

# Seagrass-Watch

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

## Floods

### impact on seagrass

Adopting meadows

Seagrass fertilising farms

Status of Qld seagrass 2010

South east Asia seagrasses

Shadow over Kapparahota

Perfect Hydeaway

Learning from severe climate events

Ascidians



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### From the editors

Earlier this year, three-quarters of the state of Queensland (Australia) was declared a disaster zone due to some of the highest floods in over 30 years and one of the most powerful cyclones to have affected the state since records commenced. Major plumes of flood water were reported discharging into coastal areas, raising concerns about the impact on seagrass and the animals they support; in particular sea turtles and dugongs. In this issue, there are articles on severe climate events, including how flood waters can impact seagrass communities and what we can learn from such events.

Included are also articles on the status of seagrass in Queensland prior to the events of this year; threats from elevated nutrients and macroalgae competition on seagrasses in Sri Lanka; and how seagrass wrack is used as a fertiliser in India.

You can also read about an innovative approach to involving citizens in seagrass conservation in Portugal; extension activities during the International Year of Biodiversity; and a meeting of seagrass scientists in Thailand to not only promote seagrass research, but to highlight the importance of seagrasses in SE Asia. You can even learn about ascidians.

#### COVER:

A plume of turbid water over a seagrass meadow on the flood tide, Green Island, Qld  
Photographer L. McKenzie

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

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# Surviving the flood

## How long can seagrass “hold it’s breath”?

Article by Len McKenzie & Richard Unsworth

*Globally, 2010 was one of the hottest years on record and as warm air tends to hold more water, it's not surprising that 2010 was also one of the wettest. Extreme weather events and associated flooding had devastating effects later in the year and leading into 2011.*

Most seagrasses around the world grow in nearshore areas prone to runoff from adjacent lands. During high rainfall events on river catchments/watersheds, floodwaters can discharge in plumes from river mouths into marine waters. River flood plumes can be vast extending several hundreds of kilometres along the coast and can last from days to weeks. Intertidal and subtidal coastal habitats within the path of these plumes are the most threatened.

Freshwater from flood plumes can directly affect salinity in shallow/intertidal waters and have a negative impact on those species adapted to a saline environment. The effects of floods, although part of the environmental hazards of tropical and sub-tropical marine environments are exacerbated by pollutants and sediments from the land.

If seagrass meadows occur within the spatial extent of either sediment deposition or the flood plume itself, they are likely to be impacted. Seagrass as marine plants are particularly vulnerable to freshwater, with growth reduced during salinity stress. Sediments transported by river flood plumes have an immediate effect on coastal seagrasses through sediment deposition. Burial of subtidal and intertidal plants occurs as most sediment is deposited within the first few kilometres of a river mouth. Where sediment deposition is greater than the ability of the buried seagrass to grow through the sediment using energy reserves, plants will die. In addition, while sediments remain suspended in the water column turbidity is high, and light reaching the seafloor is reduced, impacting coastal and deeper water seagrasses beneath the plume. The impact of river flood plumes on seagrass will depend upon the amount of sediment deposited and the persistence of the plume. In Hervey Bay (Queensland, Australia) in 1992, seagrass loss occurred due to a number of factors such as

sediment deposition, light deprivation, and the physical removal of the seagrass by the action of the flood and associated storms<sup>(1)</sup>. As sediments also carry nutrients and toxicants, the concentrations of these associated elements delivered to seagrass meadows will be higher closer to the river mouth. Elevated nutrients stimulate algal growth further reducing light availability to the plant and toxicants such as herbicide inhibit plant growth, ultimately resulting in plant death. Besides transporting sediments, nutrients and land sourced toxicants, flood plumes also contain debris which can physically impact seagrass.

Impacts from floods can be devastating to not only seagrass, but also to the animals they support. This can be direct, such as entangle marine life in debris, or indirect. For example, the loss of seagrass from Hervey Bay after two major floods and a cyclone within a three week period in 1992<sup>(1)</sup> almost wiped out the local dugong population for which the seagrass was their primary food source<sup>(1,2)</sup>.

The rate at which seagrasses can be impacted by flood waters, depends on the seagrass community (species composition), where the seagrasses are (habitat) and the duration of the impact. Evidence from a flood in Hervey Bay in 1999, indicates that apart from the immediate impact of sedimentation, seagrasses will begin to decline within 1-2 months and depending on the habitat, declines will continue for 6-9 months after the flood impact<sup>(3,4)</sup>. This “delayed” response is of concern as the impacts to seagrass resources may be greater than first observed. The ability of seagrass species to survive such conditions is analogous to determining how long it can “hold it’s breath”.

The resilience of seagrass to flood impacts varies greatly and recovery depends on the seagrass community, habitat and the cause of the impact. Species that are structurally smaller and

rapidly growing (eg *Halophila* and *Halodule*) are typically adapted to higher disturbance regimes including floods and storm. In contrast, species which occur in lower disturbance environments such as sheltered bays and estuaries are higher biomass, slower colonising seagrasses such as *Zostera*. Their capacity to recover from the impact of flood plumes will depend on their seed bank reserves, the availability of vegetative fragments and also on their initial resistance to the impact.

The speed of seagrass recovery from flood impacts depends on the persistence of the impacting factor. Recovery of deeper water (>15m depth) seagrasses, where the impact from the flood waters was primarily light deprivation, may begin within a few months, with full recovery within 1-2 years<sup>(1,5)</sup>. Recovery of intertidal seagrass, where the impact was primarily sedimentation/burial may not begin for 14-18 months, with full recovery in 2-3 years<sup>(4)</sup>. Shallow subtidal meadows however, take a lot longer to recover due to the continual resuspending of finer particles settling on the plants and seafloor. In these habitats, recovery has been shown to take more than 3-5 years<sup>(1,6)</sup>.

Floods are a natural part of coastal environments, and in some tropical locations over 90 percent of seagrass meadows are inundated every year by primary flood plumes<sup>(7,8)</sup>. However, of concern is that it is very likely that global anthropogenic greenhouse gas emissions



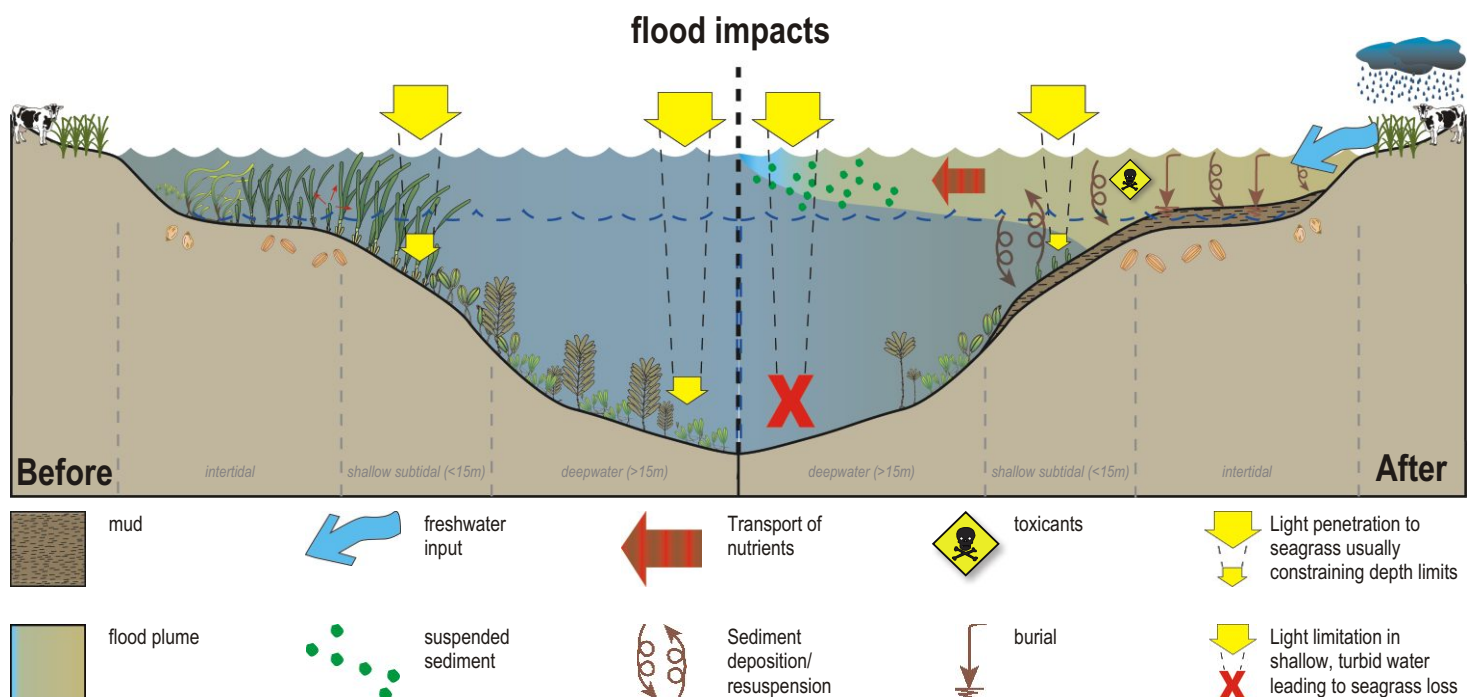
in the twentieth-century have substantially increased the risk of flood occurrence<sup>(9)</sup>.

Coupled to the issues of climate change are the reduced capacity of marine habitats around the world to take additional stress given their existing threats from coastal development and poor water quality.

Extreme weather is thought to be increasing in and is considered by the United Nations to be a potential indicator of climate change. According to the

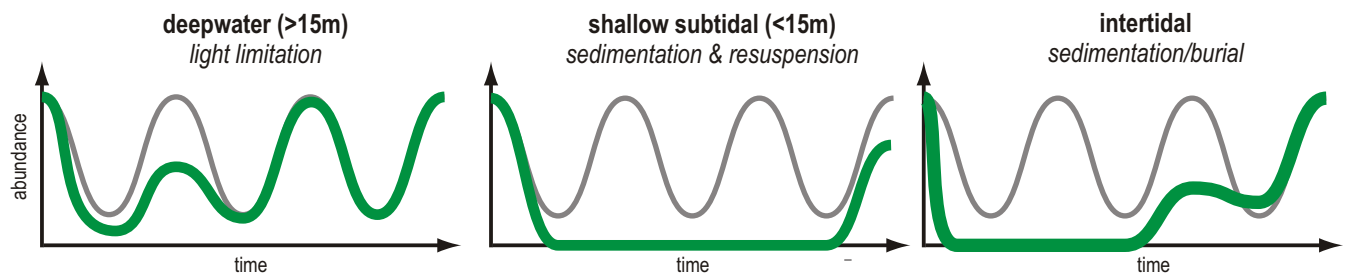
Intergovernmental Panel on Climate Change, there is a 90 percent chance that heavy precipitation events will become more frequent. Already, it reports, "The frequency of heavy precipitation events has increased over most land areas, consistent with warming and observed increases of atmospheric water vapour."<sup>(10)</sup>

Although floods are a natural part of the Queensland environment<sup>(8)</sup>, the widespread and intense nature of the 2011 floods were unprecedented. From



Conceptual diagram depicting expected impacts on seagrasses from flood plumes





**Stylised patterns of impact and recovery of seagrass abundance from flood plumes for intertidal, shallow subtidal and deepwater habitats.**  
Time period from impact to expected recovery is 3 years. Normal seasonal pattern shown in grey.

mid December 2010 to mid January 2011, heavy rainfall across central and southern Queensland river catchments, due to TC Tasha combining with a trough during the strongest La Niña weather pattern since 1973, resulted in some of the highest floods in over 30 years. Three-quarters of the state of Queensland was declared a disaster zone.

[La Niña is a cooling of ocean temperatures in the east and central Pacific, which usually leads to more rain over much of Australia, Indonesia and other parts of Southeast Asia.]

Reports that Queensland coastal waters seaward of the major catchments were experiencing major inundations of freshwater from rivers, creeks and inland water bodies raised concerns regarding the impact on adjacent nearshore environments, including corals and seagrasses. These turbid floodwaters contained varying amounts of freshwater, sediments, nutrients and pesticides as well as other potential contaminants and could have significant impacts on seagrasses.

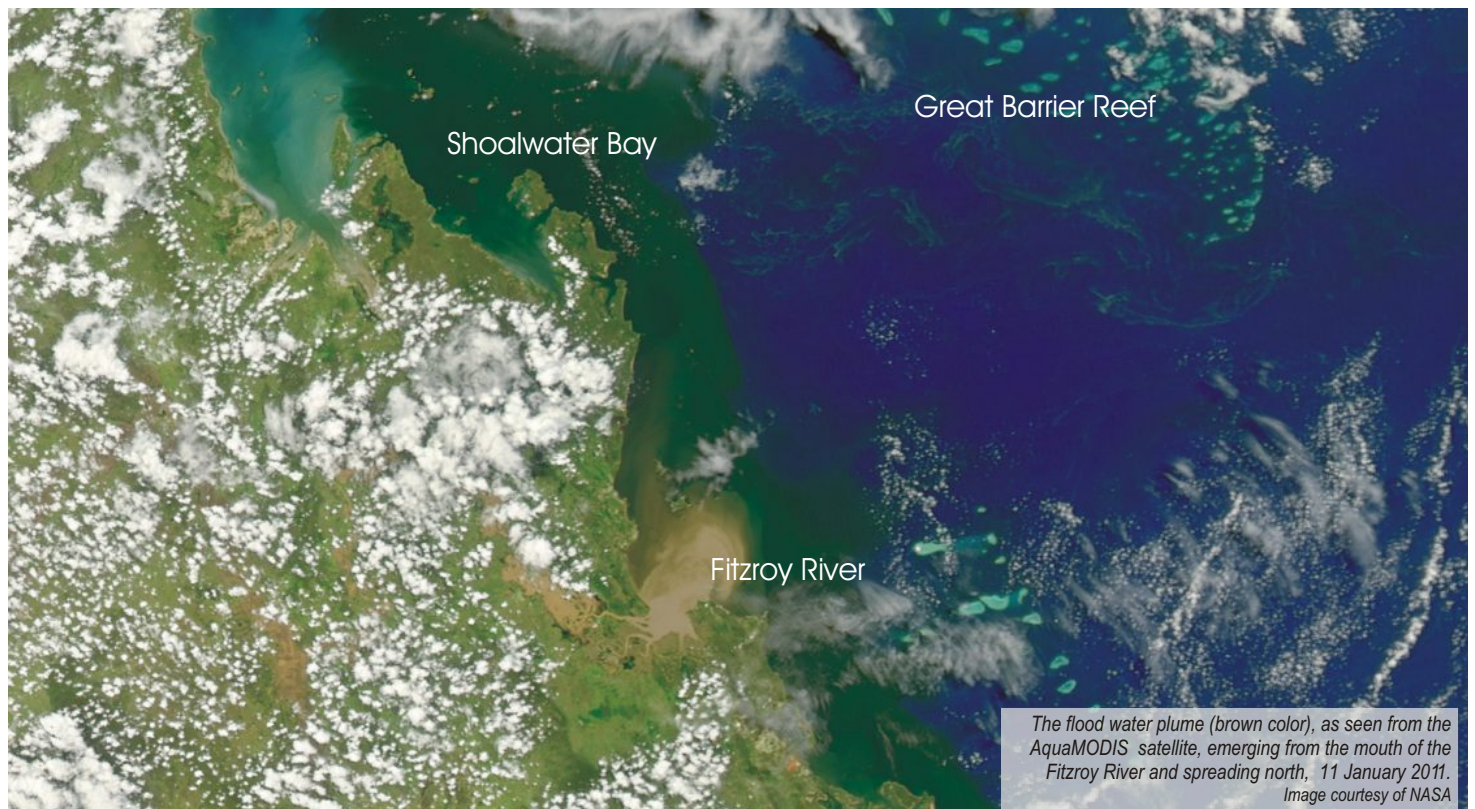
The main regions with significant seagrass meadows that were adjacent to the flooded catchments were Shoalwater Bay, Great Sandy region and Moreton Bay.

Seagrasses in Queensland were already in decline (see article page 18) and in south east regions the extreme flooding could be the proverbial “straw that broke the camel's back”. This will impact on a range of environmental values and potentially affect the ecological character of the Ramsar sites in Moreton Bay and Great Sandy Strait and the World Heritage Area of the Great Barrier Reef. Concerns regarding the flow-on effects of habitat loss, such as the fishing industry or lack of food for dugong and turtle may yet to be realised.

The full extent of the flood impacts on our seagrass may not be known for several months. To help measure the level of impact, Seagrass-Watch monitoring can play an important role in providing quality data on seagrass status which will assist coastal managers to make decisions on how to respond with greater confidence.



**Images**  
Mud and debris washed down suburban drains after the Brisbane floods (top)  
Houses under water in the Brisbane suburb of Yeronga. Most houses along this street had flood water through their second storey (above). Photos courtesy Zane & Marc Yoshida



The flood water plume (brown color), as seen from the AquaMODIS satellite, emerging from the mouth of the Fitzroy River and spreading north, 11 January 2011.  
Image courtesy of NASA



# Shadow over Kapparithota

Sri Lanka

Article by Bandara W M D K,  
Terney Pradeep Kumara P B &  
Gamage K G N P

Photography Bandara W M D K &  
Terney Pradeep Kumara P B



After a four hour drive along the western and southern coastline from the capital city of Colombo, one can reach the busy coastal town of Weligama. Being a fishery and tourism dominated economic centre of southern Sri Lanka, Weligama is also popular amongst the ecologists & naturalists for its unsurpassed richness of marine biodiversity.

Along the 800m stretch of warm, shallow coastal waters of Weligama are several islets, a fringing reef and number of seagrass meadows.

Seagrasses of this area are distributed as small or intermediate size meadows, thriving within the shallow Weligama Bay. From its earliest reputation, the seagrass meadow of Kapparithota has been known as one of the largest, most diverse, healthy and famous spots of Weligama Bay.

Organised data collection on this seagrass meadow was started in mid 2009, where Kapparithota was used as a sampling and continuous data-collection site for the undergraduates of the B.Sc Fisheries and Marine Sciences degree program of the University of Ruhuna. Such periodical ecological surveys primarily focussed on the seagrass cover estimates, pollution estimates, and diversity estimates of allied fauna and flora.

Observations made during late November 2010 showed several species of macroalgae, out-competing the native seagrass growing in the Kapparithota region. In mid December 2010, a detailed ecological assessment was conducted to determine the spatial extent of seagrass and macroalgae of the Weligama - Kapparithota seagrass meadow.

Described in this article, is a comparative account of the past and present status of the Kapparithota seagrass meadow, with respect to its species composition and spatial extent.

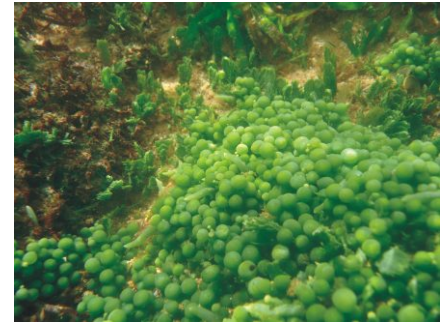
Field data collected to date reveals the presence of five seagrass species associated with the Kapparithota seagrass meadow: *Thalassia hemprichii*, *Cymodocea rotundata*, *Halodule uninervis*, *H. pinifolia* and *Syringodium isoetifolium*. Of all the seagrasses, in both 2009 & 2010, *Thalassia hemprichii* was the dominant species, which stretched along the shoreline region of the meadow. The two species of *Halodule* (*H. uninervis* & *H. pinifolia*) occupied the above region as small sparse patches, exhibiting relatively low ground cover. *Syringodium isoetifolium* seemed to be the dominant species in relatively deeper (1.0 - 1.5 m) regions with fine-textured sandy substratum. *Cymodocea rotundata* was only observed in 2009, with an extremely limited distribution and encompassing relatively insignificant ground cover.

Although the initial survey revealed a great prosperity of species richness and abundance of seagrasses, later, the 'reality' shifted its phase towards a harsh phenomenon. Kapparithota seagrass meadow started to shrink, in terms of spatial extent and diversity. An important feature of highlight was the local extinction of two seagrass species within the above meadow during the sampling period.



Kapparithota coastline (left)





*Caulerpa taxifolia*. This fast spreading invader, with its genetic counterpart *C. sertularoides* has made a burst in abundance and distribution, while invading the shallow fore-regions of the coast, previously occupied by *Thalassia hemprichii*.

*Cymodocea rotundata* which had a relatively insignificant ground cover of 0.09% in 2009 seemed to have perished from the Kapparahotta meadow in later months. Neither individuals nor aggregates of the above species were recorded during the three sampling events conducted in 2010. Furthermore, *Halodule pinifolia*, which exhibited lower ground cover compared to its 'trident-tipped' counterpart (*H. uninervis*), was not recorded since July 2010.

With the local extinction of *Cymodocea rotundata* and *Halodule pinifolia*, species richness of the Kapparahotta seagrasses meadow decreased by 40% during the sampling period. Furthermore, all seagrass species showed a temporal decreasing trend of its spatial distribution. For example, the dominant species of this meadow, *Thalassia hemprichii*, has sustained an average loss of 16.1% cover. On a percentile scale, this loss accounts for about 81.27% from its 2009 value. This scenario seems to be more or less similar for the loss of other seagrass species.

The most possible causes for this drastic decline could be a result of changes in nutrient levels and intensifying algal competition.

#### Images:

Kapparahotta fish harbour which is located very close to the seagrass meadow. The photographer was standing on the meadow when he took this photograph. Distance to anchorage is 10-15m (above left)

Rich growth of *Caulerpa racemosa* and *C. taxifolia*, Kapparahotta. (above)

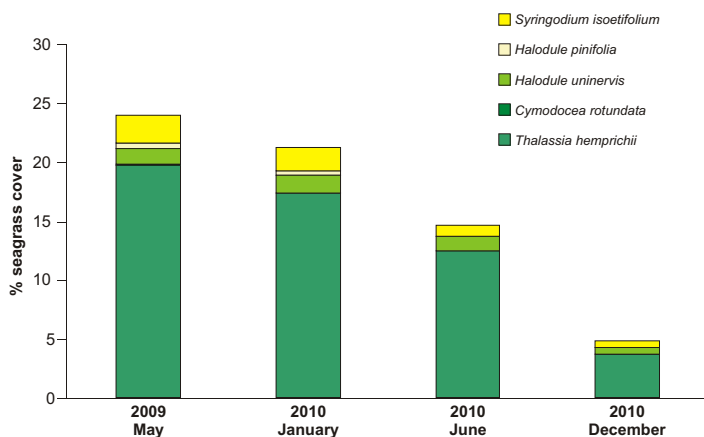
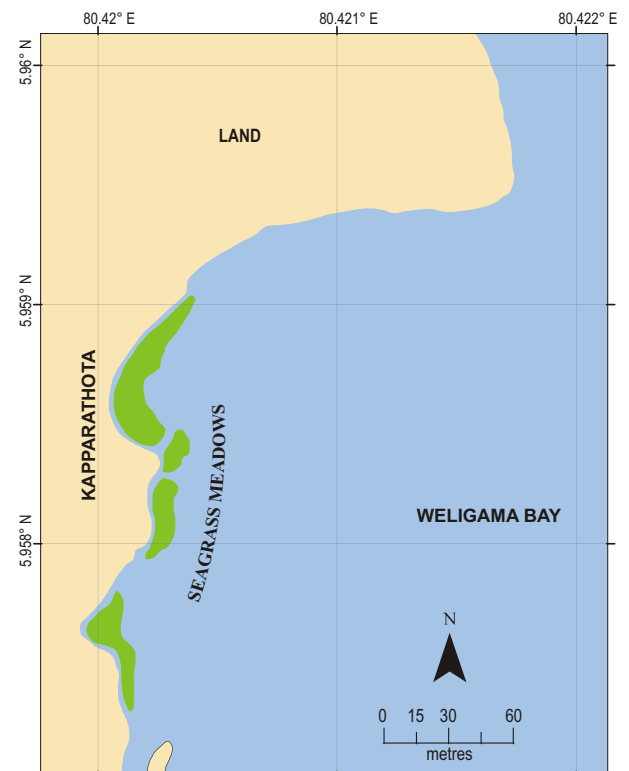


Figure 1: Percent seagrass cover at Kapparahotta within the sampling period from 2009 to 2010





Nutrient data (Nitrate & Phosphate) shows an increasing trend, as the concentration values of phosphates were almost 50 times higher from its initial value (0.05ppm in 2009 vs. 2.35ppm in 2010) . Similarly, nitrate levels have also increased by nearly six-fold (1.91ppm in 2009 vs. 12.41ppm in 2010).

**Nutrient levels of the study area during the sampling period.**

Means are reported with Standard Deviation (SD), with the range in parentheses. Note that data of January 2010 are not available.

sampling period	Dissolved Nitrate (ppm) mean ±SD (n=3)	Dissolved Phosphates (ppm) mean ±SD (n=3)
2009 May	1.91 ±0.19 (1.72 - 2.10)	0.05 ±0.01 (0.05 - 0.06)
2010 June	9.21 ±2.45 (6.44 - 11.09)	0.99 ±0.11 (0.89 - 1.10)
2010 December	12.41 ±2.52 (9.59 - 14.44)	2.35 ±0.23 (2.10 - 2.56)

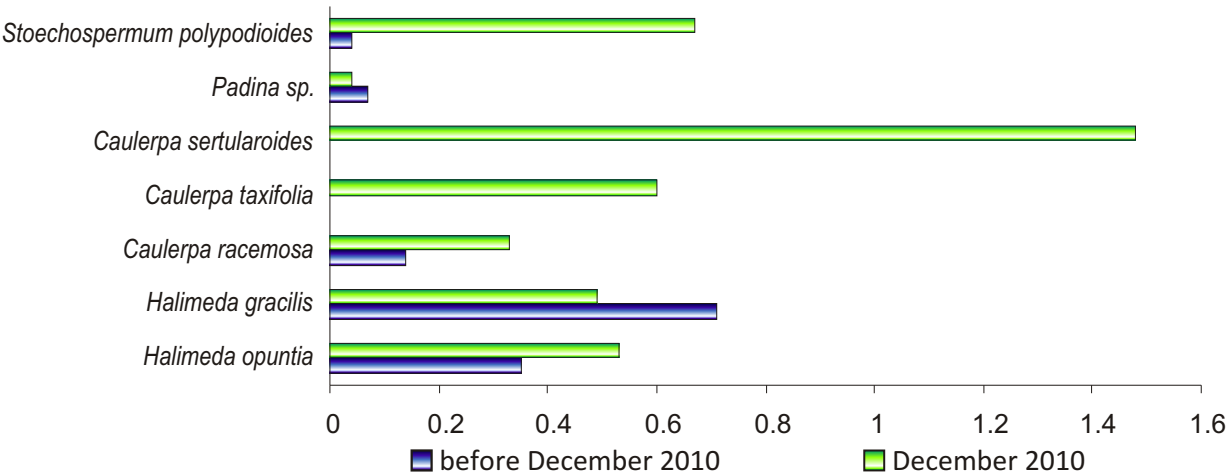
Where have all these nutrients come from? The answer is quite straight forward. The Kapparahota fishery harbour, adjacent fish landing centre, numerous residences and some main tourist hotels all discharge untreated nutrient rich effluent into the nearby sea.

Since December 2010, the major macroalgae found within the study site were *Halimeda opuntia*, *Halimeda gracilis*, *Caulerpa racemosa*, *Padina* sp., and *Stoechospermum polypodioides*. But during the 2010 survey, it was found that the ground cover of *Stoechospermum polypodioides* and *Caulerpa racemosa* dramatically increased.

Furthermore, one of the key features of notice about the macroalgae composition was the enhanced spreading of the so called 'killer-algae' *Caulerpa taxifolia*. This fast spreading invader, with its genetic counterpart *C. sertularoides* has made a burst in their abundance and distribution, while invading the shallow fore-regions of the coast, which were previously occupied by *Thalassia hemprichii*.

With increased nutrients and intensified algal competition, it is possible that the decreasing trend of the seagrass cover may continue. As the observed changes in species composition occurred rapidly, it might only be a matter of time before we observe the elimination of the remaining seagrasses.

Another detailed ecological assessment is planned for early this year. It is expected that this would also bring about some interesting facts regarding the status of the Kapparahota seagrass meadow and its fate. Even if the hour is too late to take necessary counter measures to protect this seagrass meadow, if the local community and local government take actions sooner, this important ecosystem & its services would be able to be ensured in the long-run.



**Figure 2:** The change in percentage cover of macroalgae in the Kapparahota seagrass meadow before and during the 2010 December sampling effort

**Images**

Undergraduate of Dept. of Oceanography and Marine Geology sampling seagrass during the 2009 survey. This region is a mixed community of *Halodule uninervis* & *H. pinifolia* (left)  
Sparsely distributed *Thalassia hemprichii* within the study site (right)





# Can we learn from severe climate events?

Australia

Article by Rob Coles, Len McKenzie & Alana Grech  
Photography Len McKenzie & Rob Coles

Dunk Island July 2008



*In the early hours of 3 February 2011, severe Tropical Cyclone Yasi (Category 5) crossed at Mission Beach on the northern Queensland coast. Rated as one of the most powerful cyclones to have affected Queensland since records commenced, TC Yasi brought sustained winds of 205 km/h, gusting up to 285 km/h, and a 5 m tidal surge.*

A hurricane Katrina size storm, the level of disturbance to coastal and nearshore environments from Innisfail to Townsville was considerable. Subsequent flooding from the associated rains also resulted in flood plumes discharging from rivers into near shore environments in the region.

The Marine Ecology Group based in Cairns and Townsville were asked to assess the damage to the local seagrass meadows and to advise on any management responses required.

The questions are challenging ones! They presuppose a level of knowledge about our seagrass meadows at a relatively small scale and in an area chosen randomly by the chance movement of the tropical storm.

We broke our response into four questions:

1. What seagrass information did we have on the extent of the meadows, abundance and species composition for this region prior to the cyclone;
2. What information do we have about its trends and condition, variability and values prior to the cyclone;
3. Can we estimate how much seagrass was damaged or destroyed; and
4. What coastal management or fisheries management changes are necessary to ensure continued protection or recovery?

*Severe Tropical Cyclone Yasi originated from a tropical low northwest of Fiji. The system intensified to a Category 3 cyclone at about 4pm on 31 January 2011. Late on 1 February the cyclone strengthened to a Category 4 system, then early on 2 February, the cyclone intensified to a marginal Category 5 system.*

*Yasi maintained this intensity and its west-southwest movement, making landfall on the southern tropical coast near Mission Beach (138km South of Cairns) between midnight and 1am early on Thursday 3rd February. Being such a strong and large system, Yasi maintained a strong core with damaging winds and heavy rain, tracking westwards across northern Queensland and finally weakened to a tropical low near Mount Isa around 10pm on 3rd February.*

Source: Australian Bureau of Meteorology

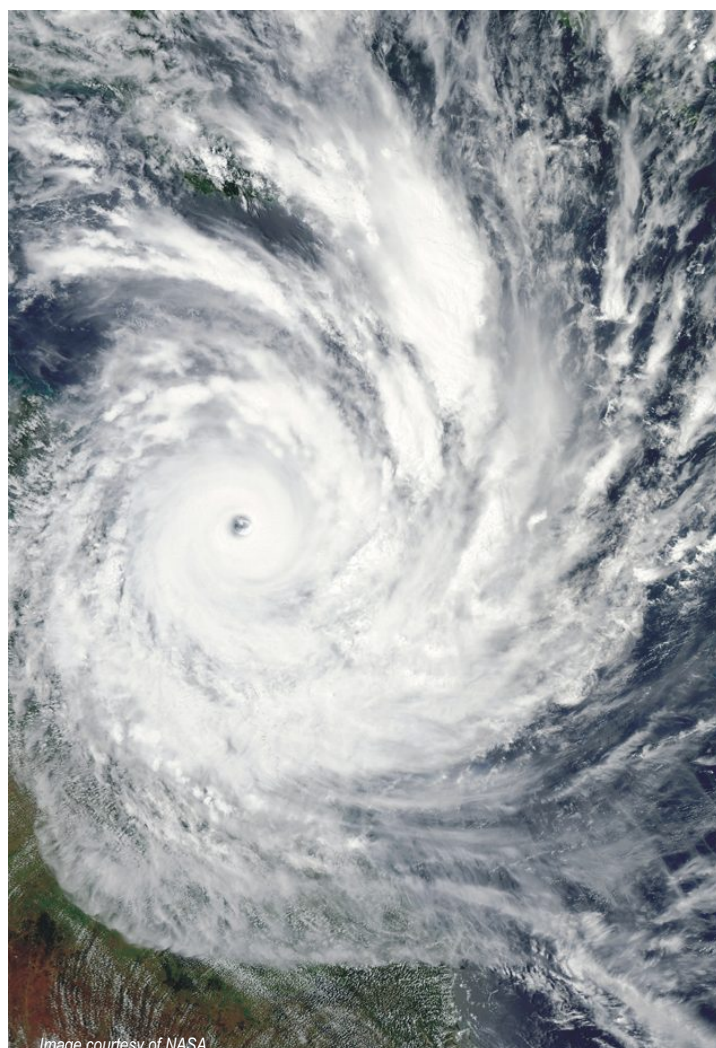


Image courtesy of NASA





*After making landfall at Mission Beach, in the early hours of 3 February 2011, the level of disturbance to coastal and nearshore environments between Innisfail and Townsville from severe TC Yasi (Cat. 5) was considerable. The erosion and sand movement over the intertidal banks on Dunk Island (Mission Beach) severely impacted the seagrass meadows on the Island. Only a few isolated shoots remain.*

We are lucky in north-eastern Australia. The presence of the Great Barrier Reef and its importance as one of the world's most famous natural assets ensures environmental monitoring programs are supported. The seagrass meadows in the area of the cyclone impact had been surveyed in 1987 and 1996 and modelled for probability of seagrass presence in 2010 (see page 18). So we can reasonably answer Question 1.

For Question 2 we have 12 long-term monitoring sites within the impact zone and are able to make some interesting observations. The La Niña cycle, which probably spawned cyclone Yasi had already had an impact on seagrass meadows with noticeable declines in abundance and area. It has just been very cloudy, windy, and wet for the last 12 months in this part of the world and these declines and mostly natural (see page 18).

Questions 3 and 4 are harder. Yes we can quickly look at intertidal meadows and have done so since TC Yasi. As expected

little seagrass was found and coastal erosion has reformed many of the beach and mudflat profiles. Mapping sub-tidal meadows is more difficult. It is expensive and time consuming, requiring divers, real time cameras and boats. And will the information justify the cost? We would have difficulty interpreting the data because of poorly understood natural seasonal variability and natural spatial changes. We do have some information collected for existing programs and that will probably have to suffice.

Which bring us to the final question? Is there anything government management agencies, NGO's and local citizens can do to ensure the remaining seagrass meadows are protected and recover? Well, yes of course we can intervene at any level from education programs to replanting. But we need to ask about the cost and effectiveness of these approaches and the protection framework already in place - no point in replanting a seagrass meadow to have it destroyed by marina development in the future. And we suggest that "knee jerk" reactions to severe events such as cyclones diverts attention away from the need for longer term understanding of risk and resilience of tropical ecosystems and the need to tailor management systems to provide long term protection.

We are keen as well to ensure lessons learned from these events are shared amongst the seagrass constituency. Are approaches developed in north eastern Australia at all relevant in other countries around the world?

So watch this space, as we will explore approaches to managing risks to seagrass in a future edition of the Seagrass-Watch magazine!!!!



*Dunk Island Day trip centre destroyed by Yasi*



## A chance to share your expertise in the area of seagrass and mangrove management!!

We are running a session at the Coastal and Estuarine Research Federation Conference, Daytona Beach Florida starting 6th November 2011. The session is titled:

Tropical Ecosystems (SCI-085) Threats to Coastal Marine Habitats in the Tropical Indo-Pacific Region

Conveners: Robert G. Coles (rob.coles@deedi.qld.gov.au), Norman Duke (n.duke@uq.edu.au) and Len McKenzie (Len.McKenzie@deedi.qld.gov.au)

Strategies have been developed to understand and manage the cumulative impacts of multiple pressures on the coastal ecosystems, particularly those of seagrass and mangroves, and the goods and services they provide in the tropical Indo-Pacific region. These are tailored to meet the needs of different countries but meet a common theme - there is increasing cumulative environmental pressures on coastal habitats and a requirement for sustainable development based on understanding of ecosystem linkages. This session will explore our experiences from this region. We encourage a blend of pure science and science applied to management strategies and solutions. (SCI-085; Tropical Ecosystems; Habitat Mapping and Assessment; Management, Planning and Policy)

We encourage you to submit an Abstract for our session

For more information visit [www.sgmeet.com/cerf2011](http://www.sgmeet.com/cerf2011)

**Rain drenched Cardwell (below) 2 months after Cyclone Yasi devastated the small sea side town:** Cardwell was one of the worst affected towns after Cyclone Yasi made landfall, with the eye of the cyclone passing over Dunk Island and Tully (38km north) around midnight on 2nd February. Cardwell suffered major damage to structures and vegetation. Most of the beach had lost its sand and every structure was damaged to some degree. Wind gusts were estimated to have reached 290 km/h and a 5 metre tidal surge was observed at the Department of Environment and Resource Management storm tide gauge at Cardwell, which is 2.3 metres above Highest Astronomical Tide. The anomaly occurred at about 1.30am on a falling tide, averting more serious inundation. In the 24 hours of the cyclone passing, 240mm of rain fell on Cardwell and a near record rainfall total of 897.8mm for the month was recorded.

Source: Australian Bureau of Meteorology Monthly Weather Review







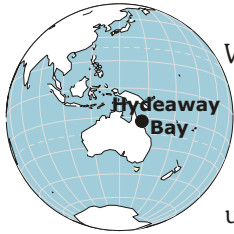
# perfect Hydeaway

Australia

Article by Len McKenzie

Photography Len McKenzie &  
Rudi Yoshida





Located in the Whitsunday region of central Queensland, the secluded township of Hydeaway Bay lives up to its name.

Approx 50km from Airlie Beach, the township is situated in the remote northern section of Cape Gloucester on the shores of Shoal Bay. Hydeaway Bay was established in 1985 from an expired pastoral lease and has a small resident population of just over 300, with many homes also owned as holiday getaways.

Seagrass-Watch monitoring sites were established on the fringing reef adjacent to the township in April 2000 and have been monitored since March 2001 by local resident and one of Seagrass-Watch's longest volunteers, Maren Mathews. The sites were originally established because local residents were concerned about the possible impacts of coastal development with the anticipated expansion of the township. There are no major rivers flowing into this coastal section and a high proportion of the catchment in this region is covered with native terrestrial vegetation. Negative impacts from catchment inputs and urban and agricultural development are likely to be low.

The seagrass meadows on the fringing reef flat at Hydeaway Bay cover approximately 157ha and are predominately mixed meadows of *Halodule uninervis*, *Halophila ovalis*, *Cymodocea rotundata* and *Thalassia hemprichii*. Seagrass abundance follows a seasonal trend, characterised by maximum cover (>20% cover) in summer/autumn (December-April) and minimum cover (<20% cover) in winter



#### Images

Sea cucumbers (*Holothuria coluber*), across the reef flat is a significant feature of the meadows (top left)

The Hydeaway Bay Team: Valda, Tony, Maren and Victoria (Avril was photographer) (top right)

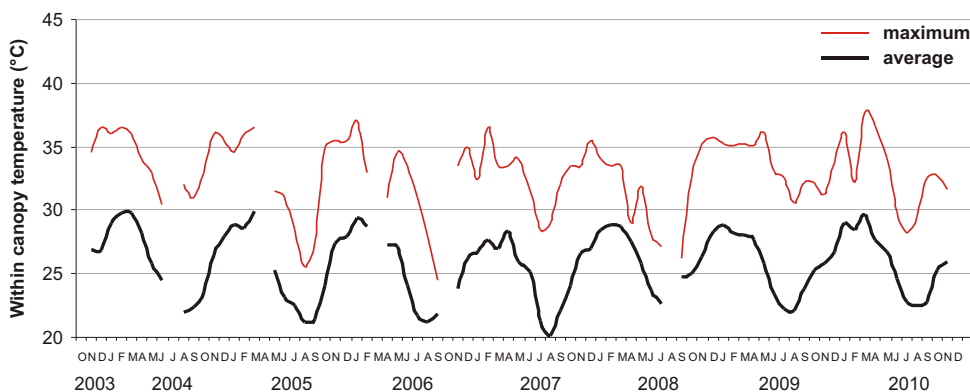
Bailer Shells mating on the reef flat, July 2007 (above)

(June-July). This suggests that seagrass meadows at these sites are primarily influenced by natural factors (temperature, light, wave action). The seagrass cover is generally below the long-term average for reef habitats of the Great Barrier Reef and until recently, no long-term trends were apparent. Over the last 12-18 months, seagrass cover has declined. However this decline is not

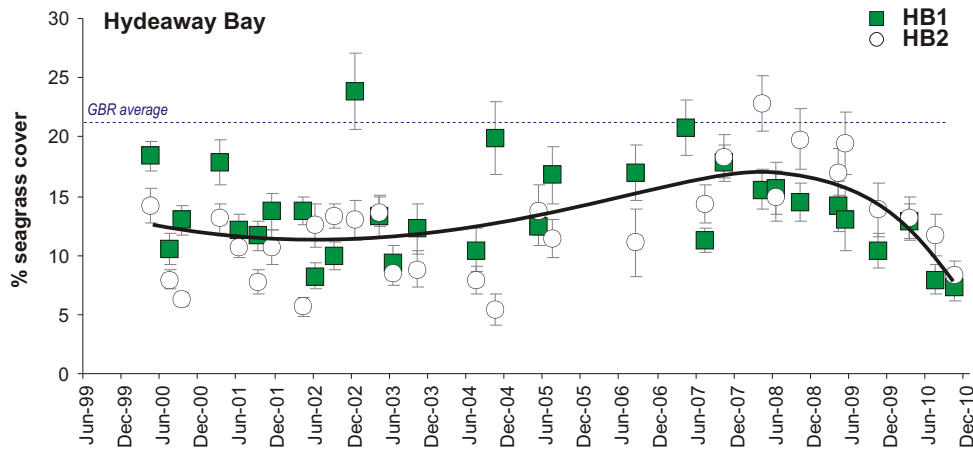
confined to Hydeaway Bay, as seagrass meadows in the Great Barrier Reef south of Cairns have also shown a similar decline (see page 18).

At Hydeaway Bay maximum epiphyte cover (>35-75%) occurs in spring-summer (October - December) and autumn (March), and minima in winter. High epiphyte cover in spring-summer may be the result of higher high water temperatures and light availability. High rainfall during summer may also enrich waters with nutrients necessary for epiphyte growth. Algal cover remained below 20% with no seasonal pattern.

The presence of large black sea cucumbers (*Holothuria coluber*), or snakefish, across the reef flat at both sites is a significant feature of the meadows. The numbers of these sea cucumbers can be so great at times, that navigating your way across the reef-flat can be quite time consuming. But these are not the only abundant animals, as hermit crabs, stromb shells are also common. Lots of protected species are also found across the meadows, including the Horse's Hoof or Bear Paw clam *Hippopus hippopus* (issue 39) and Bailer Shells (*Melo amphora*). If







you're lucky, during July you can find the Bailer Shells mating and then in October observe them laying their eggs - a rare sight. Dugongs also visit the bay, as feeding trails are often found in the shallow *Halodule uninervis* meadows adjacent to the beach at the southern end of the reef-flat.

Being on a reef flat, seagrasses at Hydeaway Bay are also interspersed with corals (soft and hard). In early 2002, Maren reported coral bleaching on the edge of the reef and at the same time observed "burnt" seagrass. It was this event which prompted Seagrass-Watch to establish an *in situ* temperature

monitoring component to the program (see issue 40).

Experimental studies on tropical seagrasses by Seagrass-Watch HQ in 2003 determined that the sensitivity of seagrass to elevated seawater temperatures was species specific and that short term exposure to temperatures above 40°C resulted in leaf death: a condition known as "burning" (see Issue 40). Fortunately, no extreme temperatures have been recorded at Hydeaway Bay since temperature monitoring was established.

Continued monitoring of seagrasses at Hydeaway Bay is important as it is a "reference" site against which the condition of other reef habitat seagrass meadows in the region can be compared. Ensuring that coastal development is managed to minimise impacts to the near shore habitats, will enable Hydeaway Bay seagrasses to continue as a critical habitat and food resource, and also provide valuable habitat for green sea turtle and dugong moving between Edgcombe Bay and the Whitsunday Islands.





# adopting meadows



Portugal

Portugal

Article by Alexandra Cunha

Photography Alexandra Cunha & Jorge Gonçalves

**A**DOPT-A-SEAGRASS-MEADOW is a seagrass conservation program that aims to raise the charisma of the seagrass habitats and to create awareness for the increasing threats that menace this coastal ecosystem. Seagrass habitats in Portugal are very poorly known, ignored by the public, governmental entities and even fellow scientists. Only three species of seagrass occur in Portugal: *Zostera marina*, *Zostera noltii* and *Cymodocea nodosa*. Seagrass meadows are localised in drowned river mouths and sheltered bays, with *Z. noltii* on the large intertidal mud flats, and *Z. marina* seaward in the shallow subtidal (accompanied by *C. nodosa*). The idea behind the Adopt-a-Seagrass-Meadow is to create a network of people that will survey all the seagrass meadows present along the Portuguese coast.

“Adoptive parents” first apply for adoption and are obliged to:

- monitor the protected meadow twice a year,
- organise seagrass awareness activities at least twice a year,
- keep informed about coastal activities and write to the official entities in case of knowing about any activity that can damaged the “protected” seagrass,
- raise funds to assist the program, and finally,
- keep the project website updated with the activities conducted which support seagrass conservation.



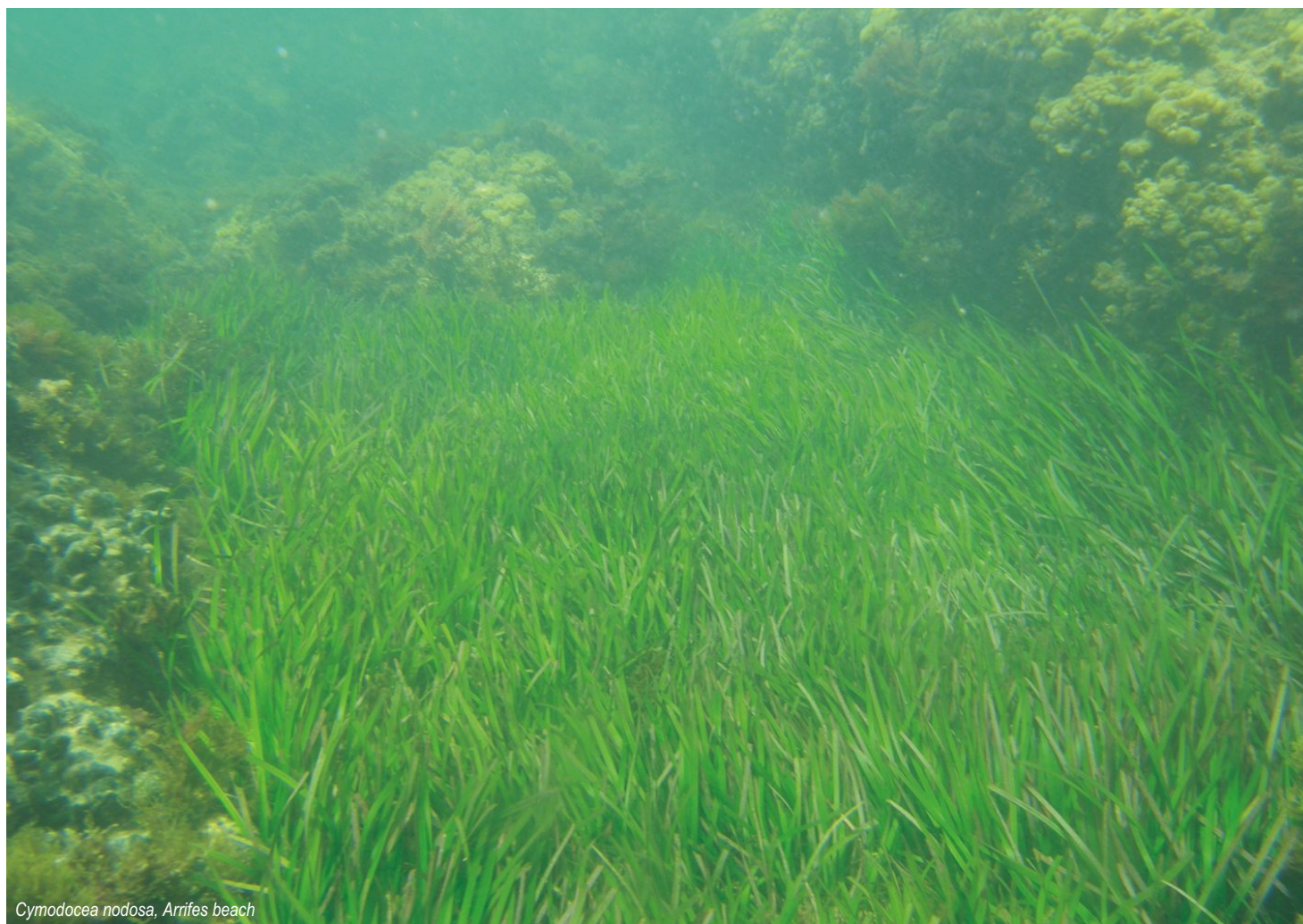




**Cuttlefish eggs attached to *Zostera marina* leaves:** The black eggs, generally called "sea grapes" are often mistaken for macroalgae air bladders and resemble a black bunch of grapes. The black colour comes from the cuttlefish's defensive ink.



“Adoptive parents” need to “apply for adoption” and are obliged to monitor the protected meadow twice a year

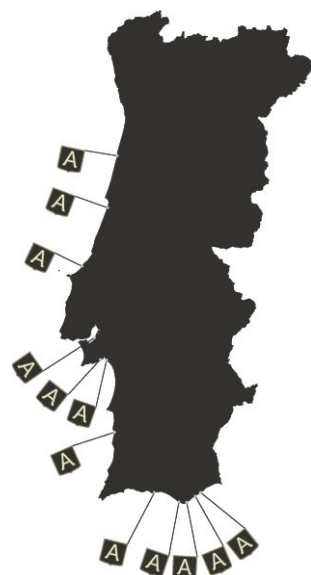


*Cymodocea nodosa, Arrifes beach*

“Adopt-a-Seagrass-Meadow” started in February 2010, and has great success with 14 meadows already adopted (locations of which are marked on the adjacent map). Some of the meadows had more than one interested group, and so we had to create “Adoption Consortiums”. One of the greatest joys of the program was that we were able to reach a large range of people, from our scientific colleagues who thoroughly embraced the program, to SCUBA diving schools, NGOs, secondary schools, Fisherman Associations, Boy scouts, etc.

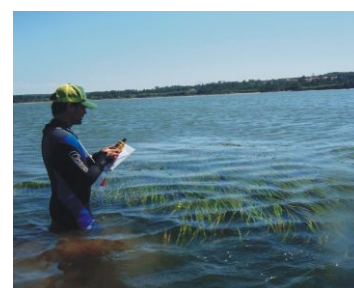
The media has also embraced the idea and many newspaper articles have been released. Internet blogs, television and radio shows have also talked about the program. Everyone is very eager to help stop the destruction of this critical habitat.

This program shows that civil society is ready to share with scientists to advocate marine conservation and that it is up to us all to contribute.



*Images left to right*

*Looking for shellfish in the meadows of Fuzeta , Collecting samples in a Zostera noltii meadow, Seagrass meadow in ilha Culatra, Monitoring of the Óbidos lagoon*





# Ciência Viva

Article and photography by Carla Pacheco

Summer 2010  
Portugal

2010 was the International Year of Biodiversity. The main purpose was to Celebrate Earth Life Diversity and avoid Biodiversity Loss. Under the “Ciência Viva Summer 2010” program (coordinated by the National Agency for Scientific and Technological Culture) the Estremoz Science Center, School of Sciences and Technology of the Evora University and the Seagrass-Watch project held a Bioactivities project.

During a few days in July/August 2010, biological observations were conducted at several beaches of the Southwest Alentejo and Vicentina Coast Natural Park, with special emphasis in the Furnas Beach Mira River Estuary (Vila Nova de Milfontes). The Bioactivities project organised a number of displays to promote and raise awareness for the preservation of biotic communities and stimulate knowledge about the importance of these ecosystems. Experimental and educational materials were provided, using a marquee settled in the sand, for interested persons who frequented the beaches.

Daily and during low tide periods, we also organised field trips in order to observe the marine angiosperms communities *Zostera noltii*. With the assistance of science supervisors, participants were able to observe, record and monitor biotic and abiotic factors. It



began with the determination of abiotic measures (e.g., atmospheric temperature, water pH, weather conditions). Using portable water temperature and salinity equipment the participants measured and recorded the abiotic factors in several places. In the same location, the biotic biodiversity was observed using hand lenses; where necessary some samples were collected more detailed observations under a microscope. Taxonomic field guides enabled the identification of the fauna and flora.

In this activity the trash found on the beach was also collected as a way to raise awareness of the extremely negative consequences of waste disposal in ecosystems.



*Bioactivities project raising awareness for the preservation and stimulating knowledge about the importance of ecosystems (above and below left)*

*Mira River Estuary, Vila Nova de Milfontes (below right)*

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Bioactivities  
promote,  
raise awareness  
and stimulate knowledge  
about the importance  
of these ecosystems.

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Status 2010

# Queensland Seagrasses

Torres Strait  
& East Coast

Australia



Article by Len McKenzie, Alana Grech,  
& Rob Coles

Photography Len McKenzie  
& Helen Taylor

*Abridged version: McKenzie et al. (2010) Queensland  
seagrasses. Status 2010 - Torres Strait and East Coast.  
Fisheries Queensland (DEEDI), Cairns. 6pp*

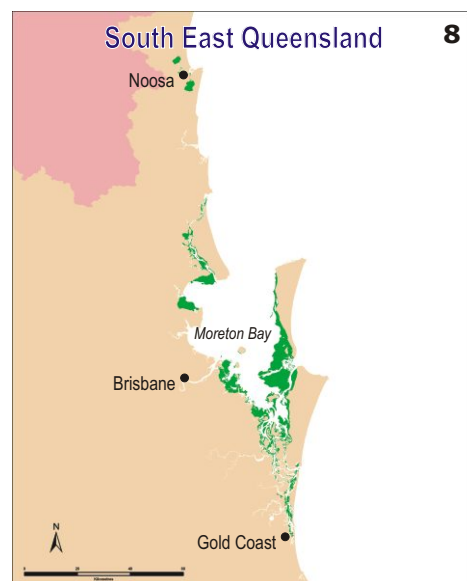
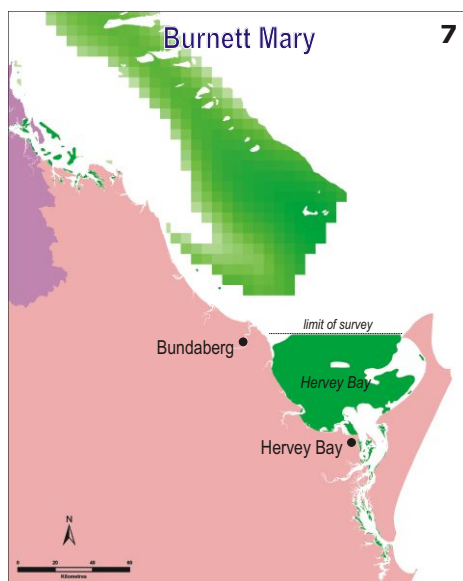
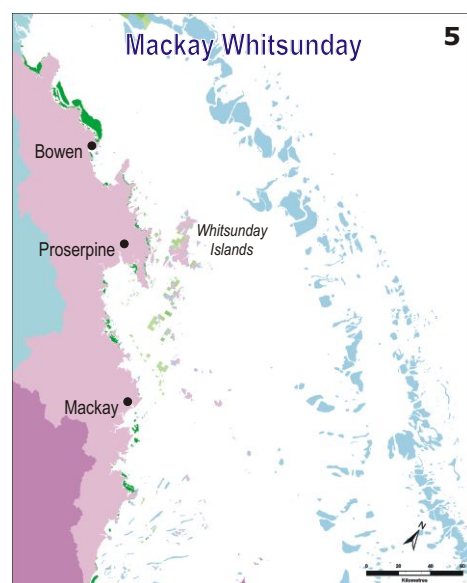
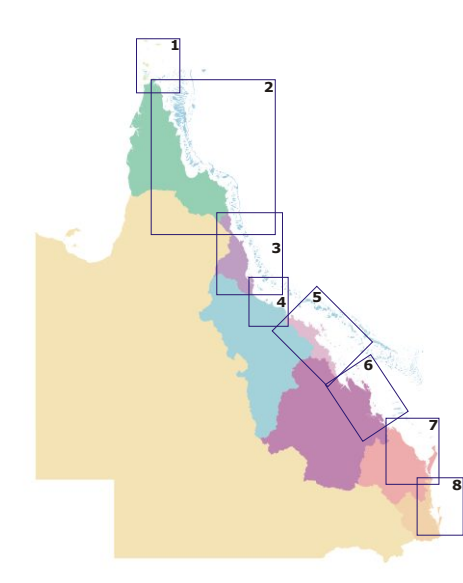
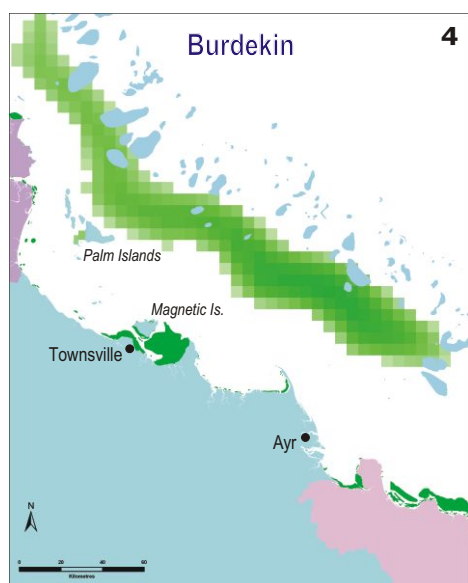
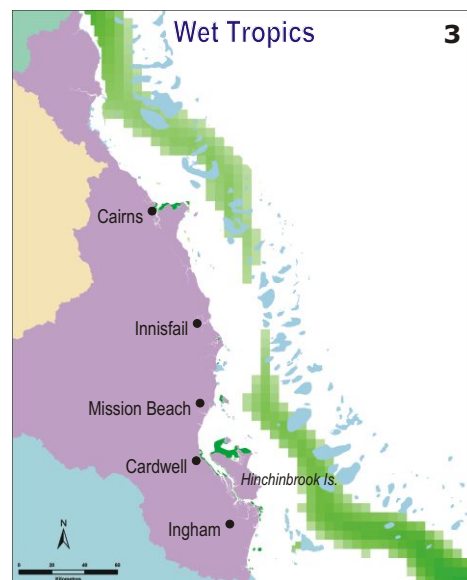
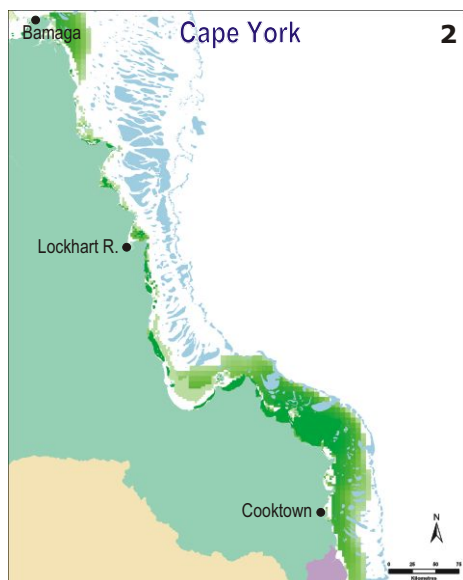
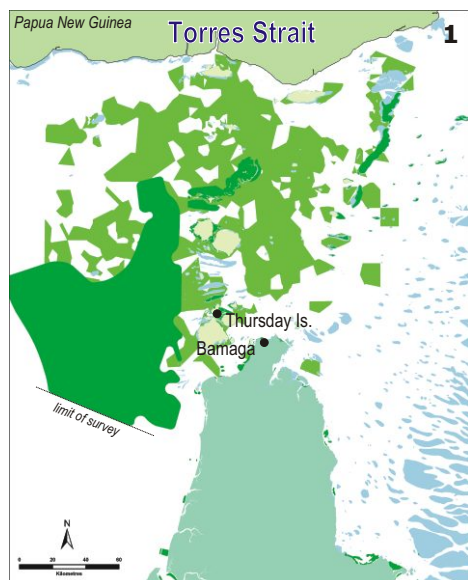
**S**EAGRASSES are a key component of the marine ecosystem of Queensland and are essential for sustainable and productive fisheries.

There are 15 seagrass species common in Queensland waters, a region that is part of the Indo Pacific centre of seagrass biodiversity. Seagrasses are widespread and found from the upper intertidal region, on reef platforms, and down to 70 metres below sea level. The diversity of seagrass species in Queensland reflects the variety of habitats provided by coasts, bays, estuaries, and reefs as well as the complexity of the Torres Strait island systems and the length of the Great Barrier Reef and inshore lagoon. Seagrass habitats can be separated into four major categories: estuary/inlet, coastal, reef and deepwater. All but the outer reef habitats are influenced by seasonal pulses of sediment-laden, nutrient-rich river flows, resulting from high volume summer rainfall. Cyclones, severe storms, wind and waves as well as macro grazers (fish, dugongs and turtles) influence all habitats in this region. The result is dynamic, spatially and temporally variable seagrass meadows.

The Torres Strait and the east coast of Queensland have some of the most extensive seagrass meadows in the world with an estimated 17,206 sq km in the strait and at least 38,079 sq km down the east coast.


The threats to seagrass are almost all in the southern half of Queensland (south of Cooktown). Seagrass meadows in Queensland have declined in abundance down the east coast over the last 3-4 years, however the total area of seagrass in Queensland has changed little over the long-term (5-10 years). Seagrass declines where they have occurred are most likely the result of natural variations in climate, particularly tropical storms and flood run-off, against a background of reduced water quality.





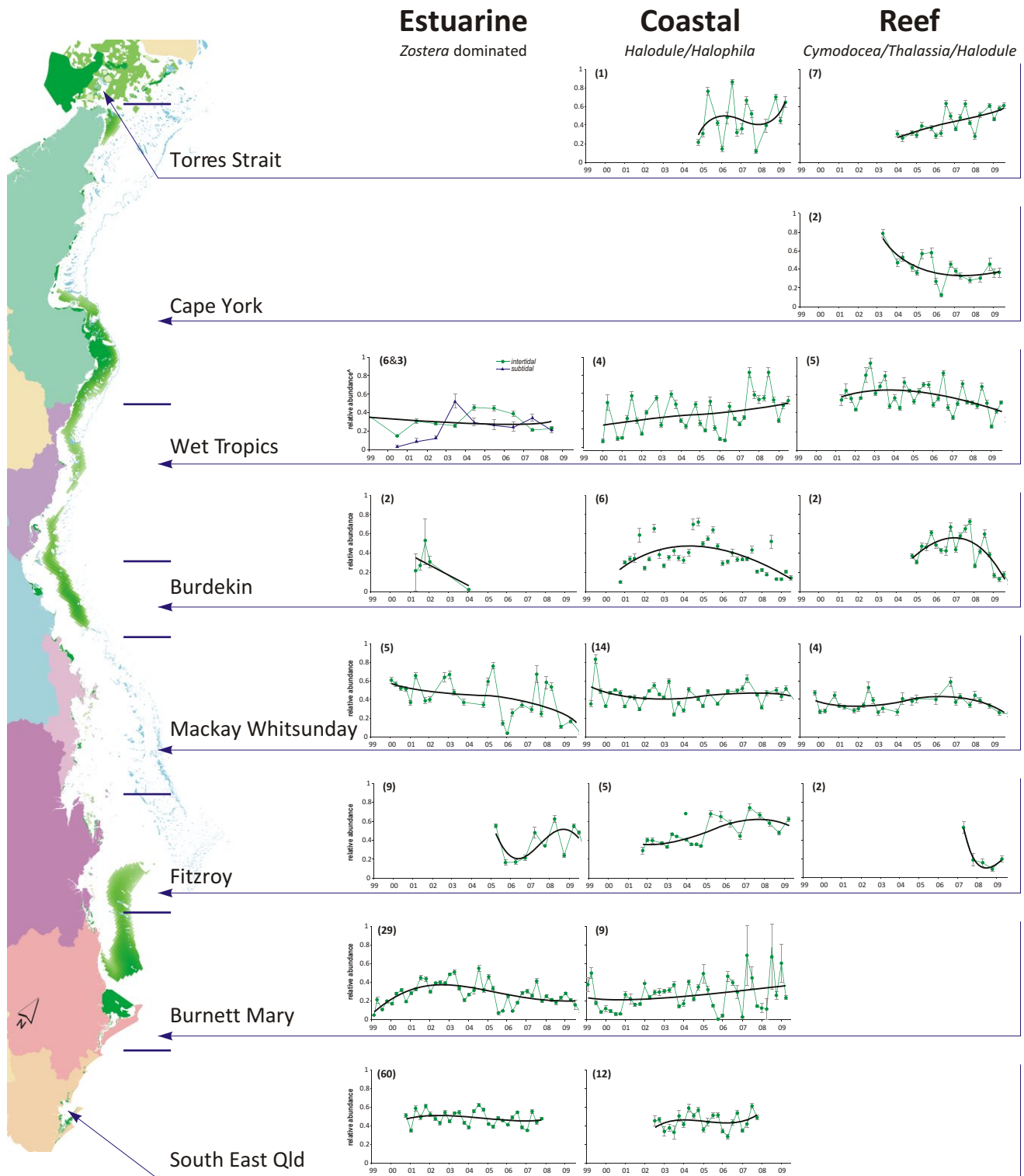
Legend: Seagrass maps are composite (all mapping surveys pooled).

 Actual meadow boundary

 50% - 100% Modelled meadow probabilities (pixel size of 2km<sup>2</sup>) from all deepwater (>15m) survey points pooled.























**Distribution of coastal (<15m water depth) and deepwater (>15m) seagrass in Torres Strait and along the east-coast of Queensland by Natural Resource Management (NRM) area.**









The data underpinning this assessment of seagrass status along the east-coast of Queensland and Torres Strait has been collected from the Seagrass-Watch program, with additional input from the Habitats at Risk program. Seagrass-Watch plays a key role in tracking changes to coastal seagrass meadows in Queensland, nationally and globally, providing early warning of coastal ecological decline. The Habitats at Risk program is a partnership with industry to provide expert advice on coastal, fishing and port management to ensure Queensland develops its industries with the least impact to seagrass habitats.



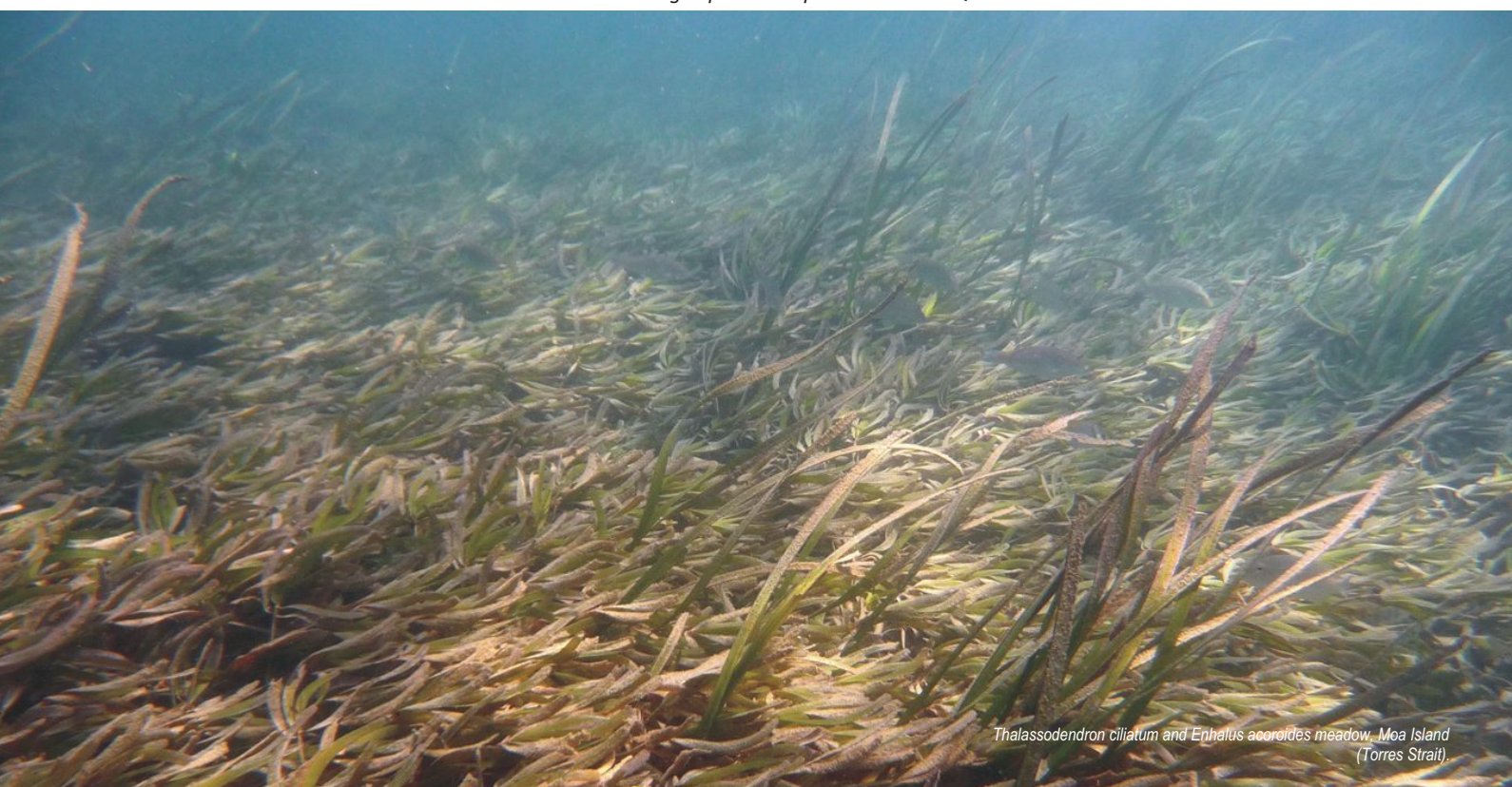
NRM	Area of seagrass (km <sup>2</sup> )	# species	mean % cover	abundance data quality	status (since Jan2007)
<b>Torres Strait</b>	<15m = 13,413 >15m = 3,793	total = 13 estuary = 2 coastal = 11 reef = 11	58.4 ±1.2 (Feb 2007-Mar 2010) 36.6 ±0.5 (Jun 2004-Mar 2010)	deficient inadequate sufficient	  
<b>Cape York</b>	<15m = 1,843 >15m = 10,641	total = 15 estuary = 4 coastal = 6 reef = 9	17.5 ±0.5 (Oct 2003-Apr 2010)	deficient deficient inadequate	  
<b>Wet Tropics</b>	<15m = 201 >15m = 6,638	total = 14 estuary = 5 coastal = 5 reef = 9	22.6 ±0.7 <sup>^</sup> (Dec 1993-Nov 2009) 12.4 ±0.2 (Aug 2000-Apr 2010) 30.3 ±0.4 (Nov 2001-Apr 2010)	inadequate sufficient sufficient	  
<b>Burdekin</b>	<15m = 551 >15m = 2,372	total = 11 estuary = 3 coastal = 8 reef = 8	11.3 ±1.4 (Sep 2001-Jun 2004) 19.6 ±0.3 (Apr 2001-Jun 2010) 30.3 ±0.6 (May 2005-Jun 2010)	deficient sufficient adequate	  
<b>Mackay Whitsunday</b>	<15m = 154 >15m = 293	total = 12 estuary = 4 coastal = 5 reef = 8	20.7 ±0.4 (Jun 2000-Mar 2010) 20.1 ±0.2 (Sep 1999-Mar 2010) 12.0 ±0.2 (Apr 2000-Mar 2010)	inadequate sufficient adequate	  
<b>Fitzroy</b>	<15m = 240 >15m = 6,725	total = 6 estuary = 4 coastal = 3 reef = 4	18.0 ±0.5 (Oct 2005-Apr 2010) 19.8 ±0.2 (Apr 2003-Apr 2010) 2.3 ±0.2 (Sep 2007-Apr 2010)	sufficient adequate inadequate	  
<b>Burnett Mary</b>	<15m = 1,026 >15m = 6,992	total = 8 estuary = 8 coastal = 5	9.9 ±0.1 (Aug 1999-May 2010) 3.8 ±0.1 (Aug 1999-Feb 2010)	sufficient adequate	 
<b>South East Qld</b>	<15m = 401 >15m = unknown	total = 9 estuary = 8 coastal = 7	35.0 ±0.2 (May 2001-Dec 2008) 33.7 ±0.5 (Feb 2003-Jul 2008)	sufficient sufficient	 

Area calculated from composite (all mapping surveys pooled). Area measures for seagrass >15m depth determined by actual mapping and modelled probabilities 50% (pixel size of 5km<sup>2</sup>) from all survey points pooled. NB: actual and modelled information is at different levels of precision.

<sup>^</sup>Abundance in blue = grams Dry Weight m<sup>-2</sup> above-ground. Abundance data quality (column 5) indicates level of precision: deficient = no or very few monitoring sites; inadequate = several sites but not enough to be representative; adequate = enough sites to be representative; sufficient = many sites available.

Status:  increasing or stable  decreasing  variable/uncertain  unknown

We thank all Queensland Seagrass-Watch participants whose dedication and data collection over the past decade have made this article possible.  
We thank M. Rasheed, H. Taylor, M. Waycott (JCU) and the Marine Ecology Group for their contributions and also the many organisations who assisted with monitoring in partnership with Fisheries Queensland.



*Thalassodendron ciliatum* and *Enhalus acoroides* meadow, Moa Island (Torres Strait).





# Southeast Asia

Thailand

Article by Anchana Prathep.  
Additional text Len McKenzie  
Photography Len McKenzie

# seagrasses





## World Seagrass Conference & 9th International Seagrass Biology Workshop



Over 135 people from 25 countries attended the World Seagrass Conference (WSC) and 9th International Seagrass Biology Workshop (ISBW-9) from 21<sup>st</sup>-30<sup>th</sup> November 2010, in Phuket and Trang. A total of 112 world seagrass experts came from outside Thailand to present their recent research in seagrass biology and to tackle the workshops on seagrass conservation and restoration.

The conference was hosted by Prince of Songkla University, Hat Yai, Thailand; and was greatly supported by various organizations including the Thailand Convention & Exhibition Bureau to help promote the conference and Thai culture. The conference venues were Club Andaman Hotel, Phuket between

21-25 November for the WSC and Anantara, Trang between 27-30 November for ISBW-9.

The aims of the WSC and ISBW-9 were to promote seagrass research and to highlight the importance of seagrasses to the Southeast Asian region. Seagrass ecosystems are a critical part of coastal ecosystems throughout the region, filtering coastal waters, and providing the basis of a food web and nursery grounds and habitat for many marine organisms, some of which are used for local fisheries. In Southeast Asia, the functional aspects of seagrass ecosystems require more research and the values of these habitats need better understanding by managers and government agencies. Seagrasses are in decline worldwide, and in Southeast Asia are threatened by coastal development, aquaculture and fishing practices as well as land-derived





In Southeast Asia, the functional aspects of seagrass ecosystems require more research and the values of these habitats need better understanding by managers and government agencies...



*Seagrasses are in decline worldwide, and in Southeast Asia are threatened by coastal development, aquaculture and fishing practices as well as land-derived sediment and nutrient run-off.*

sediment and nutrient run-off. We were therefore provided with the opportunity to highlight the importance of seagrasses by bringing both the conference and workshop to Thailand.

Seagrass scientists, students, and managers, as well as representatives from NGOs, government sectors and policy makers attended the conference and presented their research under various seagrass related topics. There were two keynote lectures in Phuket on the current state of seagrass research and problems such as climate change and seagrass conservation on a global scale. In Trang, the workshop focussed on “Seagrass Conservation and Restoration in Southeast Asia”, where participants presented and contributed under the topics of seagrass conservation and restoration. This was to emphasise the importance of seagrass ecosystems and to increase the awareness of seagrass conservation as well as to share and tackle the problems facing the region.

There was a strong emphasis on demonstrations towards seagrass management in the area by experts in the fields of restoration, monitoring and conservation of tropical seagrass systems.

There were other activities during the conference including:

- seagrass photo competition (where the winning photos were assembled to create a 2011 Seagrass Calendar),
- student oral presentation and poster competitions, and
- field excursions to experience and share knowledge in the field using the seagrass in Thailand as a model and a comparison.

There were also some other activities during the conference including Long Kratong Night and Thai Southern Traditional Dances to promote the Thai culture. The conference was a great success and the next workshop (ISBW-10) will be held in Brazil in 2012.





## WCS & ISBW-9

# Field excursions

### Sirinath Marine National Park.

Located just south of Phuket airport on the north-western tip of Phuket Island, the park was the venue for one of the excursions during the WSC. The park covers an area of around 90 square km and the main seagrass and coral was best seen surrounding Nai Yang Island. Much of the coral reef in the area was devastated by the 2004 Boxing Day tsunami and more recent bleaching events. *Thalassia hemprichii* dominated meadows with some *Cymodocea rotundata* cover much of the shallow reef flat. Although the seagrass appeared in pretty good condition, there were very few invertebrates to be seen. The location is important to the subsistence fishery of the area and is regularly gleaned. Discarded gill nets and fish traps were also scattered over the intertidal meadow.

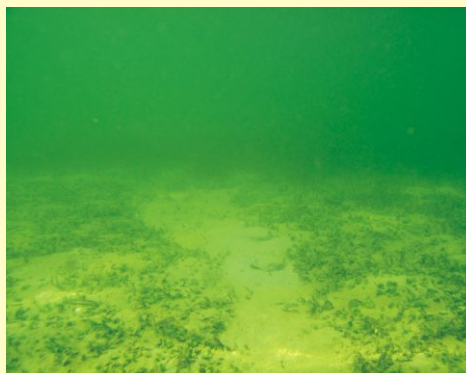
Seagrasses of Sirinat and Haad Chao Mai National Parks.  
Dugong feeding trail, Haad Chao Mai National Park (centre)



### Haad Chao Mai National Park

Located on the coast of the Andaman Sea in Trang, southern Thailand, the park was the setting of the ISBW-9 excursion. Declared a national park in 1981 to protect the mangroves of the area (which were being harvested for charcoal and knocked down to build shrimp ponds), the park also includes the largest seagrass meadows in Thailand and the largest dugong population in the region. So revered are the dugong, that they are the flagship species for conservation in Trang. The park was also the location of the 1st international Seagrass-Watch training workshop in 1998.

Seagrass meadows occur along the coastline of Haad Chao Mai National Park. The meadow at Laem Yong Lam (located in the northern part of the park), between Muk Island and the mainland, is the largest seagrass meadow (18 km<sup>2</sup>)



Participants exploring Laem Yong Lam meadow

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Laem Yong Lam  
is the largest seagrass  
meadow along the  
Andaman Sea coast  
of Thailand.

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along the Andaman Sea coast of Thailand. In the southern parts of the park, a large meadow (8.9 km<sup>2</sup>) surrounds Ko Talibong and several smaller meadows are found at the mouth of Trang River, one of the largest rivers in southern Thailand.

Seagrasses in the region are threatened by a combination of inappropriate/illegal fishing practices, reduced water quality (e.g., runoff and siltation from upland clearing), and coastal development. Fortunately, the seagrasses of the park received little impact from the 2004 Boxing Day tsunami.

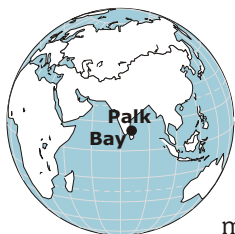
Seven seagrass species are reported from the park: *E. acoroides*, *H. uninervis*, *H. ovalis*, *C. rotundata*, *C. serrulata*, *T. hemprichii* and *S. isoetifolium*. ISBW-9 participants were keen to explore the Laem Yong Lam meadow and verify each of the species. Another exciting sight for many participants was evidence of dugong feeding (grazing trails) throughout the meadow.





# Seagrass *as* fertiliser

Article by T.Thangaradjou, S.Raja and Pon. Subhashini  
Photography T.Thangaradjou



Palk Bay in India is known for its extensive and diverse seagrass meadows and is

identified as one of the most significant seagrass regions in the country, second only to the Gulf of Mannar. Seagrass in the bay forms dense productive meadows. When leaves are shed from the original plant during growth, they are called wrack and they drift ashore to accumulate in large mounds.

Seagrass wrack has been used traditionally as fertiliser in several parts of the world, including Portugal, France, Vietnam, China and Australia. In Australia, semi decomposed *Posidonia australis* is collected from windrows along beaches, sieved to remove stalk material and processed at moderate temperature and alkalinity to produce a liquid plant nutrient. When applied to crop plants, this

fertiliser consistently produces higher yields. Hence, it is no wonder that seagrass wrack is successfully used as fertiliser for coconut plantations in the Palk Bay region.

Seasonal changes and adverse weather conditions cause the leaves of seagrasses to shed. Upon reaching the shore, the plant material starts to decay and one can see different stages of seagrass decomposition both vertically and horizontally along this coast. *Cymodocea serrulata*, *C. rotundata* and *Syringodium isoetifolium* dominates the hundreds of tons of wrack washed ashore.

The wrack forms a thick mat of semi composted organic matter. Often polluting the coast, it has a rich nutrient value that is used by the local community as an economically viable alternate organic fertiliser.

Partially decomposed wrack invites beneficial bacteria and fungi to work on it and remineralise the soil and improve soil

aeration. This compost also improves soil texture, increases the population of soil microorganism and earthworms thereby enhances the supply of plant nutrients to the coconut trees. Coastal villages of the Palk Bay region are mostly covered by sandy soil with nutrient limitation, thus application of seagrass fertiliser is practised as the farm management of sandy soil to increase its fertility. Seagrass fertilisers are applied twice in a year, once during June and the next in October before the onset of the monsoon. The wrack along with inorganic fertilizer are applied together in circular basins of 1.8m radius and 25cm deep around the tree and covered with soil. The inorganic chemical fertilisers (N:P:K, 0.25kg:0.35kg:0.90kg) are mixed with 10 kg of seagrass wrack. This combined fertiliser is applied at 10-15 kg per coconut tree depending on the age of the tree. The soil gets nourished with the seagrass fertiliser leading to a good yield from the coconut farms.





*Villagers knee deep in seagrass wrack*

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Seagrass fertiliser is a versatile component in coconut farming, it not only improves soil conditions, but also the economy of the farmer

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Seagrass fertiliser is indeed a versatile component in coconut farming as it is not only improving the soil conditions, but also the economy of the farmer. Fertilising a hectare of coconut farm once in a year with inorganic fertiliser and traditional organic manure (usually cow manure and wastes) costs around  $\sim \$14,500$  hectare<sup>-1</sup> year<sup>-1</sup>. When the combined seagrass fertiliser is used, the cost is  $\sim \$4,500$  hectare<sup>-1</sup> year<sup>-1</sup>. Fortunately, this organic seagrass fertiliser is easily available, inexpensive and does not require any processing such as composting or salt removal and pertains as a sink of accumulated nutrients. Removal and

clearance of seagrass wrack from coastal regions also helps retain the beaches clean and neat as natural removal and cleaning takes long time.

The rising prices of inorganic fertilisers have paved the way for the demand of organic fertiliser which are eco-friendly. Thus the concept of seagrass wrack as fertiliser would help the farmers to become less dependent on inorganic or chemical fertilisers and thereby reduce the cost of farm inputs. Unfortunately, at present there is still a dearth of research based information on seagrass fertiliser for coconut farming.

*Seagrass wrack has many important ecological roles in marine ecosystems: providing micro-habitat; food for micro-organisms; nutrient cycling; and cover on-shore/beach (retaining moisture and reducing temperatures). In some countries, a permit is required for removal/collection of wrack.*

**Images:**

*Wrack washed up on local beach (below left)  
Truck loaded with wrack for transport to coconut plantation (below right)*





Animal facts

# ascidians

Article by Len McKenzie  
Photography Ria Tan  
(wildsingapore.com)



A common animal which lives on seagrass leaves is an ascidian. Ascidians (commonly known as sea squirts) are mostly found throughout shallow marine environments of the world, including seagrass meadows, and are actually relatives of mammals.

Ascidians belong to the subphylum Urochordata - one of the major groups of the phylum Chordata, which includes the vertebrates (fishes, amphibians, reptiles, birds and mammals). Looking at an ascidian you wouldn't think they look much like us, but during development (before birth), we had the same characteristics, including: a nerve cord along the back of the body; a 'notochord' or firm rod of cells beneath the nerve cord (this is our backbone); and gill slits (they disappeared in some chordates, but were present during evolutionary development). Ascidians are an evolutionary link between invertebrates and vertebrates. They have a primitive backbone at some stage of their life cycle, but in other aspects they resemble invertebrates.

There are 2,300 species of ascidians. Some are solitary animals, while others may form colonies with many individual animals called zooids. Solitary ascidians range from 1mm to 10cm in size, however colonies can range from 1cm to 1m in diameter.

Ascidians are sac-like marine filter feeders which attach to substratum such as rocks, shells and seagrass blades. The entire animal is encased in a little bag ('askidion', from the Greek 'bladder' or 'little bag') with two openings, or siphons. Ascidians feed by taking in water through the oral (buccal) siphon. The water enters the mouth and pharynx. The pharynx is ciliated and contains numerous gill slits (stigmata), arranged in a grid-like pattern. The beating of the cilia sucks water through the siphon and mucus-covered stigmata, into a water chamber called the atrium. Water then exits through the atrial siphon. The animal often violently expels water from these siphons, hence the common name of "sea squirt". On average, an ascidian can filter 1 body volume of water per second. A tiny animal only a few centimetres long may pump a hundred litres of water in a span of 24 hours.

Planktonic food particles are filtered from the water and trapped as they pass through the stigmata. Food then passes downwards into the oesophageal opening at the base of pharynx, to a stomach which secretes enzymes that digest the food. An intestine runs upwards from the stomach and opens into a cloaca just below the atrial siphon.

Most ascidians are hermaphrodites (produce both eggs and sperm) and

reproduce by releasing eggs and sperm into the water. The free-swimming larva are known as ascidian tadpoles. After about 36 hours, the tadpoles attach themselves to a hard surface head-first. They then undergo metamorphosis and mature into the adult form. Many colonial sea squirts are also capable of asexual reproduction.

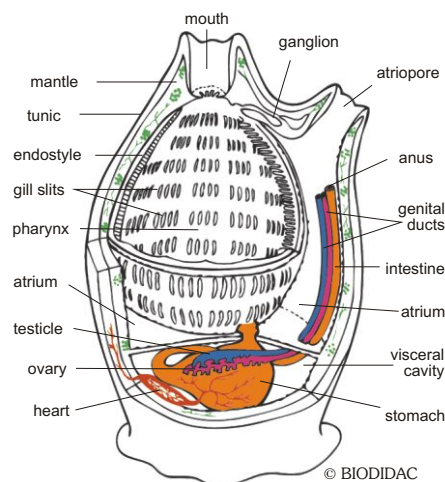
Ascidians can grow quickly, can tolerance of a wide range of environments, and although eaten by flatworms and nudibranchs, they have few predators. The exceptional filtering capability of adult ascidians causes them to accumulate pollutants, which makes some species sensitive indicators of pollution. However, over the last few hundred years, most of the world's harbours have been invaded by non-native ascidians that have clung to ship hulls. Unwanted populations can cause significant economic problems, and invasions have disrupted the ecosystem by smothering native animal species.

Ascidians are often mistaken for sponges. However, ascidians are complex animals and tend to be smooth and slimy, while sponges tend to be rough and are usually not slimy.

So next time you're estimating the cover of epiphytes on seagrass blades, keep an eye out for ascidians and record their presence in the comments section of the datasheet. This information can provide us with important indications of pollution or environmental unbalance.

For more information, visit wikipedia, [www.wildsingapore.com](http://www.wildsingapore.com) or [australianmuseum.net.au](http://australianmuseum.net.au)

## major internal features of a solitary adult ascidian



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