Earth Systems and Climate Change Hub
National Environmental Science Programme
climate change **science brief**

Marine heatwaves off Western Australia: future projections

As our climate has warmed, the severity, duration and frequency of marine heatwaves – periods of abnormally high temperatures in the ocean – have increased.

The Western Australian coast experienced its most devastating marine heatwave event in 2011. It caused widespread impacts to the local environment, ecology and ocean-dependant industries.

Earth System and Climate Change Hub researchers have investigated the likelihood of marine heatwaves with a similar intensity and duration occurring on the coast of Western Australia in the future.

Impact of the 2011 marine heatwave

During 2011, a large area of ocean between Perth and Shark Bay experienced temperatures more than 2.5°C above normal levels over a two-month period. As a result of this marine heatwave, about 36% of the seagrass meadows of Shark Bay experienced an overall dieback. These seagrass meadows have important ecosystem functions and economic significance. They are also of significant cultural value to the Traditional Custodians of Shark Bay, the Malgana people. In addition, scallop and crab fisheries were closed, a range of seaweed species became regionally extinct and kelp forests died back and were replaced by turf-forming algae. Corals were also severely impacted, along with invertebrate species. Even several years after the heatwave, only parts of the ecosystem have shown reasonable recovery, indicating that the marine heatwave had a lasting effect on the region.

Given the severity of these impacts on the region, the Earth Systems and Climate Change (ESCC) Hub set out to investigate how likely it would be for a marine heatwave of this magnitude to occur again.

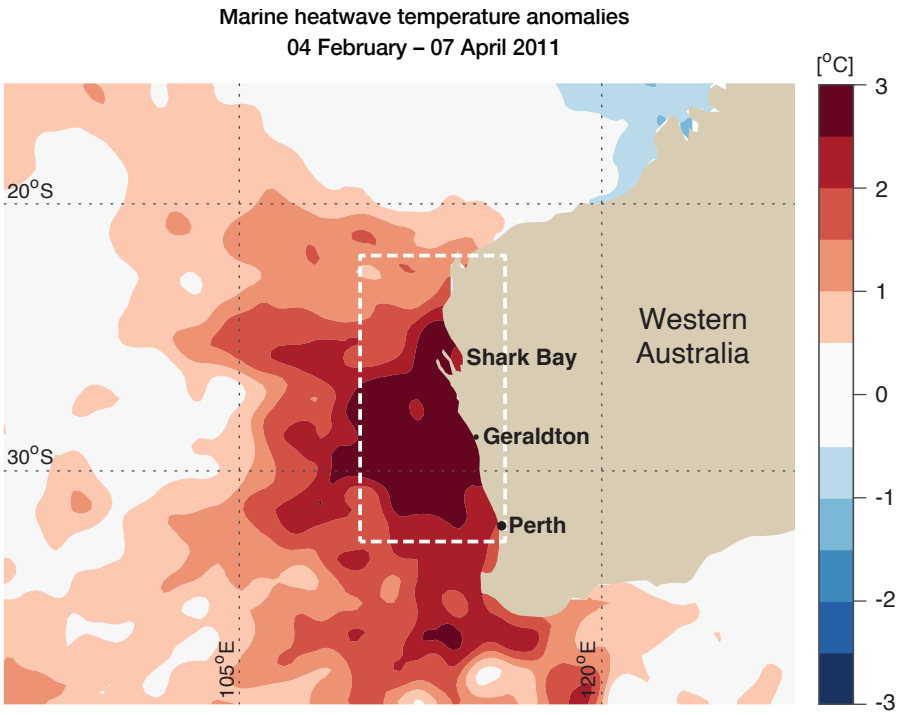

FIGURE 1 **Mean sea surface temperature anomalies during the 63 days of the 2011 WA marine heatwave relative to the 1983-2012 seasonal climatology.** The white dashed box indicates the extent of the area analysed.

Drivers of WA marine heatwaves

The strongest and longest marine heatwaves along the Western Australia (WA) coast are typically associated with the Ningaloo Niño phenomenon. The Ningaloo Niño is an interannual pattern of sea surface temperature variability similar to the El Niño-Southern Oscillation (ENSO) pattern in the Pacific Ocean.

La Niña events act to strengthen the Leeuwin Current, which runs southward along the coast of WA transporting warmer tropical waters into the region. Therefore, marine heatwaves are more likely to occur off the coast of WA following a La Niña, and 2011 was no exception as it followed the extreme La Niña of 2010/11.

Climate projections of future marine heatwave events

ESCC Hub researchers examined the likelihood of an extreme marine heatwave occurring under two possible future scenarios: a low emissions scenario (RCP2.6) and a high emissions scenario (RCP8.5).

While for any given scenario there is a wide range in simulated marine heatwave statistics, analysis of climate projection results under the two different emissions scenarios reveal starkly different outlooks.

Currently, it is estimated that marine heatwaves with an intensity similar to the 2011 event will occur approximately once every 80 years.

Under a low emissions scenario, future maximum marine heatwave intensities are not likely to change substantially, and the maximum intensity observed in 2011 will likely remain a relatively rare event, perhaps occurring once every 50 years by 2100. However, under a high emissions scenario, the observed 2011 maximum intensity is likely to become an annual event by 2100.

ESCC Hub researchers also found that under a high emissions scenario, the ocean off the WA coast is likely to be in a permanent marine heatwave state by 2100 (compared to a 1983-2012 baseline). Under a low emissions scenario, almost 200 marine heatwave days per year are projected to occur by 2060, and should stabilise through to 2100 – a similar number as observed during the 2011 event.

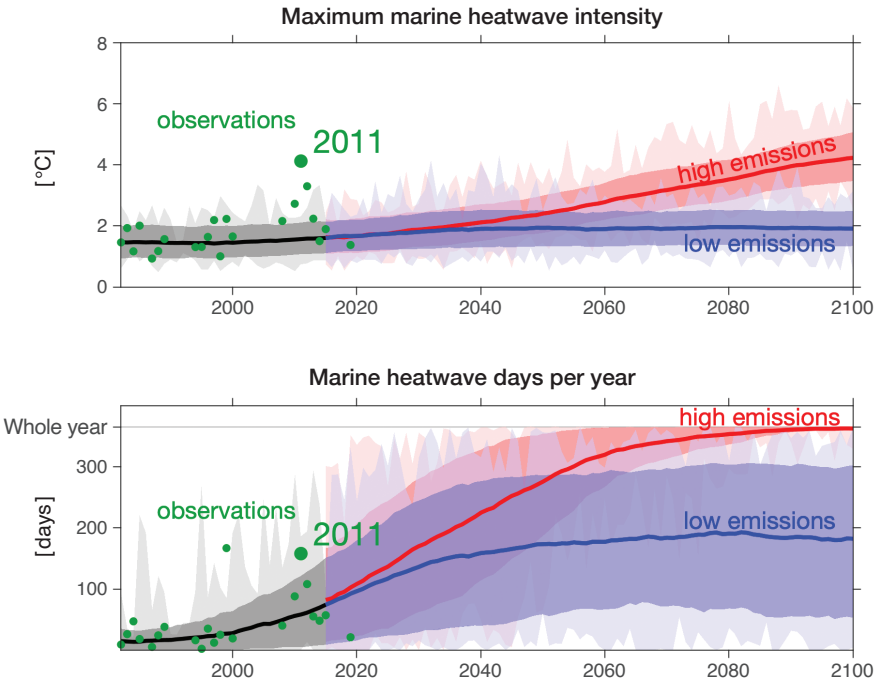

FIGURE 2 **Marine heatwave frequency and intensity is projected to increase more under a high emissions scenario compared to a low scenario.** Model projections from 17 CMIP5 models, under low (RCP2.6) and high (RCP8.5) emissions scenarios. Light shading denotes the full model ranges, darker shading the 66% likelihood range, and solid lines the model mean.

Marine heatwaves have led to dieback of seagrass meadows off the coast of Western Australia, with repercussions for marine species which depend on them for food and shelter.
Image: iStock.com/Damocean

Planning for future marine heatwaves

Changes in the duration, frequency and intensity of future marine heatwave events will have implications for marine ecosystems and ocean-based industries. Already, marine managers in Western Australia are considering ways to adapt to and manage future marine heatwaves and their impacts, such as closing fisheries prior to or during heatwave events, reducing catches following major marine heatwaves and seeking longer lead-time seasonal forecasts to allow more time for preparation.

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