



The Harmful Algal Bloom (HAB): do we dare consider future scenarios?

The devastating *Karenia mikimotoi* algal bloom in South Australia is not just a current crisis; it presents alarming future scenarios for the state's precious marine ecosystems and industries. While the immediate impacts are profound, the long-term consequences could be even more far-reaching, especially given the unique characteristics of *Karenia* and South Australia's environment.

Documenting the Devastation and Hidden Scale

The scale of the current *Karenia* bloom's impact is being diligently documented, not only through official surveys but also through vital citizen science initiatives. Projects like the Great Southern Reef (GSR) and [Crab.e.Cam](#), alongside hundreds of citizen recordings of mortalities washing ashore via platforms like iNaturalist, are providing invaluable real-time data on the bloom's devastating reach. This information is then made easily and freely available, empowering the public and informing scientific understanding.

Adding to this, South Australia's flagship fisheries patrol vessel, the Southern Ranger, is conducting crucial underwater observations in Gulf St Vincent. These dives, utilizing remote operated vehicles, aim to understand the bloom's direct effects on the ecosystem, especially given the alarming number and diversity of species already washing up dead.

A critical challenge in fully grasping the bloom's impact is the high turbidity of the water. Stormwater runoff, combined with the dense algal bloom, significantly reduces underwater visibility. This "murkiness" effectively hides the true extent of the local damage, meaning the full scale of the ecological catastrophe may only become apparent once the waters clear from less runoff.

Future Scenarios: A Persistent Threat

Future scenario modeling, notably by Flinders University's, Associate Professor Jochem Kaemph, paints a concerning picture. It indicates that the *Karenia* bloom is likely to move further inshore and have an extended residence time in the gulfs, primarily due to the slow flushing time of these water bodies, estimated at around one year. This means the bloom, or its effects, could linger for a considerable period.

A key factor in this persistence is the mixotrophic nature of *Karenia*. Unlike many algae that solely rely on photosynthesis, *Karenia* can also "eat" other organic matter. This characteristic gives it a significant advantage, particularly when combined with nutrient-rich stormwater runoff. It creates a high potential for the bloom to be "reignited" or sustained by these intermittent nutrient influxes.

South Australia's climate, particularly its Mediterranean characteristics, often sees stormwater runoff events even in the height of summer. While historically, substantial rainfall in summer is less common than in winter, intense, short-duration storm events can still deliver significant volumes of runoff. These events, coupled with warmer waters and increased daylight during summer, would provide ideal conditions for *Karenia* to flourish. This scenario strongly suggests an increased likelihood of reigniting and extending the bloom's dispersion and duration throughout the warmer months.

Terrestrial and Nearshore Pressures: Fueling the Bloom

Terrestrial and nearshore pressures further exacerbate the risk of reigniting the *Karenia* bloom:

- **Polluted Stormwater:** Stormwater runoff from urban and agricultural areas is a significant source of nutrients (like nitrogen and phosphorus from fertilizers, pet waste, and decaying organic matter) that act as food for algae. As our cities grow and development continues, more impervious surfaces mean less water infiltrates the ground and more runs off into waterways, carrying pollutants directly into the marine environment. This constant supply of nutrients could provide the continuous "fuel" *Karenia* needs to maintain its presence especially where water pools from stormwater discharges to the coast.
- **Dredging:** Dredging activities, while necessary for coastal protection and maintenance of harbours disturbs sediments. These sediments can contain dormant algal cysts (resting stages of algae) and release trapped nutrients into the water column. This disturbance, especially if occurring in areas where *Karenia* has established itself or where its cysts are present, could potentially trigger new bloom events or re-energize existing ones. It also increases turbidity, which can stress marine life, making them more vulnerable.

Long-Term Environmental, Economic, and Amenity Consequences

Karenia have been reported in Japan, China, Ireland, Norway, New Zealand, the English Channel, and America, resulting in huge marine mortalities. *K. mikimotoi* is planktonic and often forms recurring blooms in coastal waters, particularly in enclosed areas. It is eurythermal and euryhaline, meaning it can tolerate a wide range of temperatures and salinities. The ongoing and potential future impacts of this *Karenia* bloom could potentially have profound consequences across South Australia for years to come:

- **Environmental Devastation and Recovery Time:** The scale of the current marine mortalities is unprecedented. Recovery from widespread habitat loss, such as the estimated 5,000 hectares of seagrass loss from past events (e.g., in Gulf St Vincent in the 1970s and 1980s), can take decades, if not longer. For slow-growing foundational species like seagrasses (e.g., *Posidonia* spp.), even small seagrass losses can take a decade or more to recolonize. The loss of foundational species like sponges and macroalgae (seaweeds) is particularly critical. These species provide complex habitat structure, shelter, and nursery areas for countless other marine organisms, from juvenile fish to invertebrates. Their widespread death will have cascading effects throughout the food web, potentially leading to a long-term decline in fish populations and overall ecosystem health.
- **Impact on Fisheries:** South Australia's gulfs and southern waters are intrinsically linked to commercial fishing of migratory oceanic species such as Australian herring, tuna, and kingfish. These waters serve as crucial feeding grounds, nursery areas, and migratory pathways. Local fisheries including prawns, crabs and scalefish may also be impacted. The disruption of the food web, the direct mortality of baitfish and juveniles, and the broad-scale habitat destruction caused by the *Karenia* bloom may severely impact these fisheries. Even if the bloom recedes, the disruption of life cycles for many species will mean ongoing impacts for years, affecting recruitment, stock sizes, and ultimately, the livelihoods of fishers. The closures of key fishing and aquaculture zones will continue to inflict economic pain.
- **Threatened and Endangered Migratory Species:** The southern ocean waters and gulfs are also vital to migratory species like turtles, listed as Endangered or Vulnerable under the Commonwealth



Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). South Australian waters serve as important foraging grounds and migratory pathways. The direct toxicity of the bloom, the loss of food sources, and the general degradation of their marine habitat pose significant threats to these already vulnerable populations, potentially hindering their recovery efforts.

- **Amenity Consequences:** Beyond the ecological and economic fallout, the bloom has severely impacted the amenity of South Australia's coastline. The inability to enjoy clean beaches, swim in clear water, or participate in recreational fishing and water sports directly affects the wellbeing and lifestyle of South Australians and impacts tourism. This loss of connection to the natural environment, coupled with the distressing sight of marine mortalities, has a tangible social and psychological cost.

Valuing Our Natural Assets: A Path Forward

While the current crisis underscores the immense challenges, the development of South Australia's environmental acts and policies, including the recent Biodiversity Act, demonstrates a growing recognition of the intrinsic value of our natural assets. It also provides for critical habitat protections and a nationally consistent process for listing threatened species.

This legal framework reflects a societal understanding that a thriving natural environment and rich biodiversity are not just aesthetic preferences but are imperative for our well-being and long-term prosperity. From the simple pleasure of a clean beach to the complex ecological balance that supports commercial fisheries, South Australians depend on these natural assets. The current *Karenia* bloom serves as a stark reminder that while progress in environmental legislation may seem slow, it is more critical than ever to ensure robust policies are in place and actively implemented to protect and restore our precious marine environments for future generations. The challenge now is to translate this legislative intent into tangible actions that build resilience against such unprecedented environmental crises.

Karenia mikimotoi has a global presence and a history of recurrent outbreaks. Long-term monitoring that can provide crucial information on bloom dynamics, predicting outbreaks and mitigating their impacts is imperative for planning for devastating effects on marine ecosystems and associated industries. The recent event in South Australia underscores the ongoing challenge and the critical need for robust, proactive strategies. In my next article, I will discuss holistic monitoring of SA's waters that takes into consideration the local pressures on SA's marine estate.