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Seagrass-Watch

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Rising seas

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Local eyes Global wise

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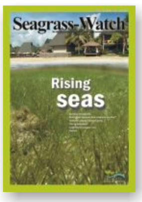
From the editors

Our oceans sustain a vast wealth of biological diversity, deliver critical ecosystem services, supply valuable natural resources, and are a central component of the climate system. As our climate changes, so do our oceans. Sea-level rise is a central element in detecting, understanding, attributing and correctly projecting climate change. But what is the impact of sea-level rise on our seagrasses? In this issue, we look at those possible impacts.

In this issue we also take a closer look at sea-level rise in the Torres Strait, where impacts to seagrass and the fisheries they support, could have significant flow on effects to the local communities, economy and culture of the Torres Strait.

Unfortunately, some areas of seagrass are already being lost, possibly due to coastal development and coastal runoff. In this issue you can read how Indigenous Rangers are helping to monitor the seagrass at Goold Island and how awareness raising is increasing interest in seagrasses in the Kimberley region and north Queensland . You can even learn about forams.

By continuing to raise awareness of the importance of seagrass in our marine ecosystems, we can also help to ensure management responses are focused on reducing other environmental stressors which will assist in making seagrass meadows resilient enough to survive the impacts of climate change.



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Seagrass-Watch acknowledges the Traditional Owners on whose sea country we monitor

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Rising Seas

our oceans are changing

Article and photography by Len McKenzie

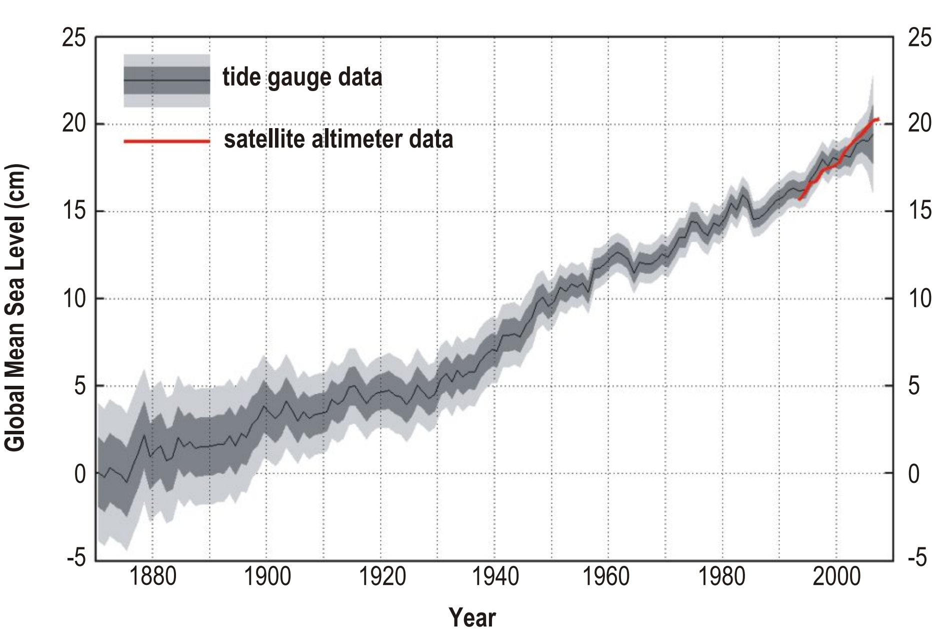
We are living in a world in which the climate is being substantially modified by human activity. These changes are leading to a wide range of impacts, just one of which is a rise in sea-level at a rate which has not been experienced for at least 5,000 years.

Although the global average (eustatic) sea-level has probably varied by less than 1.0mm per year over the past several thousand years prior to 1900, historic records from tide gauges indicate the sea-level has been steadily rising at a rate of 1 to 2.5mm per year since 1900. With the beginning of high-accuracy satellite altimetry in the early 1990s, measurements of global mean sea-level point to a higher rate of average rise (up to 3mm per year). The suggestion is that the rate of sea-level rise is accelerating.

Sea-level can rise by two different mechanisms with respect to climate change. The first is the expansion of seawater as the oceans warm due to an increasing global temperature. The second is the melting of ice over land, which then adds water to the ocean.

Satellite data is also showing that sea-level rise is far from uniform, with higher rates in some areas and even falls in others. Measurement of sea-level at a location is relative and the result of the increase in volume of water from global warming, plus changes in vertical land movement at a particular location, e.g., mid-ocean ridge spreading, tectonic plate subsidence, and compression of surface sediment by seawater mass. Some of the largest rates of sea-level rise have occurred over the western Pacific and eastern Indian Oceans (approaching 30mm per year) where the average sea-level is rising at about 4.3mm per year, primarily a consequence of the El Niño/La Niña-Southern Oscillation mode.

During the 21st century, sea-level will continue to rise due to warming from both past (20th century and earlier) and 21st century greenhouse gas emissions. This is because thermal expansion is ongoing as warming of the oceans penetrates into deeper waters. Often referred to as the 'commitment to sea-level rise', even if the climate is stabilized immediately, sea-levels will continue to rise for many centuries.



Global mean sea-level (cm) 1870 to 2008 *(from Bindoff et al. 2007). Black line is annual mean sea-level: 1870 to 1950 is reconstructed, 1950 to present from coastal tide gauge measurements. Dark grey band is mean sea-level variance and light grey shows 90% confidence interval. Red line is satellite altimeter data from combined TOPEX/Poseidon + Jason-1.*

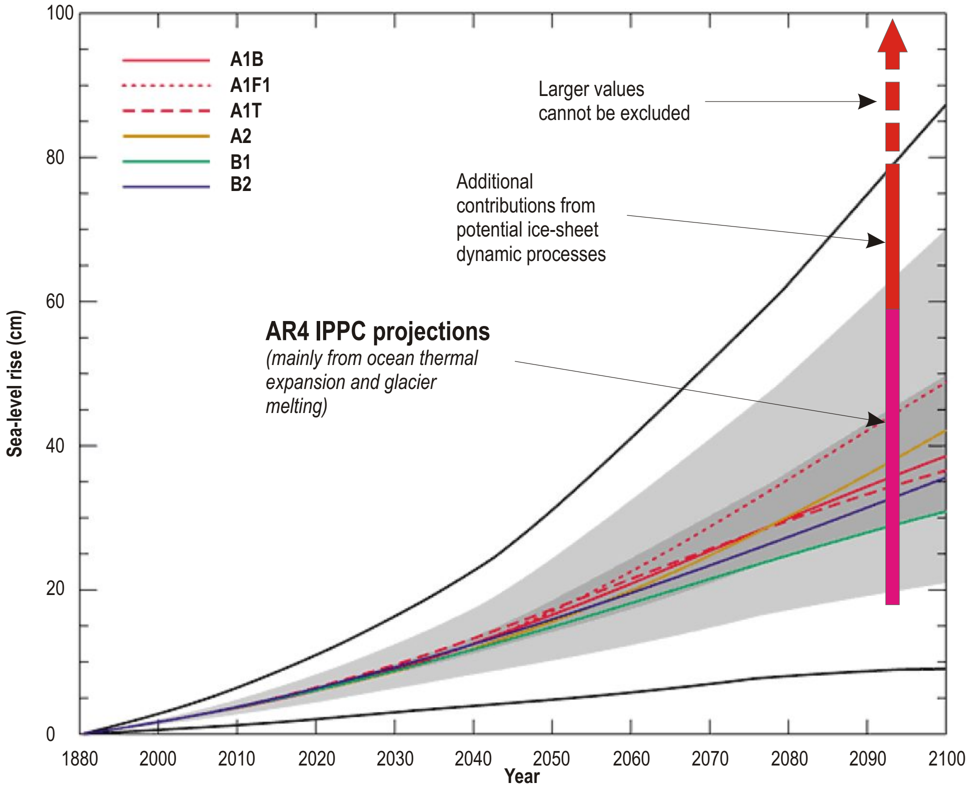
Computer models are used to provide projections of the future climate over time scales of centuries. The most robust projections of 21st century sea-level rise are the assessments of the Intergovernmental Panel on Climate Change (IPCC) of 2001 and 2007. The IPCC Third Assessment Report (TAR) predicts that total global average sea-level rise from 1990 - 2100 will be 110 - 770 mm (0.77m). The IPCC Fourth Assessment Report (AR4) (IPCC 2007) only provides maximum and minimum projections for 2090-2099, where the predicted upper limits are unchanged, but the lower limit is higher.

Scientific research indicates that the Pacific is the region in the world to be most effected by climate change. The Pacific Small Island Developing States are the subject of much concern in view of their vulnerability to sea-level rise. The impacts of sea-level rise on Tuvalu and Kiribati have been a subject of considerable controversy. Sea-level changes are of special significance, not only for the low-lying atoll islands but for many high islands where settlements, infrastructure and facilities are concentrated in the coastal zone. Sea-level rise may also result in a reduction or loss of small islands.

What is known, is that global sea-level rise will have a pervasive impact by raising the mean water level on top of the combined effects of high tides, surface waves, storm surge, and flooding rivers. Such events have the potential to cause inundation and wave induced erosion of coastal landforms. By 2100, rising sea levels will expose an additional tens of millions of people annually to the risk of coastal flooding. Adaptation will become increasingly challenging for many people around the world, particularly those living in vulnerable coastal communities, those subject to substantial changes in rainfall, and those with few resources or options.

The effects of sea-level rise are not limited to the potentially tragic effects on human settlements they also extend to altering the ecosystems that support the coastal fisheries on which many people depend for food security and livelihoods. One question surrounding climate change is how sea-level rise will affect seagrass ecosystems and the services they provide.

Elevated sea-level will have a multitude of effects on seagrasses. Increased water depth will reduce sunlight penetration to the seagrass canopy reducing photosynthesis, productivity, and geographic distribution. Changes in tidal dynamics (e.g., water current speed, circulation flow patterns, tidal range) could have impacts including reductions in light, increased exposure of plants at low tide, and an increase in water column turbidity. The increase in upriver penetration of salt water and increases in salinity levels and pulses within estuaries is also to be expected with a rising sea-level. Seagrasses require specific salinities for reproduction and propagation; shifting salinity regimes would limit the reproduction and distribution of some seagrass species yet favor those that are more salt-tolerant. Increased salinities have also been associated with an increase prevalence of 'wasting disease'; a highly destructive disease known to impact seagrass meadows. All these changes will alter seagrass distribution and reduce the quality of a variety of seagrass habitats.

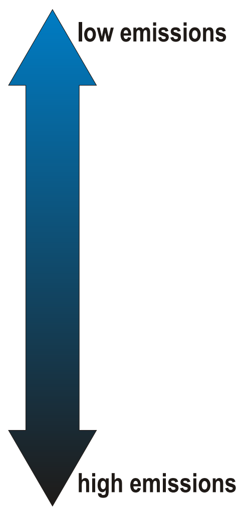


Projected sea-level rise (cm) for the 21st century. *The projected range of global averaged sea-level rise from the IPCC 2001 Assessment Report (Church et al. 2001) for the period 1990 to 2100 is shown by the lines and shading. The central dark shading is an average of models for the range of greenhouse gas emission scenarios. The light shading is the range for all models and all scenarios and the outer bold lines include an allowance for land-ice uncertainty. The updatedAR4 IPCC projections of 2007 for the greenhouse gas emission scenarios are shown by the bars plotted at 2095. The magenta (lighter) bar is the range of model projections (90% confidence limits). Ocean thermal expansion and melting of glaciers and ice caps are the largest contribution to this range. The red bar is a potential but poorly quantified additional contribution from a dynamic response of the Greenland and Antarctic ice sheets to global warming. Note that the IPCC AR4 states that "larger values cannot be excluded, but understanding of these effects is too limited to assess their likelihood or provide a best estimate or an upper bound for sea-level rise."*

Projected global average sea-level rise at the end of the 21st century

(cm at 2090-2099 relative to 1980-1999). Model-based range excluding future rapid dynamical changes in ice flow

scenario	Scenario description	global sea level (cm)
B1	*a more integrated and ecologically friendly world; global population peaks in 2050 and then gradually declines; low emissions and rapid introduction of clean and resource efficient technologies*	18 – 38
A1T	*a more integrated world where global population peaks in 2050 and then gradually declines; emphasis on non-fossil energy sources*	20 – 45
B2	*a more divided (localised) and ecologically friendly world, where population continuously increases; low emissions with slower and more fragmented technological change*	20 – 43
A1B	*a more integrated world, where global population peaks in 2050 and then gradually declines; a balanced emphasis on all energy sources*	21 – 48
A2	*a more divided (locally focused) world, where population continuously increases; slower and more fragmented technological changes*	23 – 51
A1FI	*a more integrated world where global population peaks in 2050 and then gradually declines; an emphasis on fossil-fuels (Fossil Intensive).*	26 – 59



from Table SPM.3, IPCC (2007)

Essential infrastructure such as the San Antonio Elementary School in Puerto Galera (Oriental Mondoro, Philippines) is threatened by future sea-level rise

Seagrasses growing at their maximum depth limits will therefore be unable to survive, and a shift in the location of the maximum depth limit shoreward is expected. For instance, the distribution of seagrass species presently occupying subtidal zones will shift shoreward to occupy areas currently existing as intertidal zones. This shoreward migration will depend on the degree of coastal inundation and shoreward habitat availability at any given location. Where habitat availability is limited by physical barriers (e.g. either natural or constructed) or unfavourable conditions (e.g. lack of soft-sediment substrate), seagrass species diversity will ultimately be reduced, and there will be an overall loss of seagrass area. The progressive inundation of low-lying coastal lands as sea-levels rise is likely to cause shoreline erosion, increasing the turbidity of shallow coastal waters. The sensitivity of seagrasses to light reduction from sea-level rise is likely to depend on local water quality conditions and the species present.

To date, there has been no documented evidence of seagrass loss due to sea-level rise, and equally there has been no experimental manipulations to suggest how rapidly seagrasses could adapt to these conditions. Historically, seagrasses have adjusted to large scale changes in sea-level. The predicted climate change over the next century will, however, be more rapid than in the past. Given the massive, and adverse existing consequences for seagrass from urbanisation and agriculture, the main strategy should be to minimise the impact of non climate related stressors on seagrass. For example, the hardening of shorelines through coastal development poses a significant risk to seagrass habitat availability as sea-levels rise. Minimising impacts will ensure that seagrass is in optimum health and is therefore more likely to show greater resistance and adaptive capacity to the rapid rate of climate change.

Further reading:
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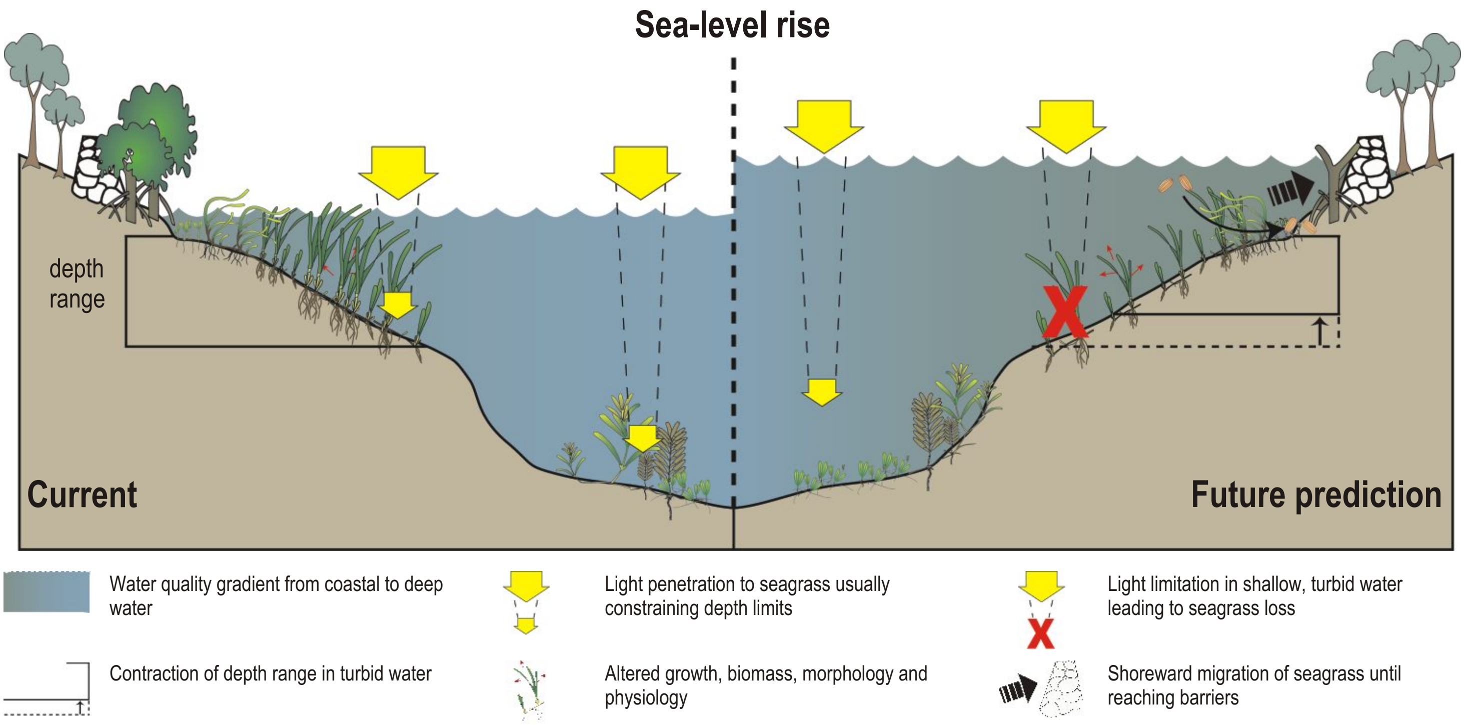
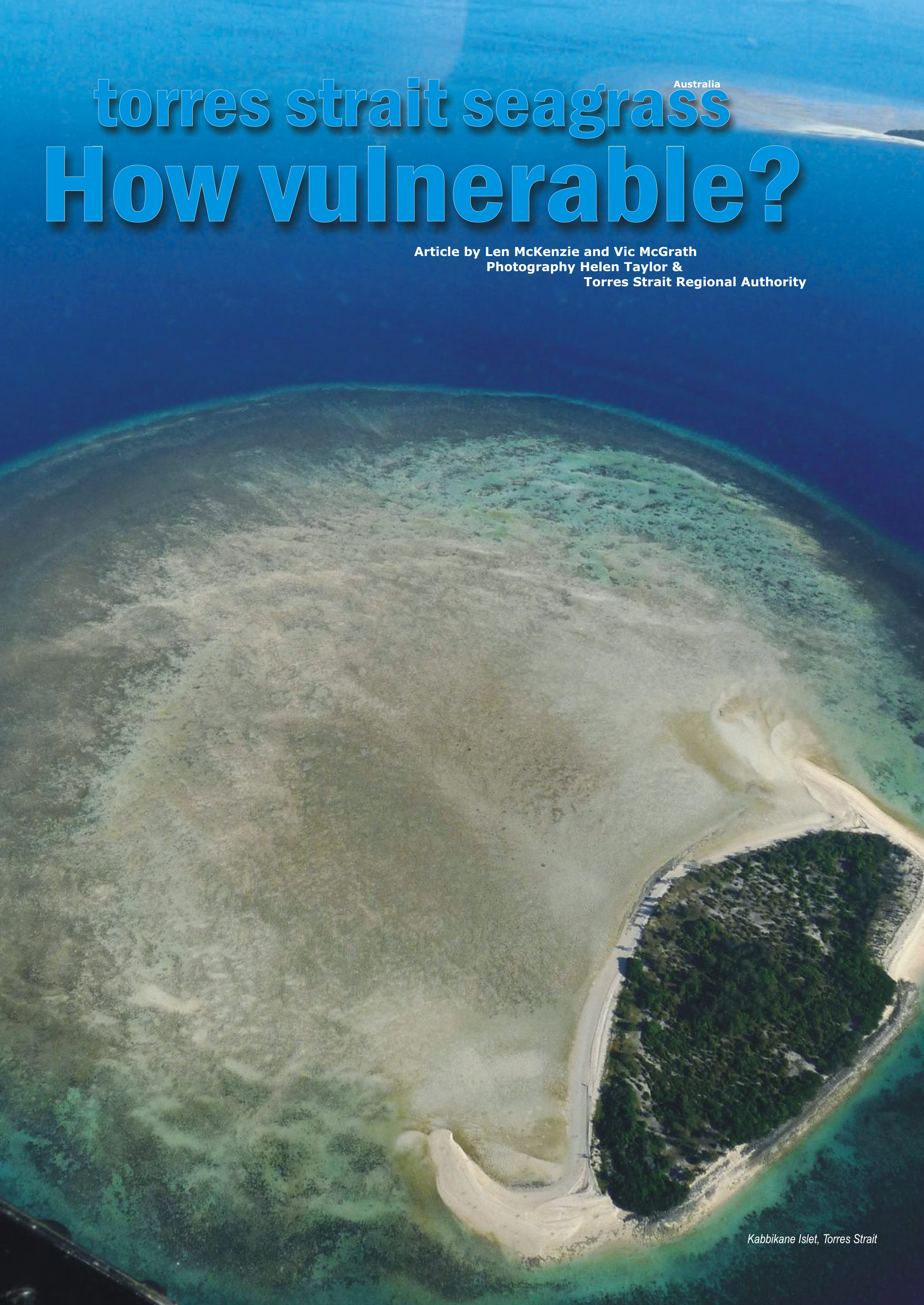


Conceptual diagram depicting expected impacts on seagrasses from sea level rise under climate change predictions (from Watcott *et al.* 2007).

Australia

torres strait seagrass
How vulnerable?

Article by Len McKenzie and Vic McGrath
Photography Helen Taylor & Torres Strait Regional Authority



Kabbikane Islet, Torres Strait

Lying between Papua New Guinea and the northern most tip of mainland Australia, the 8,000 residents living on the low-lying islands of the Torres Strait are amongst the most vulnerable in Australia to sea-level rise.

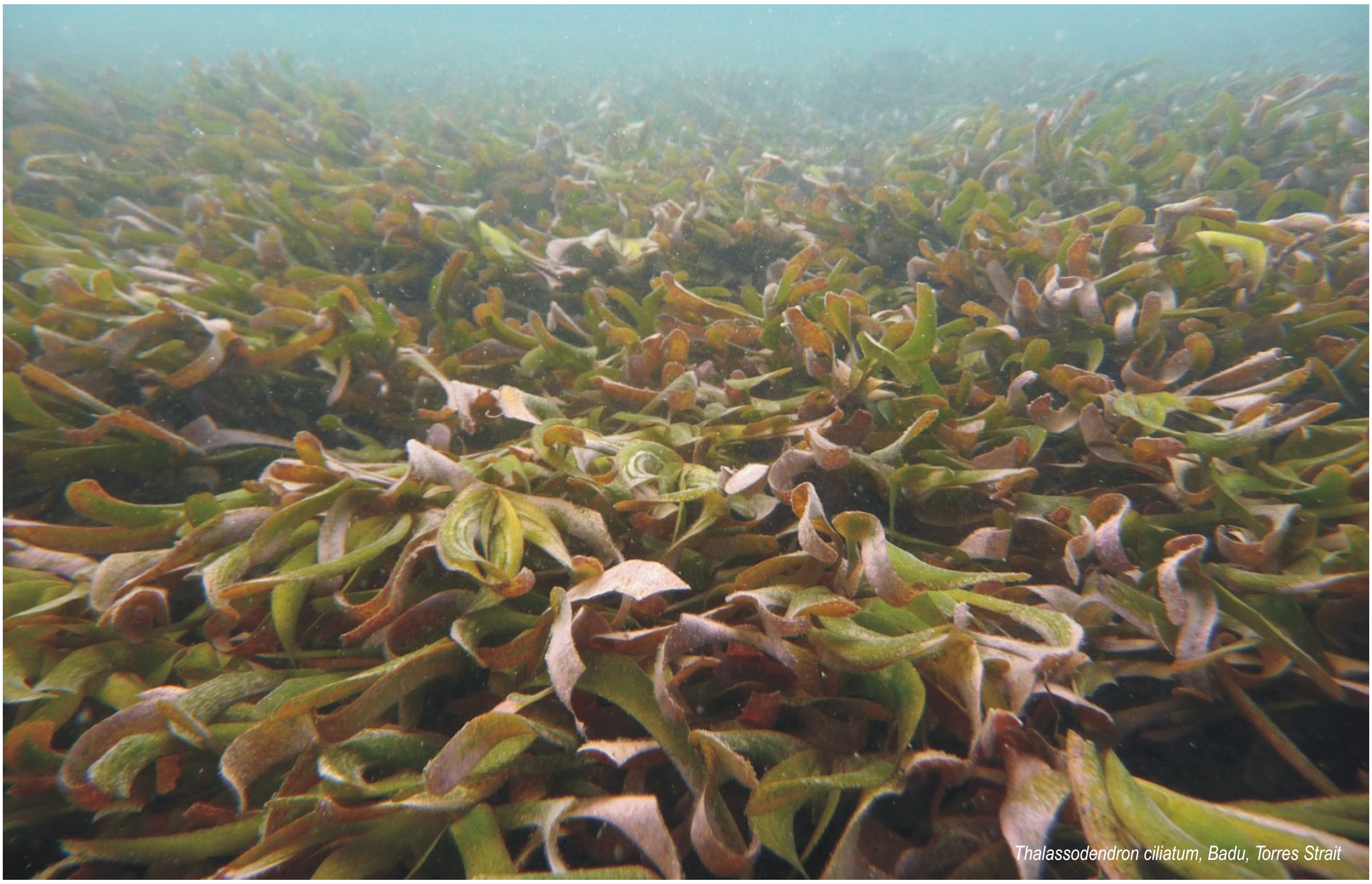
Located on one of the world's most extensive continental shelves, the Torres Strait provides a multitude of habitats and niches for the highly diverse Indo-Pacific marine fauna. Extensive seagrass meadows occur in the western and northern areas, forming critical habitat for marine turtles and resident dugong populations.

There are strong cultural, social, economic and spiritual links between Torres Strait Island people and their sea country; governed by their distinct Ailan Kastom (Island Custom). This gives Torres Strait Islanders unique knowledge of the local climatic and marine conditions. In recent years, however, Islanders have observed changes in their environment (e.g., greater and more regular flooding, coral bleaching) that cannot be explained by their long-established traditional knowledge, and many are concerned that these could be linked to climate change.

The impact of sea-level rise is of significant concern for residents of the Torres Strait. Flooding on some islands appears to be getting worse, and the community of Warraber had to build a seawall to protect their cemetery. The low lying nature of several islands and the extent of current inundation problems suggest that any significant sea-level rise could threaten the viability of these communities.

Unfortunately, there are great uncertainties associated with the climate predictions for the Torres Strait. The Torres Strait Regional Authority (TSRA) has commissioned the CSIRO to model local climate change impacts on temperature and other key variables . However climate change projections for the wider region, encompassing Cape York Peninsula and the Asia/Pacific suggest a troubling future for Torres Strait Islanders and the marine ecosystems on which they depend. Predictions include: average wet-season rainfall to increase by up 4% by 2030 and 13% by 2070; average wind speeds (either through increase in frequency of strong wind events or in the average strength of the wind) to intensify in both the summer and winter seasons by 2070; average temperatures to increase by between 1 and 5 degrees Celsius by 2070; and the Torres Strait to experience slightly greater (0.05m) than global average sea level rise to 2090. A rise in sea-level associated with changing weather patterns, such as increased wind, wave and temperature, will contribute to more frequent storm surges, tidal inundation and island erosion.

The expected impacts on seagrass with sea-level rise will most probably include changes in the distribution of seagrass species. Sea-level rise will favour species which are able to tolerate lower levels of light and higher levels of disturbance



Thalassodendron ciliatum, Badu, Torres Strait

King tides threaten the low lying islands of the Torres Strait: Saibai Island and Thursday Island (above) (courtesy TSRA) Uninhabited coral cays throughout the Torres Strait, such as Bramble Cay (left), are vulnerable to sea level rise.

The Torres Strait region comprises hundreds of islands, 18 of which are permanently inhabited. Of these inhabited islands the four central coral cay islands (Iama, Masig, Poruma and Warraber), and the two coral-based muddy islands of Boigu and Saibai (located close to the Papua New Guinea) are particularly susceptible to a changing climate and coastal inundation due to their low elevation above sea level. Higher mean sea levels combined with sea-level extremes due to tides and storm surge will increase the severity and frequency of inundation. Faced with the threat of a loss of lifestyle and livelihoods from salt water inundation, relocation is a real possibility in the long-term for many Torres Strait Islanders living on the most vulnerable islands. Such an outcome would be devastating for the Islanders who have such a unique and holistic relationship with their environment.

Sea-level rise alone is unlikely to have similar devastating impacts on the 17,206 square kilometres of seagrass in the Torres Strait, as the majority (78%) is in waters shallower than 15m. Although the increased water depth of 15-90cm over the 21st century may reduce sunlight penetration to the seagrass canopy to some degree, it will only impact those species which are currently near their minimum light requirements (e.g. *Thalassia hemprichii* and *Cymodocea* spp.).

Dense subtidal meadows of Halophila spp. cover much of the Torres Strait seafloor (Badu Island)

As only 2.6 percent of the Torres Strait is terrestrial land, expansion of seagrass to shallower area is limited and the turbidity associated with the erosion of the islands may be minimal. Intertidal species such as *Enhalus acoroides* which require the ability to touch the water surface to sexually reproduce may however be significantly impacted by rising seas, and may become rarer in the region as a consequence.

The expected impacts on seagrass with sea-level rise will most probably include changes in the distribution of seagrass species. Sea-level rise will favour species which are able to tolerate lower levels of light and higher levels of disturbance, ie., *Halophila* spp. and *Halodule uninervis*. Fortunately, these species are also primary food of turtle and dugong in the Torres Strait. This region presently sustains the highest dugong populations in the world. With possibly greater impacts to seagrass resources in other areas of the Indo-Pacific (due to coastal development and runoff), Torres Strait may become a regional refuge for endangered/vulnerable species which depend on seagrass for food and habitat.

It is most likely that other factors associated with climate change (e.g., elevated temperatures, increased winds speeds, changes in currents and water circulation) will have a more significant impact on the seagrass resources of the Torres Strait. The combination of these factors could result in greater disturbance events which could resuspend sediments across the shallow continental shelf increasing water column turbidity and reducing light availability. When coupled with increasing water temperature, all these changes will alter seagrass distribution and reduce the quality and variety of seagrass habitats.

Continual monitoring of the seagrass resources and their habitats across the region will provide a measure of how seagrasses are responding and how their condition compares with other regions across the Indo-Pacific. Understanding the resource and the possible consequences of climate change will enable Torres Strait Islanders to prepare and adapt, as ultimately, the impacts of climate change on marine ecosystems and the fisheries they support, could have significant flow on effects to the local communities, economy and culture of the Torres Strait.

Vic McGrath is a Community Liaison Officer with the Land and Sea Management Unit, Torres Strait Regional Authority
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Sources & further reading:
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Dense seagrass meadows cover Madge Reef (foreground) and the intertidal mud-flats of Horn Island.

interest *in* Seagrass grows

Australia

Article by Fiona Bishop
Photography Len McKenzie & Rudi Yoshida

"International researchers in the Kimberley are working to unlock the secrets of the region's seagrass meadows. The head scientist for the world's biggest monitoring program joined locals on Broome's mudflats today to study some of the most important meadows on Earth."

So announced TV news reporter Deborah Kennedy, on the eve of the Seagrass-Watch training workshops held in the town of Broome, in the remote Kimberley region of north Western Australia[1]. The region's leading newspaper, The Broome Advertiser, also ran a full-length story on the training[2].

The media interest in the Seagrass-Watch training reflects a growing public concern for the seagrass meadows in the Kimberley, owing to some new anthropogenic threats. These include severe outbreaks of the cyanobacterium *Lyngbya majuscula* in Broome's famous Roebuck Bay[3], and proposed dredging operations in other areas along the West Kimberley coast.

This concern has coincided with a jump in community awareness of the importance of the Kimberley's seagrass ecosystem as a fish nursery, food for turtle and dugong, habitat for a broad diversity of benthic invertebrates, as a water purifier and as a coastal health indicator species. The community is eager to learn more, especially since the Kimberley is one of the least studied places in the world in terms of its seagrass meadows.

Given so much community interest in seagrass, it is not surprising that the recent Seagrass-Watch training workshops were such a success, with dozens of participants registering for the Level 1 and Level 2 courses. Participants included the Nyul Nyul and Bardi Jawi Indigenous rangers, who travelled hundreds of kilometres from their communities on the Dampier Peninsula to attend the training.

Grazing trails (foreground) are evidence of the importance of Roebuck Bay seagrass meadows to local dugong populations.

Level 1 training consisted of a fascinating day-long class room session with laboratory exercises and written assessments. Topics included seagrass taxonomy, ecology, threats, monitoring methodology and how Seagrass-Watch monitoring assists with the management of seagrass resources globally. This was followed by a practical exercise out on Roebuck Bay, monitoring the "Town Beach" site. Feedback from the Level 1 participants included comments such as: *"completely fascinating and extremely helpful"*, *"informative and enlightening"* and *"very thorough, well suited to a wide variety of people."*

Some of the Bardi Jawi rangers, who run a monitoring program at the community of One Arm Point, at the top of the Dampier Peninsula, had completed the Level 1 training in 2009, so they travelled down to undertake the advanced Level 2 course, to further hone their skills. *"The seagrass is important to us,"* Bardi Jawi ranger Chris Sampi explained to the local newspaper reporter. *"The dugong eat it, it's a habitat for fish and we eat the dugong and the fish. It's an important part of the food chain"*[4].

The Level 2 course also involved a practical field exercise, with participants monitoring the "Demco" site. Classroom topics included a revision of seagrass biology & identification, an in-depth look at protocols, Seagrass-Watch assurance/quality control, factors important for seagrass growth, seagrass threats and classroom activities on data entry. The day concluded with a vulnerability analysis, where participants practised identifying and rating the threats to seagrass in the Kimberley region, with the help of a computer program. Dredging and coastal development rated as two of the most significant threats. Other threats identified included urban run off and increased nutrient input.

On behalf of all participants, I would like to thank Len and Rudi from Seagrass-Watch HQ for delivering such comprehensive and valuable training, and helping to build capacity across the West Kimberley region.

The media interest in the Seagrass-Watch training reflects a growing public concern for the seagrass meadows in the Kimberley, owing to some new anthropogenic threats

The Seagrass-Watch workshops were organised by the Broome Community Seagrass Monitoring Project, and supported by Environs Kimberley, the Department of Environment and Conservation, Coastwest, the Port of Broome and Seagrass-Watch HQ.

References

1 WIN Channel's Regional West Australian Nightly News, 10th September 2010

2 The Broome Advertiser Newspaper, page 7, September 16 2010. Article by Ben Jones entitled "Expert Passes On Knowledge".

3 Roebuck Bay is a "Ramsar Listed Wetland of International Importance" and an important feeding ground for many thousands of birds that migrate from as far away as Siberia each year.

4 Chris Sampi's quote was reported in the Broome Advertiser Newspaper article entitled "Expert Passes On Knowledge" by Ben Jones, September 16, 2010, page 7.

Goold seagrasses

Australia

Article by Louise Johns
Additional text Len McKenzie
Photography Jane Mellors, Louise Johns & QPWS Rangers

Goold Island is a small (8.3km^2) continental island located 17 kilometres offshore from Cardwell in tropical north Queensland. The Island is a national park within the Great Barrier Reef World Heritage Area.

The Bandjin and Girramay Aboriginal people are the Traditional Owners of Goold Island (traditionally know as Marrajumban). Traditional use of the island is well established and evidence of early Aboriginal occupation includes the large stone fish trap on the northern end of Western Beach, a large campsite, and some shell middens. The fish trap is one of the few lasting structures left by the former inhabitants in this area and indicates the lifestyle and the food sources used during Aboriginal occupation of the island. As well as the physical evidence of Aboriginal use, Goold Island, in common with many other areas, had cultural and spiritual significance to the Aboriginal people of the area, values which remain today for descendants of the original inhabitants.

Goold Island is included within the region represented by the Girringun Aboriginal Corporation (representing Traditional Owners from Rollingstone to Mission Beach). In December 2005, Girringun traditional owners signed the first ever Traditional Use of Marine Resources Agreement (TUMRA) in Australia for the management of traditional hunting of protected species in the greater Hinchinbrook Island area, including Goold Island. TUMRAs are a formal agreement between Saltwater Traditional Owners, Great Barrier Reef Marine Park Authority (GBRMPA) and Queensland Parks and Wildlife Service (QPWS) and how collectively Traditional Owners manage traditional take of turtles and dugong. Since 2007, Seagrass-Watch HQ has assisted the Girringun and the Cardwell Indigenous Rangers Unit (QPWS) by including seagrass as part of their turtle and dugong monitoring program.

Seagrass meadows are found throughout the region and are an important food resource for dugong and turtle of the area. Goold Island is surrounded by extensive meadows (approx 10,000ha) of *Halophila*/*Halodule* in the deeper subtidal waters[1]. Intertidal seagrass meadows are found on the fringing reef flats on the south western and southern shores of the island.

In September 2010, I visited Goold Island with the Cardwell QPWS indigenous rangers for their third annual Seagrass-Watch monitoring event. As the seagrass has declined in the last two years at Goold Island, we hoped we might see some recovery this year. In 2008 there was a lush meadow of *Cymodocea serrulata* with some *Halodule uninervis*, and *Enhalus acoroides* with around 45% cover. In 2009 the meadow had shrunk in size with only *Cymodocea serrulata* present.

The Island is located in Rockingham Bay, an area which is influenced primarily by the Tully and Murray Rivers. Both of these

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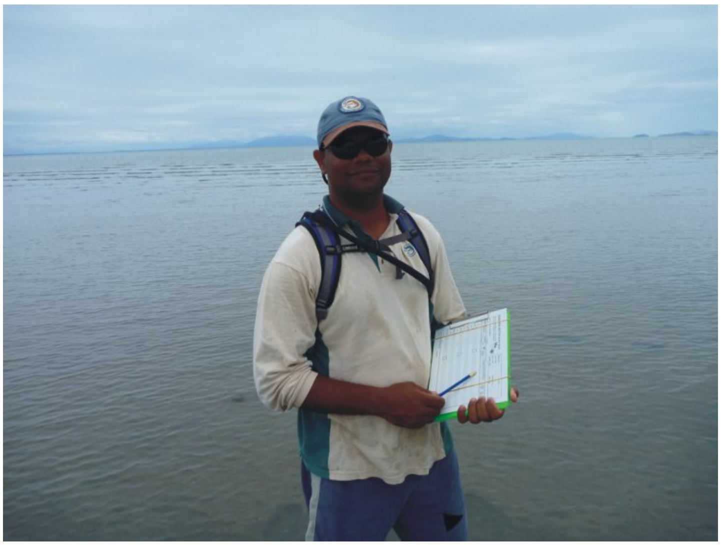
rivers have been labelled as medium/high risk to inshore areas by the GBRMPA. Of the two rivers, the Tully is the largest with an annual discharge of 0.12x10^{6} tonnes of fine sediment, 125 tonnes of phosphorus and 1,300 tonnes of nitrogen[2]. Approximately 93% of seagrass meadows within the Tully marine area are inundated every year by primary flood plumes, exposing the seagrass to intermittently high sediment and high nutrient concentrations for periods of days to weeks and potentially high loads of particles settling on the plants and seafloor[3]. Besides sediments and nutrients, flood plumes may also contain herbicides (e.g., diuron). Goold Island is located within the modelled herbicide first flush plume zone for the Tully-Murray Rivers[4] and diuron was reported from nearby seagrass meadows in 2006[5]. With such impacts to the region, we were keen to see how the seagrasses at Goold Island had faired after the annual monsoon and particularly wet previous months.

During the August 2010 monitoring we noticed when getting into the water from the boat, how muddy the substrate was, which was a bit concerning as it is usually quite sandy at the monitoring site. Unfortunately the meadow has reduced even further this year with only patches of *Halophila ovalis, Halodule uninervis* and *Cymodocea rotundata* present in just four quadrats. There was still plenty of fauna present though with lots of starfish, feather stars, dog whelks, shrimps and hermit crabs digging their burrows.

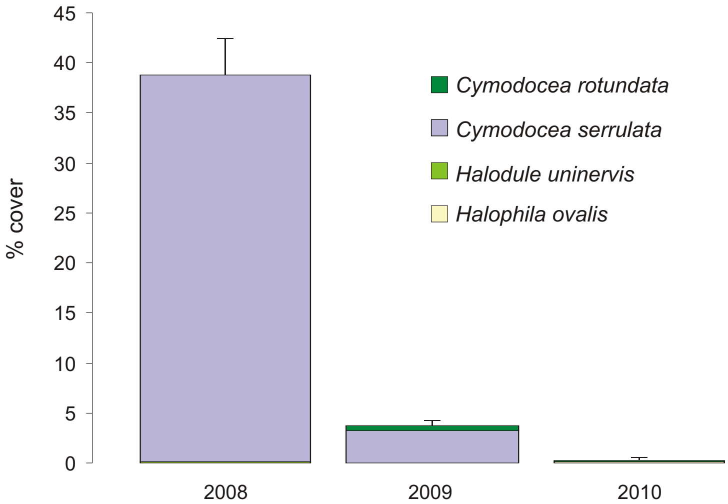
We noticed on the southern side of the island around the corner from the Seagrass-Watch site that a number of turtle were resting on the reef flats over the low tide cycle. We made the most of the situation and the rangers measured and took photos of the turtles. One of the smaller turtles had an injured rear flipper and a mark on its shell indicated a possible boat strike.

Next year we are looking forward to including new Girringun indigenous ranger unit in the Goold Island Seagrass-Watch monitoring program. Hopefully, the seagrass will have recovered.

1 Lee Long et al (1998) Baseline Survey of Hinchinbrook Region Seagrasses
2 Brodie et al. (2009) ACTFR Report No 09/02
3 Devlin & Schaffelke (2009) Marine and Freshwater Research 60: 11091122.
4 Lewis et al (2009) Environmental Pollution 157: 24702484.
5 McKenzie et al (2008) www.gbrmpa.gov.au



Cardwell indigenous ranger Evan Ivey



Raising Enviromental awareness

Article by Cecilia Villacorta-Rath and Naomi Smith
Photography Cecilia Villacorta-Rath & Naomi Smith

Front Beach, Bowen

As part of it's commitment with the community, Fisheries Queensland (Department of Employment, Economic Development and Innovation) participates in events promoting knowledge and conservation of our main natural resources. These events include EcoFiesta, organised by the Townsville City Council, and Education Days in schools along north Queensland, organized by Seagrass-Watch HQ.

EcoFiesta is a 2-day festival that gathers Townsville residents every year to celebrate and introduce environmentally friendly initiatives and sustainable development. Fisheries Queensland attended the event and presented information on the state of seagrass in tropical areas and also promoted the work conducted by scientists and volunteers who monitor seagrass along the north Queensland coast.

Children were also involved in fun activities such as badge-making, colour-in pictures and building a seagrass meadow with their own messages for the community. The little-ones showed great interest learning about the marine environment by sharing their fishing and snorkelling stories and completing activity books. With a big community turn-up and great music from some of the most popular local bands, EcoFiesta 2010 was a huge success. We are looking forward to sharing another eco-weekend with Townsville next year.

Education Days are carried out annually by teams from Seagrass-Watch HQ and usually consists of a combined basic theory of seagrass and hands-on field work. The students are taught about the biology of seagrass and its importance in the ecosystem and an overview of the Seagrass-Watch methodology. Then it is time to get ready for the field trip; all they need to bring is a hat, sunscreen and lots of enthusiasm. On the beach children are divided into groups and, although they are under adult supervision at all times, they are in charge of the field work. The field trip consists of assessing seagrass meadows along fixed transects, including species identification and relative abundances, percentage cover and presence of seeds. The data gathered is entered in the records and can be compared to seagrass abundance and distribution on previous years. Field trips are an excellent way of applying the knowledge kids just

received in the classroom; in addition, it develops communication, team-work and problem solving skills.

This year we brought Education Days to Belgian Gardens State School and Townsville Grammer School in Townsville, and Bowen State Primary School in Bowen.

The Grade 6 students from Belgian Gardens State School under the watchful eye of their teacher Mr Brett Murphy were given a seagrass presentation on what is seagrass and how do we monitor it. Then two of the students gave us a tour of their coral reef fish tanks in which they are undertaking a breeding program for clownfish and seahorses. There is a rotation of students that must complete the daily tasks, such as feeding and cleaning of the tanks and a few students take on the weekly water quality checks. The two students that showed us around have now taken what they have learnt at school onboard and have started their own marine tanks at home. It is a great program that not only teaches the students about marine life but also gives them responsibilities and life lessons. The next day the Grade 6 students went out to Rowes Bay and monitored the seagrass meadow. While the seagrass in this area has declined to very sparse patches the students were well behaved and completed their tasks with enthusiasm and a passion for learning.

The next Education Day took place during the second week of June at Bowen State Primary School. Kids from Grade 6 attended the seagrass presentation where they demonstrated interest on preserving native resources and habitats in order to maintain their close connection to the ocean. Later that day, 24 students and their teacher, Mr. Ian Haworth, gathered on Front Beach to conduct the seagrass assessment. Seagrass-Watch local site coordinator (BW2), Mrs Lesley Bullemor also came along to help in the field. The weather conditions were excellent and made it a very enjoyable fieldtrip. The meadows were composed of healthy *Halodule uninervis, Halophila ovalis* and *Zostera capricorni*, which provided an excellent habitat to gastropods, crabs and polychaetes. Seeds were not abundant, as the

reproductive season usually takes place later on the year. After almost 2 hours of exciting work, the fieldtrip was over and we gathered on the beach to have a snack, drink some water and take a group photo.

The last education day was held with Grade 11 Biology students at Townsville Grammer School. Students from three classes were given a 50min presentation on seagrass, identification, biology, threats and monitoring. This was accompanied by fresh seagrass specimens for which the students had to identify using the identification key and then had to draw. This was an introduction for the students who will, in early October, be monitoring the seagrass meadow at Picnic Bay as part of their biology class assessment. We wish the students well.

For more information on how to get your school involved, visit *http://www.seagrasswatch.org/education.html.*

Rowes Bay, Townsville

Animal facts

Forams

Article by Len McKenzie
Photography Rudi Yoshida

Within our seagrass meadows is a marine creature that is neither a plant nor an animal. You may recognise them as small white, pink or greenish discs covering the sea floor or attached to seagrass leaves. They are Foraminifera.

Foraminifera (forams for short) are single-celled microorganisms (protists) with shells that consist of successive chambers that intercommunicate through orifices called foramina. Depending on the species, the shell (referred to as tests) may be made of organic compounds, sand grains cemented together, or calcium carbonate. These tests may be spherical, discoidal, tubular, or some other odd shapes. Forams grow from a centre chamber from which consecutive chambers are secreted. Fully grown individual forams range in size from 0.1mm to more than 5cm in diameter. Tests of a South Pacific species are large enough to be used as jewelery and are often referred to as "mermaid's pennies".

Cytoplasm (cellular fluid) completely fills the chambers of the test and emerges through the exterior apertures where it covers the outside of the test and emits fine projections called reticulopodia (similar to the pseudopodia of an amoeba); with which the microorganism attaches itself on the substratum, moves, and captures its prey. Even though they are not true animals, forams act somewhat like animals.

Forams live for between 15 days and 3 years, depending on the species, and can be very particular about the environment where they live. Most of the estimated 4,000 living species of forams live in the world's oceans, from the intertidal to the tropics to the poles. Of these, 40 species are planktonic. The remaining species are benthic, living on shells, rocks and seagrass or in the sand and mud of the bottom. In places, foraminifera are so abundant that the sediment on the bottom is mostly made up of their tests. Benthic forams can be herbivores (grazing on algae, bacteria, or diatoms), carnivores (preying on copepods and other forams) or opportunistic omnivores. Many of the large benthic forams have symbiotic algae (zooxanthellae) within their cytoplasm which aids in supplying energy. Forams are preyed upon by scaphopods, worms, gastropods, sand dollars, and fish.

Marginapora streaming cytoplasm through pores to catch prey (coutesy Image Quest 3-D 2001)

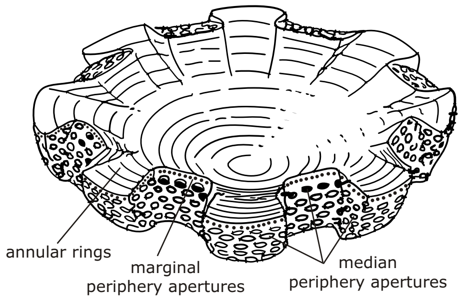
Associations of forams and seagrass meadows are widely reported in the literature. Seagrass undoubtedly provides a suitable substrate for forams, which they in turn may reduce fouling by grazing on the biofilm of microalgae and bacteria growing on seagrass blades. There is even some suggestion that gas bubbles released from seagrass may help transport forams in intertidal areas. Foram species richness in tropical or near-tropcial seagrass meadows is high; 66 species were found living in a small area of Thalassia in the Forida Keys. The best known associations with seagrass meadows (in particular Thalassia) are those of the family Sortidae whose species have symbiotic algae within (e.g. Marginopora spp, Amphisorus spp, Sorites spp). Most tests of Marginopora from open reef areas have a flat, lenticular shape, with a hole in the centre. In more protected lagoons, tests of Marginopora have a crinkled periphery and a greater number have their early chambers preserved.

Forams are recognized from the beginning of the Paleozoic Era (550 million years ago) to the Present. Several species of the family Sortidae are regarded as tracers of ancient seagrass habitats, and paleontologists in Florida have used seagrass-associated foraminifera as a proxy of seagrass abundance to assess water quality of the past few hundred years. Benthic foraminiferans have also been widely used as indicators of eutrophication in coastal marine ecosystems. The vertical zonation of forams in the intertidal zone, has been suggested as a useful tool to assist with sea-level reconstructions and foram shell chemistry can also tell us about the chemistry of the water in which it grew. These data help us understand how climate has changed in the past and thus how it may change in the future.

So next time you're out seagrass monitoring, keep an eye out for the little discs which scientists may use in years to come as an indicator of seagrass and environmental health.

Sources & further reading
Bellier et al (2010) Short Treatise on Foraminiferology
Sen Gupta, BK (2002) Modern Foraminifera
Richardson, SL (2006) Marine Ecology 27: 404–416

The annular-concentric test, with thickened and folded margins, of *Marginopora vertebralis.*



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