

# Seagrass-Watch

The official magazine of the Seagrass-Watch global assessment and monitoring program

## Ocean acidification

Can seagrass help?

Traditional owners monitoring sea country

Archer Point's seagrass

Reef Rescue MMP 2009

Lamun monitoring in Bali

Labrador's angels

Beware, estuarine crocodiles inhabit these waters

Labour Day workshops in Singapore

Volunteers increase in Hervey Bay



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## From the editor

The world's oceans are carbon dioxide sponges. They have absorbed around half of the 1,300-1,800 billion tons of anthropogenic CO<sub>2</sub> emitted into the atmosphere since the beginning of the industrial revolution circa 1750. This has slowed the process of global warming, but at a price: the excess CO<sub>2</sub> absorbed by the oceans is changing the pH of seawater. In this issue two of the worlds leading scientists on seagrass physiology debate the affects of ocean acidification and the role seagrass could play in mitigating the effects.

In this issue you can read about the latest Reef Rescue Marine Monitoring Program sampling. Find out what has been happening in the southern Great Barrier Reef region and around Townsville.

You'll also find articles on traditional owners monitoring their sea country in Torres Strait, the increase of volunteers in Hervey Bay and training workshops in Cooktown, Bali and Singapore.

You can also catch up with the Raffles Girl School's project to monitor the productivity and health of seagrass at Labrador Park (Singapore) and from schools in the Torres Strait. You can even learn about estuarine crocodiles and how to be croc wise.

### COVER:

Coral amongst seagrass (Levuka, Fiji).  
Photographer Len McKenzie

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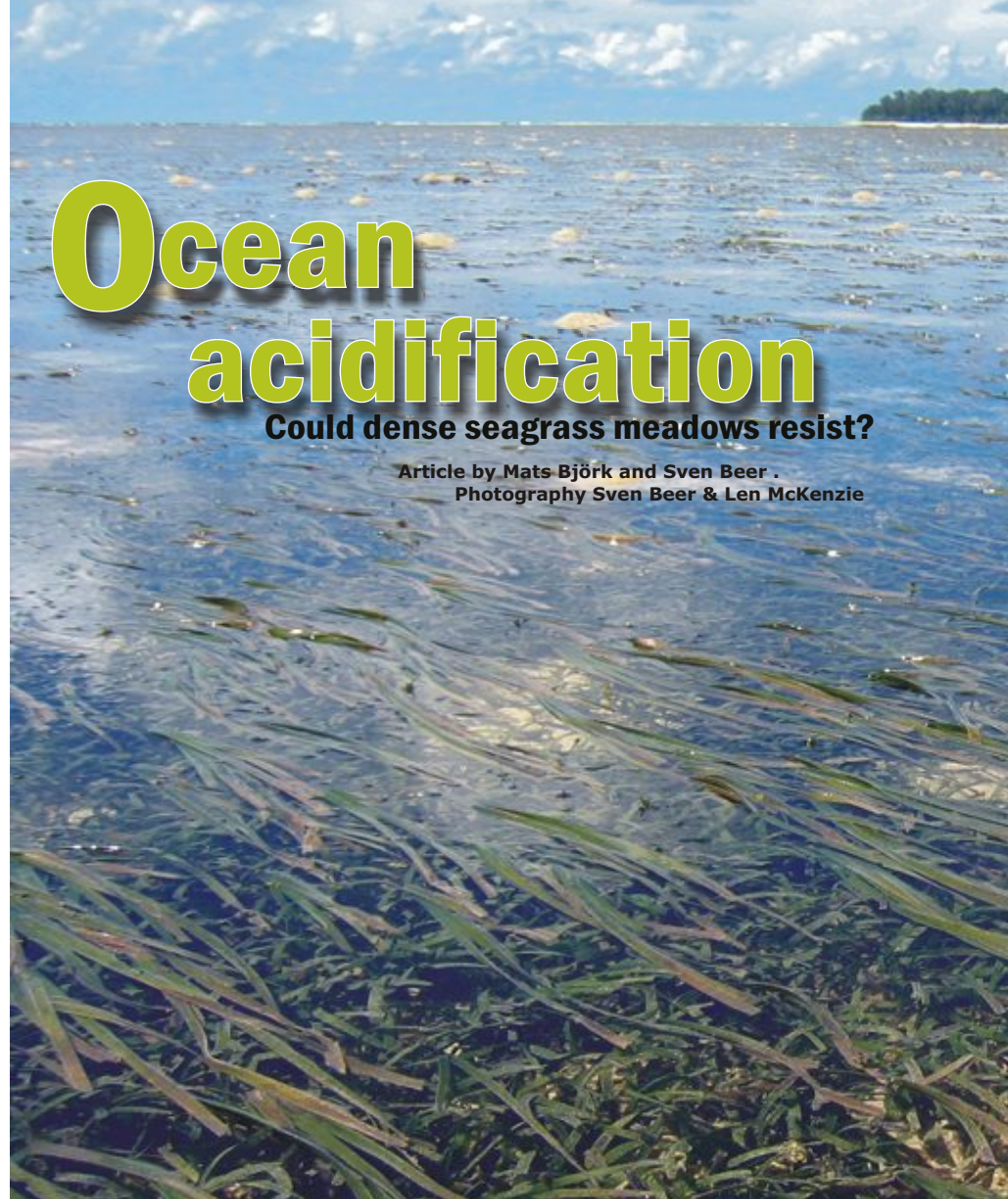
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Seagrass-Watch acknowledges the Traditional Owners on whose sea country we monitor

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**NEXT ISSUE OUT SEPTEMBER 2009**



# Ocean acidification

## Could dense seagrass meadows resist?

Article by Mats Björk and Sven Beer .

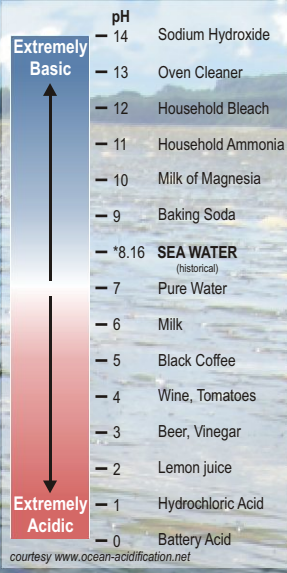
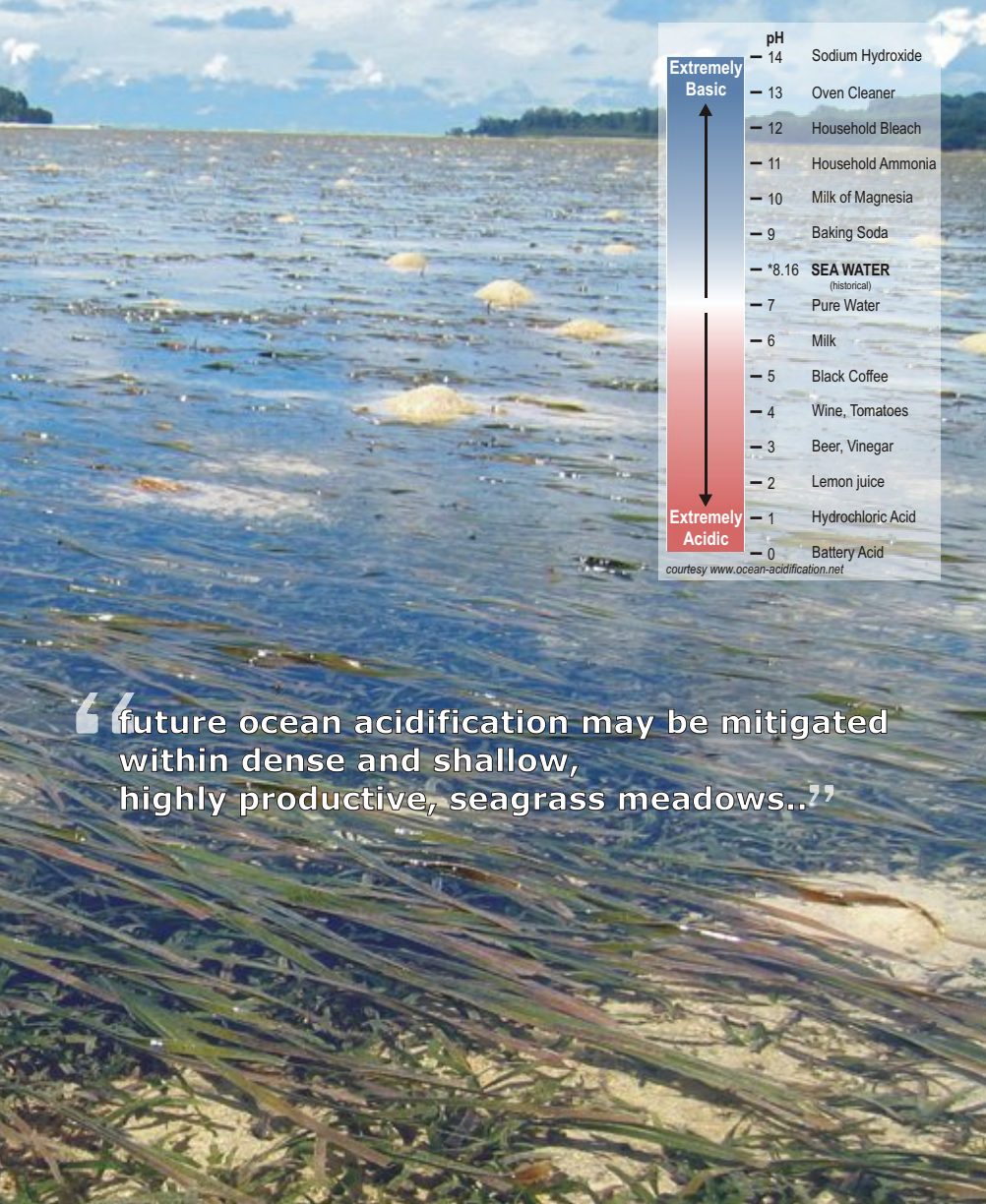
Photography Sven Beer & Len McKenzie

While photosynthesis can raise the pH of seawater, it has only recently been recognised that diurnal pH fluctuations caused by seagrass photosynthesis can affect physiological processes in the biota living within dense seagrass meadows. Could it be that the daily pH increases in such ecosystems will also counter possible future ocean acidification?

When performed in water, photosynthesis always causes an increase in pH. This is basically because CO<sub>2</sub> is withdrawn from the water column and as a consequence, so are the protons associated with carbonic acid. Because of the often large mass of flowing water surrounding the plants, the increase in seawater pH is usually very small and is mainly noticeable within the diffusion boundary layer of the leaf surface. However, in dense plant stands, the seawater pH may fluctuate significantly with photosynthetic carbon uptake and respiration. This has been found during phytoplankton blooms, as well as for rock-pools and shallow-water habitats containing dense stands of macroalgae. Seagrasses can also increase the pH of their surrounding seawater. This was shown for tropical tidal pools as well as densely populated seagrass meadows during low tide. In the latter, it was recently found that such daily pH increases both limited photosynthesis of the seagrasses and algae, and stimulated calcification of calcareous algae growing within the meadows.

Increased CO<sub>2</sub> concentrations may within the future reduce the average oceanic-water pH by 0.1-0.4 units. In coastal waters, this pH reduction may be exacerbated by anthropogenic emissions of nitrogenous and sulphurous compounds. Whether, and if so how much, this projected decrease in pH can be counterbalanced by daily pH increases caused by seagrass photosynthesis, and how the resulting pH may affect the biota within seagrass meadows, will be discussed in this article. Within this discussion, it must be taken into account that increases in dissolved CO<sub>2</sub> will bring about changes in other inorganic carbon forms that are in equilibrium with CO<sub>2</sub> (i.e. HCO<sub>3</sub><sup>-</sup> and CO<sub>3</sub><sup>2-</sup>). As





“Future ocean acidification may be mitigated within dense and shallow, highly productive, seagrass meadows..”

a final result, while the dissolved CO<sub>2</sub> concentration will follow that of the atmosphere, a doubling or tripling of the CO<sub>2</sub> concentration will only result in a slight increase in the total seawater inorganic carbon content since acidification reduces the proportion of the ionic carbon forms in relation to CO<sub>2</sub>.

One aspect of ocean acidification is a decrease in CaCO<sub>3</sub> saturation levels, which, consequently, will have negative effects on calcifying organisms. This results in decreased calcification or even dissolution of calcite and aragonite structures. This has been shown experimentally for calcareous algae and corals. Regarding seagrasses, it is mainly the photosynthetic productivity that will be affected since some of these plants may arguably be inorganic-carbon limited in nature and, since CO<sub>2</sub> is readily taken up by all marine macrophytes, future elevated dissolved- CO<sub>2</sub> levels therefore may result in higher rates of photosynthesis and growth. Indeed, there is some experimental evidence for this scenario. Alternatively, the significant increase in pH caused by photosynthesis in dense seagrass stands during low tides and/or slow water movements could effectively counteract the potential CO<sub>2</sub> enrichment and limit seagrass photosynthesis.

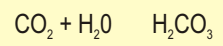
So, what will be the net result of these potentially opposing influences on seagrass growth? Let us examine two possible scenarios: one in sparse meadows where the seagrass area to surrounding-water volume ratio is low and/or water flow rates are high (scenario 1); and the other in dense seagrass meadows where the seagrass to surrounding-water ratio is high and the water exchange rate is low (scenario 2).



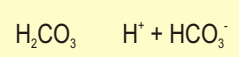
Above: Scientists using the diving-PAM in Chwaka Bay Tanzania. Read more on Zanzibar and Chwaka Bay in Issue 27, November 2006

### How is atmospheric CO<sub>2</sub> responsible for ocean acidification?

When CO<sub>2</sub> dissolves in seawater, it forms carbonic acid:

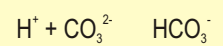


This carbonic acid dissociates in the water, releasing hydrogen ions and bicarbonate:



Acidity is a measure of the hydrogen ion concentration in the water, where an increase in hydrogen leads to an increase in acidity (and a decrease in the pH scale used to quantify acidity).

These hydrogen ions then combine with carbonate ions in the water to form bicarbonate.



This removes carbonate ions from the water, making it more difficult for organisms to form the CaCO<sub>3</sub> they need for their shells or skeletons.

Photosynthetic characteristics of tropical seagrass can be measured using a submersible Pulse-Amplitude Modulated fluorometer (diving-PAM). The diving-PAM underwater fluorometer is a unique instrument for studying *in situ* photosynthesis in underwater plants, including macroalgae, seagrasses and corals. It opens the way for a profound analysis of these organisms under natural conditions.





### Scenario 1.

Those  $\text{CO}_2$ -limited seagrasses living in sparse meadows may well benefit from elevated atmospheric and, thus, dissolved  $\text{CO}_2$  levels and the lowering of the seawater pH by increasing their productivity. This is due to both the direct effect of the higher concentration of dissolved  $\text{CO}_2$  and the lowering of the pH, the latter of which facilitates the generation of  $\text{CO}_2$  from  $\text{HCO}_3^-$ . Of course, this  $\text{CO}_2$ -stimulated photosynthesis and growth scenario could only function in situations where a potentially  $\text{CO}_2$ -limited seagrass is not limited by other resources (e.g. it would be effective only under high irradiances but not at depths). In this scenario the increased photosynthetic activity will not be able to counteract the acidification of seawater from increased atmospheric  $\text{CO}_2$  levels.

### Scenario 2

The high pH generated by seagrass photosynthesis could counteract the effect of increasing  $\text{CO}_2$  levels and ocean acidification. Here, at least  $\text{CO}_2$ -limited seagrasses may also benefit from  $\text{CO}_2$  enrichment in the beginning of the light period. However, these seagrasses would then quickly reach their pH compensation point, where photosynthesis would cease. The pH compensation point is the pH at which  $\text{CO}_2$  concentrations are too low to support net photosynthesis even if  $\text{HCO}_3^-$  to  $\text{CO}_2$  conversion systems (e.g. via extracellularly acting carbonic anhydrase and/or outwardly directed proton pumps) were present. This cessation of photosynthesis occurs for many seagrasses at pH values of around 9, which can also be found in dense tropical meadows during low tide. Since it is likely that a set amount of photosynthetic carbon fixation is needed for a seagrass stand to reach its pH-compensation point (and there is no net carbon gain for the rest of the day after this point has been reached), increased  $\text{CO}_2$  levels and ocean acidification may be less important in this scenario.

From the above it follows that future ocean acidification may be mitigated within dense and shallow, highly productive, seagrass meadows. This implies that the negative effects of acidification on the rates of calcification in organisms associated with these meadows may be reduced or avoided. If so, these high-productivity meadows may be looked upon as areas that are safe from ocean acidification, which further highlights the need for their protection from decline.

*This discussion is largely based on the recent paper "Seagrass photosynthesis controls rates of calcification and photosynthesis of calcareous macroalgae in a tropical seagrass meadow" by I.S. Semesi, S. Beer and M. Björk (Mar. Ecol. Prog. Ser. 382: 41-47 (2009)). Other relevant references can be obtained from the authors. **Mats Björk** Botany Department, Stockholm University, 106 91 Stockholm, Sweden ([mats.bjork@botan.su.se](mailto:mats.bjork@botan.su.se)); **Sven Beer** Department of Plant Sciences, Tel Aviv University, Tel Aviv 69978, Israel ([svenb@ex.tau.ac.il](mailto:svenb@ex.tau.ac.il)).*



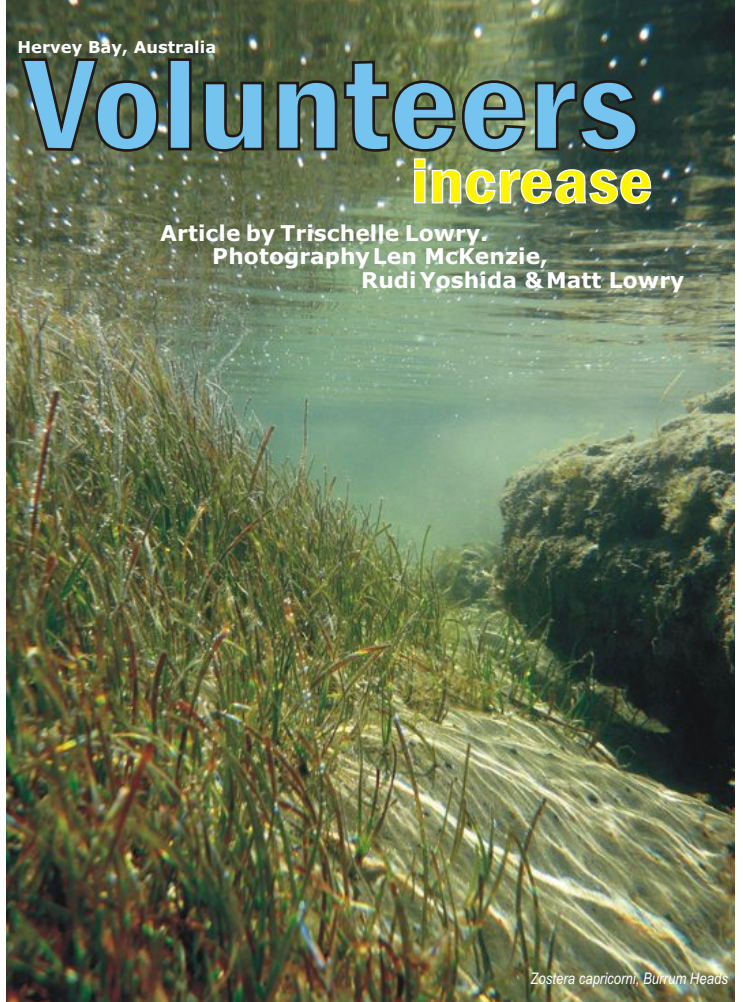
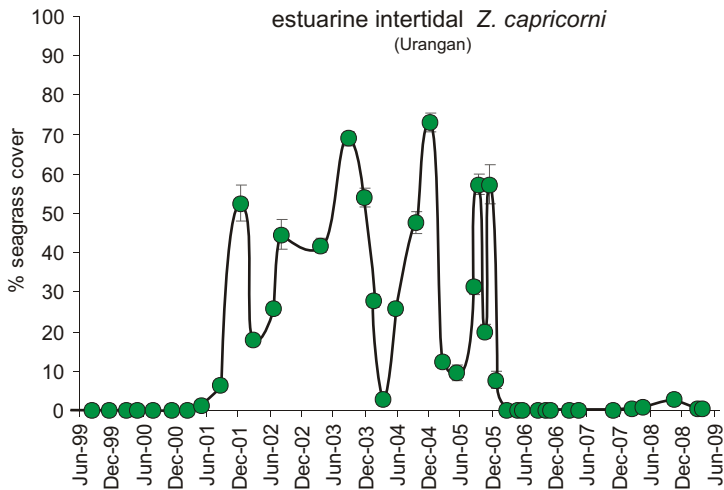




2009 has seen our happy band of volunteers increase in number, which has been a great boost for our group. We undertook monitoring in February and again recently in May, however bad weather, including Cyclone Hamish, has hampered the monitoring of some sites. We hope for fine weather for our next round of monitoring in August.

Over the past month I have had the opportunity to visit ten of our monitoring sites to reinstall missing pegs and attach identification tags. Seagrass is still reasonably scarce along the transects and within the quadrats, but there are some very promising patches within close proximity of most sites.

Burrum Heads had the best overall coverage, both within the monitoring sites and stretching into vast meadows of *Halophila ovalis* and *Halodule uninervis* between sites. There was also evidence of numerous dugong feeding trails in this same area. The Toogoom and Dundowran sites still only had very sparse coverage but gutters on the approach to these sites contained small patches of *Halodule uninervis*. The Urangan sites seemed to be returning to a muddier sediment type and are showing signs of recovery with meadows of both *Zostera capricorni* and



Hervey Bay, Australia

# Volunteers increase

Article by Trischelle Lowry.  
Photography Len McKenzie,  
Rudi Yoshida & Matt Lowry

*Zostera capricorni*, Burrum Heads

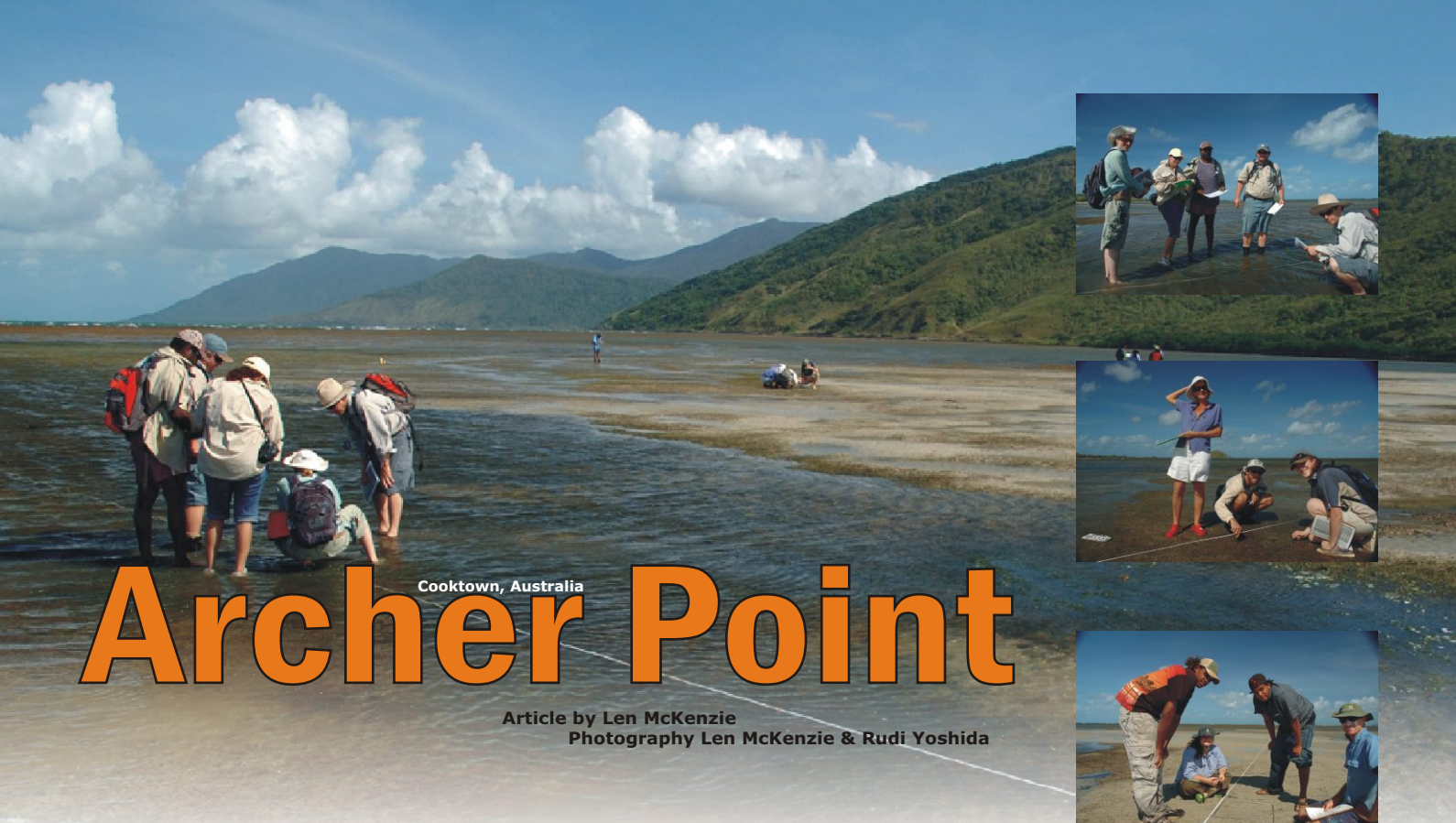
*Halophila ovalis* establishing on both ends of the transects.

On a recent trip to Woodgate (just north of our Burrum Heads monitoring sites) I was excited to come across some *Zostera capricorni* leaves washed up on the beach which was extremely healthy and over forty centimeters in length. It was also promising to hear from one of the local Hervey Bay council environmental officers of a sighting of seven dugong feeding just off one of the local beaches. Till next time happy monitoring.



Trischelle and Renae Measom monitor Urangan

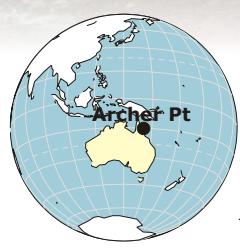




# Archer Point

Cooktown, Australia

Article by Len McKenzie  
Photography Len McKenzie & Rudi Yoshida



Archer Point is the only location monitored in the Cooktown region on the wet tropical coast of north-eastern Queensland. The region includes a major catchment and river system (Endeavor and Annan Rivers). Intertidal seagrass meadows in the region are situated along nearshore sand and mud banks and consist mostly of *Halodule uninervis* and *Halophila* dominated meadows. Shallow subtidal coastal meadows consist of *Halodule uninervis* and *Halophila* communities mostly found along the sheltered coasts and bays. *Cymodocea* spp., *Thalassia hemprichii*, *Syringodium isoetifolium* and a suite of *Halophila* species dominate intertidal reef platform habitats of this region.

environment where it is difficult for seagrass seedlings to establish or persist.

In late March, Seagrass-Watch HQ travelled to Cooktown to conduct a two day Level 1 Training workshop at the River of Gold Motel. The workshop was well attended by participants from the local community, officers from Queensland's Department of Environment and Resource Management (DERM) and Indigenous rangers.

Seagrass meadows throughout the region are characterised by low nutrient concentrations and are primarily nitrogen limited. From December to March (wet season) low seagrass abundance often coincides with high rainfall and high loads of sediments and nutrients to nearshore marine waters. Sediments and nutrients decrease light availability for seagrass by reducing light penetration in the water column and promoting the growth of algae that can shade seagrass blades. Warm water temperatures during summer also promote growth of algae and can lower productivity of seagrass meadows. Coupled with physical disturbance from storm activity, seagrass growth and abundance may therefore be severely depleted over the wet season. Seagrass meadows are generally most abundant in October-November following the dry season that has more favorable light and temperature conditions.

Of the seagrass habitats types identified for this region, monitoring of intertidal seagrass meadows only occurs on a fringing reef platform. These habitats support diverse seagrass assemblages. On fringing-reefs, physical disturbance from waves and swell and associated sediment movement primarily control seagrass growing in these habitats. Shallow unstable sediment, fluctuating temperature, and variable salinity in intertidal regions characterize these habitats. Sediment movement due to bioturbation and prevalent wave exposure creates an unstable







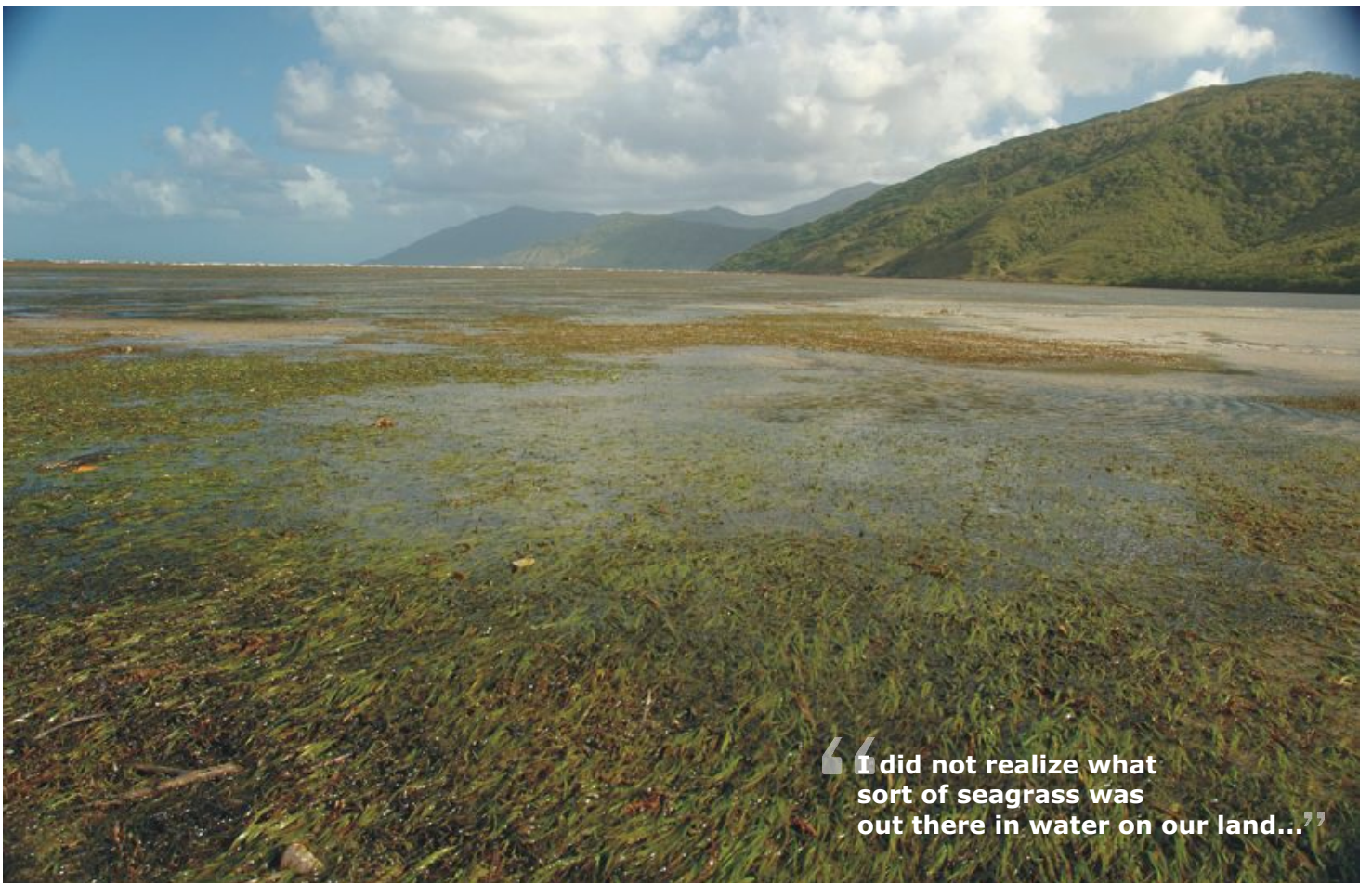
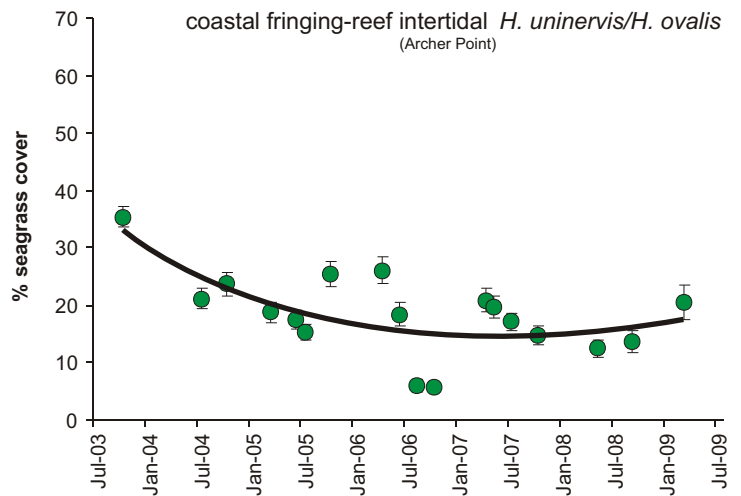
Day 1 of the workshop included seagrass identification, background on seagrass ecology, the importance of seagrass and how to monitor seagrasses using the Seagrass-Watch protocols. The field component, on day 2 was held at Archer Point. Intertidal seagrass meadows at Archer Point are located on a fringing reef platform in a protected section of the bay adjacent to the headland.

Archer Point is monitored as part of the intertidal seagrass component of the Reef Rescue Marine Monitoring Program. The sites are dominated by *Halodule uninervis* (both wide and narrow leaf varieties), however another five seagrass species are also present in the sites and bay (*Halophila ovalis*, *Cymodocea rotundata*, *Cymodocea serrulata*, *Enhalus acoroides*, *Zostera muelleri* ssp. *capricorni*). Species composition has remained relatively stable over the past 12 months. The overall meadow distribution however, has increased.

Epiphyte cover on seagrass leaf blades at Archer Point are generally variable. Overall, the abundance of epiphytes appears to have declined since monitoring began in 2003 and epiphyte abundances remained low over the past monitoring period. Percentage cover of macro-algae is also variable. Although abundance increased in 2006 and 2007, it has since declined significantly. Overall, macro-algae appear to be declining in abundance at Archer Point.

Seagrass cover has generally followed a seasonal trend over the last couple of years (higher abundance in late spring/early summer), and the long-term average was between 16% in winter (Dry) and 19% in late Dry season. Overall, the meadow appears to have recovered from the decline reported 12 months ago, and has stabilised within long-term abundances.

This recovery was possibly driven by the increased reproductive effort reported in 2007/2008, indicating the potential for the meadow to recover.



“I did not realize what sort of seagrass was out there in water on our land...”





Central Qld, Australia

# After the Monsoon

Article by Sam Hedge.  
Photography Sam Hedge, Naomi Smith & Richard Unsworth



In February this year I started working with Seagrass-Watch HQ at the Northern Fisheries Centre (QPI&F) in Cairns. My new role with the team initially

involved many long days in the lab processing samples from previous sampling trips. This processing enables us to compile detailed data on seagrass tissue nutrients, reproductive effort and plant morphology. The data is used to examine the effects of water quality.

By April I was looking forward to some time in the field! Our initial trip was to take us (Richard Unsworth, Naomi Smith and I) to Gladstone Harbour and Rodds Bay.

Rodds Bay turned out to be a great initiation to seagrass field work. The mud at both sites was deep and hard to move through, making working against the clock a chore. Unfortunately the seagrass proved hard to find at this location. It had disappeared completely from site RD1. RD2 displayed limited cover of *Zostera capricorni* although rhizomes were abundantly present under the surface. This could be a seasonal decline (lower after the monsoon), a consequence of



Naomi and Sam prepare for what's ahead

decreased salinity or increased turbidity from the heavy freshwater runoff. Hopefully the cover will bounce back during the year.? The team are also investigating new ways to move around extremely muddy sites such as Rodds Bay. Small sleds could possibly reduce our impact on the site (and ourselves!).

The team's next mission was to complete two sites in Gladstone Harbour. The Gladstone Harbour sites at Pelican Banks provided a welcome relief in a solid substrate to work on. As the tide dropped we encountered many turtles moving off the seagrass flats. Large meadows of *Zostera capricorni* were found with limited small patches of *Halophila ovalis*. Having a short tidal window in which to work emphasised the importance of the rapid assessment technique. There appears an approximate 50% reduction in seagrass cover for these sites since the last sampling event. Cover at this location has been steadily increasing since the large losses in 2006. Again, might a large wet season early this year be a clue to the change in seagrass cover?

Our next trip was off-road and involved a 4WD full of gear and driving two days to Shoalwater Bay. Both sites at Shoalwater (Ross Creek and Wheelan's Hut) are accessed through the Defence Force training area. From the Army base HQ it takes an hour drive on dirt roads out to the camp site at Sabina Point. Both sites here have been surveyed since early 2002. This area is relatively unchanged from human impacts due to its remote nature. The seagrass meadows at both sites are quite large on the extensive tidal flats. During a big low tide the tidal flats seem to extend for miles out to sea! Ross Creek has

showed consistently good cover of between 15-40% since monitoring began. The meadows are comprised mostly of *Zostera capricorni* with around 20% *Halophila ovalis*. Similarly at Wheelan's Hut, seagrass cover has been fairly consistent between 12 and 27%.

After Shoalwater the team travelled to Great Keppel Island to complete our sampling. At Monkey Beach, both sites exhibited very patchy *Halodule uninervis* meadows with very limited amounts of *Halophila ovalis*. In deeper water we noticed significant amounts of *Halophila spinulosa*. These sites, which have only been monitored since late dry 2007, have generally shown low cover.

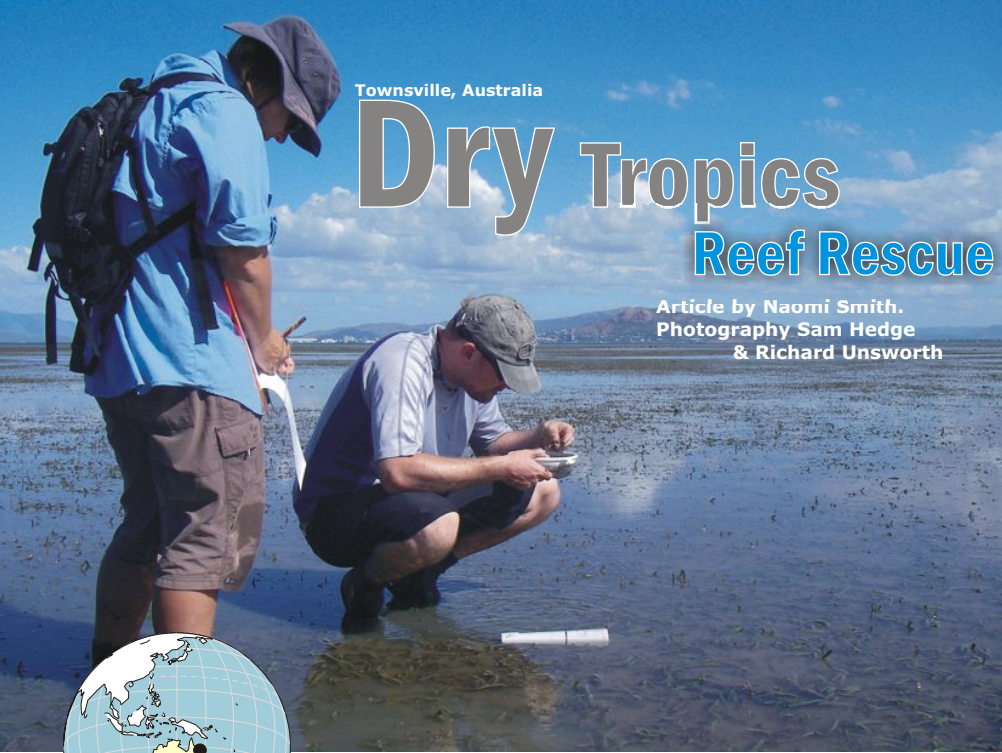




Townsville, Australia

# Dry Tropics Reef Rescue

Article by Naomi Smith.  
Photography Sam Hedge  
& Richard Unsworth



The last of the late Monsoon (March/April) Reef Rescue sampling was in Townsville. It was greeted with glorious weather which made it a pleasure to be out and about in the seagrass meadows. It was also a nice break to work on sandy and reef-top seagrass meadows compared to the muddy sites we had just completed.

We started out at Cockle Bay (MI2) on Magnetic Island where the dominant species at this site is *Cymodocea serrulata* with some *Halodule uninervis* and *Halophila ovalis*. While the dominant species has stayed the same, there appears to be a drop in the overall percent cover of seagrass. However it was the sediment that appeared to have changed the most, from gravel to more sand/mud. As Don Kinsey (U3A) who regularly monitors the site pointed out, we had just had a Monsoon with unusually high rainfall (2300mm from November to February) and significant storms and associated surges. This history was conspicuously reflected in the whole reef-flat area being coated with a thin but all pervasive layer of mud. This mud was probably only a millimetre or so thick but very obvious. On a positive note, we were quite excited to find some *Cymodocea serrulata* seeds.

We also found low seagrass cover at our coastal site at Bushland Beach. On the way out to our site we observed *Halodule uninervis*, *Halophila ovalis* and patches of *Zostera capricorni*, but in our site itself only *H. uninervis*. The seagrass percent cover over the site was only about 10%. However, seeds were found in 23 out of the total 30 cores examined. The highest number of seeds recorded in a core was 56 intact (whole seeds) and 10 germinated (half seeds).

Unfortunately our other coastal monitoring site at Shelley Beach wasn't much better. Although we were helped by five keen volunteers (Antasia, Greg, Pete, Mike and Anna) there wasn't a lot of seagrass to be found. The seagrass cover was very low and like Bushland Beach only *Halodule uninervis* was present at the actual site but *Halophila ovalis* was observed on the walk out.

Sediment movement across the bank had disturbed the site and buried much of the seagrass (and our peg!). Fortunately there was quite a bit of fauna life with hermit crabs scuttling around. Only 6 of the total 30 seed cores taken had seeds in them.

To complete monitoring for the quarter, it was back over to Magnetic Island to sample Picnic Bay. Compared with January's data, the overall seagrass cover has decreased. This could be seen especially on transect 1 where no seagrass was found but in January there was seagrass from 20m onwards. While the species present were the same (*Halodule uninervis*, *Halophila ovalis* and *Thalassia hemprichi*), there was an increase in the abundance of *T. hemprichi* present. Only one core had seeds in it but interestingly one core did have a *H. uninervis* shoot with 10 fruits still attached.

Now it's back to the lab to process the new seagrass reproduction samples and analyse the sediments for herbicides. Thank you to Richard and Sam for a successful Reef Rescue field trip

Above: Naomi and Richard seed counting, Magnetic Island  
Below: Team at Shelley Beach



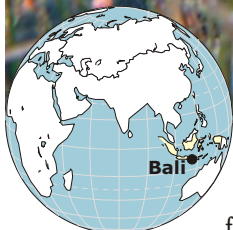


# Bali lamun

Article & Photography Len McKenzie  
& Rudi Yoshida



Sanur, Bali



Seagrass meadows (*lamun*) form a significant coastal habitat throughout the Indonesian Archipelago. They extend from intertidal to subtidal, along mangrove coastlines, estuaries, and shallow embayments, as well as coral-reef platforms, inter-reef seabeds and island locations. They play a vital role in supporting coastal marine communities and are important in maintaining coastal water quality and clarity. The seagrasses are also an important component of

coastal fisheries productivity and food for marine green turtles and dugongs.

It is generally acknowledged that eight genera and 13 species of seagrass inhabit Indonesian coastal waters. These include: *Cymodocea serrulata*, *Cymodocea rotundata*, *Enhalus acoroides*, *Syringodium isoetifolium*, *Halodule pinifolia*, *Halodule uninervis*, *Halophila spinulosa*, *Halophila decipiens*, *Halophila ovalis*, *Thalassia hemprichii*, *Halophila minor*, *Thalassodendron ciliatum* and *Ruppia maritima*. The *R. maritima* records are based on specimens at Herbarium

Bogoriense collected from Ancol-Jakarta Bay and Pasir Putih-East Java, but have never been reported since (the development of Jakarta has destroyed the mangrove forest in Ancol).

In early May 2009, Seagrass-Watch HQ visited the island of Bali in southern Indonesia to conduct Seagrass-Watch Level 1 training. It has been four years since Seagrass-Watch last visited Bali and since then relatively little has happened apart from annual monitoring in Karimunjawa. Hopefully the workshop will ignite interest, as most participants were new to the program. Workshop participants were from a diverse range of academic, government and non-government organisations, including: University of Udayana, Bogor Agricultural University, Mataram University, Institute for Marine Research and Observation, Ministry of Marine Affairs and Fisheries, The Indonesian Coral Reef Foundation, Conservation International, The Nature Conservancy and the Wildlife Conservation Society.

Classroom and laboratory sessions were conducted at the Coral Triangle Center (The Nature Conservancy) and the field session was at Sanur beach (SN1).

The reef flat at Sanur in southern Bali is covered by extensive intertidal and subtidal *Enhalus acoroides* dominated seagrass meadows. Meadows extend from nearshore to reef crest. During the field session the *E. acoroides* were flowering on the low spring tides and participants observed lots of female flowers, fruits and male flowers (dispersing across the water surface). Lots of *Thalassia hemprichii* fruits were also observed floating over the monitoring site.

Along the fringing reef of the Sanur coast, the inner walls of the well-developed grooves of the reef crest are heavily overgrown by *Thalassodendron ciliatum*. *T. ciliatum* is often found attached to hard rock and coral limestone at the seaward margin of reefs (i.e., fringing reefs to atolls). With its strong woody rhizomes and roots, it is able to root in a variety of sediment types, including the groves in the coral reef which run almost perpendicular to the incoming swell.





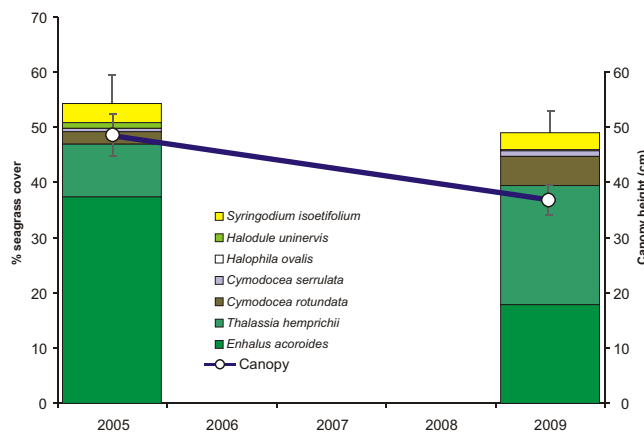


Although Sanur beach is subjected to a great number of pressures from coastal development, the seagrass meadow at SN1 is similar to when it was last monitored in May 2005. Seagrass abundance and canopy height were not significantly different between sampling events. Also, epiphytes and macro-algae abundance remained low (20 and <2% respectively).

The site is located on a section of the Sanur reef flat/lagoon where fishing and gleaning is discouraged. Although not an official no-take area, it is generally respected by the coastal community. Either side of the area remained popular with many locals taking advantage of the low tides to fish or collect whatever animals they could find amongst the seagrass.

Coastal communities in Indonesia are highly dependent of seagrass ecosystems and the economic value they provide. Seagrasses provide direct value to people who sell the plants to feed cattle and goats

or captive dugongs in aquariums. Plants are also directly traded to make handicrafts (particularly in Bali) or as food. For example, fishers commonly eat *Enhalus* fruit for breakfast (about 10 per meal), particularly in areas of Seribu



Island and the eastern part of Indonesia. They cook the fruit and mix it with ground coconut.

Indirectly seagrasses are valued for supporting fisheries, for the harvest of ornamental snails and for marine tourism.

Seagrasses are directly valued at ~US\$80,000 ha<sup>-1</sup>year<sup>-1</sup> (Kuriandewa, 2008, South China Sea Project). However a study of three villages in East Bintan estimated the total economic value of seagrass and its ecosystems was up to US\$3,634,796 ha<sup>-1</sup>year<sup>-1</sup> (Dirhamsyah 2007 Oseanologi dan Limnologi di Indonesia, 33(2):257-270). Marine tourism was one of the largest contributors to the economic gain of seagrass ecosystems in that area.

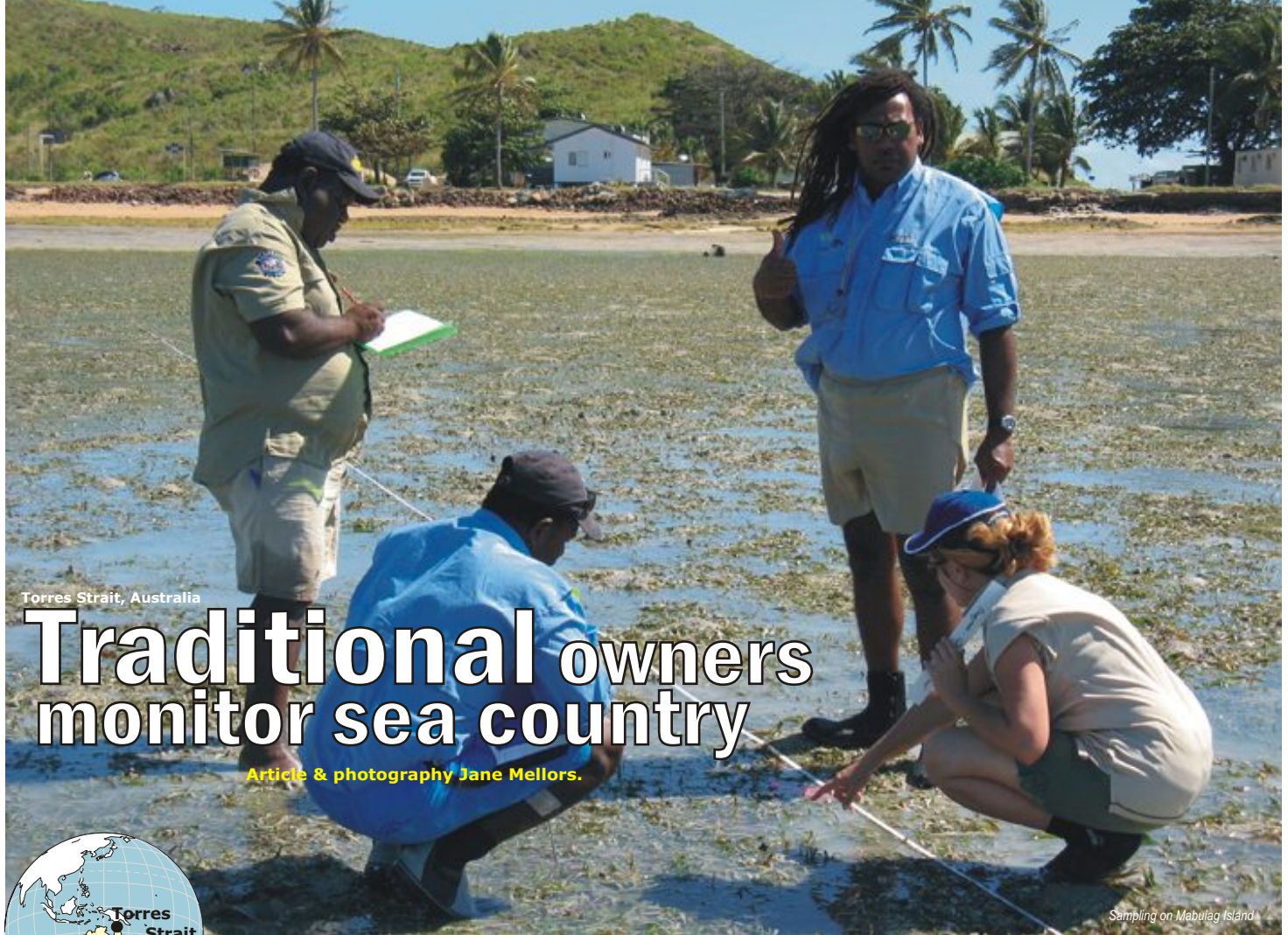
After completing the training, many participants commented that they did not realize the importance of seagrasses, and were keen to return home so they could impart their knowledge to their local communities to help support seagrass and marine conservation.

The workshop was supported by the Wildlife Conservation Society (Indonesia, Marine), local coordination by Stuart Campbell (WCS), The Nature Conservancy (Coral Triangle Center), and Seagrass-Watch HQ.



*Thalassodendron ciliatum*, Sanur, Bali

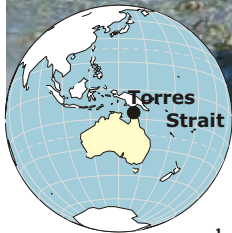




Torres Strait, Australia

# Traditional owners monitor sea country

Article & photography Jane Mellors.



Sampling on Mabulag Island

Two new sites at Mabuyag (Mabuiag Island) and Mer (Meer, Murray Island) have been established within the Torres Strait to complement the existing sites on Waiben (Thursday Island), Ngurapai (Horn Island) and Keriri (Hammond Island).

The monitoring of seagrasses at the new island communities has been initiated as part of the implementation of the Dugong and Turtle Management Plans that identified seagrass monitoring as an important action of the plan. In these instances the monitoring is being done in partnership with the new ranger groups or dugong and turtle project officers.

## Mabuyag

The first new site was established in late March on Mabuyag (Mabuiag) with the newly formed Mabuygiw Ranger unit. We established a site at Panay (MG1) in front of the basketball courts. It is quite a diverse site with up to 7 species being identified along the transects. The species present were *Cymodocea rotundata*, *Cymodocea serrulata*, *Enhalus acoroides*, *Halodule uninervis*, *Thalassia hemprichii*, *Syringodium isoetifolium*, and *Halophila ovalis*. Since then, we monitored the site a second time in late May with the ranger mentor Karen Vidler. Noticeable differences between trips were there were hardly any *Enhalus* fruits around, seagrass cover was down and epiphyte cover higher. Also during the late May trip the south easterly trade winds started in earnest. During this trip we also trialed some equipment in relation to subtidal monitoring. With some minor adjustments and finding areas suitably out of the winds we may be establishing a subtidal site.

## Mer

A Seagrass-Watch site (MR1) was established with the assistance of the Dugong and Turtle Project Officer Moses Wailu as part of

the implementation of the "Murray Island Dugong and Turtle Management Plan" "Keriba Luzabzab-Lera Dorge Dugong and turtle management plan" for the Mer Dowar Waier Traditional Owners of the Kemerker Meriam Nation (Eastern Islands). This site is located out the front of Mud (pronounced Murd) Village and is a known foraging site for turtle. The dominant seagrass within the site was *Cymodocea rotundata* and *Thalassia hemprichii*. We also found within the meadow *Halodule uninervis*, *Enhalus acoroides* and *Halophila ovalis*. The seagrass plants all showed evidence of heavy grazing by turtles and fish. It is also a great meadow for Artie (octopus) to live in.

Both new sites are representative of intertidal reef top seagrass communities.

[Read more, from the schools page 15](#)



Wet and Windy, Mer Island





Pulau Semakau *Enhalus* meadows



Above: Workshop participants at Chek Jawa demonstration site  
 Above left: Monitoring Pulau Semakau's vast seagrass meadows

# Labour day <sup>Singapore</sup> workshops

Article by Len McKenzie & Rudi Yoshida.  
 Photography Ria Tan (Wild Singapore),  
 Len McKenzie and Rudi Yoshida



Two workshops and two field sessions were held over the Labour Day long weekend in May 2009. Seagrass-Watch HQ was back in Singapore to catch up with TeamSeagrass and conduct both Level 1 (basic) and Level 2 (refresher) training.

Pulau Semakau was the field event that kicked off the training workshops.

The location has been monitored for over two years and the Level 2 participants demonstrated their skills at monitoring all three sites on Labour Day morning. After a safety briefing from Siti and Ria, the participants collected their equipment and ventured to their assigned monitoring sites. The monitoring sites are located on the western side of the island. Vast tracts of *Enhalus acoroides* fringe the island, stretching for kilometres. Pulau Semakau is one of the few places in Singapore where *Syringodium isoetifolium* occurs in abundance. After a brief delay at PS1 (due to someone removing the permanent markers), all three sites were successfully completed within a couple of hours.

After a couple of hours rest, it was then on to the Botanic Gardens Botany Centre where Level 1 participants got to learn the background knowledge required to properly and confidently conduct

Seagrass-Watch monitoring. It was an intensive five hours, with the classroom session finishing just after 9pm. Early the following morning, Level 1 participants caught bumboats from Changi Village to Chek Jawa, where they completed their training with the field component. A demonstration site was set up close to the board walk. This generated a lot of interest for other park visitors. Ria, Siti and Wei Ling proved excellent seagrass ambassadors. Eight seagrass species have been reported from Chek Jawa: *Halophila beccarii*, *Halophila spinulosa*, *Cymodocea rotundata*, *Halophila ovalis*, *Halophila minor*, *Halodule uninervis*, *Thalassia hemprichii* and isolated clumps of *Enhalus acoroides*. The meadows are predominately within a shallow protected lagoon behind a large sand bank. Meadows are mainly intertidal, however the seaward edges of the sand bank are fringed by large *Halophila spinulosa* meadows. In Dec 2006/Jan 2007, Chek Jawa's seagrass meadows were decimated by heavy rainfall and associated freshwater flooding, but since then have improved.

The workshops finished off with the Level 2 classroom session on the Sunday. Participants refreshed their taxonomy skills and learnt about the details of the Seagrass-Watch QAQC. They also experienced how important it is to be properly trained and record data according to the standard protocols. Their skills of observation were also tested during the classroom exercises. The day was finished off by learning how to use a GPS and a "treasure" hunt through the beautiful Singapore Botanic Gardens to find the secret letters at eight locations which spelt out a secret seagrass word.

The training and the events were a huge success. Special thanks to Ria, Siti, Wei Ling and Shufen, for organising the workshops. Seagrass-Watch in Singapore is an initiative of TeamSeagrass in close partnership with the Biodiversity Centre of the National Parks Board. The workshops were supported by the National Parks Board Biodiversity Centre, Seagrass-Watch HQ, and TeamSeagrass Singapore.



On the 8<sup>th</sup> May 2009, we took our first trip down to Labrador Park. We were introduced to various marine organisms that can be seen on the rocks in the intertidal zone, such as *Onchidiidae*, small crabs and Polychaete. We learnt the right and safe way of opening rocks so as to prevent attacks from marine creatures which reside underneath. Our teacher-mentor, Mr Lim, taught us how to identify algae and the various species of seagrasses. We had the chance to try out our new booties! He also taught us about the ecological relationships between the corals and seagrasses, and showed us the calcium carbonate skeleton of a dead coral.

After being debriefed, we went down to the beach once again! We picked up 3kg of rubbish which consisted of styrofoam, plastic bottles and other non-biodegradable materials, just as a start to the maintenance of the beach. Unfortunately, we also saw a great extent of pollution. It was a fulfilling trip to Labrador Park and we are certainly very excited about our next trip!

# Studying Singapore Labrador

Article by Labrador Angels.  
Photography Len McKenzie & Lim Cheng Puay



We are the two new teams that will be working with seagrasses for the next one and half years. The first team are Grace Cheong, Jin Yifeng and Zenia Quek and the second team are Goh Hua Zhen, Regina Lau and Tan Li Ying.

The main objectives of our project, working together, are to maintain

Labrador Park so as to clear the marine waste washed on shore, and to map out the distribution of the different species of seagrass. Our mapping is aimed at aiding future research and recreational activities to be done at Labrador Park.

The first team will be focussing on the distribution of seagrass *Thalassia hemprichii*, *Enhalus acoroides* and *Halophila ovalis*. The second team will be monitoring the growth of *T. hemprichii*, to find out the factors that affect growth!

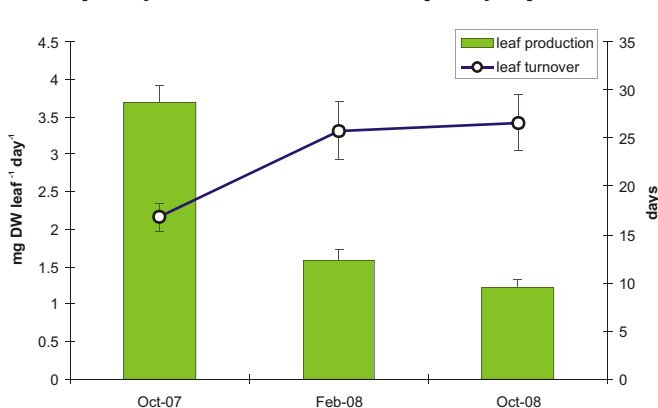


## *Thalassia hemprichii* leaf growth

In 2007, the Raffles Girl School began investigating the productivity of the dominant seagrass at Labrador Park, *Thalassia hemprichii*. The students were interested in how fast it grows and what may effect it.

*T. hemprichii* at Labrador Park is fairly typical of plants reported from other Indo-Pacific Seagrass-Watch sites. Average canopy height varied from 6.5-9.5cm and compares favourably with the 6.8cm (max=23cm) Indo-Pacific average. The growth rates also appear within the ranges expected for the species.

*T. hemprichii* leaf growth rates at Labrador Park were higher in October 2007, and consequently the time it takes to completely replace a leaf (16.8 days) was faster. The lower



growth rates in October 2008 were unexpected and may be the result of climatic factors. Further investigation is recommended.

Nevertheless, the data suggests that *T. hemprichii* at Labrador Park are relatively healthy and what you see today is the result of the last 2-4 weeks growth.



Additional text Len McKenzie





Monitoring Back Beach, T12



Front Beach, T12



Hammond Island

# Second round for new watchers

Torres Strait, Australia

Article & Photography by Jane Mellors.

This is the second time this cohort of newly trained Seagrass-Watchers has monitored.

### Thursday Island (Waiben)

TI1 is a reef-top seagrass community showing high diversity in species, whilst TI2 is more coastal in representation. This is probably because the TI2 site is in the upper intertidal and inhabited by the more opportunistic species *Halophila ovalis* and *Halodule uninervis*. At TI1, cover was noticeably down, algal cover was up and epi-cover remained relatively stable.

At TI2, cover was marginally down, as was algal cover while epi-cover was slightly higher. Seed counts were also noticeably down.

### Horn Island (Ngurapai)

This site is representative of a muddy coastal site, with *Halodule uninervis* and *Halophila ovalis* dominating. *Zostera capricorni* is making more of a presence within the site. Seagrass cover was down, as was algae cover, though epi-cover was higher than the last time we sampled. Seed counts were down by about half of what they were in March.

### Hammond Island (Keriri)

This site is a another typical reef-top seagrass meadow. This site is in a bit of a hollow, so whilst the surrounding meadow was nice and dry our site was in around 11cm of water. The meadow was blanketed in a mat of blue green algae. Underneath this mat the seagrass appeared healthy with not much epiphyte cover. Seagrass cover and epi-cover were dramatically lower while algae cover was almost 6 times higher than that recorded during the March sampling.

Seagrass cover at all sites was lower, though levels of change with regard to algae and epi-cover varied at all the sites. At TI1, TI2 and HI1, the seagrasses especially the larger species, *Thalassia*, *Enhalus*, *Zostera* showed signs of burning probably due to prolonged exposure during the daytime spring tides and wind induced desiccation. At a couple of the more exposed sites (MG1, TI2) relatively large amounts of fresh (green) wrack was piling up on the beaches.

### Seagrass awareness

Dugongs were the theme of the Seagrass-Watch travelling education jamboree in the Torres Strait recently. The first stop was Mer Campus where we talked to three classes from Prep to Year 6. After a brief discussion about seagrass habitat as food for dugong and turtle and homes for fisheries related animals, the students made dugong masks. The more inquisitive students joined Karen, Moses and I in learning how to identify different species of seagrass.



Mabuiag Mr R's class

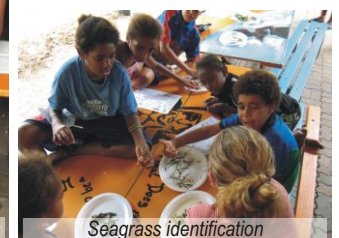
Students of Mabuiag Campus also made dugong masks after a quick question time on what they knew about seagrass at the whole of school assembly. Then it was a brief presentation at the Thursday Island Junior Campus to the Yr 2 class that are known as the Dhangal (dugong) grade. The jamboree finished off at the Senior Campus addressing the Yr 10 Marine Studies class on the Biology and Taxonomy of Seagrasses. This was followed up with an exercise on identifying 8 different seagrass species.



Mer Island students with dugong masks



Tagai College Yr 10



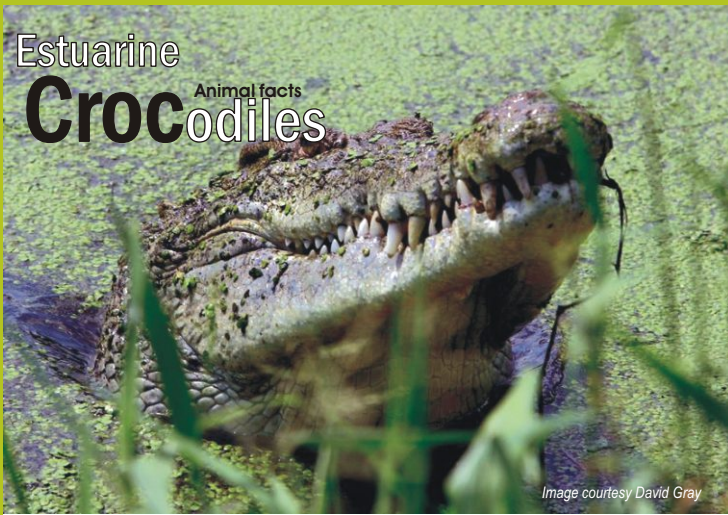
Seagrass identification

For more information on Seagrass-Watch education visit : [www.seagrasswatch.org/education.html](http://www.seagrasswatch.org/education.html)



# Estuarine Crocodiles

Animal facts



**F**or many Seagrass-Watchers across the tropical Indo-Pacific, awareness of estuarine crocodiles is always in the back of your mind when venturing out onto the mudflats. A better understanding of these animals and some simple procedures will help to ensure risks are minimised.

Estuarine crocodiles (*Crocodylus porosus*) are found from India, throughout south-east Asia and New Guinea, across to northern Australia, Vanuatu and the Solomon Islands. Although most commonly seen in tidal reaches of rivers, they can be found along beaches and around offshore islands/coral quays. They have reigned as key predators in marine coastal environments for millions of years and differ little from their prehistoric ancestors that stalked the earth before the dinosaurs.

Estuarine crocodiles are the largest and the heaviest of present-day reptiles and can grow to six metres in length. They have a relatively long broad somewhat flattened snout, or muzzle. The outer margin of the snout are the jaws, which carry a row of sharp teeth, held in sockets and replaced continuously.

The crocodile is well adapted to its amphibious way of life. The elongated body with its long, muscular paddle tail is well suited to rapid swimming. The external nostril openings, the eyes, and the ear openings are on the highest parts of the upper side of the head. These important sense organs can remain above the water surface even when the rest of the head is submerged.

Like many nocturnal animals, crocodiles have eyes with vertical, slit-shaped pupils; these narrow in bright light and widen in darkness. Crocodiles are able to see underwater due to a transparent membrane which can be drawn over the eye when the lids are open. Crocodiles also have a keen sense of smell. Small sensory buds around the top and bottom jaws allow crocodiles to detect vibrations - crucial when hunting in murky water.



Crocodiles are able to stay underwater for extended periods of time because of they can slow their heart rate, allowing them to hold their breath. Estuarine crocodiles are also unique in that glands embedded in their tongue tissue excrete excess salt when the animal is living in a highly saline environment.

Being reptiles, crocodiles use the water, sun and shade to maintain their body temperature around 30-

33°C. When basking, they orientate their bodies to ensure the maximum surface area is exposed to the sun. Because they are unable to sweat, they avoid over-heating by returning to the water or lying with their jaws agape, allowing cool air to circulate over the skin in their mouths.

Males reach sexual maturity at about 17 years of age and at a length of approximately 3.3m. Females are capable of breeding when around 12 years of age and approximately 2.3m long. During the breeding season (pre-monsoon), male crocodiles become very mobile as they look for a mate, so sightings are more prevalent.

The female constructs a nest/mound of vegetation and soil on the banks of a watercourse into which she deposits between 40 and 70 oval-shaped eggs. The rotting vegetation incubates the eggs inside the mound, and the temperature and duration of incubation determines the sex of the young. A temperature of 32°C produces both sexes but most are male. Temperatures lower or higher than this result in increasing numbers of females. After about 90 days the hatchlings emerge from the nest.

Young estuarine crocodiles hunt as soon as they hatch preying on small insects, crabs, prawns and shrimps. As they get larger so does the range of potential food items. Full-grown adult estuarine crocodiles are able to feed on whatever they can overpower: sea turtles, pigs, dogs, cattle, horses, buffalo and even other crocodiles.

To capture prey, estuarine crocodiles wait in ambush. Their muscular tail propels them through the water and allows them to lunge forward with great power and speed. It can also be used to thrust them vertically to capture a bat or bird in mid-flight or in foliage. If the crocodile cannot swallow an animal whole, the crocodile either drags it under the water and twists it in a "death-roll" until it dies, or the crocodile will shake its head in an attempt to break off more manageable pieces.

Crocodiles are often observed basking on the banks where they are generally inactive. They are less likely to be seen when they are in the water as they swim just below the surface, with only their eyes and nostrils visible. Crocodiles use physical displays, chemical and vocal signals to communicate. They have no vocal chords so forcing air from their lungs through the back of the throat or nostrils is how they make their vocal noises.

## Be croc wise



When visiting crocodile habitats, take care. Respect these animals and appreciate that crocodiles are part of the ecosystem. You are responsible for your own safety, so if crocodiles occur in your area, please follow these guidelines:

- Never take unnecessary risks
- Obey crocodile warning signs
- Check for recent sightings with local residents or Parks and Wildlife rangers before conducting sampling
- Sample when intertidal banks are fully exposed. Never swim or stand in water above knee-height
- Stay well back from any crocodile slide marks or nests. Crocodiles may be close by
- Never provoke, harass or interfere with crocodiles or their eggs
- Never clean fish or discard fish scraps near the water's edge
- Do not allow your pets near the water
- If sampling at night, have a dedicated observer with a spot light to check for crocodiles
- Be extra vigilant during the crocodile breeding season (pre-monsoon)

More info, visit [http://www.epa.qld.gov.au/nature\\_conservation/wildlife/living\\_with\\_wildlife/crocodiles/](http://www.epa.qld.gov.au/nature_conservation/wildlife/living_with_wildlife/crocodiles/)

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