The state and trends of quality of habitats and communities – Water column, inner shelf (0 - 25m).

Persons providing input into the assessment and contact details

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Current State

Based on biomass the major communities found in the water column are phytoplankton>bacteria>zooplankton>fish (Marchant 2002). The water column is the habitat and the major determinants of quality for most pelagic organisms can be considered to be temperature (T), salinity (S), light, nutrients, dissolved oxygen (DO), pH, and food availability. The inner shelf waters around Australia are generally warm, mostly saline, well illuminated, low in nutrients, and phytoplankton, zooplankton and fish abundance. The inner shelf is also the pelagic marine habitat most exposed to human induced pressures and has local habitats that range from heavily disturbed to pristine. The capability of this habitat to support the existing flora and fauna can be considered to be under threat (e.g. Game et al. 2009) from: inputs from the terrestrial environment (e.g. sediments in runoff or due to increased erosion, nutrients, wastes), harvesting of biota, invasive species, infrastructure development (e.g. impoundments, harbours, hardening), mariculture, mining, oil and gas extraction, climate change (warming, falling DO, decreasing pH). There are many areas of local habitat degradation, with the most impacted areas tending to be embayments and estuaries with significant population pressures and limited exchange (e.g. Alyazichi et al., 2015; Mckinley et al., 2011). In spite of improvements in the management of these types of pressures the magnitude of the growth in mineral exports, agriculture exports and population growth would suggest that development impacts will have risen. At the same time across many jurisdictions improvements in sewage treatment and disposal mean that potentially dangerous pathogens are increasingly rare. For example in 2015 96% of NSW open beaches with high rates of recreational use were rated good or very good (NSW EPA, 2015). At a larger geographic scale our shelf waters are experiencing increasing impacts from global pressures such as warming. Shelf waters from Port Hedland to Cape Howe have risen ~ 1°C from 1993 to 2013 (Foster et al., 2014), and portions of the SW region were 3°C warmer during February 2011 than normal (Pearce and Feng 2013). There is evidence that dissolved oxygen has declined (Thompson et al. 2009) and will continue to decline due to warming (Talley et al., 2016). This is likely to lead to more losses of marine fauna due to low oxygen; such as the unprecedented event during 2015 in Cockburn Sound (Pattiaratchi 2016). Recent blooms of toxic phytoplankton in regions where they never bloomed before (Campbell et al., 2013) and the SE shellfish that have suffered badly from disease outbreaks (Hooper et al., 2007; Lewis et al., 2012). There is evidence of widespread responses to climate related pressures across the major types of biota, phytoplankton, zooplankton and fish (e.g. Johnson et al. 2011, Thompson et al. 2016) as well as our coral reefs under increased stress from rising temperatures and declining pH (Mongin et al., 2016).

Trends

The temporal window for this SOE (2011-2016) commenced with the La Niña event that ended the Millennium Drought. Above average rainfall and river run-off during 2011 supplied much of the north, northeast and east coast of Australia with above average sediment and nutrient loads but the consequences for pelagic habitats and their communities are largely unquantified. There are some excellent studies of local environmental conditions but they do not constitute a scientific, national assessment of the status or trends of pelagic communities along the inner shelf.

Improvements in satellite technology and interpretation means they are providing better information regarding the status and trends of some parameters (e.g. turbidity, chlorophyll *a*) from these shallow waters. Following national (e.g. IMOS) and international experience (e.g. IGMETS (http://igmets.net/) a relatively small number of time series of *in situ* ecological monitoring combined with satellite data can provide a powerful tool to assess trends.

Regions

North: Above average rainfall across much of northern Australia in 2010, 2011, 2014, 2015 means more nutrient inputs to the inner shelf. Local changes in phytoplankton were mixed, geographically heterogeneous responses; some strongly positive and some strongly negative (Fig. 1). During 2015 zooplankton biomass at the Darwin NRS was 180 mg m^{-3}, which was the highest biomass found at any NRS from around the country. Phytoplankton also increased from 2011 to 2015 (regression of seasonally detrended chlorophyll *a* vs date, P = 0.008) at the Darwin NRS (Fig. 2).

North-east: This region also experienced high rainfall in 2010, 2011 and 2012 resulting in localized increases in nutrient inputs, phytoplankton biomass and diatoms in the Great Barrier Reef (GBR) Lagoon (Thompson et al. 2015, Thompson et al. 2016).

East: The east coast saw a general trend towards more phytoplankton (Fig. 1).

South-east: The huge rise in the toxic phytoplankton species *Alexandrium tamarense* has resulted in the closure of harvesting for many species of seafood along the east coast of Tasmania. The Pacific Oyster Mortality Syndrome (POMS) created serious challenges for the oyster industry in NSW and spread to Tasmania.

South-west: The west coast of Australia has been warming strongly (Feng et al., 2013). Long term trends of warming are correlated with declining phytoplankton biomass (Siegel et al., 2013) as the low biomass tropical communities move further south (Thompson et al., 2015).

North-west: Over the entire North west region chlorophyll *a* decline significantly between 2002 and 2016 (see also the assessment on the state and trends of primary productivity), but since IMOS monitoring at the NRS at Ningaloo ceased in 2013 it is more difficult to assess near shore habitat or community changes.

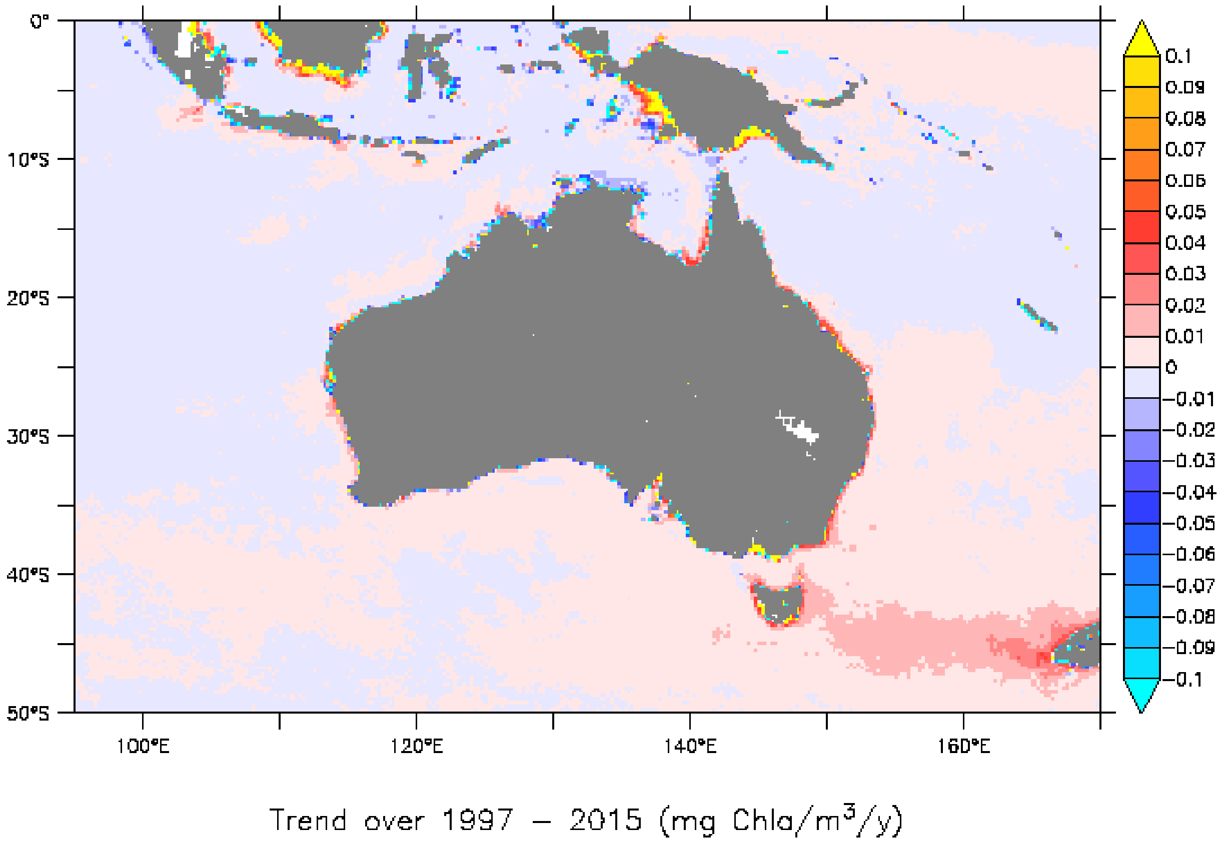

Figure 1. Trends in chlorophyll *a* concentrations derived from satellite detected ocean colour over the period from 1997 to 2015 for the Australian region (Data from http://www.globcolour.info/. Accessed Feb 2016).

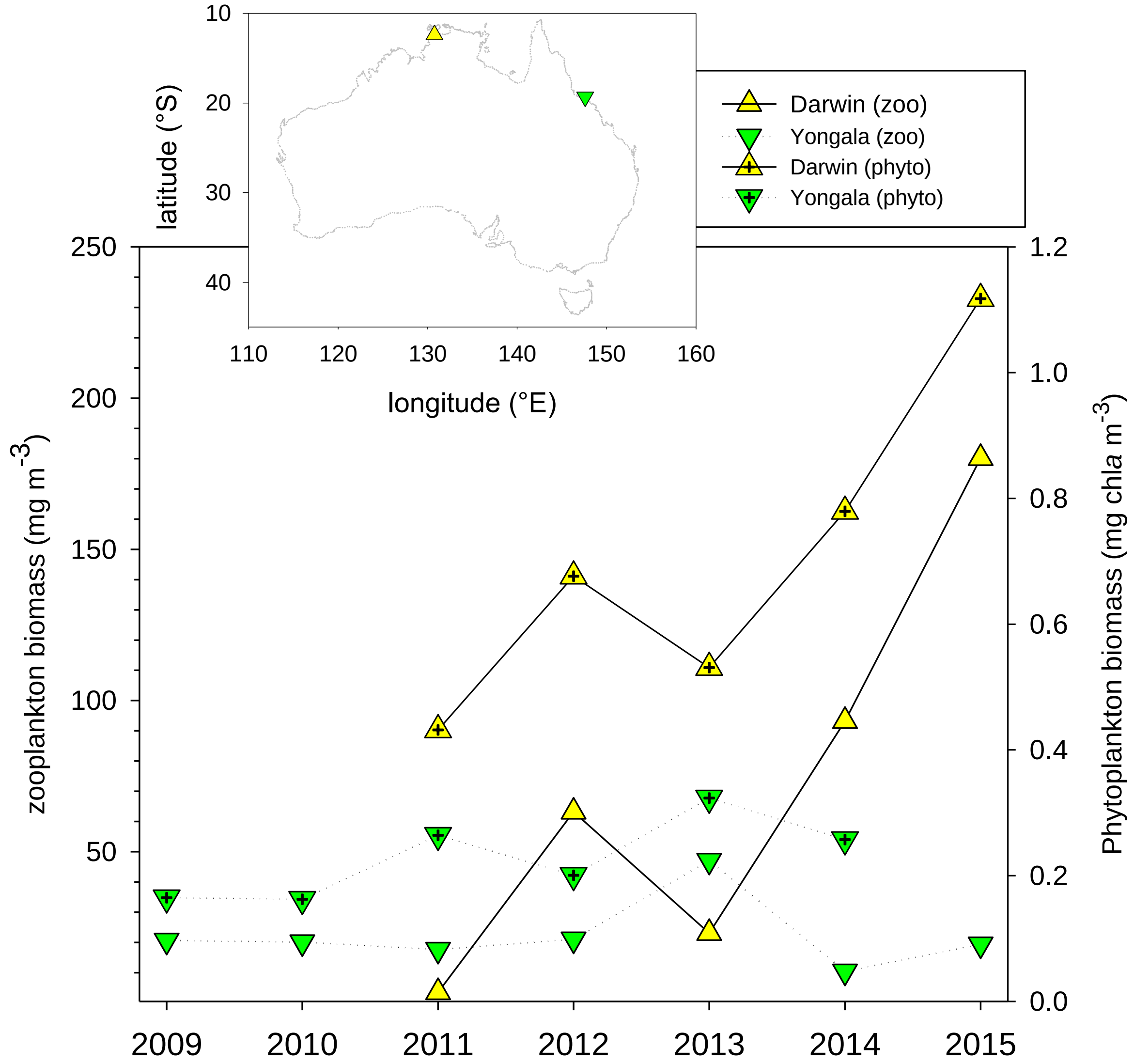

Figure 2. Average annual biomass of zooplankton and phytoplankton (as chlorophyll *a*) from Integrated Marine Observing System's (IMOS) National Reference Stations (NRS) at Darwin and Yongala. Also inset map showing the locations of the IMOS NRS at Darwin and Yongala. Only phytoplankton at Darwin showed a significant ($P = 0.008$) trend over the available data.

Gaps and major uncertainties

Satellite derived estimates of parameters such as chlorophyll *a* become less reliable in shallow waters near shore. A lack of *in situ* monitoring outside of estuaries makes determining status and trends difficult. At this time with only 2 IMOS NRS in ≤ 25 m of water (at Darwin and Yongala in the GBR) there is insufficient data on most measures of habitat quality to accurately assess the regional or national trends of pelagic habitats and their communities along the inner shelf.

Assessment summary

Year	Assessment grade		Confidence		Comparability
	Grade	Trend	Grade	Trend	
2016	Good	Unclear	Limited evidence or limited consensus	Limited evidence or limited consensus	Grade and trend are somewhat comparable to the 2011 assessment
2011	Good	Deteriorating	Limited evidence or limited consensus	Limited evidence or limited consensus	

Assessment Summary text (20 word)

Mixed local responses to pressures with some localities improving and some deteriorating.