Earth Systems and Climate Change Hub
National Environmental Science Programme

TECHNICAL REPORT NO. 2: SUMMARY

Climate drivers of the 2015 Gulf of Carpentaria mangrove dieback

Photo: Norm Duke

ESCC Hub researchers investigated the oceanic and atmospheric conditions leading up to the major mangrove dieback in late 2015 to identify potential stressors that contributed to the tree deaths. They found that it was most likely a result of a combination of very dry conditions and lower than average sea level. In combination, it appears that these conditions were unprecedented since at least 1971, and linked to the strong El Niño of 2015/16.

More detailed attribution studies are necessary to determine what role, if any, human-induced climate change played in the 2015 dieback event. This would help inform natural resource policy-makers, planners and associated decision-makers about the causes of such events and how they may change into the future.

Mangroves and the 2015 dieback

Work conducted by Duke et al. (2017) as part of a joint NESP project between the Northern Australia Environmental Resources Hub and Tropical Water Quality Hub showed that approximately 7400 hectares of mangroves suffered dieback across a 1000 km front along the southern Gulf of Carpentaria in late 2015.

Mangroves are a vitally important part of the local ecosystem, providing homes and nurseries for an array of aquatic life, protecting coastlines from extreme weather and erosion, filtering out sediment from river run-off to protect coral reefs and sea grass, as well as absorbing and storing large amounts of carbon dioxide. The total value of these services is conservatively estimated to be AU$1.7 billion annually (Lovelock et al. 2015), a value likely diminished by the dieback event.

Mangrove trees require moisture from a combination of sources, including sea water. They can become stressed when sea levels are low and their roots are exposed for long periods of time. High temperatures can also exacerbate moisture loss, leading to further stress. In the absence of other disturbances such as pollution or tropical cyclones, hypersalinity can kill them.

Timing of the event

While the main dieback occurred late in 2015, satellite data suggests that the trees were already not as green and vigorous as usual at the end of the preceding wet season (March-April 2015) and throughout 2015. This suggests that the dieback may have been the result of cumulative stress.

The **Earth Systems and Climate Change Hub** is funded by the Australian Government's National Environmental Science Programme

Climate drivers

Local sea levels were unusually low for most of 2015. As sea levels dropped at the start of the dry season, ocean salinity levels were high. An early end to the 2014/15 wet season, below-average vapour pressure, and below-average top layer soil moisture since February 2015 point to moisture loss as a major factor.

Near surface land temperatures in the region were also high through most of 2015, with maximum temperatures at least in the top 20% from February to September, and November the warmest on record for much of the affected coastline.

The coincidence of unusually hot and dry conditions with low sea level likely provided a stressful environment for the mangroves. This cumulative stress during most of 2015 almost certainly contributed to the major dieback near the end of 2015.

The combination of dry and warm conditions in the six to nine months preceding the dieback has not been experienced since records began in 1971.

Did climate change play a role?

The unusually low sea levels contributing to the dieback were largely a result of the strong El Niño in 2015/16. While the combination of these low sea levels and very dry conditions underpinned the mangrove dieback, detailed attribution studies are necessary to determine what role, if any, human-induced climate change played in this event.

Next steps

There are still many questions with respect to understanding why the major mangrove dieback occurred, if it has happened before and if climate change played a part.

Development of a climate-based mangrove stress index could be used to identify (and consequently study) dieback events that may have occurred in the past, and assess potential dieback conditions in the future. Such an index would serve as an important management tool for mangrove communities and possibly other vulnerable ecological communities.

Better understanding of the climate drivers of events such as this one will help inform natural resource managers, policy-makers, planners and associated decision-makers about current and future risks.

References

Duke NC, Kovacs JM, Griffiths AD, Preece L, Hill DJE, van Oosterzee P, Mackenzie J, Morning HS, Burrows D. 2017. Large-scale dieback of mangroves in Australia's Gulf of Carpentaria: a severe ecosystem response, coincidental with an unusually extreme weather event. *Marine and Freshwater Research*, doi:10.1071/mf16322

Lovelock CE, Cahoon DR, Friess DA, Guntenspergen GR, Krauss KW, Reef R, Rogers K, Saunders ML, Sidik F, Swales A, Saintilan N, Thuyen LX, Triet T. 2015. The vulnerability of Indo-Pacific mangrove forests to sea-level rise. *Nature*, 526, 559–563. doi:10.1038/nature15538

For more information, please refer to the full technical report:

Harris T, Hope P, Oliver E, Smalley R, Arblaster J, Holbrook N, Duke N, Pearce K, Braganza, K and Bindoff N. 2017. Climate drivers of the 2015 Gulf of Carpentaria mangrove dieback. Earth Systems and Climate Change Hub Technical Report No. 2, NESP Earth Systems and Climate Change Hub, Australia.

The report is available at **www.nespclimate.com.au**.