Tropical Water Quality Hub

National Environmental Science Programme

Northern Australia Environmental Resources Hub

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Facilitating natural regeneration processes: Planting seedlings is not the best response to mass mangrove dieback in the Gulf of Carpentaria

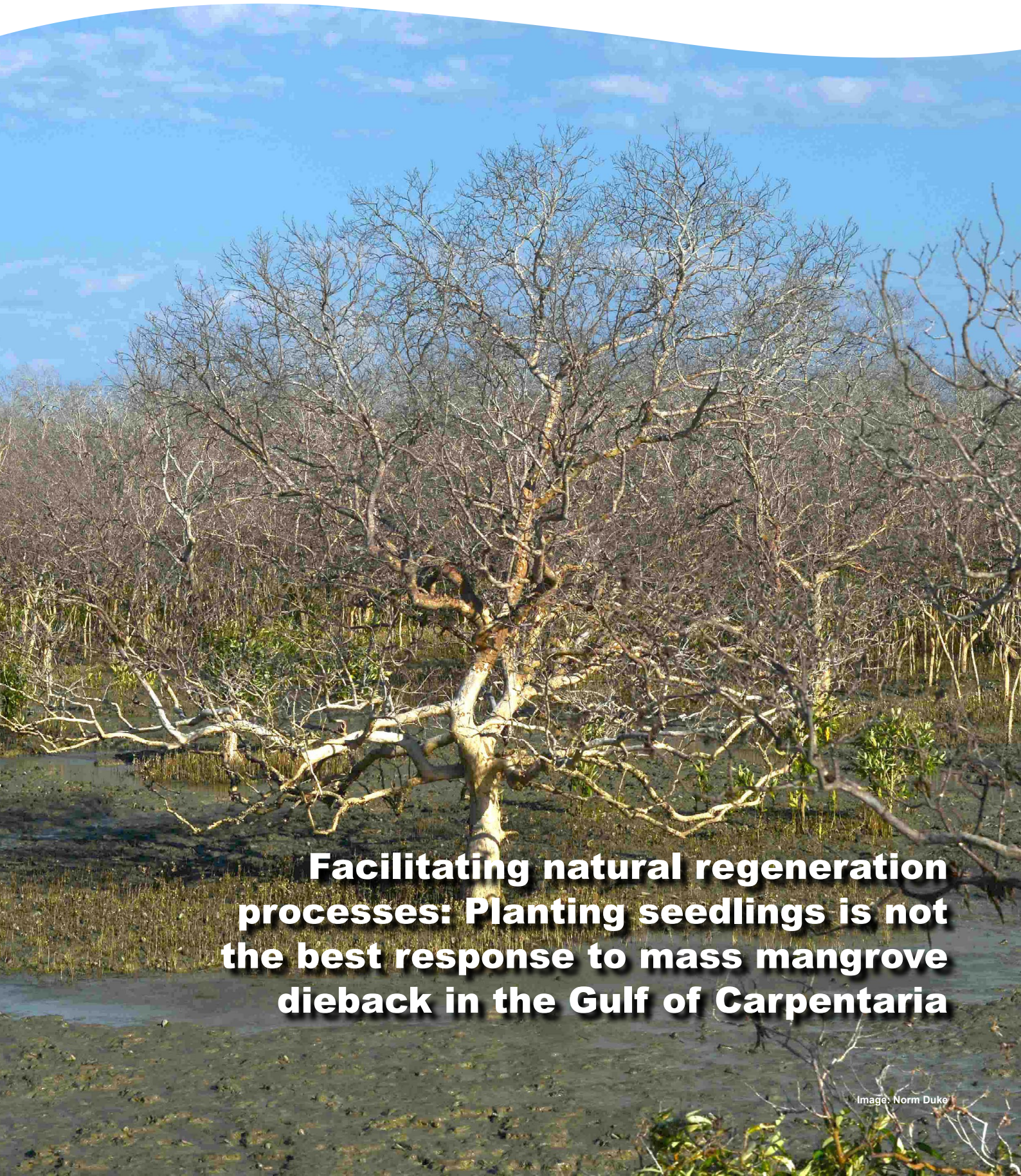

Image: Norm Duke

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This report is available for download from the NESP Tropical Water Quality Hub website: **www.nesptropical.edu.au**

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The issue

When mangrove ecosystems are healthy, they provide valuable structure, carbon sequestration, shoreline protection, shelter, nursery habitat, and food for estuarine, coastal, and reef fisheries and other marine life of cultural and economic importance. These benefits extend to the maintenance of shoreline stability with the buffering of exposed shorelines from erosion and retreat inland. These shoreline protection benefits are much needed where sea levels are changing and storm severity is increasing, as is already occurring with global climate change. Healthy living mangrove habitats also hold considerable carbon reserves both in their woody structure and below ground in peaty sediments. These underground reserves only persist while the living vegetation on top remains intact and protected. The loss of mangrove systems results in a reduction in the buffering and filtering of runoff from the land and in the capture of harmful agents like agricultural chemicals and excess sediments and nutrients. These and other benefits provided by these shoreline ecosystems can only be maintained where these natural habitats remain intact and functional.

In early 2016, shocking images emerged from a remote part of northern Australia showing that millions of mangrove trees had suddenly died along the of Gulf of Carpentaria coastline (Duke et al. 2017). This dieback was unprecedented in scale, severity and extent, and was widely reported in national and international news. The cause was unknown and the implications for local and regional ecosystems and dependent valuable traditional and commercial fisheries were feared to be considerable. Investigations were hampered both by the remoteness of the region, making access difficult and expensive, and scarcity of spatial and environmental records.

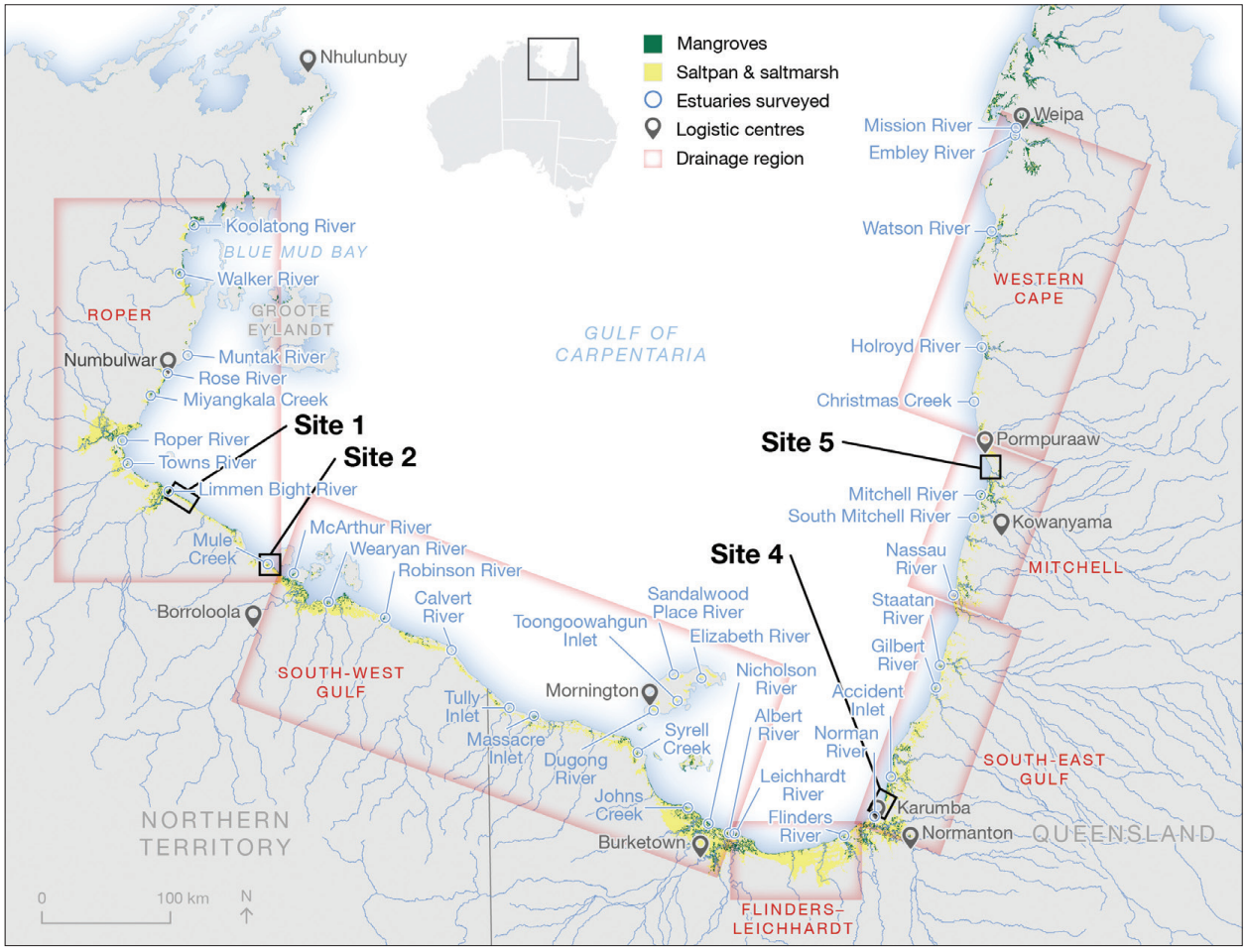

Figure 1 Area surveyed by air and on-shore by Indigenous rangers and scientists in response to reports of mass mangrove dieback in 2015-6. Courtesy of NESP Northern Australia Environmental Resources Hub

The process

The National Environmental Science Program (NESP) Tropical Water Quality (TWQ) and Northern Australia Environmental Resources (NAER) Hubs jointly investigated the extent, cause, and possible treatment of the dieback. It was immediately recognised that local Traditional Owners and Indigenous rangers were best placed to investigate the condition of mangroves on their country. The scientific teams worked with local communities and Indigenous ranger groups such as the Mabunji Aboriginal Corporation with their Li-Anthawirriyarra land and sea ranger group based at Borroloola in the Northern Territory. This close working relationship was important for several reasons – the scientists learned from the people most affected by the mangrove dieback about local values, issues and concerns, while the Indigenous rangers were trained in a number of modern mangrove monitoring techniques without which the study would have been unfeasible.

Also involved were community members like environmental consultants, fishers and tourist operators from various groups, and local natural resource management (NRM) groups surrounding the Gulf of Carpentaria including the Cape York NRM, Northern Gulf Resource Management Group, Southern Gulf Catchments Inc and Territory Natural Resource Management.

As part of the first response, the research project leader Dr Norm Duke (James Cook University) initiated briefings and an exploratory investigation using available information, as well as two opportunistic aerial surveys at widely located sites across the southern Gulf region, including Limmen Bight River with the Northern Territory Government, and the Norman, Leichhardt and Albert Rivers. These surveys provided invaluable data and imagery from which a research article was rapidly written and published with the CSIRO journal Marine and Freshwater Research. This article had the immediate result of bringing national and international attention to the dieback.

During the project, the aim was to build a dialogue with local Indigenous people to inform them of the research being undertaken, update them on the results and findings, incorporate their views and knowledge of climate processes influencing their local natural marine and tidal wetland ecosystems, and engage, equip and train locally based rangers in the monitoring of environmental condition using systematic, simple and robust scientific techniques. Training involved formal instruction in the use of monitoring equipment supplied and the acquisition of useful geo-tagged image data using the shoreline video assessment method (S-VAM; Mackenzie et al., 2016). The training program included the compilation and publication of a dedicated training manual for Indigenous rangers (**MangroveWatch, 2019**).

Training in each session involved an initial discussion around a computer screen projection to explain the reasons for monitoring and to introduce the equipment to be used. This was followed by a field visit to a nearby estuary using one or two small vessels depending on the numbers of rangers attending. There were generally up to 10 rangers at each session.

Image: Jock Mackenzie

The outcome

Approximately 39.4 million trees died in just a few months during the 2015 event, releasing an estimated 820,895 tonnes of carbon. The dieback was caused by a short-term but dramatic drop in sea level in the Gulf of Carpenteria caused by extreme El Niño conditions. Analyses of the data collected during this study have enabled development of a sea level stress index with defined thresholds for lethal and sublethal impacts on mangroves, which may provide several weeks' warning of imminent future mass mangrove dieback events in the Gulf.

Two tropical cyclones in 2018–2019 had localised severe impacts along 600 km of dieback-affected shoreline, hindering mangrove recovery by pushing wrack piles of dead mangrove wood across large areas, destroying recovering trees and seedlings, coupled with destructive shoreline scouring and erosion.

It is increasingly apparent that the survival of beneficial mangrove habitat greatly depends on well-intentioned and best-informed management interventions backed up with updated knowledge of habitat condition gained from regular monitoring. Better understanding of the cause of the dieback, the trajectory of mangrove recovery, and the ability to predict future events means there is now the potential for interventions to reduce the severity of impacts and promote recovery. Strategies to ensure the long-term health and resilience of mangrove ecosystems can be pursued at the local, national and global scale. To be most effective, these strategies should be enacted concurrently:

1. Climate change abatement schemes enacted at national and global levels are needed to reduce the risk posed to mangrove ecosystems from desiccation, flooding, sea level fluctuations and more frequent and severe tropical storms and cyclones.
2. The resilience of mangrove communities and associated habitats will be strengthened by either removing or managing the impacts of local processes, such as feral pig damage, fires and weed invasions.
3. To deal with the likelihood of future dieback events, we strongly recommend there be a remedial watering strategy to keep affected trees alive during periods of extreme low moisture conditions. From our current studies, we now know the threshold low sea levels that will kill mangrove trees on these shorelines, and a monitoring scheme that signals when weather and sea level conditions become threatening can be devised. Where trees can be kept alive during inevitable stress conditions then much of the progressive pressures associated with climate change can be managed far more effectively. In this case, prevention is both the most reliable response, and the cure.

Local Traditional Owners and Indigenous ranger groups could lead or be involved in some of these strategies, especially pig, fire and weed management. In addition to their substantial traditional knowledge and vested interests in the health of their mangrove forests, they now have many of the scientific and monitoring skills that will be needed to care for their country.

Intervention involving replanting of mangrove propagules is not recommended. This conclusion is soundly supported in this investigation by 1) our observations of adequate natural recruitment coupled with 2) other observations of cumulative impacts by factors like severe cyclones, flooding and rising sea levels. Assistance with recruitment by planting is unnecessary because the surviving mature mangrove trees have generated enough propagules (seedlings) to achieve abundant natural recruitment across the impacted region of the Gulf. Survival and establishment of recruits, were observed to be problematic due to both episodic and continuous effects of strong storms, fires, weeds, and feral pigs. Such cumulative impacts have disrupted recovery, reducing normal growth and establishment of young mangrove plants.

Other resources

Duke N.C.,Mackenzie J.,Kovacs J.,Staben G.,Coles, R.,Wood A., & Castle Y. (2020). Assessing the Gulf of Carpentaria mangrove dieback 2017-2019. Volume 1: Aerial surveys. James Cook University, Townsville, 226pp.

Duke N.C., Mackenzie J., Hutley L., Staben, G., & Bourke A. (2020). Assessing the Gulf of Carpentaria mangrove dieback 2017-2019. Volume 2: Field studies. James Cook University, Townsville, 150pp.

Long et al. (2021). Realising the benefits of ecosystem restoration for Queensland: synthesis of new knowledge from the NESP TWQ Hub. Report to the National Environmental Science Program's Tropical Water Quality Hub, Reef and Rainforest Research Centre, Cairns.

MangroveWatch, 2019. Indigenous Ranger field guide to the Shoreline Video Assessment Method. Centre for Tropical Water and Aquatic Ecosystem Research (TropWATER), James Cook University, Townsville.

Image: Norm Duke

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Reef & Rainforest Research Centre

Australian Institute of Marine Science

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