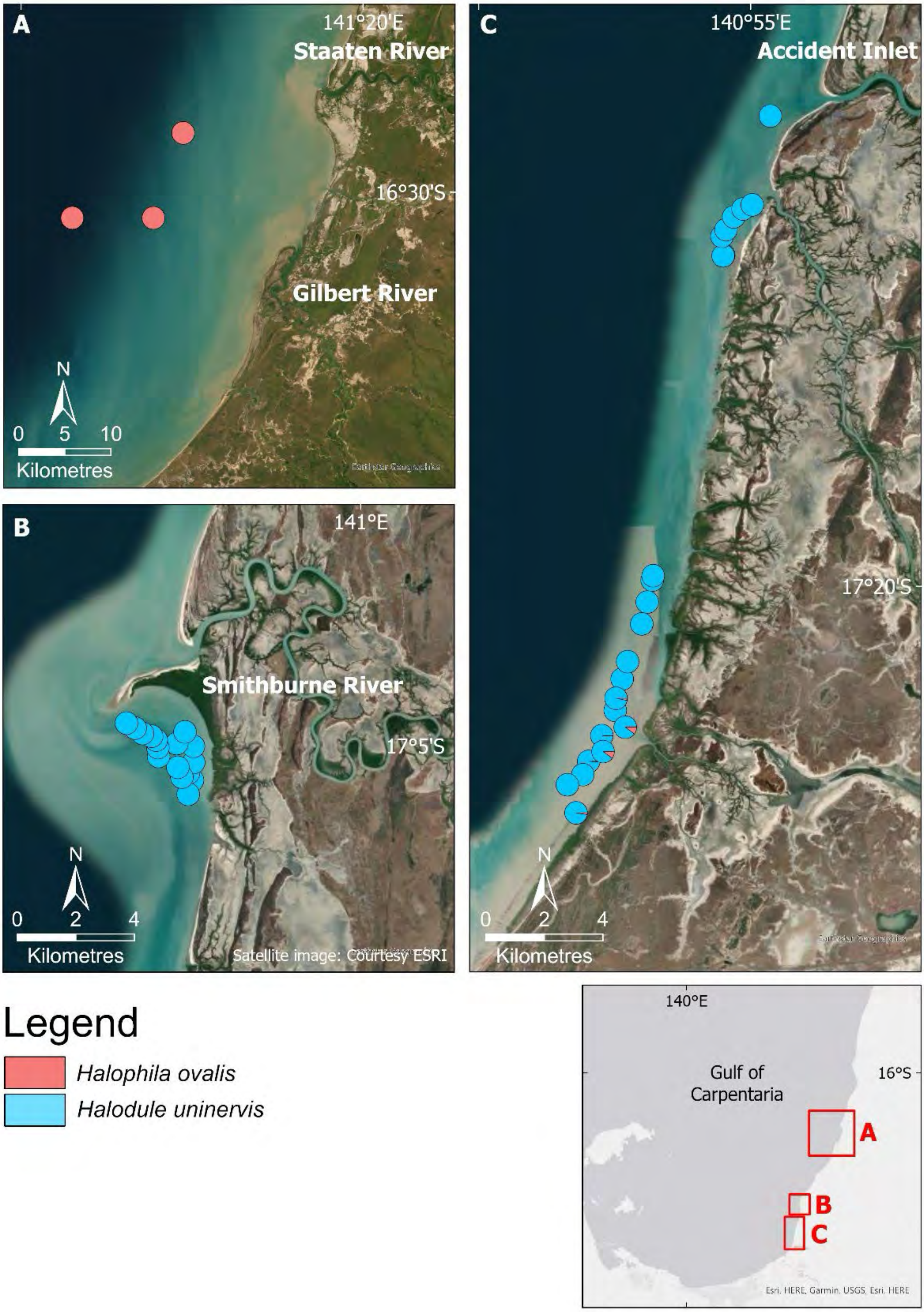

Figure 7: Seagrass species at survey sites.

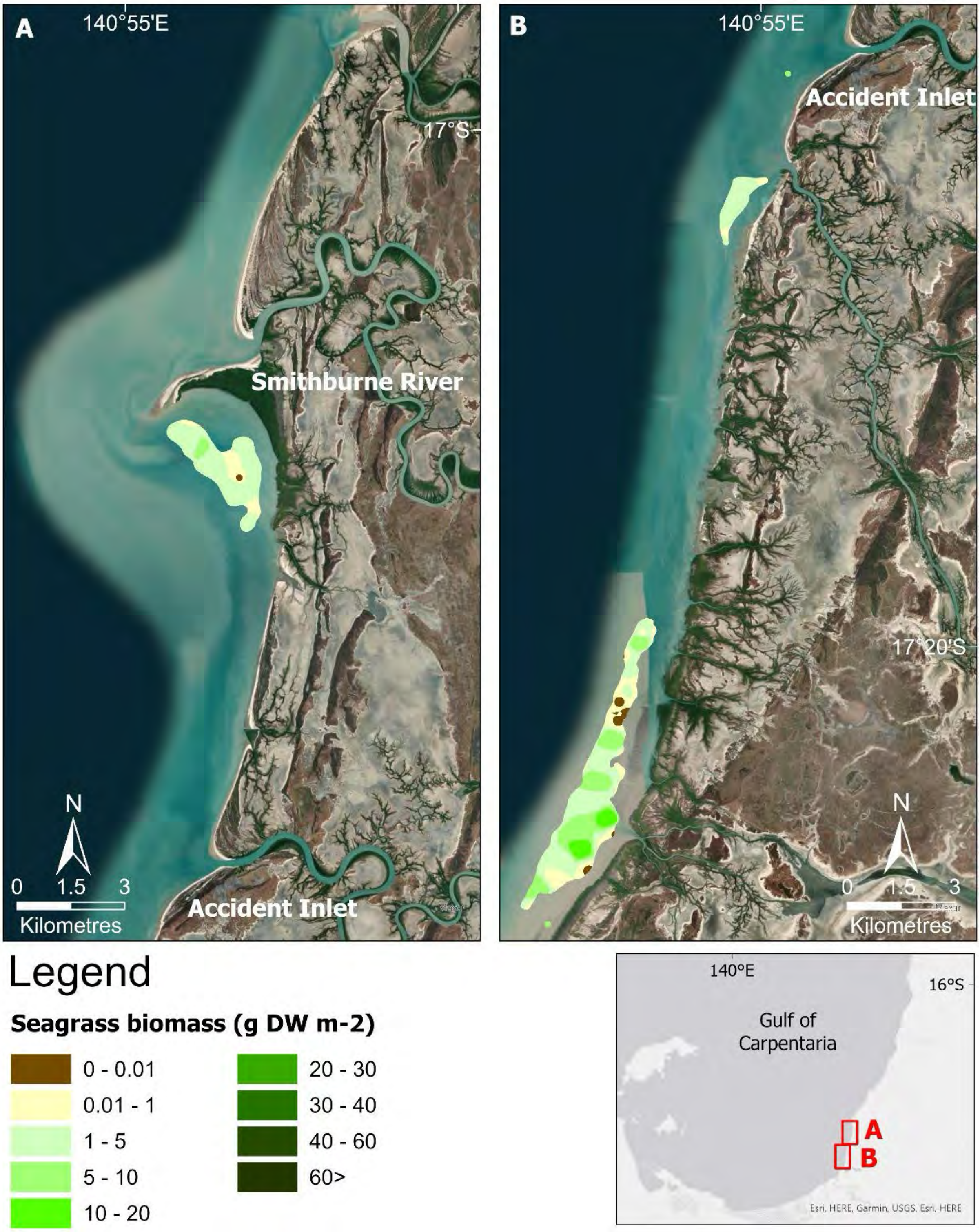

Figure 8: Seagrass biomass variation across intertidal meadows.

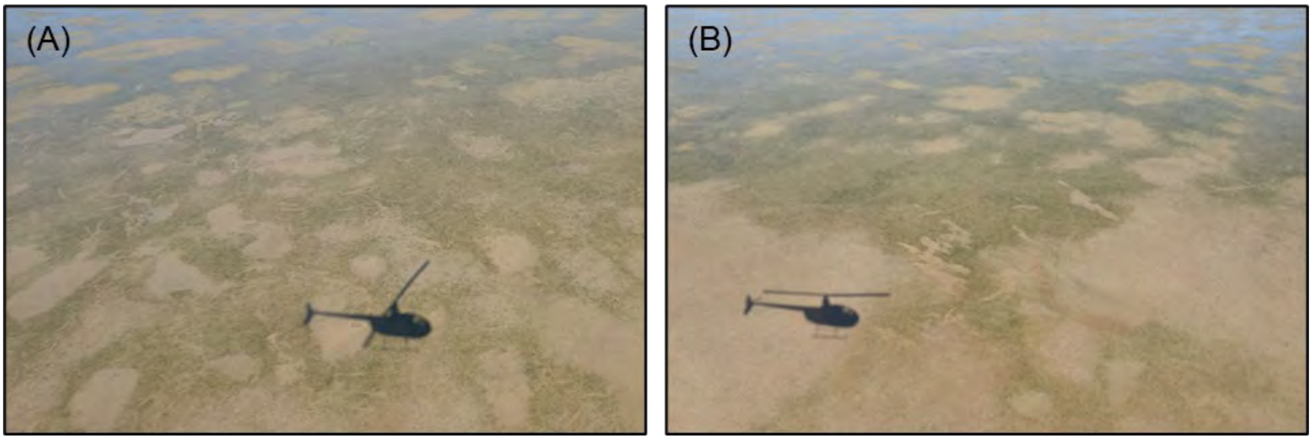

Figure 10: Dugong feeding trails are visible from the helicopter during intertidal surveys.

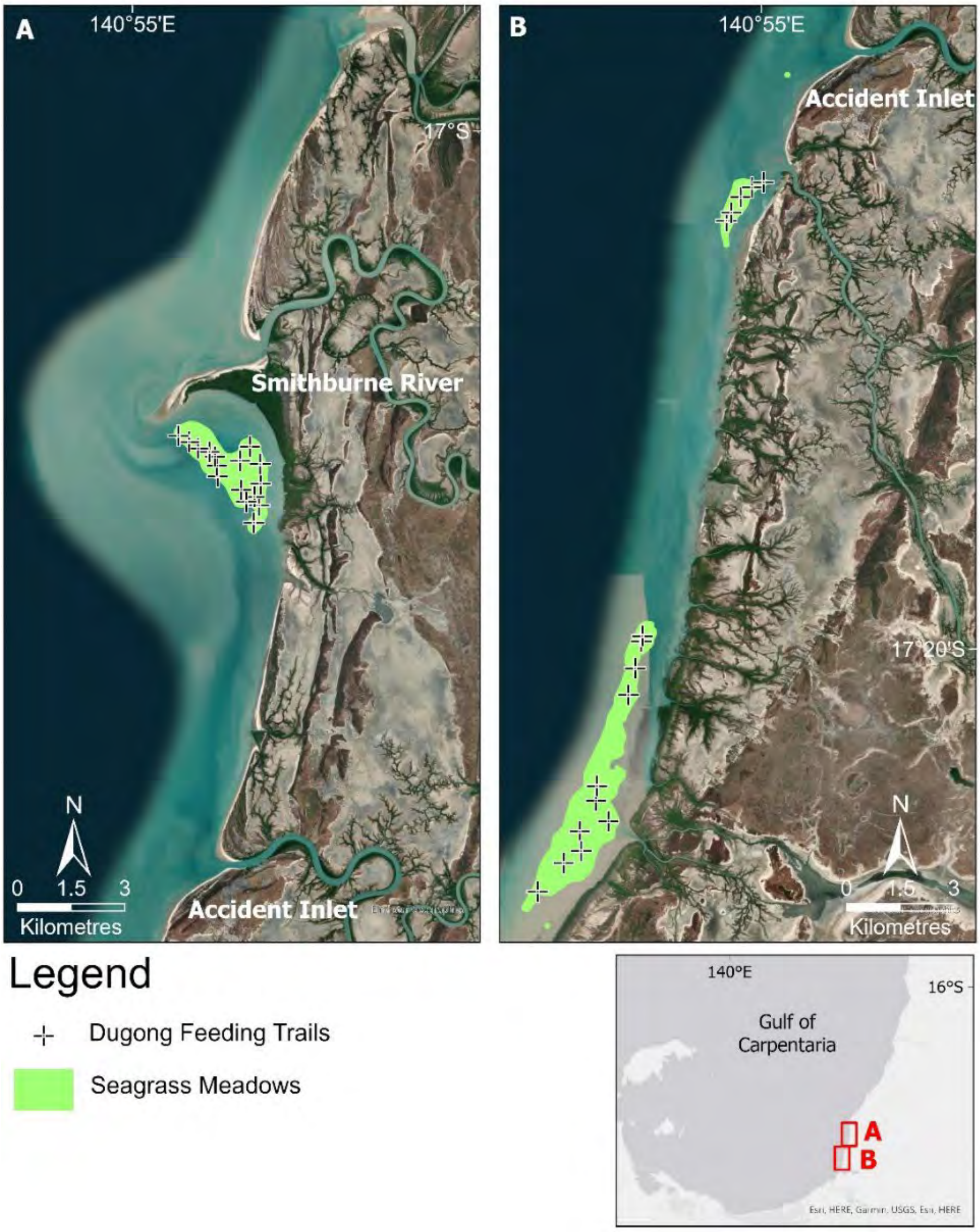

Figure 9: Intertidal seagrass meadows and dugong feeding trails at survey sites.

3.2. Macroinvertebrate and algal communities

Filamentous was the only algae type recorded on the intertidal survey. It was found at seven sites (2%) between the Gilbert River and Accident Inlet. Erect macrophyte was the only algae type recorded on the subtidal survey; it was found at two sites (4%) near the Gilbert River with <1% cover (Figure 11a).

Benthic macroinvertebrates were recorded at 11 subtidal sites (22%) between the Staaten River and Duck Creek, and always with low cover (<2%) (Figure 11b). Benthic macroinvertebrates included soft corals – sea pens and sea whips – present at six sites (12%) with <1% cover (Figure 4f). Sponges were present at one site with 0.1% cover (Figure 4g). Other BMI, including hydroids and ascidians, were recorded at six sites (12%) with cover ranging from 0.1–1.2% (Figure 4h). No benthic macroinvertebrates were recorded at intertidal sites.

Mobile (non-habitat forming) and sessile (habitat forming) invertebrates from a diverse range of taxa were identified from the benthic sled net samples (Figure 12), including:

- Porifera (sponges)
- Urochordata (ascidians)
- Mollusca (gastropods, bivalves, cephalopods)
- Echinodermata (ophiuroids, crinoids, echinoids)
- Crustacea (brachyurans, penaeids, isopods, decapods, arthropods, stomatopods)
- Cnidaria (scyphozoans, alcyonarians, scleractinians, gorgonians, hydrozoans)
- Ctenophora
- Bryozoa
- Annelida (segmented worms)

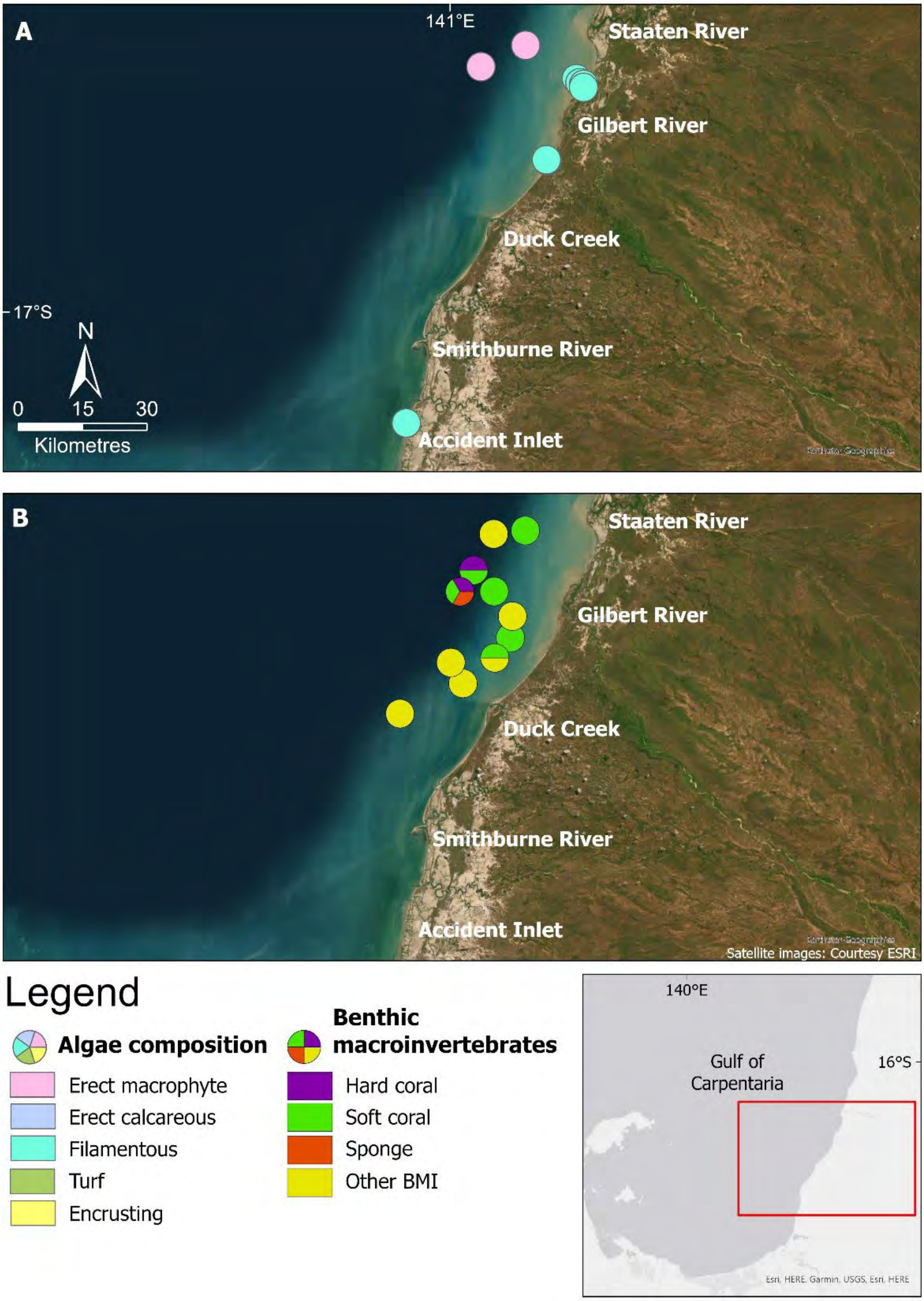

Figure 11: (a) Algae cover and composition, and (b) Benthic macroinvertebrate presence and composition at survey sites.

Figure 12: Examples of fish, mobile and sessile invertebrates sampled using the sled net in the Kurtijar IPA.

4. Discussion

4.1. Benthic habitats

Despite its ecological richness and cultural importance, the south-east Gulf of Carpentaria remains one of northern Australia's least understood coastal regions. This survey addresses this gap, providing updated information on the benthic habitats of intertidal and shallow (<15 m depth) coastal areas of Kurtijar Sea Country. This vast, dynamic marine environment – shaped by extensive riverine inputs and expansive estuarine wetlands – supports a high diversity of marine life, including dugongs, turtles, prawns, and fish (Poiner et al., 1987; Roelofs et al., 2005). This survey builds on recent efforts that have greatly expanded our understanding of benthic habitats elsewhere in the Gulf, including new mapping projects in collaboration with Traditional Owners and rangers in Kaurareg and Angkamuthi Sea Country in West Cape York (Carter et al., 2023b), Wellesley Islands (Carter et al., 2024b, 2024c), Marra Sea Country (Collier et al., 2022; Smith et al., 2025), Yanyuwa Sea Country (Groom et al., 2023), and Southeast Arnhem Land (Carter et al., 2023a). A recent data synthesis has also been compiled and made historical data available for the region (Carter et al., 2024a). While annual seagrass monitoring occurs at the ports of Karumba and Weipa (Reason et al., 2025; Scott & Rasheed, 2025), there is no consistent seagrass monitoring for most of the Gulf coast, leaving a critical gap in our ability to detect ecological change and emerging threats to benthic habitats in important areas such as the Kurtijar IPA.

This work forms part of NESP Marine and Coastal Hub Project 3.5 – Partnerships for Seagrass Research and Protection – which brings together researchers, Traditional Owners, and management agencies across remote northern Australia to address critical data deficiencies in seagrass distribution, condition, and ecological function. Through coordinated mapping, data synthesis, and partnerships, the project is building a comprehensive baseline of northern Australia's seagrass habitats. The Kurtijar Sea Country survey contributes to this broader effort by improving spatial coverage in one of the least studied coastal regions of the Gulf of Carpentaria.

The survey mapped intertidal and subtidal seagrass habitats across Kurtijar Sea Country, revealing clear spatial patterns in species distribution. Intertidal meadows between Karumba and the Smithburne River were dominated by *H. uninervis*, consistent with long-term intertidal monitoring at Karumba (Scott & Rasheed, 2025) and with surveys conducted in 1986 and 2004 (Coles et al., 2004; Roelofs et al., 2005) (Figure 13a, b). While the species present remained the same, historically most sites with seagrass supported both *H. ovalis* and *H. uninervis* (Figure 13c, d). Offshore subtidal surveys in the northern area offshore from the Gilbert and Staaten Rivers recorded only *H. ovalis* at three subtidal sites.

The survey area was dominated by mud and had poor to zero visibility. The low-density seagrass cover dominated by *H. uninervis* and low levels of *H. ovalis* reflects these species' known tolerance to turbid, low-light environments (Collier et al., 2016; Longstaff & Dennison, 1999). This species composition is also similar to other mud-dominated, turbid inshore environments in the Gulf, such as around the Roper River mouth in Marra Sea Country (Carter et al., 2023a; Collier et al., 2022), around the Sir Edward Pellew Islands in Yanyuwa Sea Country (Groom et al., 2023), and on Queensland's east coast (Carter et al., 2021a; Carter et al., 2021b).

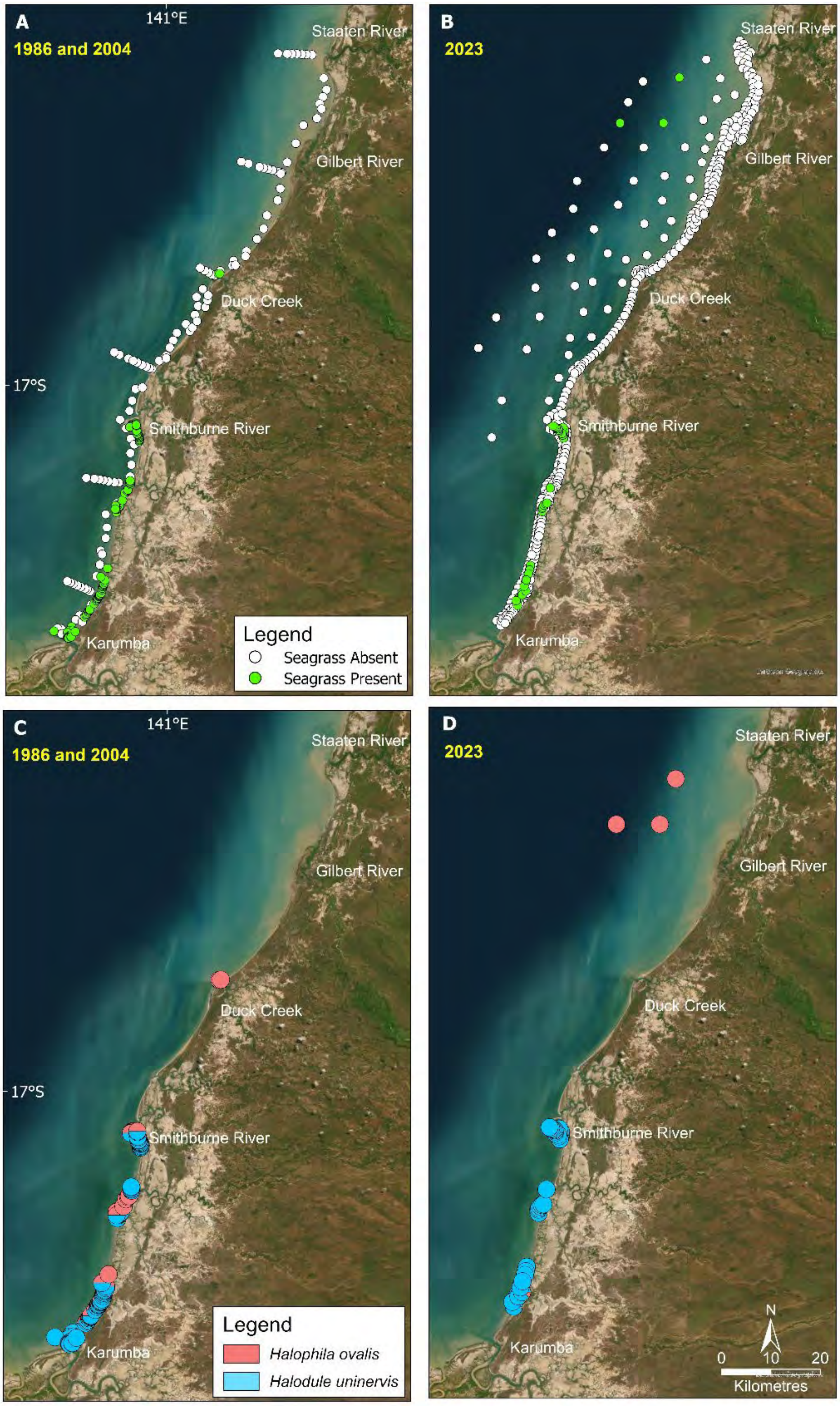

Figure 13: Seagrass presence and absence at individual survey sites in (a) 1986 and 2004 (Coles et al., 2004; Roelofs et al., 2005) compared with (b) 2023 (this survey). Panels c and d show species distribution in (c) 1986 and 2004 compared with (d) 2023.

Recent environmental conditions across the south-east Gulf – particularly above-average rainfall and increased river discharge – have significantly influenced seagrass condition in monitored areas – providing important context for our observations during the Kurtijar IPA survey. Annual long-term ports monitoring at Karumba and Weipa recorded condition declines between 2022 and 2024, likely linked to the wet seasons of 2022–2023 and 2023–2024 (Reason et al., 2025; Scott & Rasheed, 2025). At Weipa, meadows declined from good condition in 2022 to satisfactory in 2023, with the temporary loss of *H. uninervis* in one meadow but returned to good condition by 2024 (Reason et al., 2025). At Karumba, meadows declined from very good condition in 2022–2023 to poor in 2024 due to a substantial biomass and area loss, though *H. uninervis* remained dominant. A stable seed bank indicates strong recovery potential, as observed in previous flood-impacted years (Scott & Rasheed, 2025). While the adjacent Kurtijar IPA likely experienced similar pressures, the absence of long-term, site-specific monitoring makes it difficult to assess trends or resilience in this region.

A notable shift in seagrass distribution was the marked reduction of *H. ovalis*, which occurred in very low abundance at six sites in 2023 compared to its historical dominance at more locations (Figure 13c, d). This species is more sensitive to low light from riverine discharge and turbidity (Longstaff & Dennison, 1999) and may have declined following the wetter-than-average conditions from 2022 to 2024. Establishing monitoring between Karumba and the Smithburne River will help determine if this decline is temporary. By contrast, we recorded *H. ovalis* at three subtidal sites where it was absent historically, all located offshore from those surveyed in 1986. This likely reflects the broader spread of survey sites, with occurrences near the outer (deeper) edge potentially due to clearer offshore waters, where river discharge and wind-driven resuspension are reduced, as observed for *H. decipiens* in the Limmen Marine Park (Collier et al., 2022).

The habitat data collected during this survey provides a comprehensive baseline for Kurtijar Sea Country – essential information for the Kurtijar people and Government to make informed management decisions around Kurtijar Sea Country and the IPA. Baseline surveys of the intertidal coastline between Karumba and the Northern Territory border (2024–2025) will deliver a complete intertidal habitat map covering over 500 km of the southern Gulf. This foundational dataset will guide future monitoring, with Normanton Rangers to begin drone-based monitoring in the area in 2025. The southern Gulf lacks environmental data to explain changes in benthic habitats and associated fauna. Integrating water quality and temperature monitoring would provide critical insight into environmental drivers of change, enabling Traditional Owners and managers to act early to protect and sustain the region’s coastal ecosystems.

Despite the patchy nature of seagrass meadows in the Kurtijar IPA, this coastal region supports critical foraging habitat for dugongs and marine turtles – both culturally significant and vulnerable species in the Gulf. Numerous dugong feeding trails were observed in the intertidal *H. uninervis* meadows, alongside direct sightings of a dugong and turtle during the surveys (Figure 9, Figure 10). As the only living member of the family Dugongidae, dugongs (*Dugong dugon*) have high biodiversity value. Dugongs are listed as vulnerable to extinction (IUCN, Nature Conservation Act) and are a protected marine and migratory species in Australia (*Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act, 1999)). Australian waters support most of the world's dugongs, and the Gulf of Carpentaria, with a large population of ~12,500 individuals, is one of the most important regions for dugongs in Australia (Marsh et al., 2008). Aerial surveys in 2007 found the density of dugongs is highest in the south-east Gulf in the waters adjacent to the Kurtijar IPA around the Wellesley Islands (Marsh et al., 2008).

All six marine turtle species in Australia are protected and listed as vulnerable, endangered or critically endangered (IUCN Red List, EPBC Act 1999). Genetic studies of green sea turtles (*Chelonia mydas*) in the Gulf have found their populations are unique in that they stay within the Gulf rather than migrating long distances (Kennett et al., 2004). The Kurtijar people have a cultural responsibility to care for dugongs and marine turtles in their saltwater Country and to ensure the seagrass habitats that sustain them remain healthy (Carpentaria Land Council Aboriginal Corporation, 2014).

Sick dugongs in poor condition were observed in the Torres Strait in the 1970s and in the southern Gulf in the early 2000s following seagrass losses (Kwan & Bell, 2003; Marsh et al., 2008). These events were suspected as a result of extreme weather, increased turbidity, and elevated ocean temperatures, though a causal link could not be confirmed due to the lack of baseline data in the southern Gulf (Kwan & Bell, 2003; Marsh et al., 2008). Seagrass diebacks are also known to decrease dugong fecundity (Marsh & Kwan, 2008), underscoring the need for comprehensive baseline surveys and ongoing benthic habitat monitoring in the region.

The Kurtijar IPA had sparse invertebrate communities with low benthic cover (<2% cover), with most algae and macroinvertebrates in subtidal waters between Duck Creek and the Staaten River (Figure 11). Solitary soft corals such as sea pens and whips, along with hydroids and ascidians, formed the main structural habitats. Mobile invertebrates – crustaceans, echinoderms, molluscs, worms, and others – were also collected in the sled net at most subtidal sites, revealing a rich diversity below the surface. These findings highlight the ecological productivity of the area, even in soft-sediment habitats with little structure, and underscore the importance of baseline biodiversity data in this largely unstudied part of the Gulf. Understanding which species occur and where they are found is essential for detecting change, guiding conservation, and recognising the biological richness of Kurtijar Sea Country.

Concerns remain about the effects of water resource development on coastal communities in this region. The Gulf of Carpentaria Model of Intermediate Complexity for Ecosystem Assessments (MICE) incorporated connectivity between riverine, estuarine and marine systems, quantifying the impacts of water extraction on downstream fisheries and species of concern (Plagányi et al., 2022). It identified high risks to prawn fisheries, barramundi, mud crabs and mangrove habitat under multiple extraction scenarios, with the greatest risk – classified as ‘intolerable’ – to largetooth sawfish (Plagányi et al., 2022). While the model predicted low risk to seagrass, it did not consider turbidity or increased nutrient levels, both linked to seagrass declines (Longstaff & Dennison, 1999; Plagányi et al., 2022).

4.2. Recommendations

Seagrass habitats are reliable indicators of environmental health (Roca et al., 2016) and are critical for supporting marine biodiversity in the Gulf of Carpentaria. Their extent, density and species composition vary seasonally and annually in response to natural events such as floods, cyclones, and human impacts (Carter et al., 2023c; Lambert et al., 2021; Unsworth et al., 2012). With growing threats and pressures along the coast, improving our understanding of these ecosystems is vital for detecting, forecasting, and mitigating declines – helping to preserve their functions and sustain the natural resources that support coastal communities.

Priority monitoring areas should focus on sites with high ecological value where seagrass underpins marine biodiversity. This survey in Kurtijar Sea Country found intertidal seagrass and limited subtidal seagrass alongside other benthic habitats. Given the sparse subtidal cover, monitoring would be best directed at intertidal habitats, which also appear to be important dugong foraging grounds. Drone monitoring will commence in 2025 at accessible intertidal sites, while helicopter surveys enable region-wide coverage and overcome access constraints. Helicopter-based monitoring could occur every few years using a streamlined method that rangers could run with minimal scientific input.

Future priorities include filling baseline data gaps to build a more complete picture of southern Gulf of Carpentaria benthic habitats. This is essential for understanding resources available to key species such as dugongs and turtles. The Kurtijar Sea Country surveys are the only recent subtidal surveys, leaving substantial gaps in the region's subtidal information.

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