National Environmental Science Program

Marine and Coastal Hub research plan 2026 – Attachment B project plan



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Project 6.1 – Cumulative spatial risk assessments for Australia's Marine Turtles – Western Kimberley

Project type: Hub research project	
Project status: New project submitted for approval	
Cross-cutting initiative:	Climate Adaptation and Threatened and Migratory Species Initiative
Project start date: 30/01/2026	**Project end date**: 20/11/2026
Total project budget: $142,563 (GST exclusive)	**NESP funding:** $85,764 (GST exclusive) **Co-contributions (cash and in-kind):** $56,799 (GST exclusive)
Project leader details:	Name: Dr Tom Vigilante and Dr Melissa Staines Organisation: Wunambal Gaamberra Aboriginal Corporation Phone: 0427163080 Email: tom.vigilante@wunambalgaambera.org.au

Project summary

This project aims to determine where green and flatback turtles are nesting along the NW Kimberley Coastline and what pressures they face, as this region was recognised by DCCEEW as one of the six priority areas vulnerable to climate change. Using a large aerial imagery dataset captured during the 2023-2024 summer and winter nesting seasons, we will map nesting sites and assess their vulnerability to climate threats. Led by the Wunambal Gaamberra Aboriginal Corporation (WGAC), this project includes a primary workshop with Traditional Owners in the community to guide conservation priorities in the Uunguu Indigenous Protected Area (IPA) and other conservation estates. Outcomes will support the identification of DCCEEW's Biologically Important Areas (BIAs) and inform spatial planning and conservation decisions. It aligns with national priorities under the NESP2 guidelines by addressing climate vulnerability, supporting the recovery of threatened species, and empowering Indigenous environmental management.

Pathway to impact

Outcomes

This project will deliver a suite of practical, spatially explicit tools and insights to support conservation decision-making for marine turtles in the Uunguu Indigenous Protected Area (IPA) and other conservation estates, including the North Kimberley Marine Park.

The primary outcomes are:

(1) Mapped nesting turtle distributions for green and flatback turtles across the IPA derived from high-resolution aerial imagery. These maps will build on those previously produced by Whiting (2018) and further identify key nesting beaches, nesting densities, habitat features, and predator presence across the NW Kimberley region. Findings from this research will be synthesised into a technical report on the nesting distribution and densities of these threatened species in the IPA.

(2) Traditional Owner-led prioritisation to inform the designation of BIAs and conservation zoning within the Uunguu IPA through participatory workshops in the community. The incorporation of a TO workshop ensures that cultural values and local knowledge are embedded ethically in the spatial planning, future management, and monitoring of these threatened species. A conservation zoning plan is also a key objective outlined in Wunambal Gaambera Healthy Country Plan (WGAC 2010). By 2030, we aim to deliver a comprehensive staged dedication of our IPA and apply IUCN zoning, with 75% primary protection. These research findings would support the identification of high-priority nesting sites for zoning as areas of higher protection within the IPA.

(**3) Climate vulnerability assessment** for primary nesting sites. A mechanistic modelling approach will be used to assess the vulnerability of primary winter and summer nesting sites identified through aerial surveys to climate change. Using environmental and climate data, the models can be used to reconstruct and project sand temperature trends and estimate impacts on hatchling success and sex ratios under past and future climate scenarios. These findings will be synthesised into a technical report focused on the vulnerability of primary nesting sites in NW Kimberley to climate change.

(4) Technical reports and spatial datasets will be delivered to research-users, including Indigenous Ranger Groups of ISWAG, government agencies (DBCA, DCCEEW) and conservation planners. These outputs will be formatted to facilitate integration into existing GIS platforms, such as eAtlas.

The environmental value of this project will be demonstrated through improved protection of high-density nesting beaches, identification of climate-resilient habitats, and enhanced capacity for Indigenous-led management. Success will be measured by the uptake of spatial products in planning documents, ranger management plans, and regulatory processes, as well as through feedback from research-users during and after the project.

Research-user	Engagement and communication	Impact on management action	Outputs
Wunambal Gaambera Aboriginal Community	Engaged in the development and design of project and outputs.	Outcomes from primary workshop with TOs to inform them of important	Technical report or research paper on the nesting distribution and

Kimberley Indigenous Salt Water Advisory Group (ISWAG) ranger groups	Communicate findings and outputs to collaborators via project workshops, project update emails and reports.	areas and threats in the region Research findings to inform the monitoring and management strategies of NW Kimberley turtles as identified in the Healthy Country Plan (WGAC 2010) and the Indigenous Saltwater Advisory group (ISWAG) marine plan. Research findings to support the protection of turtles against future development proposals.	density of turtles in NW Kimberley. Technical report or research paper on the vulnerability of turtles to climate change. Spatial dataset curation (i.e., beach morphology, turtle nesting data & predator tracks).
Migratory Species Section, Environment Branch – DCCEEW	Engaged in the development and design of project and outputs. Findings and outputs to be communicated via project workshops, project update emails and reports.	Research findings from aerial surveys and primary workshop with TOs to inform the development of Biologically Important Areas (BIAs) for green and flatback turtles in NW Kimberley. Spatial data and vulnerability assessments will support updates to the NW Kimberley stock in the Recovery Plan for Marine Turtles in Australia (2017) and the Threatened Species Action Plan 2022-2032. Climate-risk modelling will contribute to the Marine and Coastal Threatened and Migratory Species	Inclusion of spatial data in DCCEEW datasets and future assessment reports

		Strategy 2022–2032 by identifying high-risk and resilient nesting beaches.	
North West Shelf Flatback Turtle Conservation Program – WA Department of Biodiversity, Conservation and Attractions (DBCA)	Engaged in the development and design of project and outputs. Findings and outputs to be communicated via project update emails and reports.	Spatial data and vulnerability assessments will support updates to the existing datasets on the NW Kimberley stocks of green and flatback turtles.	Inclusion of spatial data in DBCA datasets and future assessment reports
North Kimberley Marine Park, (DBCA Marine Science Program)	Findings and outputs to be communicated via project update emails and reports.	Spatial data and vulnerability assessments will inform reviews of the marine park and management actions	Inclusion of spatial data in DBCA datasets and future assessment reports
NW (Kimberley) Marine Reserve Network (Parks Australia)	Findings and outputs to be communicated via project update emails and reports.	Spatial data and vulnerability assessments will inform reviews of the marine reserve and management actions	Inclusion of spatial data in Parks Australia datasets and future assessment reports
Additional outputs NA			

Project description

Project description

Problem statement

The Kimberley region supports six of the world's seven sea turtle species: green (*Chelonia mydas*), flatback (*Natator depressus*), hawksbill (*Eretmochelys imbricata*), olive ridley (*Lepidochelys olivacea*), loggerhead (*Caretta caretta*), and leatherback turtle (*Dermochelys coriacea*). Of these, the green and flatback turtles predominantly nest along the Kimberley coast and are both listed as Vulnerable under the Australian Environment Protection and Conservation Act (EPBC Act 1999). Green turtles are also classified as Endangered by the International Union for Conservation of Nature Red List (IUCN 2015), while flatback turtles remain Data Deficient. Despite their ecological and cultural significance, there remains a lack of current quantitative data on the nesting distribution, habitat use, and climate vulnerability of these two species along this remote coastline. DCCEEW has identified the NW Kimberley turtle stocks as one of the six priority areas most vulnerable to climate change in the Recovery Plan for Marine Turtles 2017. Furthermore, green turtles are documented as a priority species at risk of extinction in the Threatened Species Action Plan 2022-2032. These species are also culturally significant to the Aboriginal Communities in the region and are prioritised under the Indigenous Saltwater Advisory Group (ISWAG) marine plan. Yet, without robust spatial data that identify key nesting sites, habitat use, and main threats, it is difficult to produce targeted conservation strategies to help monitor and protect these threatened species.

This project directly addresses these gaps by analysing an extensive aerial imagery dataset of the Uunguu Indigenous Protected Area (IPA), which encompasses over 15,000 km² of Sea Country. The data from this imagery will be used to map the nesting activity and habitat characteristics (e.g., beach orientation), enabling the development of climate vulnerability indices and spatial planning tools. It aligns with national priorities under NESP2 by supporting the recovery of threatened species, climate adaptation, and Indigenous-led environmental governance.

Research Approach Scope

The project will analyse high-resolution aerial imagery collected using a three-camera swathe technique during surveys conducted by Aeroglobe across two survey periods: 11–17 December 2023 (summer nesting season) and 21–24 August 2024 (winter nesting season). These surveys covered sandy beaches along the coast of the Uunguu IPA. They were designed in consultation with turtle experts from WA Department of Biodiversity, Conservation and Attractions (DBCA) and Traditional Owners. The imagery enables a detailed assessment of turtle nesting activity, including species identification based on track morphology, track age and direction, nesting success indicators (e.g., covered body pits), nest location (e.g., within vegetation), and beach metrics (e.g., length, orientation). The research project primarily focuses on summer-nesting green turtles and winter-nesting flatback turtles, with opportunistic data collected during rare nesting events of hawksbill and olive ridley turtles. Loggerhead and leatherback turtles are not known to nest in the region and have therefore not been included in this project. However, we acknowledge that the IPA is likely a foraging habitat and migratory route for both of these threatened species.

This project requires no additional survey fieldwork, as the existing imagery is extensive and coincides with the peak nesting seasons of summer and winter. In April 2025, a technical report was completed and submitted to DCCEEW, summarising the nesting densities of primary nesting sites for the summer and winter survey periods analysed to date. Further analyses are required to report the nesting densities and additional nesting data captured across all sandy beaches surveyed in the IPA. These data are essential for informing conservation planning and as a habitat layer to conduct a vulnerability assessment.

A Traditional Owner-led workshop will be conducted to corroborate findings from the aerial surveys, highlight priority areas for conservation zoning within the protected areas, and identify potential BIAs based on culturally significant areas for sea turtles within the IPA and the survey results. This participatory approach ensures that cultural values and local knowledge are ethically embedded within the project and its outcomes, guiding future spatial planning decisions.

To assess the threat of climate change to the primary nesting sites identified from the aerial surveys and the workshop, reconstructions and projections of climate-induced increases of sand temperature can be produced through a mechanistic microclimate model 'NicheMapR' (Gammon et al. 2024; Bentley et al. 2020). This model utilises site-specific physical variables, including soil properties, climate, and terrain, to estimate both above- and below-ground temperatures. In-situ long-term temperature data recorded at nest depth at selected sites are required to validate the model. Overall data logger deployment success in the study area in 2023 - 2024 was relatively low (due to equipment failures), with temperature data collected from 14 data loggers for durations ranging from 4 to 289 days. The longest temperature dataset has been collected from South Maret Island (Nov 2023 – Aug 2024), followed by East Montalivet and Quoy Island (Nov 2023 – Apr 2024). However, these datasets are substantial enough to validate modelled sand temperature data for the primary nesting sites. As a second step, predicted sand temperatures will be used to categorise the thermal stress embryos would experience if they developed at each beach and to identify rookeries at risk (Gammon et al. 2024). Finally, emergence success and hatchling sex ratio will be estimated at selected at-risk rookeries using the 'DEVOUR' embryonic development R model (Gammon et al. 2024). This 3-step method enables scalable projections of the thermal environment and the subsequent impact on population demographics. The outcomes of this model will identify which, if any, nesting beaches may be at higher risk of reduced hatching success and biased sex-ratio, and which ones may present as climate refugia. These insights will inform conservation priorities and adaptive management strategies under projected warming conditions.

Certain activities have been identified as out of scope for this project, including further aerial surveys, genetic sampling of turtles, satellite telemetry of nesting females, and the development of new software (e.g., machine learning for track detection).

Related Prior Research

This project builds on earlier aerial surveys and turtle monitoring efforts conducted in collaboration with Indigenous Ranger groups across the Kimberley region. In the 2000s, environmental assessments linked to petroleum and gas exploration (e.g., RPS 2009, 2010; Waayers 2014) examined the presence of turtles in areas targeted for industrial development. These development investigations were explored but not completed by INPEX on Cassini Island and Maret Island, as well as in the Dampier Peninsula and Lacepede areas. These studies involved aerial surveys, satellite tracking, and on-ground assessments, contributing to a growing awareness of important areas for turtles in the Kimberley region. Satellite telemetry studies have since been completed for several rookeries along the west coast, including the Maret Islands in the now-Uunguu IPA (Waayers et al. 2019). Near-complete coverage of the Kimberley islands and coast was achieved during an aerial survey over eight to nine flight days in 2014 for both the summer and winter nesting seasons by the Western Australian Marine Science Institution (Whiting, 2018). Throughout the surveys, >44,000 georeferenced aerial images were captured, analysed and annotated to quantify the visual evidence of turtle tracks or body pits. These guided later verification by ground truth patrols with indigenous ranger groups along the Kimberley coast in accessible areas. A GIS classification gave a priority ranking of turtle rookery beaches across Kimberley. This information provided complementary information to Traditional Owners about important turtle areas within their local areas and IPAs.

Prior research has demonstrated that aerial surveying is the most effective method for capturing information on nesting activity across this large and remote region. However, these prior surveys were not conducted with a three-camera swathe and high-resolution imagery (approximately 1 pixel ≈ 2cm) captured with the Aeroglobe system. Hence, an updated survey using a GIS tool developed by WA

DBCA (Fossette et al., 2021) was required to build on the previous knowledge of nesting activity in the area.

Linkages to Other Research and Hubs

This project complements ongoing research under the NESP2 Marine and Coastal Hub, particularly in areas related to climate vulnerability, threatened species recovery, and Indigenous-led conservation. It also aligns with DCCEEW's broader efforts to map and protect BIAs across northern Australia. These data will contribute to spatial data that may be used by other NESP hubs working on marine biodiversity, climate adaptation, and Sea Country planning.

Application and Impact

The research outputs (vulnerability indices, spatial maps of nesting activity, and prioritised BIAs) will directly inform regulatory and conservation decision-making. These tools will support environmental impact assessments, Marine Park planning and conservation zoning, threatened species recovery actions, Indigenous Ranger group management plans and climate adaptation strategies. By embedding Traditional Owners' perspectives and using existing datasets efficiently, the project offers a cost-effective, culturally grounded approach to improving marine turtle conservation in one of Australia's most ecologically significant regions.

Sustainability of Tools and Outputs

While the project does not involve the development of new software or web applications, all spatial outputs will be compatible with existing GIS systems used by ranger groups, government agencies and policymakers. Data products will be archived and made accessible through the NESP data repositories, and ongoing support will be provided through partnerships with the NESP Marine and Coastal Hub. The involvement of experienced GIS practitioners and Indigenous Rangers ensures that tools and knowledge generated will be sustained beyond the life of the project.

Project 3.2 – Developing a National Indigenous Environmental Research Network – Marine and Coastal research case studies

Project type: Existing project seeking amendment	
Project start date: 01/02/2023	**Project end date**: 12/12/2025 **Extension request**: 20/11/2026
Project Budget extension:	**NESP:** $200,000 (ex GST) **Cash and in-kind:** $150,000 (ex GST)
Total project budget: $1,950,000 (GST exclusive) includes budget extension above	**NESP funding:** $1,000,000 (GST exclusive) **Co-contributions (cash and in-kind):** $950,000 (GST exclusive)
Project leader details:	Name: Dr Leah Talbot Organisation: NAILSMA Phone: 0473 171 983 Email: leah.talbot@nailsma.org.au

Project variation rationale:

Indigenous Australians own, manage, or have rights to nearly 60% of the country, as well as over extensive parts of the coastal waters. These areas are rich in biodiversity and cultural heritage, but research involving Indigenous Estate has often been shaped without Indigenous leadership and input. Indigenous Knowledge has also historically been undervalued, with many research projects excluding Indigenous people from planning, implementing, and interpreting results.

In the past year, more than 300 participants have taken part in workshops, roundtables and case studies to co-design the National Indigenous Environmental Research Network (NIERN). The result is a well-defined model for establishing a membership-based, Indigenous-led and owned organisation to help guide national priorities for environmental research and provide services to connect Indigenous research users and providers.

This project extension will focus on repatriating the current NIERN findings to participants in the initial study consultations. This extension work will also seek to develop an approach to long-term investment and refinement of the work plan. A functional, Indigenous-led research network will enhance all forms of research practice involving Indigenous Australians. Extending the work on developing the NIERN will ensure the greatest possible support for this concept from Indigenous communities and maximise its chances of becoming a functioning entity.

Project variation details

Pathway to impact*

Outcomes		
This project will provide the governance, strategic plan and socialisation of NIERN at the local, state, and national levels to enable: - Indigenous organisations to define their own research objectives; - Working across tenures and political boundaries to collaborate at scale; - Alignment with research entities and governments to invest in the activities leading to measurable impacts.		
Research-user	**Impact on management action**	**Outputs**
DCCEEW: Parks and Heritage (Australian Marine Parks, GBR, IPAs,) Environment – all Water – wetlands Science and Research – NESP, Climate change, SoE	This project will identify a pathway for Indigenous leadership and delivery of environmental research, via the business case and funding required to establish this entity. It will provide insights into research priorities identified by Traditional Owners around Australia.	Provide a summary report for NIERN to enable communication of project outcomes. Communication of project outputs via a webinar.
Traditional Owners and their organisations, and Native Title Holders and Leaders	Local and regional processes for Indigenous participation in environmental research operate at many different scales. The NIERN project will provide suggested pathways for involvement in all elements of environmental research across different scales	Direct involvement with Traditional Owners in order to understand their preference for membership in NIERN. Provide a summary report for NIERN to enable communication of project outcomes. Communication of project outputs via a webinar.
Research Institutions (e.g. Universities, CSIRO, AIMS)	The NIERN concept aims to provide advice and pathways to researchers to help establish better working relationships and improved ethical engagement at all stages of research.	Direct involvement in the development of research outputs. Opportunity to engage through a membership-based arrangement. Provide a summary report for NIERN to enable communication of project outcomes.

		Communication of project outputs via a webinar.
NGO's (e.g. Bush Heritage, AWC, WWF, TNC)	The NIERN concept will support organisations seeking to meet their environmental goals through working with Indigenous organisations. This work will also establish a better understanding of expectations for positive Indigenous outcomes from external investment.	Provide a summary report for NIERN to enable communication of project outcomes. Communication of project outputs via a webinar.

Project variation – extra information

Problem statement

A national workshop at the 2022 Australian Marine Science Conference in Cairns, of Indigenous leaders from across Australia, identified opportunities and constraints for Indigenous participation and leadership in environmental research in Australia's marine and coastal regions. A significant challenge is that national research priorities are abstracted from local and regional processes. This means that the first time Indigenous organisations engage with research projects is once they have been developed and are being implemented.

Common issues raised by Indigenous groups regarding environmental research include inadequate resourcing for Indigenous-led and Indigenous-governed research institutes, a lack of dedicated funding for Indigenous academics, limited resources to support research networks, and a need to improve ethical guidelines and research protocols.

Project description

NIERN builds on previous and ongoing government endeavours to promote Indigenous Australians and their aspirations, including the recognition of traditional knowledge and the development of new knowledge to address their research needs. Particularly when those needs relate to matters that impact upon them, their rights, and their land and sea estates. NIERN seeks to build on this investment, upscaling Indigenous participation.

For this project, Indigenous leadership groups have co-designed the Network's roles and functions, as well as its membership model and business structure. The project team have tested ideas at workshops with Indigenous groups, research community and governments, with case studies providing practical insights. A business case has been developed that outlines the feasibility of the NIERN as well as the establishment and ongoing costs for the network.

A 'proof-of-concept' closed pilot process to test the effectiveness of communicating Indigenous-led research priorities and the subsequent uptake of those priorities by research institutions was also conducted. This project is a priority because government programs explicitly include statements on Indigenous engagement, participation and leadership in the development and implementation of environmental policy, and the NIERN would support this outcome.

Project progress

The nationwide consultations during the main stage of Project 3.2 agreed that NIERN will not conduct research directly. Instead, it could offer 'wrap-around' services to support both Indigenous research users and providers. It will be set up to act as a 'broker' to assist Indigenous communities and their research priorities, linking them to relevant research institutions. This includes guidance on Indigenous-led priorities, culturally safe practices, and governance models that embed cultural authority throughout the entire research process.

Indigenous communities identified four priority areas for NIERN to focus on: land and sea management, climate change and adaptation, culturally significant entities, and biocultural regional planning.

NIERN's vision is to:

- embed Indigenous Knowledges and perspectives to determine the direction and priorities for environmental research;

- establish culturally safe research standards and protocols, and strengthen Indigenous rights and knowledge; and

- increase two-way capacity in right-way science and Indigenous-led environmental research.

Right-way science, in which Indigenous and non-Indigenous participants work together at every stage of a project, will be central to NIERN's operations. This approach promotes mutual benefits, protects Indigenous Cultural and Intellectual Property, and strengthens stewardship of Country.

Explanation of what the extension will achieve

The Network will strive to be mutually beneficial to Indigenous groups, governments, and researchers by bringing cultural legitimacy to the National Environmental Science agenda. This project extension will focus on repatriating the current NIERN findings to participants in the initial study consultations. This extension work will also seek to develop an approach to long-term investment and refinement of the work plan. A functional, Indigenous-led research network will enhance all forms of research practice involving Indigenous Australians. Extending the work on developing the NIERN will ensure the greatest possible support for this concept from Indigenous communities and maximise its chances of becoming a functioning entity.

Project 3.5 – Supporting regional planning in northern Australia: Building knowledge, skills and partnerships for understanding seagrass distribution

Project type: Existing project seeking amendment	
Project start date: 01/02/2023	**Project end date**: 02/06/2026 **Extension request**: 20/11/2026
Project budget extension:	**NESP:** $80,000 **Cash and in-kind:** $80,000
Total project budget: $3,065,529 (GST exclusive) includes budget extension above	**NESP funding:** $1,309,113 (GST exclusive) **Co-contributions (cash and in-kind):** $1,756,416 (GST exclusive)
Project leader details:	Name: Alex Carter Organisation: TropWATER, James Cook University Phone: 07 4232 2015 Email: alexandra.carter@jcu.edu.au Name: Catherine Collier Organisation: TropWATER, James Cook University Phone: 07 4232 21855 Email: catherine.collier@jcu.edu.au Name: Rachel Groom Organisation: Charles Darwin University Phone: 08 8946 7136 Email: rachel.groom@cdu.edu.au Name: Kathryn McMahon Organisation: Edith Cowan University Phone: 08 6304 5145 Email: k.mcmahon@ecu.edu.au

Project variation rationale:

Data collation: Recently collected seagrass datasets from northern Australia remain scattered and often embedded in technical reports. The project will consolidate these meta datasets, along with associated data (subject to permissions), and make them accessible through eAtlas as a long-term resource for researchers, managers, and Traditional Owners. This will ensure that previous investments are fully realised and that information is discoverable and reusable for regional and national assessments.

Fragmentation: In parallel, drone and satellite imagery will be analysed to develop a nationally relevant seagrass fragmentation index. This index will provide a sensitive, early-warning indicator of resilience loss by capturing changes in patch size, shape, and distribution. It will complement existing metrics of extent and cover, and support applications in State of Environment reporting, Blue Carbon assessments, and SEEA–EA environmental accounting.

With baseline mapping, data partnerships, and drone monitoring protocols already established, this next stage of work will build directly on this foundation. Completing the collation of datasets and developing the fragmentation index will ensure that these resources are fully accessible and applied, thereby strengthening the evidence base for seagrass condition assessments required for environmental management, policy implementation, and conservation enhancement.

Project variation details

Pathway to impact*

Outcomes			
Improved understanding of seagrass distribution across all of Australia, and make this digitally and publicly available for improved planning, decision-making and environmental accounting and State of the Environment reporting			
Research-user	**Engagement and communication**	**Impact on management action**	**Outputs**
DES, Indigenous Land and Sea Rangers – Conservation Partnerships Louise Johns	Project findings and outputs to be communicated via emails, presentations and meetings as needed or requested, and through reports and community brochures.	Project outcomes will influence future ranger activities (e.g. monitoring) and work plans. Co-management arrangements will be supported by available and reliable seagrass habitat data.	Seagrass spatial dataset publicly available on eAtlas. Maps of seagrass distribution. Drone monitoring methods and reporting Indicators for rangers to implement
Science and Industry; North Queensland Bulk	Ports seagrass long term monitoring.	Input into dredge and port management plans.	Seagrass spatial dataset publicly

Ports (NQBP - Weipa) and Ports North (Ports North - Karumba and Thursday Island) Michael Rasheed (JCU project lead of ports seagrass monitoring)	Project findings and outputs to be communicated via emails, as needed or requested, through final report, and eAtlas submission. Presentations and meetings as needed or requested.	Include best practice information. A foundation to create models assessing exposure to risk (water quality and other environmental impacts, climate change, etc).	available on eAtlas. Maps of seagrass distribution.
Carpentaria Land Council Aboriginal Corporation (CLCAC) John Hogdon and Mark Hogno	We have previously discussed how a fragmentation index could be used to enhance the value of drone data. Findings communicated through presentations to CLCAC and the community (as requested). Also emails, community brochure and eAtlas submission.	Project findings and outputs can be used by Rangers and Traditional Owners to assess the condition of seagrass meadows on sea country and benchmark change. Inform dugong and turtle management policies and plans. The fragmentation Index can be used to report on drone monitoring programs that are being established through NESP 4.1.	Seagrass spatial dataset publicly available on eAtlas (specific details of public release to be discussed with CLCAC and approved through an ICIP agreement during scoping workshop and contracting). Possible exclusions include sacred sites. Fragmentation Index for assessing the condition and resilience of seagrass habitats.
Parks and Wildlife Commission, Department of Environment, Parks and Water Security, Northern Territory Government Jonathon Vea, Glenn Durie	Project progress, findings and outputs to be communicated through in person or on-line meetings, via emails, through final report and eAtlas submission.	Data compilation and fragmentation index align with the objectives of the NT Coastal and Marine Management Strategy 2019-2029 (the Strategy) which include: - foster sustainable industry for the benefit of the economy -protect the environment	Seagrass spatial dataset publicly available on eAtlas. Maps of seagrass distribution. Technical report on fragmentation index development.

		-improve our knowledge and understanding of the coast and seas. Much of the coastal seagrass meadows are within Aboriginal-owned land (intertidal). Working with TO partners, we will map these resources to identify areas of high value habitat that may require greater protection.	
Marine Parks North Network, DCCEEW, Frances Verrier Marine Parks North West Network, DCCEEW Jennifer Hoy	Project progress, findings and outputs to be communicated through ongoing discussions, and meetings as needed or requested, and through reports and community brochures	Commonwealth Marine Parks depend on knowledge of key habitats within the park and connectivity with coastal areas adjacent to the Commonwealth Marine Parks.	Seagrass spatial dataset publicly available on eAtlas. End of project information webinar with Q&A
Migratory species section, Biodiversity Conservation Division, DCCEEW, Jessica Armstrong	Project findings and outputs to be communicated via emails, as needed or requested, through final report, community brochure and eAtlas submission.	Maps will aid in implementation of the EPBC Act for migratory species, by providing detailed information on threatened species habitat. Support Biologically Important Area (BIA) data review.	Seagrass spatial dataset publicly available on eAtlas. Maps of seagrass distribution. Technical report. End of project information webinar with Q&A
Torres Strait Regional Authority Land and Sea Management Unit – Sea Team	We have previously discussed how a fragmentation index could be used to enhance the value of drone data. Project findings and outputs to be communicated via emails, presentations and	Updated data synthesis will inform dugong and turtle management policies. Provide essential knowledge of the location and composition of key environmental assets. Development of drone-based intertidal seagrass survey method can be used by TSRA rangers	Maps of seagrass distribution. Seagrass spatial dataset publicly available on eAtlas. Fragmentation Index to enhance the value of drone data for assessing the condition and

	meetings as needed or requested, and through reports and community brochures.	Report against TSRA's commitments under the EPBC Act and the objectives of Australia's Strategy for Nature 2019-2030 A foundation to create models assessing exposure to risk (water quality and other environmental impacts, climate change, etc).	resilience of seagrass habitats.
Department of Water and Environmental Regulation, WA Fiona Webster: Marine Ecosystems Branch Kieryn Kilminster: Water Science and Data Division	Project progress, findings and outputs to be communicated through ongoing discussions and meetings as needed or requested, and through reports and brochures for the community.	Project findings can be used to inform the approvals process for the Marine Ecosystem Branch, which oversees all marine developments in the State of WA. The compilation of seagrass distribution in eAtlas would aid decisions on these developments. In addition the project findings will enable the Water and Science Division to provide guidance on water extraction licenses for agricultural intensification in Northern Australia in the context of their work on seagrasses as groundwater dependent ecosystems.	Seagrass spatial dataset publicly available on eAtlas. Bilingual maps of seagrass distribution. Technical report including priorities for seagrass mapping, monitoring and management.
Department of Biodiversity, Conservation and Attractions, Marine Science Program, Biodiversity and Conservation Science, WA Simone Strydom Kevin Crook	Project progress, findings and outputs to be communicated through ongoing discussions, and meetings as needed or requested, and through reports and community brochures.	Project findings will contribute to DBCA's core need to track distribution and condition of key seagrass assets in marine parks including those where there is joint-management with Traditional Owners. Two marine parks in northern WA where there are knowledge gaps and a need to develop this understanding are the Montebello Marine Park and the recently announced Bardi Jawi Gaara Marine Park in the Buccaneer Archipelago,	Seagrass spatial dataset publicly available on eAtlas. Bilingual maps of seagrass distribution. Technical report including priorities for seagrass mapping, monitoring and management.

		which was co-designed and will be jointly managed.	
Additional outputs Project-generated outputs, including the seagrass spatial dataset, maps of seagrass distribution, and technical reports, will be publicly available to end users, researchers, and the public under the Creative Commons framework, using a Creative Commons 4.0 Attribution licence.			

Project variation – extra information

Problem statement

Consolidating data
Despite decades of seagrass research in Australia, historical spatial datasets remain fragmented, inconsistently curated, and often inaccessible to the broader research and management community. While synthesis efforts have produced consolidated datasets for the Great Barrier Reef (Carter *et al.* 2021), Torres Strait, and Gulf of Carpentaria (Carter *et al.* 2023), and composite datasets for the Northern Territory and Western Australia are nearing completion, many additional datasets generated through targeted investment by NESP (Projects 3.5, 4.1, 5.1, 5.2), the Great Barrier Reef Foundation, and port authorities remain difficult to locate. These data are typically embedded in technical reports, requiring considerable effort to identify and extract, thereby limiting their utility for evidence-based management and regional-scale synthesis.

Airborne Imagery and Seagrass Fragmentation as an Indicator of Resilience
Current ecological health indicators for seagrass ecosystems remain limited, with traditional measures such as extent and per cent cover unable to detect early-stage degradation. A more sensitive indicator is required to capture processes such as habitat isolation and edge effects, which reduce ecosystem resilience and function. Fragmentation offers this capability, providing a landscape-scale perspective that complements conventional metrics and strengthens conservation and restoration planning. Drones and remote sensing now provide cost-effective, repeatable methods for mapping and monitoring seagrass across northern Australia—and ranger groups possess the operational capacity to apply these techniques. However, there is currently no established framework for translating these highly detailed mapping outputs into a standardised fragmentation index. Baseline seagrass distributions have been mapped through NESP (3.5, 4.1, 5.1, 5.2) and complementary initiatives. Advances in drone and satellite technology are delivering increasingly high-resolution imagery. However, without investment in developing a robust fragmentation index, the full value of these datasets cannot be realised, limiting managers' and Traditional Owners' ability to detect early warning signs of degradation and implement timely, evidence-based interventions.

Project description

Consolidating data
Unpublished seagrass datasets and associated metadata will be collated and submitted to the e-Atlas to ensure discoverability for researchers, managers, and stakeholders. Data availability will be governed by approvals from funding agencies and Traditional Owners, in line with appropriate data governance frameworks. To support transparency, information sheets will be developed for funders and partners outlining data availability pathways and management processes. Project activities will include consultation with contributing researchers, preparation of communication materials for funders and partners, and the systematic collation and submission of datasets and metadata to e-Atlas.

Fragmentation
Fragmentation will be assessed using drone-derived orthomosaics and satellite remote sensing data, which provide high-resolution, spatially accurate imagery capable of capturing fine-scale patterns of seagrass. By leveraging the power of machine learning and AI, we can derive detailed mapping outputs from imagery. These methods enable consistent, repeatable monitoring across sites and timeframes, offering greater sensitivity to ecological change than traditional metrics. Subject to approval from Traditional Owners, existing imagery from the Great Barrier Reef, Torres Strait, and Gulf of Carpentaria will be incorporated.

Image datasets will be classified into vegetated, unvegetated, and other categories (e.g., coral) and analysed for spatial configuration of seagrass meadows. Key spatial metrics—including per cent cover, patch density, size, shape, distribution, and edge-to-area ratio—will be calculated, and multivariate analyses will be used to identify the most informative indicators and develop a robust fragmentation index. By comparing fragmentation metrics with conventional measures such as total extent and cover, this approach will demonstrate the added value of fragmentation as an early warning, landscape-scale indicator of ecosystem degradation. This represents an innovative step forward in seagrass monitoring, providing funders and managers with a tool that detects changes earlier, supports proactive decision-making, and enhances the capacity to track and manage ecosystem resilience.

Project progress to date

Consolidating data

Significant progress has already been achieved through Project 3.5, with baseline seagrass mapping completed across key regions of northern Australia, including the Gulf of Carpentaria (Kurtijar IPA, QLD; South East Arnhem Land, NT), Tiwi Islands (NT), Karajarri (WA), and additional sites delivered through other NESP projects. Pre-existing datasets not yet incorporated into composite products are being systematically identified, with data owners engaged to determine interest in making these datasets discoverable and to liaise with partners and co-owners on intellectual property considerations. Active discussions with NESP collaborators are already underway, and further discussions on datasets funded by ports, the Great Barrier Reef Foundation, and GBRMPA will also be sought. This represents substantial progress toward establishing a comprehensive and accessible national seagrass dataset.

Fragmentation

Aerial imagery—including drone-derived orthomosaics and high-resolution satellite data—has been collected through NESP projects 3.5, 4.1, and 5.2, as well as other related initiatives. These datasets are being analysed to quantify seagrass patch size, shape, and distribution. The imagery has been acquired both for the development of a drone-based monitoring methods manual and a scientific paper, and through routine monitoring programs undertaken with Ranger groups. Together, these provide the foundation for developing the fragmentation index.

Work is underway to finalise a manuscript outlining protocols for drone-based seagrass monitoring. This manuscript details the complete workflow, from image acquisition and in-situ spot checks, through data processing with integrated deep learning models, to the generation of spatial products such as habitat maps and quantitative ecological metrics (percent cover, species composition, and biomass). Complementary evaluation of remote sensing and modelling approaches is also progressing, with the goal of overcoming current limitations and producing a probability-based benchmark of seagrass distribution in Northern Australia. This framework will also enable hindcasting of past seagrass distributions to assess long-term changes in extent.

The fragmentation index will serve as a complementary metric within this framework, formalising how drone orthomosaics and AI derived mapping outputs can be applied in reporting ecological condition. A large volume of spatial data is already available for the analysis, including Planet satellite subscriptions, NESP project outputs, the Marine Monitoring Program, and Girringun blue carbon datasets. Additionally, several sites have multi-temporal datasets, enabling the evaluation of temporal variation in fragmentation through recovery after acute disturbances (e.g. Post-cyclone Jasper).

Explanation of what the extension will achieve

With much of the groundwork already complete, this final step will maximise the value of past and ongoing projects while ensuring long-term accessibility of seagrass spatial data and fragmentation metrics.
Seagrass spatial data will be compiled and made discoverable through eAtlas, with metadata and GIS layers (where permissions allow) submitted under Creative Commons licensing and assigned DOIs. Key maps and summaries will also be made publicly available.

Fragmentation Index Development

- A scalable index will provide an early warning of changing resilience, allowing spatial and temporal comparisons of patch distribution.
- The index will be reporting-ready, suitable for integration into report cards.
- Engagement with DCCEEW, GBRMPA, Ranger groups, and Australian Marine Parks will ensure broad uptake.
- A data report will present fragmentation levels across key sites, with discussion of how it links to complementary indicators (extent, per cent cover), habitat value, resilience, and services such as Blue Carbon.

Applications and Broader Value

- State of Environment Reporting: Adds a sensitive, spatially explicit measure of seagrass condition, strengthening national reporting and enhancing drone-based monitoring with Indigenous Ranger groups.
- Blue Carbon: Improves understanding of ecosystem stability and carbon storage, guiding site selection for protection, restoration, and investment.
- Environmental Accounts: Aligns with SEEA–EA principles by quantifying habitat integrity, tracking change, and supporting robust marine condition assessments.

Project 3.10 – A partnership approach to filling key knowledge gaps on dugongs in northern Australia using novel technologies

Project type: Existing project seeking amendment	
Project start date: 01/01/2023	**Project end date**: 06/02/2026 **Extension request:** 20/11/2026
Project budget extension	**NESP:** $ 30,000 **Cash and in-kind**: $30,000
Total project budget: $1,726,063 (GST exclusive) includes budget extension above	**NESP funding:** $629,291 (GST exclusive) **Co-contributions (cash and in-kind):** $1,094,935 (GST exclusive) **GAGI:** $1,837 (GST exclusive)
Project leader details:	Name: Dr Christophe Cleguer Organisation: James Cook University Phone: 0402948723 Email: Christophe.cleguer@jcu.edu.au

Project variation rationale:

Australia supports the largest remaining dugong population globally, with systematic aerial surveys conducted since the 1970s providing unparalleled data coverage. While regional analyses (e.g. Great Barrier Reef, Torres Strait, Shark Bay) have been undertaken, there is currently no **nationally consistent Biologically Important Area (BIA) model** for dugongs. The recent BIA case study in the northern Great Barrier Reef (Marsh et al. unpublished) enabled the development of a framework and spatial models for BIAs using kernel density modelling, which were reviewed and accepted by DCCEEW and dugong experts in Australia. Building on this work, we propose to retrieve, collate, and standardise all recent aerial survey data on dugong across the dugong's Australian range to produce a national dugong BIA model in line with the new BIA Protocol. Outputs (e.g., dugong BIA foraging and reproduction areas) will be used to identify current dugong BIAs, which are currently being updated.

This variation will deliver: (i) streamlined data sharing agreements with government agencies (Commonwealth, State/Territory), universities, and Traditional Owner partners; (ii) a consistent analysis pipeline applied nationally; and (iii) BIA maps to inform conservation policy and spatial management. Outcomes will directly support the DCCEEW Migratory Species Section, and other agencies responsible for dugong stewardship under the EPBC Act and CMS Dugong MoU. The proposed extension ensures that decades of government-funded aerial survey investment translate into actionable, national-scale management tools.

Project variation details

Pathway to impact*

Outcomes		
See details above in Project variation rationale. Developing nationally consistent BIA"s for dugong will enable spatial planning and improved decision-making to better protect this species.		
Research-user	**Impact on management action**	**Outputs**
Migratory Species Section, DCCEEW	Updates to the EPBC Act dugong species profile and conservation advice. Inform decision-making about actions that may impact protected marine species. Described in conservation plans for protected marine species, including statutory recovery plans, wildlife conservation plans, and conservation advice documents. Define 'habitat critical to the survival of the species' required in recovery plans made under the EPBC Act.	National dugong BIA maps (GIS layers). Public release of data layers on eAtlas/ALA/OBIS/BDR (subject to agreements). Final synthesis report.
Great Barrier Reef Marine Park Authority.	Updates to the EPBC Act dugong species profile and conservation advice. Inform decision making about actions which may impact protected marine species. Described in conservation plans for protected marine species including statutory recovery plans, wildlife conservation plans, and conservation advice documents. Define 'habitat critical to the survival of the species' required in recovery plans made under the EPBC Act.	National dugong BIA maps (GIS layers). Public release of data layers on eAtlas/ALA/OBIS/BDR (subject to agreements). Final synthesis report.

State Governments (QLD, WA, NT)	Support State and regional dugong management frameworks (e.g., GBR Dugong Protection Areas). Updates to the EPBC Act dugong species profile and conservation advice. Define 'habitat critical to the survival of the species' required in recovery plans made under the EPBC Act.	National dugong BIA maps (GIS layers). Public release of data layers on eAtlas/ALA/OBIS/BDR (subject to agreements). Final synthesis report.
Torres Strait Regional Authority	Identify information gaps and prioritise future research. Inform decision-making about actions that may impact protected marine species. Define 'habitat critical to the survival of the species' required in recovery plans made under the EPBC Act.	National dugong BIA maps (GIS layers). Public release of data layers on eAtlas/ALA/OBIS/BDR (subject to agreements). Final synthesis report.
Traditional Owner groups across northern Australia.	Identify information gaps and prioritise future research. Inform decision-making about actions that may impact protected marine species. Define 'habitat critical to the survival of the species' required in recovery plans made under the EPBC Act.	National dugong BIA maps (GIS layers). Public release of data layers on eAtlas/ALA/OBIS/BDR (subject to agreements). Final synthesis report.

Project variation – extra information

Problem statement

Dugongs (*Dugong dugon*) are listed as *Vulnerable to extinction* globally and hold profound ecological, cultural, and economic significance across northern Australia. Australia supports the largest remaining population worldwide and is therefore pivotal to the species' global survival. Their distribution closely follows seagrass habitats, which are highly dynamic and sensitive to extreme weather events, coastal development, and cumulative anthropogenic pressures. Maintaining dugong populations at sustainable levels is a central requirement under the *EPBC Act* and Australia's commitments to the CMS Dugong MoU.

Since the 1970s, more than 115 systematic aerial surveys have been conducted across the dugong's Australian range, representing a globally unique dataset. Government agencies have mainly funded these surveys, but their outputs remain fragmented across institutions, states, and time periods. Existing analyses are primarily regional (e.g. Great Barrier Reef, Torres Strait, Shark Bay), with methodologies that have evolved over time. As a result, there is no consistent national framework for identifying and protecting Biologically Important Areas (BIAs) for dugongs, which limits governments' capacity to implement spatially explicit, evidence-based conservation actions at the required scale. A synthesis and harmonisation of the data collected in the most recent dugong surveys across northern Australia is urgently needed to underpin national policy, Indigenous-led stewardship, and marine planning.

Project description

This project will consolidate and standardise aerial survey data for dugongs across their entire Australian range and apply the Biologically Important Areas (BIA) Protocol to produce the first nationally consistent BIA model for the species. Building on methods trialled in the Great Barrier Reef World Heritage Area, we will apply kernel density estimates to identify dugong BIAs as proxies for critical habitats, covering behaviours such as feeding, reproduction, and resting, which are relevant to the BIA framework.

The project will deliver three key streams of work:

1. Data collation and agreements – secure data-sharing arrangements with state/territory agencies, universities, and Traditional Owner groups to retrieve the most recent aerial survey datasets.

2. Data standardisation and modelling – harmonise format. The BIA models are based on uncorrected dugong sightings, so we will use these and not attempt to harmonise sighting corrections on the entire dataset at this stage.

3. Synthesis and outputs – Synthesis of dugong research work undertaken under NESP funds, as well as national BIA maps.

By uniting fragmented datasets into a single, transparent workflow, the project will maximise the value of government investment and provide managers with an authoritative baseline for dugong conservation.

Project progress to date

This project has been discussed with NESP, and we are reviewing examples of data-sharing agreements while informally contacting data owners to ensure that data sharing can commence quickly.

Explanation of what extension will achieve

The requested extension will allow the project to complete the synthesis necessary for a national dugong BIA model and ensure the outputs are delivered in a form directly usable for management.

Specifically, extension funds will enable:

- National dataset retrieval and harmonisation.
- Development of a national analysis pipeline – applying kernel density modelling, analyses across the full dugong range, ensuring reproducibility and comparability.
- Delivery of national BIA outputs – producing standardised GIS layers identifying dugong BIAs and associated metadata, hosted in national repositories (e.g., TBD but possibly eAtlas, ALA, OBIS, BDR).
- Synthesis and policy translation – preparing a consolidated public-friendly report summarising all recent NESP-supported dugong research, and highlighting implications for EPBC Act conservation advice, BIA datasets maintained by DCCEEW, and regional frameworks such as GBR Dugong Protection Areas.

The extension transforms decades of fragmented survey data into an integrated, national-scale product with enduring value for conservation policy.