19 August 2025

Submission by Prof. Ivan Nagelkerken for the Senate Inquiry on the causes, frequency, scale and duration of recent algal blooms in South Australian marine and coastal environments

Dear Sir/Madam,

Thank you for the opportunity to provide a submission to the Senate Inquiry on 'The causes, frequency, scale and duration of recent algal blooms in South Australian marine and coastal environments'.

I am associated with the University of Adelaide and the Environment Institute (Adelaide). I have been studying fish communities, coastal ecosystems (mangroves, seagrasses, coral reefs), marine food webs, and human and climate change impacts on marine ecosystems around the world (in particular in the Caribbean, Indian Ocean and Western Pacific) during the past 30 years. I have published more than 210 scientific articles and book chapters and edited one book on coastal ecosystems. I have been studying the marine ecosystems of the Spencer Gulf and Gulf St. Vincent during the past 14 years. I have also led several prestigious and large research grants studying the effects of climate change on marine fishes and ecosystems in Australia.

I would like to submit the following statements on the causes, frequency, scale and duration of recent algal blooms in South Australian marine and coastal environments as stated in the call for submissions.

Yours sincerely,

Prof. Ivan Nagelkerken

b. Ecological, economic, cultural and social impacts of algal blooms with particular reference to:

iii. Marine biodiversity and ecosystem health

The more than 26,000 records of more than 450 marine species affected by South Australia's Harmful Algal Bloom (HAB) represent only the tip of the iceberg. The vast majority of dead animal simply do not wash ashore, but rot on the sea bottom. Moreover, animals and plants attached to the substratum (e.g. onto rocky reefs) or that live inside the sediment at the bottom of the Gulf St. Vincent are unlikely to be observed washing ashore due to their attached life style.

Species will have been affected differently, but few details are known at this stage. Nevertheless, it is more than likely that species with already small populations sizes will have more difficulty recovering to their original population sizes once the HAB has cleared. Such species have small population sizes for a reason, e.g. because they are heavily exploited by humans, they have low reproduction rates, they have low survival rates in nature, or they have high sensitivity to certain environmental conditions. As such, these sensitive species need to be identified and efforts undertaken to prevent their population collapse or local extinction.

Marine reserves, and in particular no-take reserves, might harbor healthier populations of benthic habitats (e.g. kelp, seagrasses) and fish and fisheries species. It is critical to understand if our current marine reserves have provided increased resilience to those species and habitats affected by the HAB.

Even if species are not directly affected by the HAB, the entire marine food web in the coastal waters of Gulf St. Vincent and surroundings will have been affected because of reduced food availability. Mass mortality of invertebrates and smaller fishes affects the food abundance for a wide range of fish and fisheries species, as well as other iconic species such as dolphins. Moreover, the high abundances of the HAB in the seawater could outcompete benign phytoplankton that fuels the food web from the bottom up. Likewise, zooplankton abundances in the seawater could have decreased with *Karenia mikimotoi* not being a preferred food source. Zooplankton is a critical food source for benthic and pelagic food webs.

The wide range of species affected by the HAB could reduce biodiversity on local spatial scales. We know that increased biodiversity provides resilience to food webs and ecosystems against stressors such as climate change and other natural and human disturbances. The impacts of the HAB on our biodiversity need to be urgently assessed and monitored.

e. The current support and recovery arrangements for impacted industries and communities, including:

iii. research, monitoring and restoration efforts

Whilst the HAB is still active and widely spread it is critical for the government to provide immediate funding to Universities for scientific research into the drivers and spread of the HAB. This allows samples to be collected and studies to be performed during, rather than after the HAB. This can provide a better understanding of the drivers of such blooms and allows critical data collection that can be used to model and forecast future HABs and their ecological impacts on marine fish species and ecosystems in South Australia.

Recommended scientific data that need to be urgently collected are:

- How is the algal bloom tracking along the coastlines and Gulfs of wider Adelaide, and which environmental factors are they associated with (e.g. nutrient concentrations, seawater temperature, pH, dissolved oxygen)?
- Which marine species, what part of their populations, and across which spatial scales have been affected thus far?
- How are the total number of species affected and their population sizes changing due to the HAB as we proceed into spring and possibly summer?
- How have species been differently affected inside and outside South Australia's marine reserves?

f. The adequacy of long-term monitoring, forecasting and prevention strategies, including funding and institutional support for marine science and environmental data collection

Immediate species and ecosystem impact assessments, and a long-term monitoring need to be commenced to capture the HAB whilst it is still active. Without such data it will be difficult to model future HABs and their impacts on marine species and ecosystems. To enable evidence-based decisions on marine protection and restoration, the government needs to

provide financial support for scientific research into the drivers, spread, impacts and mechanisms of this HAB.

Recommendations:

- Actions need to be taken to facilitate the establishment of a centralised, freely accessible online database(s) that holds environmental and biological data relevant to the HAB.
- Ecological models need to be designed that allow insights into how the biodiversity, resilience and population size of key species have been affected.
- Ecological models need to be designed that allow insights into how the biodiversity, resilience and population size of key species could respond to future HABs, in particular in the light of increasing climate change impacts such as heatwaves, ocean warming, hypoxia, ocean acidification, droughts, and floods.
- Species populations that have been reduced below sustainable levels need (temporary) protection from (over)fishing to prevent their population collapse. The combined effects of mass HAB mortalities combined with fishing under a business-as-usual effort might prove detrimental for various species.
- Long-term monitoring of basic environmental conditions (e.g. nutrients, specific pollutions, seawater temperatures, pH, dissolved oxygen, turbidity) of coastal waters around Adelaide needs to be undertaken. These could function as important early warning signals for future HAB outbreaks (and other marine disasters).