

# BROOME COMMUNITY SEAGRASS MONITORING PROJECT: 10 YEAR REPORT CARD 2006–2016

A summary of the social and scientific results from 10 years of monitoring seagrass in the ecologically and culturally rich Roebuck Bay



**environs  
KIMBERLEY**  
SAVING THE NATURE OF THE KIMBERLEY







**Authors:** Malcolm Lindsay (Environs Kimberley), Julia Rau (Environs Kimberley), Len McKenzie (Seagrass-Watch HQ) and Rudi Yoshida (Seagrass-Watch HQ)

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This report is a summary of the key project outputs and scientific results of the first 10 years of the Broome Community Seagrass Monitoring Project. This report includes scientific results summarised from a more detailed Seagrass-Watch report (McKenzie *et al.* 2017) which is available on request from Environs Kimberley or Seagrass-Watch (hq@seagrasswatch.org, www.seagrasswatch.org).

McKenzie, L.J., Yoshida R.L., Langlois, L., Rau, J., Weatherall, K., Bishop, F., Bain, D., Ferguson, S., and Lindsay, M. (2017). *Long-term seagrass monitoring in Roebuck Bay, Broome: Report on the first 10 years.* A report to the Broome Community Seagrass Monitoring Project, Environs Kimberley. Centre for Tropical Water & Aquatic Ecosystem Research (TropWATER) report 17/35. James Cook University, Cairns, Australia, 42pp.

This project is coordinated by Environs Kimberley with support from our main project partners: Seagrass-Watch HQ, Nyamba Buru Yawuru and the Department of Parks and Wildlife. The project has been largely funded by long-term funders Coastwest and the Kimberley Ports Authority, with additional funding from Rangelands NRM, the Foundation for Rural & Regional Renewal (FRRR), Norman Wettenhall Foundation, the Shire of Broome and Seagrass-Watch HQ.

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#### For further information please contact:

##### Dr. Malcolm Lindsay

Kimberley Nature Project Coordinator  
knp@environskimberley.org.au  
Tel: (08) 9192 1922  
www.environskimberley.org.au

##### Julia Rau

Project Coordinator  
seagrass@environskimberley.org.au  
Tel: (08) 9192 1922  
www.environskimberley.org.au

##### Len McKenzie

Director Seagrass-Watch  
hq@seagrasswatch.org  
www.seagrasswatch.org



# Roebuck Bay

*"Sadly we know that our Bay is changing, under pressure from urbanisation, tourism, pearling, agricultural and industrial developments... The seagrass beds are diminishing, and it is much harder to catch salmon from the foreshore. Our Yawuru Rangers are working with the Broome Community Seagrass Monitoring Project to record these changes and to protect and manage the Bay to ensure that our cultural traditions are maintained and the Bay becomes a healthy marine environment. We thank you for your support in looking after our country. Galiya."*

**Nyamba Buru Yawuru**

**Roebuck Bay is a Ramsar and National Heritage listed wetland of international and Aboriginal eco-cultural importance, comprising biologically diverse intertidal mudflats and seagrass meadows.**

The seagrass meadows are the principal nursery and adult habitat for fish and invertebrates, and a food source for fish, invertebrates, turtles and dugongs. They are a critical bio-indicator of the larger marine ecosystem's health. The meadows and the animals they support are culturally important to the Yawuru traditional owners and other Aboriginal communities (Yawuru Cultural Management Plan 2011). The Yawuru people have

been harvesting and trading the resources of the sea for thousands of years, following rules that have protected the species. Yet this is getting harder and harder as changes are occurring in the bay. Seagrass meadows are under threat worldwide from urbanisation, dredging, water pollution and climate change. The same is true for Roebuck Bay, adjacent to the growing Broome town site.



# THE BROOME COMMUNITY Seagrass Monitoring Project

The Broome Community Seagrass Monitoring Project was started in 2006 to gather baseline data of the health of the seagrass in the bay and to increase the community's understanding of its importance. Since the beginning, seagrass monitoring has occurred four times a year at three bay sites, utilising the power of citizen scientists and Aboriginal Rangers to gather data through a rigorous method developed and supported by scientists at Seagrass-Watch HQ.

## THE PROJECT'S GOALS ARE:

- To conduct long-term monitoring of seagrass condition in northern Roebuck Bay
- To educate the wider community on the importance of seagrass resources
- To raise awareness of coastal management issues
- To provide an early-warning system of coastal environment changes for management
- To support conservation measures which ensure the long-term resilience of seagrass ecosystems.

The project is managed by Environs Kimberley with support from the Department of Parks and Wildlife, Seagrass-Watch HQ and Nyamba Buru Yawuru.

The project relies on an army of dedicated volunteers and has closely worked with many other community stakeholders including the Roebuck Bay Working Group, Conservation Volunteers Australia, Broome Chamber of Commerce and Industry, primary and secondary schools, Derby Bushrangers and the Karajarri, Nyul Nyul, Bardi Jawi and Yawuru Aboriginal Rangers and Country Managers.

This report presents a summary of the project activities and scientific findings from the past 10 years.

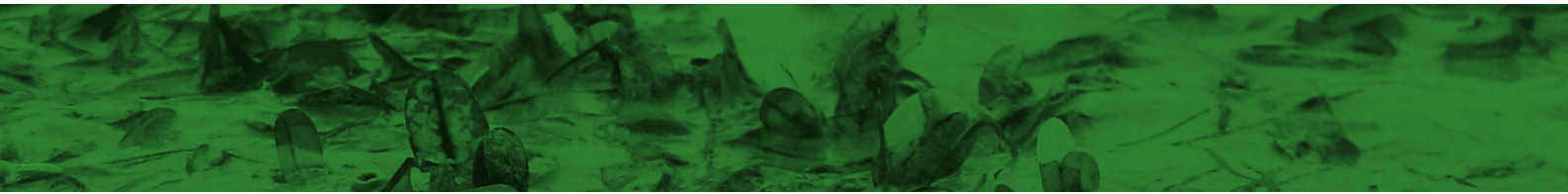
## HOW DO WE MONITOR THE SEAGRASS?

The project follows the globally standardised methodology set out by Seagrass-Watch, a global scientific seagrass assessment and monitoring program. The Broome Community Seagrass Monitoring Project is one of over 300 Seagrass-Watch monitoring sites across 17 countries. The program has a strong scientific underpinning with an emphasis on consistent data collection, recording and scientific expertise. All relevant data collected during our monitoring events in Roebuck Bay are lodged electronically with Seagrass-Watch HQ and undergo a rigorous quality-control check.

Seagrass monitoring occurs in Roebuck Bay four times a year at three sites on the intertidal mudflats of Roebuck Bay, see map. Each monitoring event takes 2–3 hours per site, during low spring tide. Volunteers are briefed before each monitoring event about methods and safety, and are shown a video 'Welcome to Country' from the Yawuru Traditional Owners. Each monitoring event is overseen by a scientist or accredited participant. At each site, 11 50cm x 50cm quadrats are placed along three parallel 50m transects and surveyed for seagrass diversity, cover and canopy height; algal cover; epiphyte cover; Lyngbya abundance; and animal diversity and abundance. Photos are taken of all quadrats and seagrass seeds are also sampled across the site (for further description of methods see Seagrass-Watch science report). The data are then entered into a spreadsheet (McKenzie *et al.* 2017) in Broome and sent to Seagrass-Watch HQ for quality control, analysis, reporting and archiving.







To further control data quality, Seagrass-Watch HQ scientists travel to Broome when funding allows to conduct accredited training workshops for the project's volunteers. Training is free to participants and educates them about seagrass ecology and survey methodology. Training results in marked increases in the quality of volunteer data. Between 2007 and 2014, over 119 people attended the training. Due to limited funding, there was no training in 2015 and 2016.

# Citizen Science Volunteers

Community volunteers are the workforce of the project. Around 14 volunteers are needed for each monitoring event, and more than 80 community volunteers are currently registered with the Project. Over the 10 years a total of 4,247 hours of volunteer time has been generously donated to the project (see Figure 1), with monitoring events during the dry season the most popular due to the weather and tourist influx.

## Total Volunteer Involvement

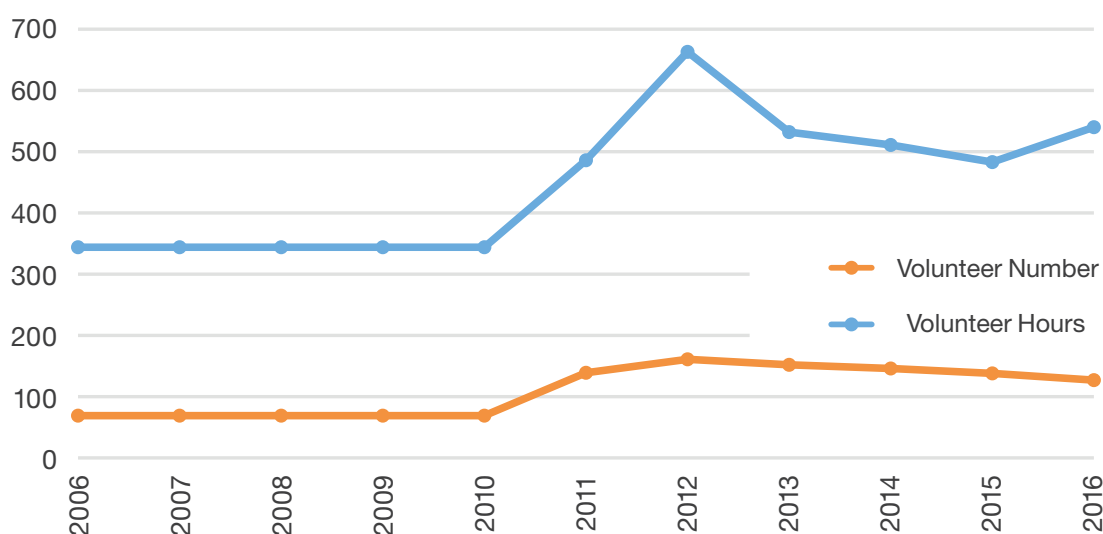
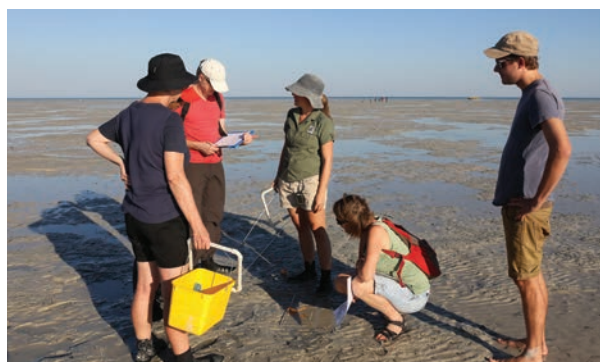


Figure 1: Volunteer number and hours over the 10 years of the project.  
Note that data between 2006 and 2010 are an estimate as data for those years were lost.

The project gathers citizen science volunteers through a range of methods. A 2016 survey of volunteers shows that word of mouth is the main way that volunteers hear about the project (63.2%), followed by Environs Kimberley's website (15.8%), social media (10.5%), posters on noticeboards (5.3%) and newspaper advertisements (5.3%). It is heartening that most volunteers hear about the project by word of mouth; it suggests that people enjoy the experience enough to recommend it to others. The same survey found that 82% of volunteers were very satisfied with the events and 84% were extremely or very likely to recommend it to a friend (0% were unlikely to recommend it). Monitoring is also encouraging that we have a team of regular volunteers who keep coming back despite the early mornings; 58% of surveyed volunteers were extremely likely to return, with a further 37% quite or moderately likely.





**The reasons that motivated the surveyed volunteers to attend events were:**

- To contribute towards looking after our local marine environment 89.5%
- To learn more about my local environment 84.2%
- To meet like-minded people 52.63%
- To support the work of Environs Kimberley 52.63%
- To be involved in a scientific project 47.4%
- To get some exercise and fresh air 36.9%

**After the events, the things that the surveyed volunteers enjoyed were:**

- To discover cool little creatures in the mudflat 84.2%
- The opportunity to get out and enjoy our beautiful bay 73.7%
- To be part of a scientific study 63.2%
- To learn about the scientific methodology 42.11%
- The muffins and coffee 36.9%
- To work in a team 31.58%
- The early morning starts 15.8%

*"Seagrass Monitoring is something to get up for. What else would bring anyone sloshing out over the mudflats at sunrise on those magical mornings when the air is still and the colours are pearly? Then there's that sense of virtue and comradeship that comes with rising in the darkness of dry season mornings, when the easterly wind cuts into one's face, to warm one's hands over coffee with other brave souls before trudging out to the seagrass, ankle-deep in cold mud, in the name of Science. There's the pride of knowing an ovalis from a uninervis, a tube-worm from a crab, and the excitement of the rare exotic marine animal that almost crawls into one's quadrat. Watching grass grow can be thrilling when it's seagrass."*

**Pat Lowe, seagrass volunteer**

*"I love being out on the mud at dawn and knowing that the data is sent through to a professional body to form part of international research. Len and Rudi from Seagrass-Watch, who lead the program, are passionate about seagrass and the role it plays in the health of bays and marine life, and meeting them here in Broome gives me confidence that the data collection is accurate and worthwhile. And of course the dedication of the local organiser Julia Rau".*

**Rose Barker, seagrass volunteer**





# OTHER PROJECT ACTIVITIES TO Engage the Community

Besides the seagrass monitoring, the project engages the wider community through a range of other activities to build knowledge, custodianship and protection of the ecologically valuable seagrass meadows of Roebuck Bay.

## Community Activities

Between 2006 and 2016 at least 73 presentations were delivered to school students across Broome and the Dampier Peninsula, to staff from a range of local organisations, community members, Aboriginal ranger groups and other stakeholders. School presentations included education packs aligned to the local curriculum and mock-up monitoring sessions on the school lawn.

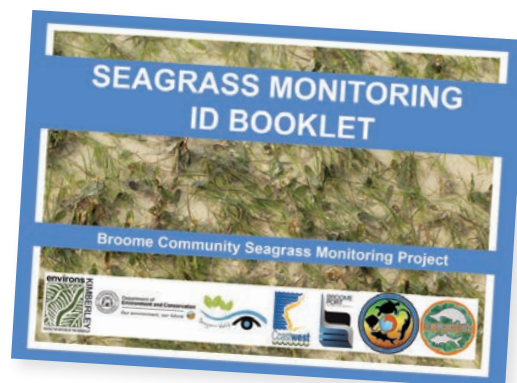


Information about the project and seagrass conservation has been communicated to the Broome community through a range of other activities, including the distribution of project brochures and flyers (2,204), newspaper advertisements (32), newsletter articles (52), radio interviews (40), television interviews (5), newspaper articles (15) and social media posts (an estimated 245 posts to 1,234 current Facebook friends). Including the presentations, this represents over 2,666 communication actions to increase the community's understanding of the project, seagrass ecology and conservation.



## Traditional Owner Engagement

Engaging Traditional Owners and including their traditional knowledge has always been an important aspect of the project. 5 Aboriginal Ranger groups (Bardi Jawi, Nyul Nyul, Karajarri, Yawuru DPaW Rangers and Yawuru Country Managers) have taken part in training and monitoring events. Further consultation, input and collaboration was sought from the Yawuru community, with dedicated funds to assist. To help inform the seagrass volunteers of the cultural importance of the bay, the project commissioned a 'Welcome to Country' video, which is shown before monitoring events. Yawuru language names have been included in Identification guides to help keep the endangered language alive.







## Beach Clean-ups

The seagrass project has organised 4 community beach clean-ups, recruiting enthusiastic volunteers to collect marine debris from the Roebuck Bay foreshore. In 2015 the first event was organised as part of the Australian Marine Debris Initiative and supported by Conservation Volunteers Australia and Tangaroa Blue Foundation. In 2016, three events were held in conjunction with the Broome Chamber of Commerce. At one event alone 456kg of garbage were collected in 3 hours!

## Fish surveys

To examine the fish and invertebrate species using the seagrass meadows, the project conducted 3 seine netting surveys near the Town Beach seagrass site in 2015-2016 under a research permit from the WA Department of Fisheries. Over 25 species of juvenile fish and invertebrates were surveyed, many of which were commercial species or principal food sources for commercial species, showing the importance of the seagrass habitat as nursery. This information has been included in our community education work.



## Temperature loggers

To better understand the local conditions, the project recently deployed temperature data loggers in the seagrass meadow at the Demco site. Over the first year temperatures ranged from a maximum of 39.4°C to a minimum of 21.6°C, with an average of 30.1°C. These data will be used to investigate future seagrass health relative to local environmental conditions.



# Project Funding

The project has been very successful in finding consistent project funding over the 10 years of the project (Figure 2), with an average of \$37,145 per year and a total of \$371,457. The majority of funding has come from Coastwest (Figure 3: 68%), with a consistent contribution of 15% from the Kimberley Ports Authority. Lesser funding has come from Envirofund, Norman Wettenhall Foundation, Foundation for Rural Regional Renewal and the Shire of Broome. In recent years, with reduced funding opportunities, the project has been obliged to source numerous smaller grants to maintain the budget. Increased grant application, reporting and acquitting requirements make this approach unsustainable. EK has held initial conversations with the Department of Parks and Wildlife for long-term funding to assist with monitoring the seagrass within the proposed Yawuru Nagulagun/Roebuck Bay Marine Park.

Most of the funding was spent on project coordination (Figure 4: 58%); a project with large numbers of volunteers, project partners and activities requires a funded position.

Significant in-kind support has been received from the project partners and volunteers. Of particular note is the in-kind time from volunteers (over \$127,410) and in-kind support from Seagrass-Watch HQ for data management and scientific assistance to the project over the 10 years (over \$79,865).

## Annual Project Funding 2006–2016

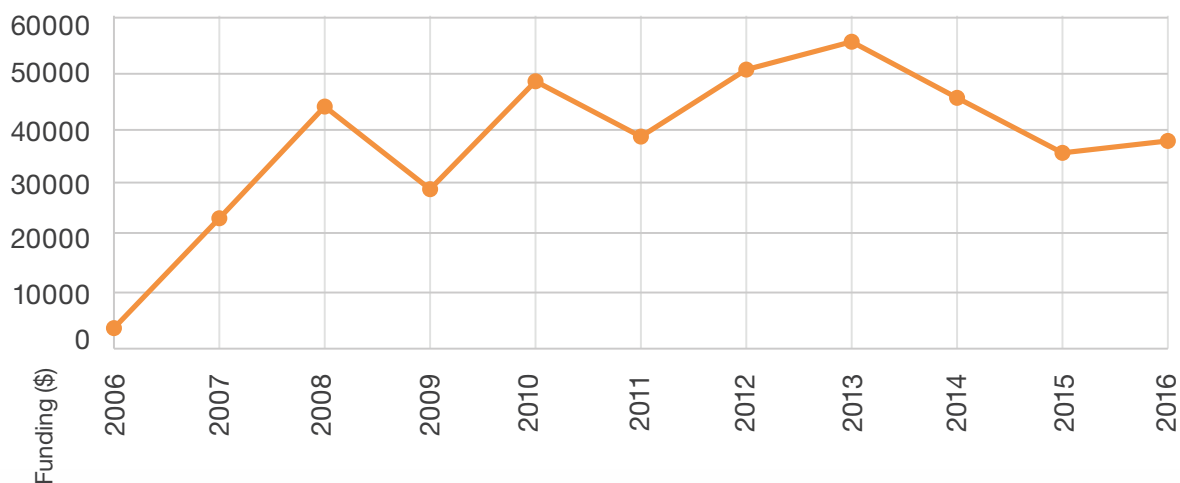


Figure 2: Annual Project Funding 2006–2016







### Funding Source (Total \$371,457)

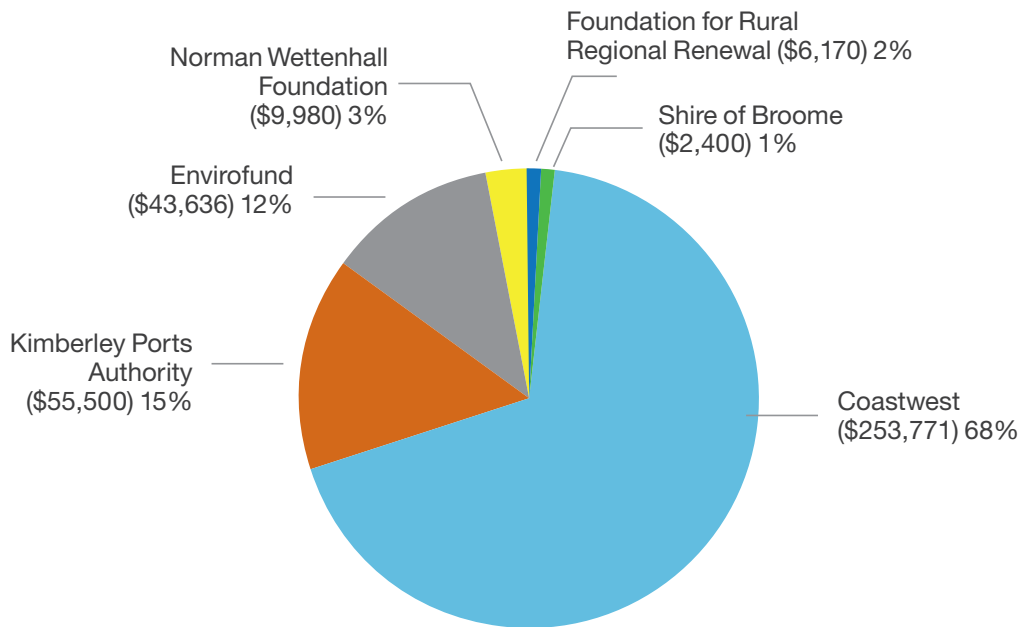


Figure 3: Project funding sources 2006–2016

### Project Expenditure 2006–2016 (Total \$371,457)

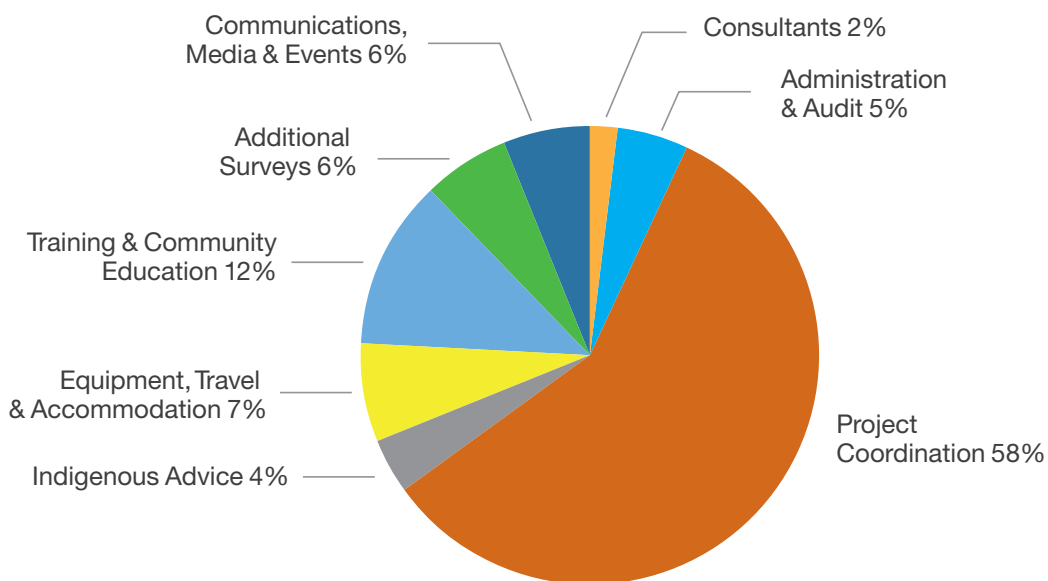


Figure 4: Project Expenditure 2006–2016



# Scientific Results

Seagrass-Watch HQ, with support from the Broome Community Seagrass Project, recently produced a scientific report analysing and interpreting the 10 years of data collected by the project. This report (McKenzie *et al.* 2017) goes into fine detail and is available from the Seagrass-Watch website ([www.seagrasswatch.org](http://www.seagrasswatch.org)) or on request from Environs Kimberley. Some of the key findings are summarised here:

## Data Quality

Collected data were checked by Seagrass-Watch HQ and data quality varied over the years. Approximately 15% of the data submitted was non-compliant and another 33% required correction by Seagrass-Watch HQ. After correction, greater than 95% of data was of high quality and sensitive to detecting change. In the last 2 years there has been a marked increase in data requiring correction, corresponding with the cessation of volunteer training events. Seagrass-Watch HQ training improves data accuracy, while correction requires considerable effort when training frequency decreases. The project needs to reinstate training as soon as possible to maintain data quality.

## Species Abundance

Two species of seagrass (*Halodule uninervis* and *Halophila ovalis*) were confirmed from Roebuck Bay, with a further two species (*Halodule pinifolia* and *Halophila minor*) under taxonomic review. The most abundant species over the 10 years was the opportunistic foundational species *Halodule uninervis*, with the colonising species *Halophila ovalis* fluctuating in abundance, declining in the wet season (Figure 5).

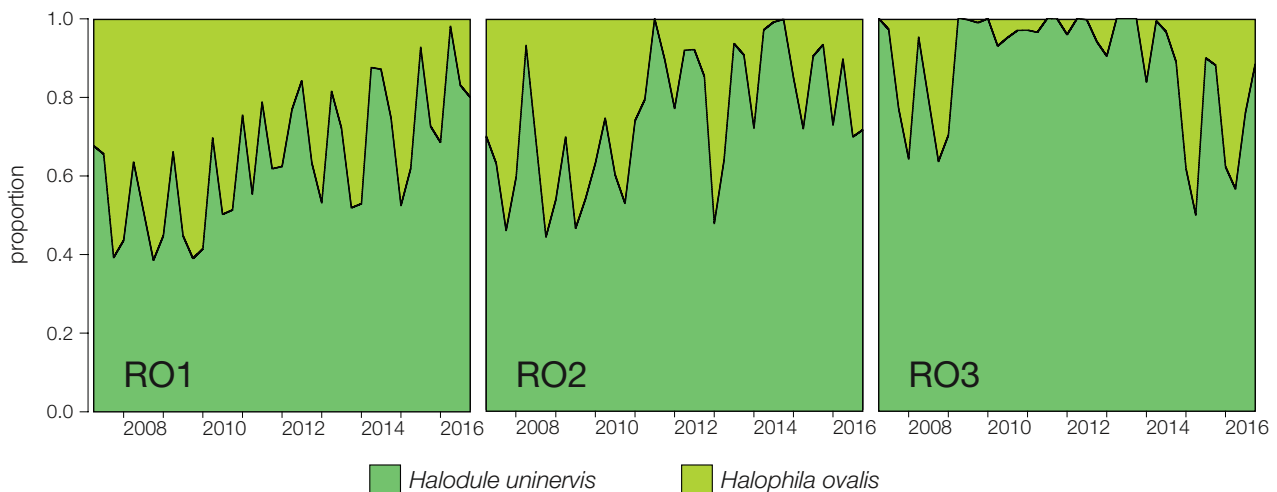
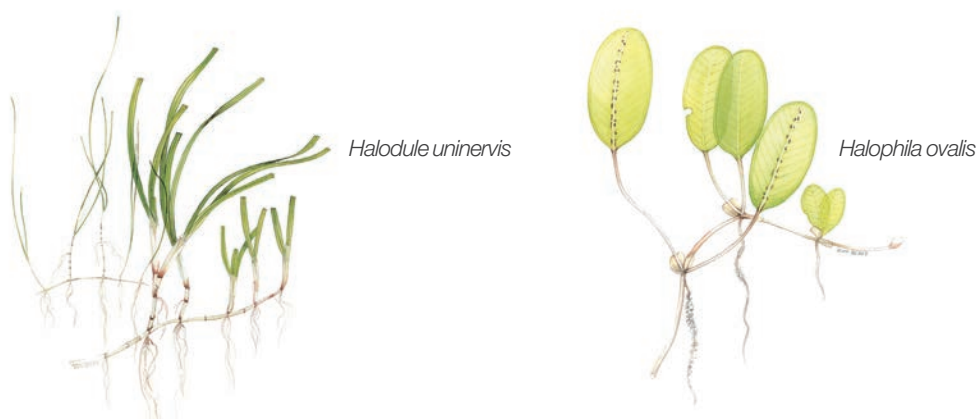


Figure 5: Proportion of seagrass abundance that is *Halodule uninervis* to *Halophila ovalis* at Town Beach (R01), Demco (R02) and the Port (R03).



## Seagrass Abundance

Seagrass cover was seasonal, being most abundant in late-dry to early monsoon season (October-December) and lower in late-monsoon to dry (April-July) (Figure 6). All sites fluctuated between years, with some consistent changes amongst sites, especially between Town Beach and Demco. The Port site generally produced a lower abundance of seagrass and seasonality was less pronounced.

The changes in abundance over the years appears to be driven primarily by environmental factors that alter sea-water temperature and light availability. Seagrass abundance was reduced by high rainfall in the preceding 3 months; it decreased during the wetter-than-average 2011–2014, yet increased during the drier 2015–2016. This can be explained by increased run-off causing less clear water and therefore less light for seagrass growth.

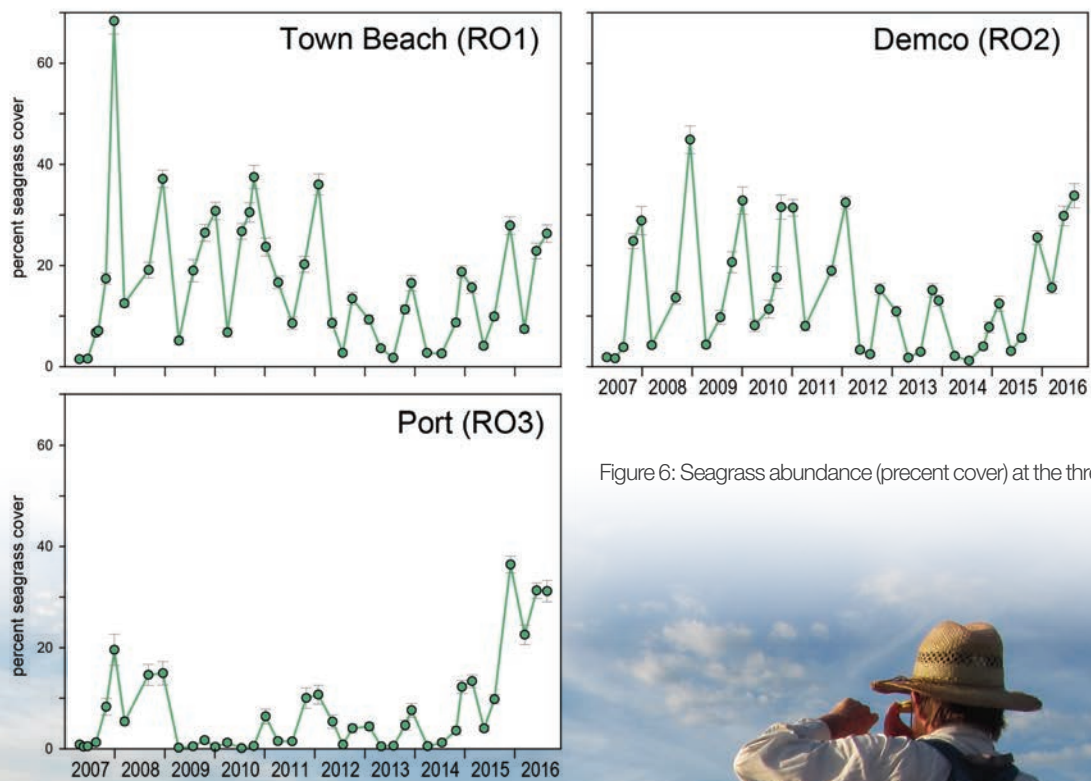
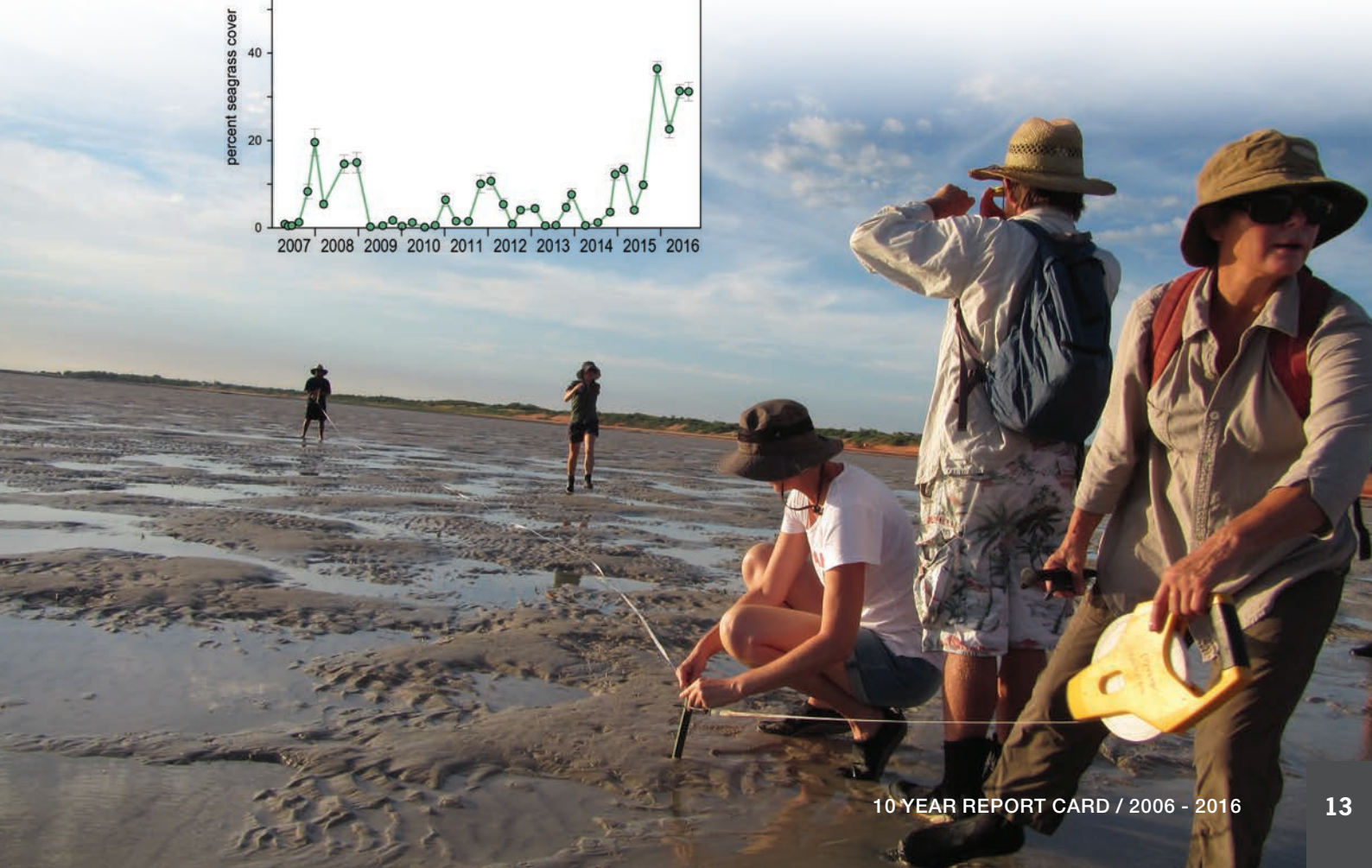


Figure 6: Seagrass abundance (percent cover) at the three sites.





# Scientific Results

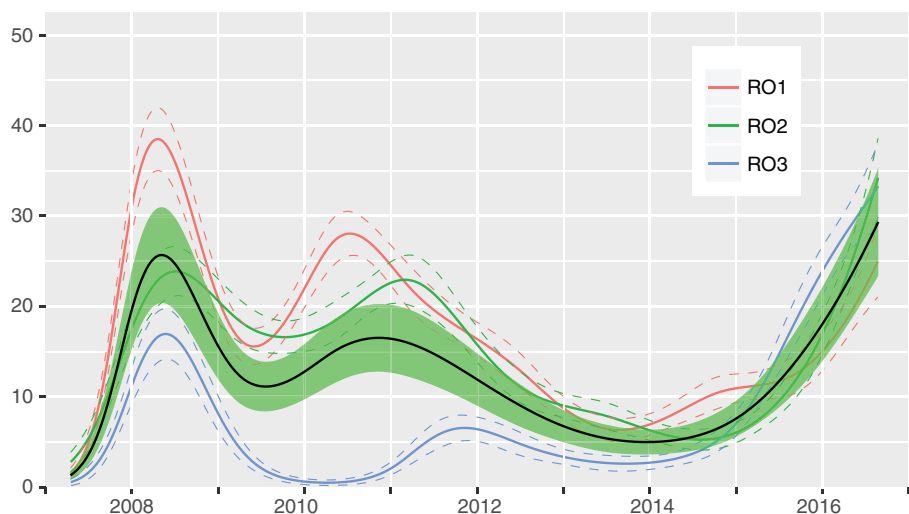


Figure 7: Seagrass abundance at the three sites (RO1 Town Beach = red, RO2 Demco = green and RO3 Port = blue) smoothed out using a statistical model (GAMM), with hatched lines representing a margin of error (95% confidence intervals). The black line and shaded green area represents the trend over all three sites.

## Seagrass seed banks

Seagrass are flowering plants which produce fruits and seeds. Some seagrass seeds persist in seabed sediments for several years, forming a bank from which meadows can recover when plants are lost or disturbed. A persistent seed bank of the foundation seagrass *Halodule uninervis* exists throughout the meadows of northern Roebuck Bay (Figure 8). Although highly variable, densities appeared higher in the wet season (December to May) after the main seagrass growth period (September to December). The size of the seed banks indicates that the meadows of Roebuck Bay have a high capacity to recover from any losses or major disturbances.

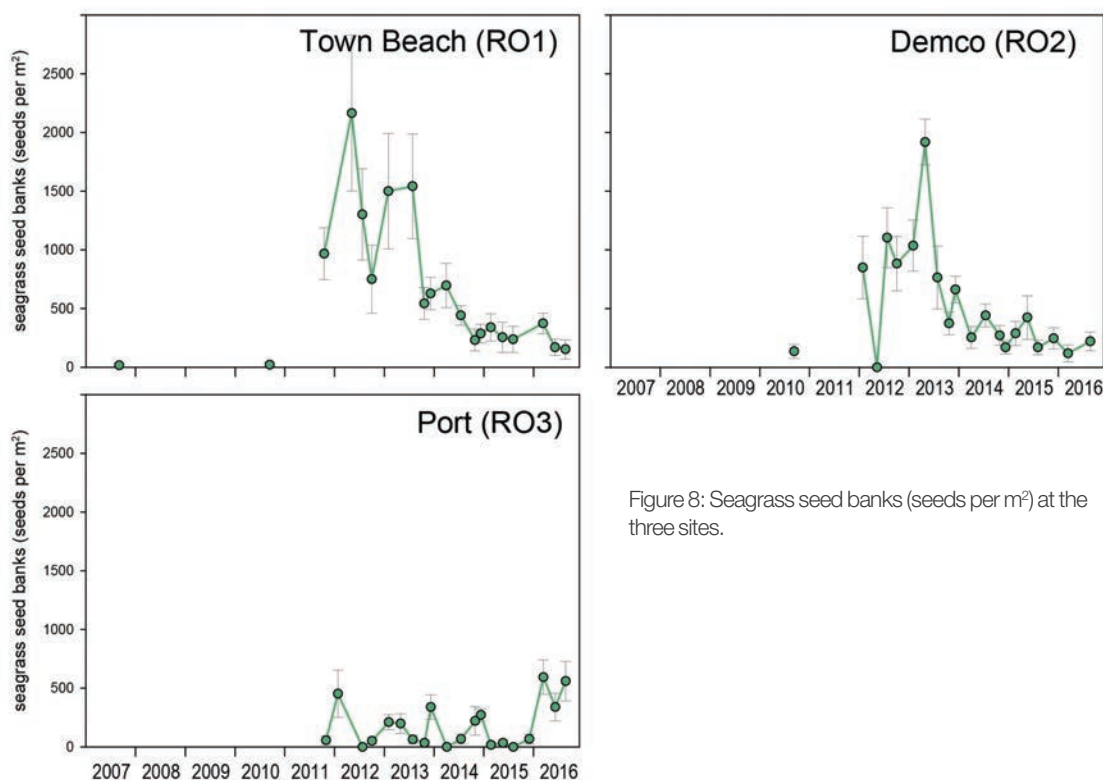


Figure 8: Seagrass seed banks (seeds per m²) at the three sites.

## Algae, epiphyte and *Lyngbya* cover abundance

The abundance of macro-algae fluctuated both within and between years but remained low at all sites over the 10 years. Epiphyte abundance was similar across all sites, being significantly higher in 2007–2009 and 2013–2014, and generally greater in late-dry/early monsoon of each year, most likely owing to increasing daylight paired with moderate temperatures. The blue-green algae *Lyngbya majuscula* occurred episodically across all sites (Figure 9), but remained at low to very low abundance. Its abundance increased in the early months of the year and after prolonged periods of above-average rainfall, most likely in response to elevated nutrients in the water.

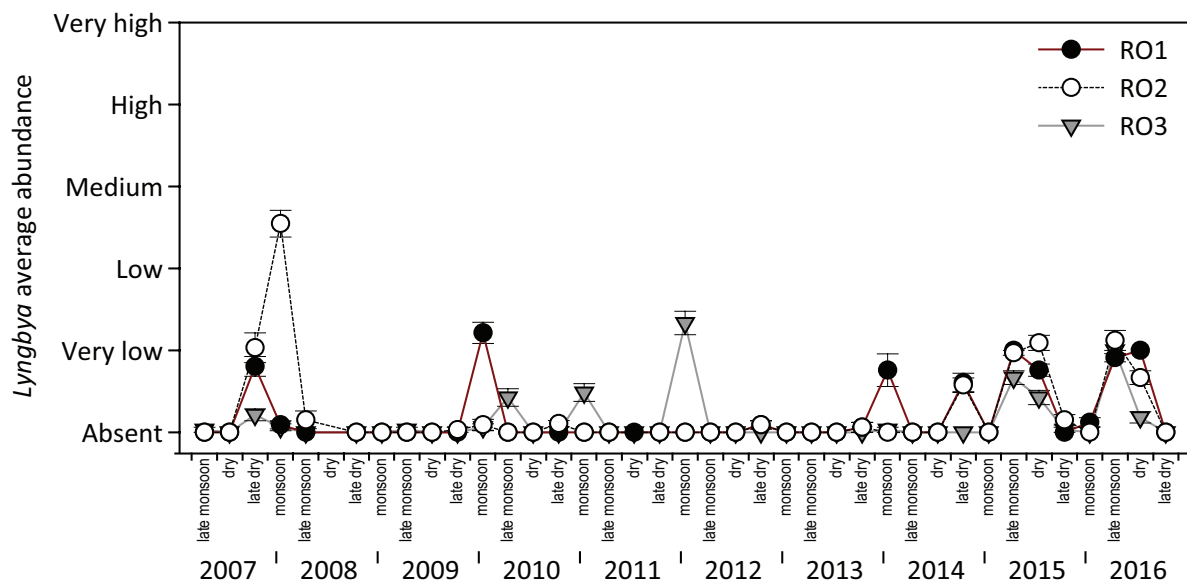


Figure 9: Average *Lyngbya* abundance at all three sites (R01 Town Beach, R02 Demco and R03 Port).





# Report card of seagrass health

To help capture and communicate the health of seagrass meadows in Roebuck Bay, Seagrass-Watch HQ developed a pilot report card using two significant indicators of seagrass resilience.

Seagrass abundance represents the ability of seagrass to deal with stressors, while the size of the seedbanks represents its capacity to recover from loss or disturbance. The two data indicators are converted to a score indicating health (0–100, 0 meaning poor and 100 meaning good), which is then converted to an annual grade (good, fair, poor and very poor) for easier communication (for more details please see the detailed science report, *McKenzie et al. 2017*). The abundance indicator relies on a baseline of 3–5 years of minimal disturbance, whereas the seedbank indicator is compared to a baseline of the long-term mean (2012–2016). These two indicators are then combined to give an overall condition grade (Figure 10).

The report card for Roebuck Bay shows that annual seagrass condition has fluctuated over the 10 years of monitoring. Seagrass condition was in a 'fair' state (B grade) when monitoring started in 2007, but improved to 'good' (A grade) the following year and remained 'good' until 2014. In 2015 when there was lower abundance and fewer seeds, seagrass condition declined to 'fair' until last year, 2016, with a resurgence of the seagrass back to 'good' health (A grade).

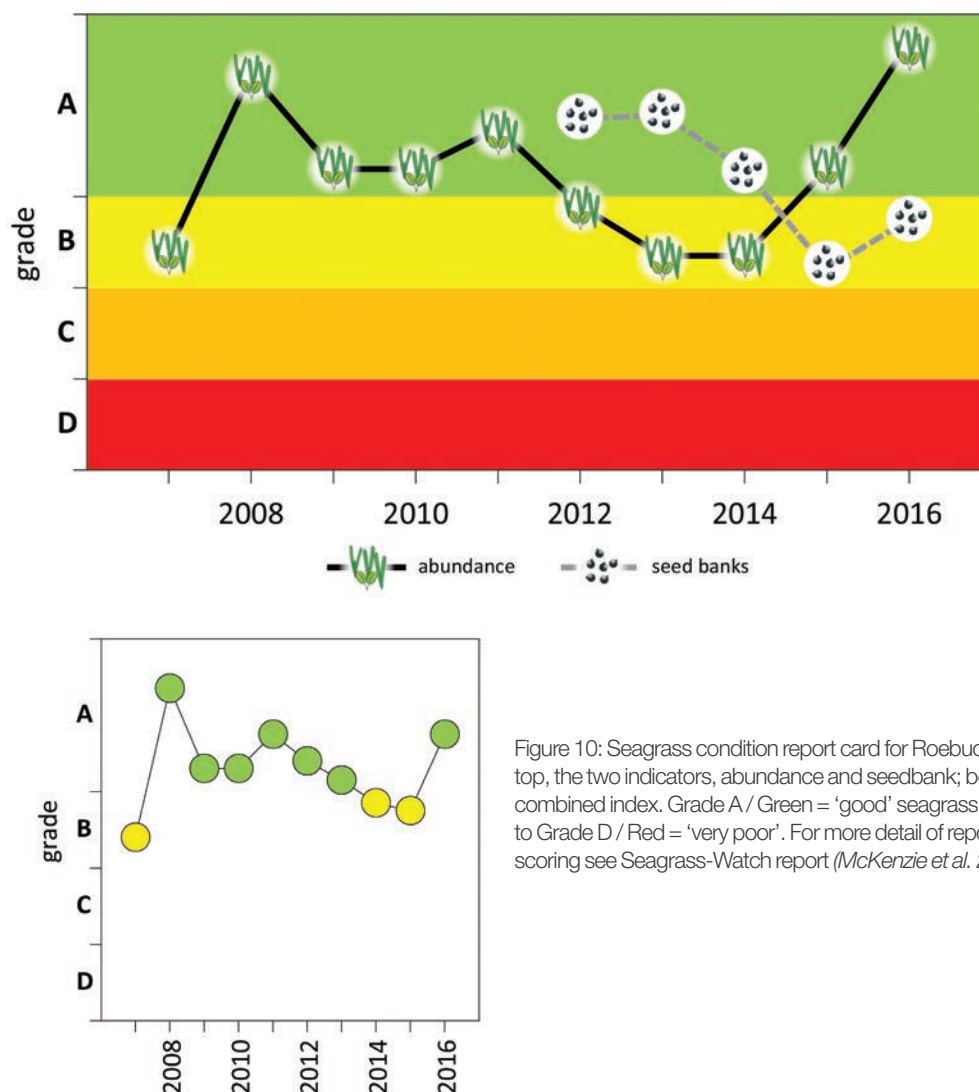


Figure 10: Seagrass condition report card for Roebuck Bay: top, the two indicators, abundance and seedbank; bottom, combined index. Grade A / Green = 'good' seagrass health, to Grade D / Red = 'very poor'. For more detail of report card scoring see Seagrass-Watch report (*McKenzie et al. 2017*).



# Scientific Recommendations

- Continue routine Seagrass-Watch monitoring at established sites
- Re-establish annual Seagrass-Watch training courses, or fund Seagrass-Watch HQ to increase the level of data quality assessment
- Introduce further insitu monitoring of temperature and light at representative sites to better understand their relationship to seagrass growth
- Investigate the factors that influence the growth of epiphytes and *Lyngbya* (e.g. hydrology, nutrients, etc.), and their potential impacts on seagrass condition
- Investigate seagrass flowering, reproduction and seed viability
- Assess and map the intertidal and subtidal seagrass communities in the Marine Park to establish representative long-term monitoring sites in the Park
- Adopt the Seagrass-Watch methodology and report card into the management of the Yawuru Nagulagun/ Roebuck Bay Marine Park.





# Overall Project Conclusions

The first 10 years of the Broome Community Seagrass have been incredibly successful and fulfilling for Environs Kimberley, project partners, volunteers and the wider community. This successful citizen science project is one of the longest running community seagrass monitoring projects in Australia.

## More specifically:

- The project has successfully been funded, coordinated, reported and acquitted over its years despite changes to staff and the funding environment
- The project has successfully conducted scientifically supported and robust seagrass monitoring at 3 sites in the bay, 4 times a year over 10 years, documenting the fluctuation and overall good health of seagrass in the bay
- This dataset has and will provide an important baseline and early-warning system for coastal managers, especially for the proposed Yawuru Nagulagun/Roebuck Bay Marine Park
- The project's successful inclusion of volunteers and the wider community has helped build community knowledge about the ecological and cultural value of seagrass and the marine environment, and the importance of conserving it.

The project now looks forward to the next 10 years of seagrass monitoring, to increasingly add value to our long-term dataset, to educate and inspire new volunteers and generations, to further deepen project partnerships, and to help monitor, understand and protect the ecologically and culturally significant seagrass meadows of Roebuck Bay.



# Acknowledgements

The project has relied heavily on our dedicated coordinators to manage the large number of volunteers, project partners and varied tasks. With projects involving large in-kind input from volunteers and project partners, a waged coordinator position is critical, to harness and make the most of the community's generous contributions. We thank these project coordinators for their time and energy over the years:

- Danielle Bain
- Kirsten Pearce
- Fiona Bishop
- Christine Howe-Piening
- Sharon Ferguson
- Kylie Weatherall
- Julia Rau

Environs Kimberley recognizes the significant support and contribution of all the funding bodies, partner organisations and community volunteers who have helped create and sustain the Broome Community Seagrass Monitoring Project over the past 10 years.

In particular we would like to thank: the Seagrass-Watch HQ team; Julie Melbourne and Dean Matthews from Nyamba Buru Yawuru; Christopher Lukes from Coastwest; key staff (Christopher Nutt, Sarah Mullineux, Luke Puertollano, Sharon Ferguson and Bonnie Tregenza) from the Department of Parks and Wildlife Broome for co-managing BCSMP; Kandy Curran from the Roebuck Bay Working Group; Captain Vic Justice, Kevin Schellack and Veronica Mair from the Kimberley Ports Authority; Beth Mellick from the Norman Wettenhall Foundation; the Kimberley Land Council; Grey Mackay from Rangelands NRM and Dr. Alexander Watson from WWF for their support.

Citizen scientists who have made outstanding efforts in collecting valuable seagrass data in Roebuck Bay include Kevin Smith, Rose Barker, Pat Lowe, Wade Freeman, Jon Hall, Juanet West, Franky O'Connor and Liz Kent.

Dr. Sora Estrella from the University of Edith Cowan assisted with her study of cyanobacteria *Lyngbya majuscula* in Roebuck Bay. The Yawuru Language Centre collaborated in developing educational material.

The beach clean-up events would not have been possible without the support of Heidi Taylor and Renee Mouritz from Tangaroa Blue Foundation, Jael Napper, CEO of the Broome Chamber of Commerce, and Anne Mueller from Conservation Volunteers Australia.

A big thank you also goes to Broome photographers Pamela Jennings, Nigel Gaunt, Kevin Smith and Kandy Curran for sharing their wonderful images with us. Last but not least we would like to acknowledge some key people from Environs Kimberley, including Louise Beames, Martin Pritchard, Jason Fowler, Christine Elsasser and Neil Hamaguchi.

## Funding Support:



## Partners and Collaborators:







*"It is a very well organised, educational citizen science project I would recommend to anyone who is interested in helping protect our bay. It is a great way to raise awareness about ecosystem health. I hope the project continues well into the future."*

seagrass volunteer



**BROOME  
SEAGRASS**  
Community Monitoring Project

*"The seagrass project is exceptional as it allows the community to learn about the values of the bay and how they can contribute to managing these values into the future. It also allows visitors and locals to participate in scientific monitoring, that contributes to the management of the bay. Children are encouraged to participate which is great for fostering an interest in the natural environment of Broome and in science. It is also a great way to make friends with like-minded people and meet Traditional Owners."*

seagrass volunteer

The Broome Community  
Seagrass Monitoring Project  
Email: [seagrass@environskimberley.org.au](mailto:seagrass@environskimberley.org.au)  
Telephone: 08 9192 1922  
[www.environskimberley.org.au](http://www.environskimberley.org.au)



@EnviroKimberley



environs.kimberley



@environskimberley