



## Seasonal cycles in Ningaloo seaweed meadows

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### Background

Marine ecosystems comprise a mosaic of habitat types that provide food and shelter for a huge diversity of plants and animals. One of the most prominent habitat types along the tropical coast of Western Australia are seaweed meadows, created by the growth of large fleshy seaweeds such as *Sargassum* spp. In these seaweed meadows we often find fish species that are found nowhere else, or the juveniles of fishes that as adults live in other habitats such as corals or sponges. Many of these seaweed-associated fishes are important targets for fishing (e.g. Spangled emperors, *Lethrinus nebulosus*) or maintaining key processes such as herbivory (e.g. Marbled parrotfish, *Leptoscarus vaigiensis*).

The Ningaloo Marine Park has an extensive network of seaweed meadows that cover up to half the total area of the lagoon. Many visitors to Ningaloo have noticed large amounts of seaweed washing ashore at certain times of the year (often during March-July), which is the result of foliose parts of the *Sargassum* breaking away from their stipes and holdfasts (Figure 1). Given these seaweed meadows are an important habitat for many other species, we need to understand the dynamics of annual variations and long term changes in the condition of these habitats. In this research project we measured the amount of seaweed (biomass) present in meadows at two locations (Tantabiddi and Coral Bay) within the Ningaloo lagoon over the summer (February), autumn (April), winter (August) and spring (November) for two years and explored whether changes in seaweed were linked to seasonal shifts in climate (sea temperature, wind direction and strength, wave heights, light and rainfall).

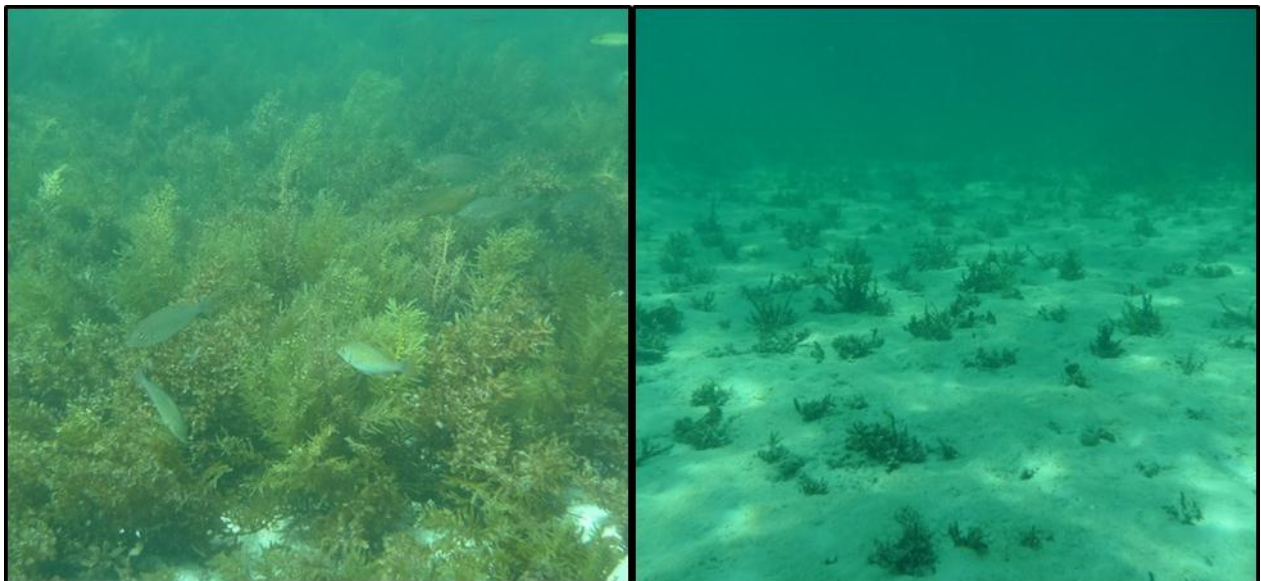


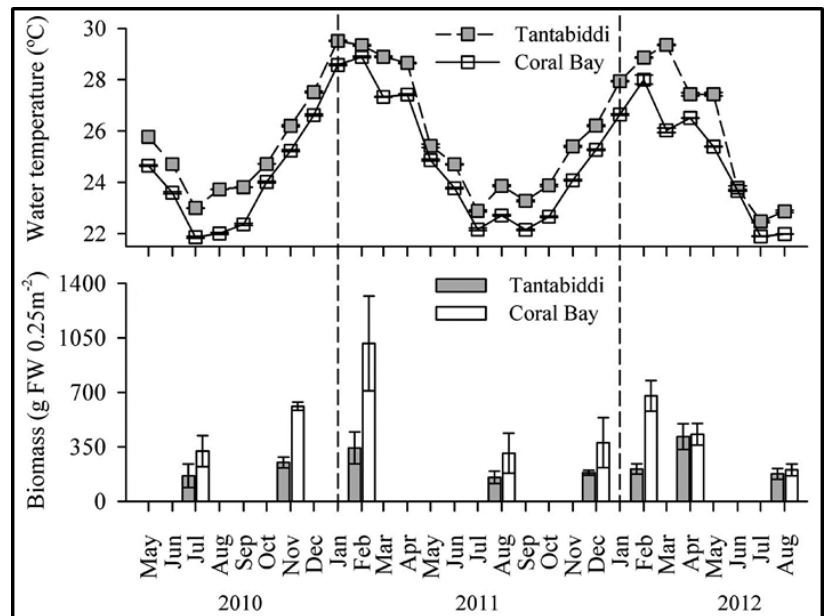
Figure 1. Seasonal changes in Ningaloo seaweed meadows from summer (left) to winter (right). Photos: Chris Fulton.

### Findings

- Peaks in seaweed biomass tend to occur within the meadows during late summer (around February each year), most of which is *Sargassum* (Figure 2);

- Changes in *Sargassum* biomass within lagoonal meadows at Ningaloo are closely linked to seasonal changes in sea surface temperature (Figure 2);
- Seaweed meadows can lose much (up to 94%) of their seaweed biomass each autumn-winter, although some meadows lose relatively little (as low as 12%) each year;
- New seaweed canopies regrow each year from the same “root” bases that persist through winter (see right panel of Figure 1), which means each seaweed individual may be quite old and important for maintaining these seaweed meadows through time;
- Seaweed meadows lose an average of 15 tonnes in biomass per hectare over each summer-winter cycle; and
- Current estimates suggest seaweed meadows cover 2,000 hectares of the Ningaloo lagoon, hence seaweed meadows are shedding around 30,000 tonnes of primary production into the Ningaloo ecosystem each year.

Figure 2. Changes in seaweed biomass within lagoonal meadows near Tantabiddi and Coral Bay (bar chart, bottom panel) at Ningaloo are closely linked to seasonal changes in surrounding sea temperature (line chart, top panel) over two years (2010-2012). Extract from Fulton et al. (2014).



## Management Implications

Seaweeds cover extensive areas of the benthos in marine parks managed by the Department of Parks and Wildlife, are major primary producers and provide habitat and food for numerous fish and invertebrate species. While some seaweed meadows underwent major losses of seaweed cover over summer to winter, other meadows retained a high amount of seaweed year-round. Spatial planning of marine parks should therefore consider: (1) protecting a large number of seaweed meadows to encompass the broad diversity of changes they experience across space and time, and (2) identifying seaweed meadows that require additional protection as critical habitat for fish, and invertebrate species that depend upon them throughout summer and winter seasons.

The strong link between seaweed biomass and temperature also suggests that changes in sea temperatures will influence when and where seaweeds are most prevalent at Ningaloo and along the west Australian coast. Any shifts in seaweed distributions will have flow on consequences for local primary production and associated animals. To account for distributional changes in seaweeds a representative selection of meadows should be considered for protection along the entire coast. Moreover, as seaweed distribution and abundance is also affected by human activities that alter nutrient loads (e.g. sewage discharge), turbidity (e.g. dredging) and hydrodynamics (e.g. development of marinas), conservation planning should aim to minimise the impact of these anthropogenic stressors on seaweed meadows of high ecological importance.

More Information: Fulton CJ, Depczynski M, Holmes TH, Noble MM, Radford B, Wernberg TH, Wilson SK (2014) Sea temperature shapes seasonal fluctuations in seaweed biomass within the Ningaloo coral reef ecosystem. *Limnology & Oceanography* 59, 156-166.