

Climate and Oceanographic Summary, Great Australian Bight 2015 - 1

Kirsten Rough – 31st August 2014

This is the first 2015-season update of Sea Surface Temperature (SST), ocean currents and chlorophyll distribution in the Great Australian Bight (GAB). If anyone has any questions or further suggestions please call or email (details appear at the end of this document).

Background:

This project was initiated after the unusual distribution of Southern Bluefin Tuna (SBT) through the 2011-12 fishing season. In response to this the status of the major climate systems that influence ocean conditions through the SBT fishing areas are routinely monitored and information updates on local ocean temperature, chlorophyll and currents distributed weekly through the 2012-13 and 2013-14 fishing seasons – these will continue for the 2015 season also.

Summary:

Through autumn and winter, the GAB Sea Surface Temperatures progressively decreased to values similar to those experienced through the early and mid 2000's (about 1 to 2°C lower than those of the past 5 years).

The SBT Habitat Forecasting Model's latest projection suggests a gradual warming of GAB area going into the 2015-fishing season. Sea temperatures approach those suitable for surfacing SBT west of longitude 133°E through November.

At the moment there are no indications from the major climate system forecasts to suggest the Leeuwin Current will be unusually strong through the next season.

The pattern and distribution of abnormally warm water masses around Australia is very similar now to what it was at the same point in time last year (suggesting similar conditions and fish distribution to those experienced last season). But please note the systems that drive these conditions are very dynamic, so updates will be provided as the fishing season approaches.

The warm water mass of the Pacific Ocean, associated with the 'El Nino' system began cooling through July and has now moved to the central Pacific. While the development of an El Nino is still possible, it is unlikely to be an event of sufficient intensity to have a major influence over conditions in the GAB.

Summary of Previous Seasons:

2013 fishing season:

From September 2012 the early indications suggested that the Leeuwin Current (LC) would not be as strong as the previous (2011-12) fishing season. This was indeed the case through the entire fishing season. However, the GAB was warmed rapidly through late December under the influence of another subtropical water mass from the Indian Ocean that was not associated with the LC. SBT were abundant and widely distributed under the influence of this water body, with aerial survey sightings and fish catches occurring from longitudes 128 to 138°E. Upwelling was not a feature of this season, with only 1 very short period in late February where water temperatures at 100m-depth dropped below 14°C.

2014 fishing season:

From September 2013 the early indications suggested that the Leeuwin Current (LC) would not be as strong as 2011 and 2012. This was indeed the case through the entire fishing season. The GAB area remained much warmer than usual throughout the winter of 2013 under the influence of the Indian Ocean. A very strong upwelling event occurred in November and regular pulses of this system kept the water temperatures at 100m depth colder than 14°C for the entire fishing and aerial survey period. SBT were abundant and widely distributed through this season, with aerial survey sightings and fish catches occurring from longitudes 128 to 137°E. The seismic survey that started 20th of January and was located adjacent to the aerial survey area didn't appear to negatively impact on the abundance of SBT in the GAB.

Outlook for 2015 fishing season:

The GAB slowly cooled through autumn and winter to reach water temperatures similar to those experienced through the early to mid 2000's.

The atmosphere component of the Pacific Ocean system did not follow and link in with the ocean side of the system – therefore the forecasted El Nino did not develop as was predicted in March. This system may develop into a very mild El Nino through the fishing season, but is unlikely to be of sufficient magnitude to have much influence on GAB conditions.

Early indications from August 2014 -

There are currently no indications from the major climate systems to suggest the Leeuwin Current will be unusually strong through this next season.

At this point in time the pattern and distribution of the unusually warm water masses in areas adjacent to Australia is very similar to what it was for the same point in time last year (see Figure 1 and Figure 2). If anything, there appears to be less indications of unusually warm water pushing into the GAB area.

The dominance of strong high-pressure systems has persisted, especially through late winter when these systems started to move southwards over the GAB area. Strong slow moving High Pressures systems were a beneficial feature of the last fishing season.

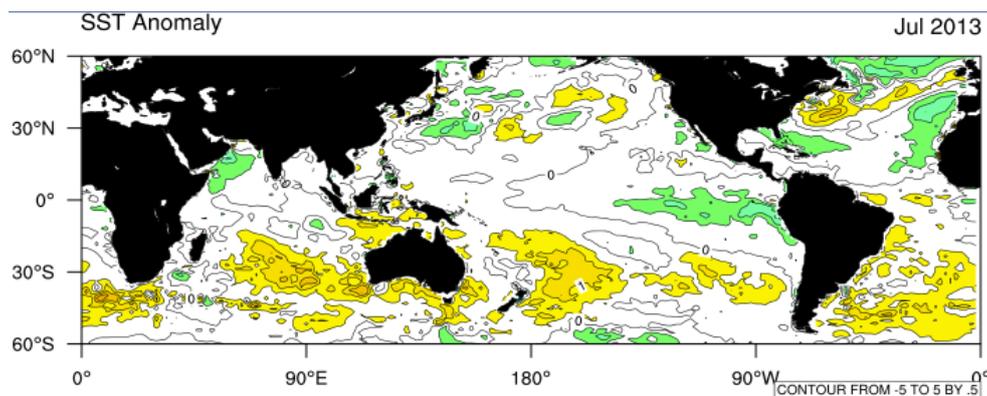


Figure 1: Sea Surface Temperature anomalies evident through July 2013 (Bureau of Meteorology 2013).

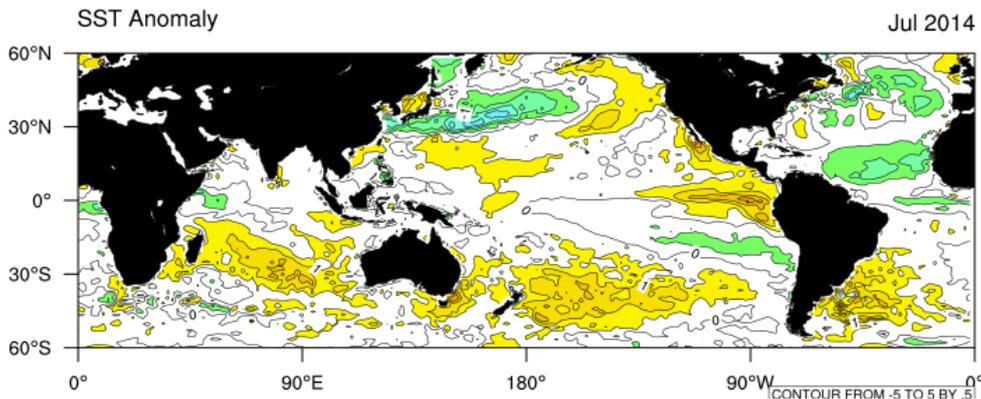


Figure 2: Sea Surface Temperature anomalies evident through July 2014 (Bureau of Meteorology 2014).

In the absence of dominating signals from any of the climate systems - at this point in time the pattern of warm water masses around Australia suggests similar conditions and fish distribution through the next season as those experienced through the last season.

Please note however that these systems are very dynamic so updates will be provided progressively as the fishing season approaches.

GAB Sea Surface Temperature (SST):

Habitat Forecasting Model:

Projections of sea surface temperature made at the start of May for the month of August is shown in Figure 3 below; and the actual situation of August is shown in Figure 4. The model is proving to be reasonably accurate up to 3-months into the future, especially along the shelf break west of longitude 134°E – the minor differences between the two graphs below are due to localised eddies in the current travelling along the edge of the shelf. To account for these localised influences the current situation and that of the previous week will remain an important output of this project.

How the situation of August looked over the previous 5 years can be seen in Figure 5. Please note the temperature scales are slightly different in Figure 5, compared with Figure 3 and Figure 4 – the website is still in the process of being modified; the goal is to have SBT preferred temperatures in the colour range of aqua to orange with yellow being the optimum. If anyone has any thoughts or suggestions on this please call or email on the contact details at the end of this document.

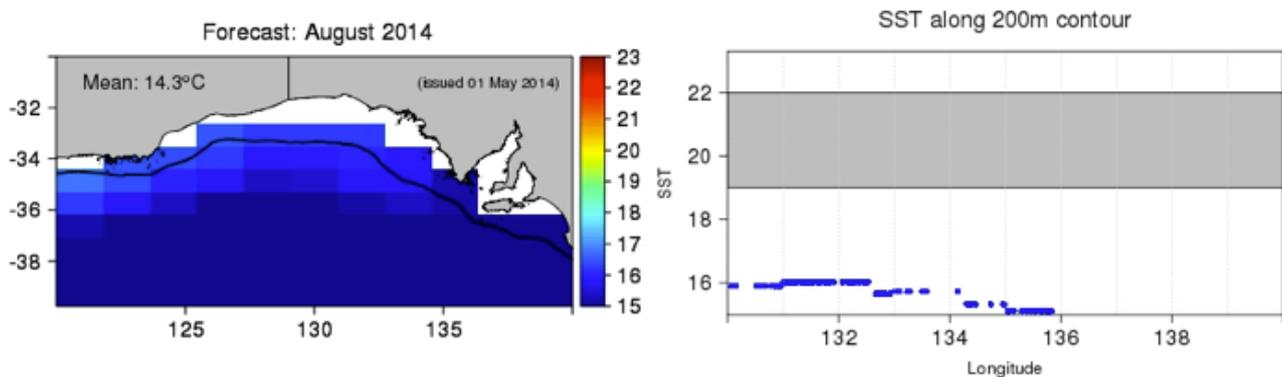


Figure 3: Forecast of SST along shelf break of the GAB fishing area for August, issued on the 1st of May (CSIRO 2014)

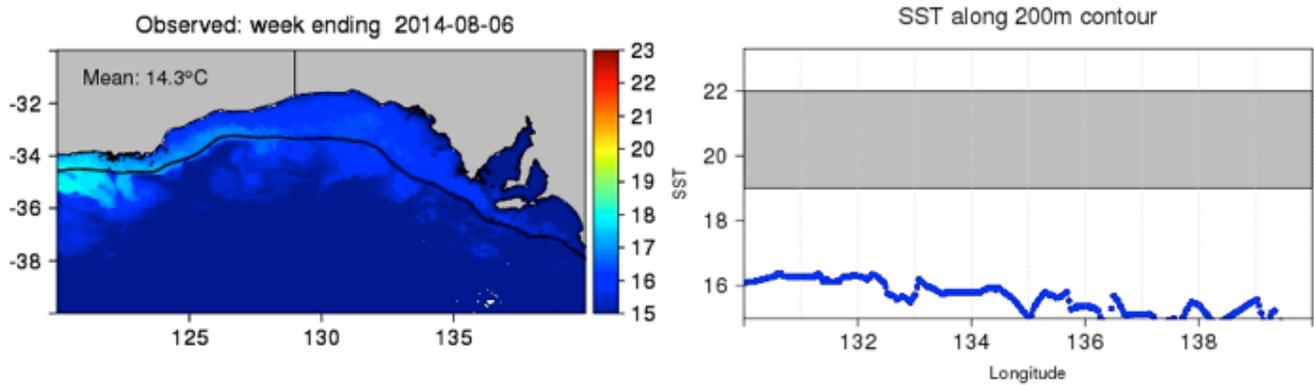


Figure 4: Actual SST along the shelf break of the GAB fishing area for the first week of August (CSIRO 2014)

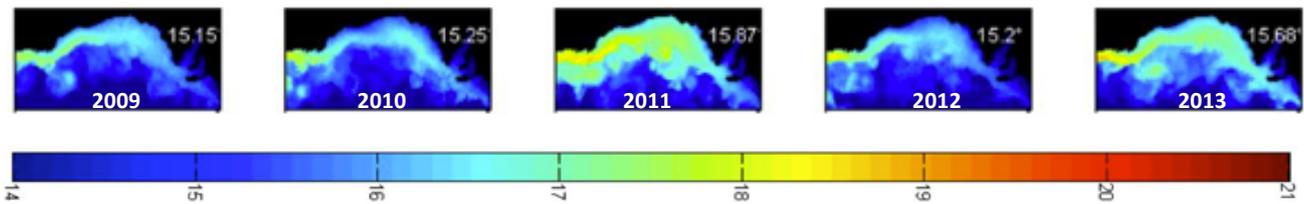


Figure 5: GAB sea temperatures through August for previous 5 years (2009 to 2013)

The latest future projection of sea surface temperature made at the end of July for the month of November is shown in Figure 6. This suggests a slow and gradual warming of the GAB area coming into the 2015 fishing season; and that sea temperatures are approaching those suitable for surfacing SBT west of longitude 133°E through November.

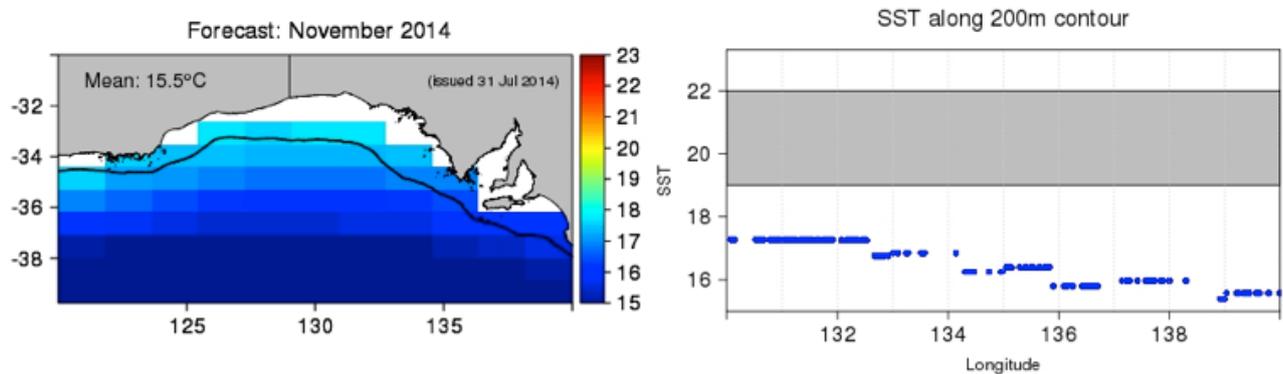


Figure 6: Forecast of SST along shelf break of the GAB fishing area for November, issued on the 31st of July (CSIRO 2014)

Please note there are satellite communication issues at the moment so the observations from the 6th August are the most recent available.

Climate / Ocean Trends:

Quick reminder:

There are at least 3 major Climate Systems that have an influence over the ocean and weather conditions experienced in the GAB. They do this by having varying degrees of influence over at least 6 water masses and currents in the vicinity of Australia. The relative influence of any one of these can be exaggerated or modified by the prevailing phase of the other(s).

The three systems are known as:

- 1) The El Niño Southern Oscillation (**ENSO** - Pacific Ocean); this system has an atmosphere and an ocean component and its influence on rainfall and ocean conditions are well

- established. Essentially warm water mass moves back and forth across the Pacific Ocean between Australia and America.
- 2) The Indian Ocean Dipole (**IOD** - Indian Ocean); this system is also an atmosphere and ocean 'coupled' system. The influence of this system is a relatively recent area of research, over the past 20-30 years links to Australian rainfall are becoming established but the influence over ocean conditions is a new area of study. This is similar to the ENSO system, whereby a warm water mass moves back and forth across the Indian Ocean between Australia and Africa.
 - 3) The Southern Annular Mode (**SAM** - Southern Ocean); this system mainly influences weather patterns and has a flow-on effect on water currents via its influence on wind speed and direction.

These systems are very dynamic, and how they interact varies considerably between years. For example, there has been a dominating influence pushing warm water in from the Pacific Ocean in 2009, 2011 and 2012 (2010 had Pacific Ocean dominating in opposite way, pushing warm water away from Australia). There was a strong co-influence from the Indian Ocean also in 2009, 2011, and 2012 where warm water was pushed towards Australia. 2012 also had the Southern Ocean system favouring fast currents through the GAB. The Indian Ocean had a dominating influence keeping the GAB warm through the winter of 2013. And through the most recent fishing season, 2014 there was minimal influence from the Pacific and Indian Oceans and a strong and beneficial influence from the Southern Ocean, especially evident through the latter half of the season.

A good example of the dynamic nature of these systems can be seen from the situation in the Pacific Ocean over the past 9 months (Figure 7):

December 2013 (top panel of Figure 7) - it was distinctly cooler on the American side of the Pacific Ocean (denoted by the black border on the right side of all panels).

Through January and February (the 2nd and 3rd panels in Figure 7) the slightly warm water mass located on the Australian side (black on left side of all panels) at about 150m-depth, consolidated and became increasingly warmer than surrounding waters.

Through March 2014 this warmer mass showed an inclination to move eastwards across the Pacific, and at this time because of the heat and size of the mass the forecasts were issued that an El Nino was imminent and it was likely to be a very intense one.

Over the next few months (April, May, June) the ocean continued to show a pattern characteristic of an El Nino, but the atmosphere component of the ENSO system did not follow this pattern. The 'coupling' of the ocean and atmosphere is necessary for the system to develop to its full potential. The fact that this didn't happen resulted in the warm water mass coming to the surface and losing heat. This heat loss probably influenced some of the unusual weather experienced across the eastern Pacific around and after this time.

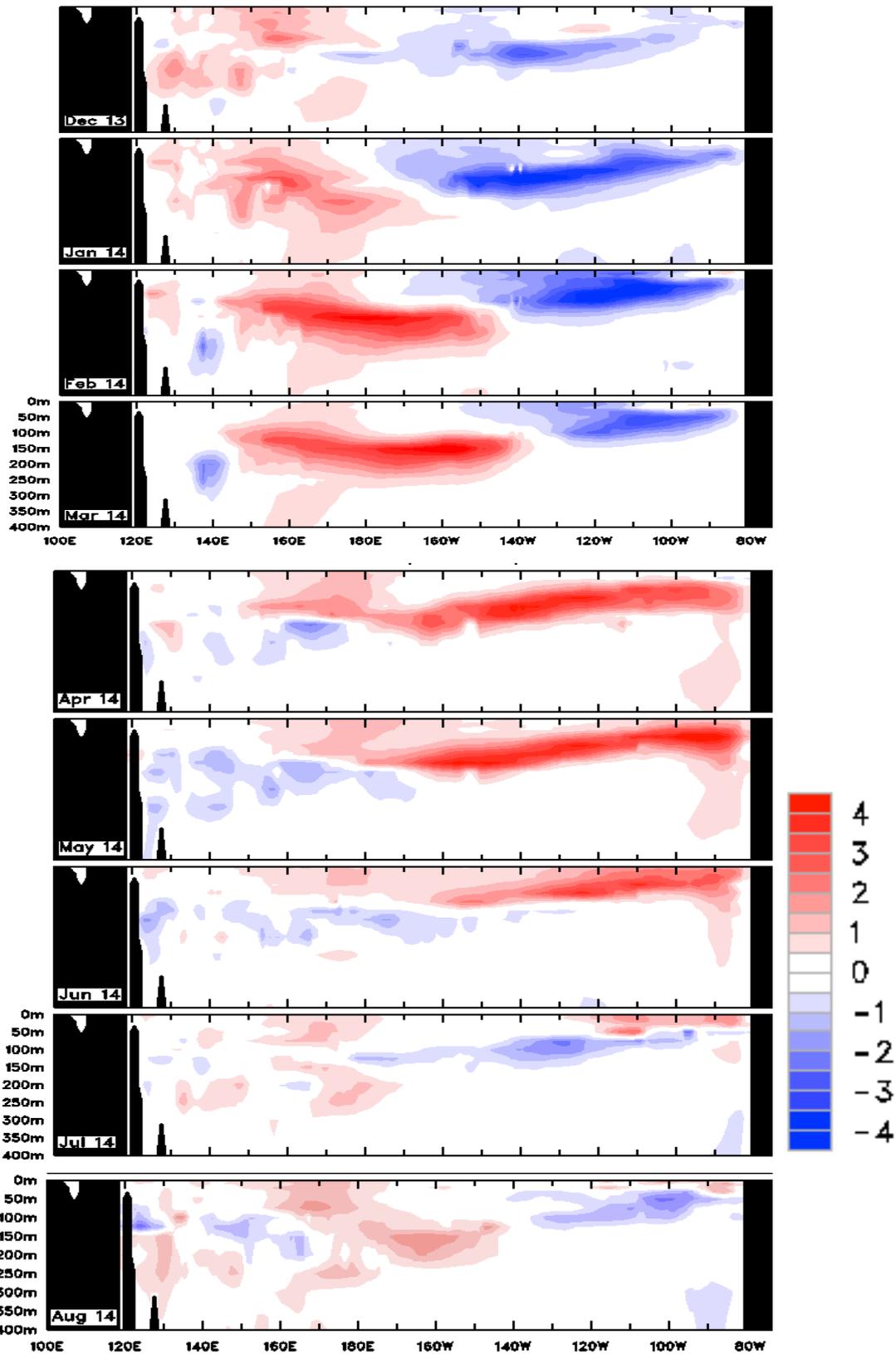


Figure 7: shows the location and depth of the warm water mass in the Pacific Ocean, and looking down the panels, how the El Nino forecast developed, and then the threat reduced over time (Bureau of Meteorology 2014).

Whilst the El Nino situation of the Pacific Ocean may seem a long way from the GAB, there are several aspects of this system that are relevant to SBT industry –

The pattern shown through April, May and June (and possibly into July also) blocks the upwelling system off the west coast of American and this is associated with reduced catches of bait fish in this area (hence potentially reduced or more expensive feed supplies for SBT).

El Nino's have been associated with improved upwelling in the GAB area.

Warm water on the Australian side can influence the nature (speed and heat) of the Leeuwin Current (down the west coast of WA and into the GAB) with a flow-on influence reducing the upwelling in the GAB. Note that it is the upwelling along the eastern section of the GAB that enhances the productivity and food supply to the bait fish (and everything else) in the area.

The development of an El Nino through late 2014 and into 2015 is still possible, but it is unlikely to be an event of sufficient intensity to have a major influence over conditions in the GAB through this next fishing season.

Useful Websites:

<http://www.bom.gov.au>

<http://www.csiro.au>

<http://www.fishtrack.com>

<http://www.oceancurrent.imos.org.au>

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