

Can the Ocean Bounce Back? Healing After Harmful Algal Blooms (HABs)

South Australia is currently experiencing an unprecedented and devastating harmful algal bloom (HAB) of the species *Karenia mikimotoi*, impacting large areas of its coastline, including metropolitan beaches, the Fleurieu Peninsula, Yorke Peninsula, Kangaroo Island, Eyre Peninsula, and the Coorong.

Historical Summary of Algal Bloom Events in South Australia

Algal blooms, including those of *K. mikimotoi*, have occurred in South Australia previously. A notable past event was a substantial *K. mikimotoi* bloom in Coffin Bay in 2014. While harmful algal blooms are a natural phenomenon globally, the current event is considered to be of exceptional scale, duration, and impact for South Australia. Earlier HABs include marine heatwave-related blooms in 2013 (*Chaetoceros* sp. diatom) that caused fish and shellfish mortalities.

Causes of the Current *Karenia* Algal Bloom

Evidence points to a combination of factors contributing to the current bloom:

- **Marine Heatwave:** An ongoing marine heatwave since September 2024, with sea temperatures approximately 2.5°C warmer than usual, combined with calm conditions, light winds, and small swells, created ideal conditions for *K. mikimotoi* to proliferate. Warmer temperatures generally favour algal growth.
- **Nutrient Influx from River Murray Flood:** The 2022-23 River Murray flood, the largest since 1956, washed a significant amount of extra nutrients into the sea. These nutrients can fuel algal growth.
- **Cold-Water Upwelling:** An unprecedented cold-water upwelling in the summer of 2023-24 brought additional nutrient-rich water to the surface, further supporting the bloom.
- **Algae Adaptations:** *K. mikimotoi* has adaptations, such as the ability to move up and down the water column to access nutrients from deeper layers, which may have enhanced its growth in these conditions. It can also assimilate the remains of other algal blooms, potentially linking it to the nutrient legacy of the Murray floods.

Spread of the Bloom

The bloom was initially identified in mid-March 2025 off the Southern Fleurieu Peninsula, particularly near Waitpinga and Parsons Beaches. It has since spread significantly, at one point covering over 4,400 square kilometres (close to the size of Kangaroo Island) at depths of up to 20m. The bloom's movement is dynamic and depends on weather and water conditions. Recent storms, instead of dissipating the bloom, have reportedly spread it into new waterways, including the Port River and West Lakes. Elevated levels of *Karenia* have been detected across Gulf St Vincent, as far south-west as Edithburgh on Yorke Peninsula to Aldinga in the east, and in areas along the upper Spencer Gulf and the north coast of Kangaroo Island, as well as the Coorong.



Environmental Effects

The *K. mikimotoi* bloom is highly toxic to marine life, primarily by damaging gills and gill structures, leading to suffocation. It produces "reactive oxygen species". These ROS are like tiny, highly unstable molecules that can cause damage to cells, similar to how rust can damage metal.

K. mikimotoi also produces cytotoxins, gymnocin A and B. The exact way gymnocin A and B cause harm is still not fully understood. They likely interfere with the basic workings of cells, potentially by damaging cell membranes (the outer skin of a cell) or by disrupting how cells communicate and function internally. There's also some thinking that gymnocins might *indirectly* mess with how cells handle oxygen, leading to what's called "oxidative stress"—an imbalance where there are too many damaging ROS and not enough protective mechanisms.

While *K. mikimotoi* is not known to produce brevetoxins, brevetoxins have been detected in this bloom event, suggesting the involvement of other *Karenia* species. The environmental impacts are devastating:

- **Mass Marine Mortalities:** The bloom has caused widespread and substantial mortalities of marine life. As of late July 2025, nearly **500 different marine species** have been affected, with almost **14,000 marine animals killed**. This includes fish (such as flounder, leatherjacket, pufferfish, Murray cod), sharks (including great white sharks), rays (including stingrays and fiddler rays), turtles, seahorses, pipis, crabs, octopuses, cuttlefish, and a wide range of invertebrates like mussels, cockles, sea snails, razorfish, lobsters, abalone, sea stars, ascidians, and worms.
- **Habitat Damage:** Benthic habitats, including reefs, seagrass beds, and sandy areas, have been damaged. The mass death of filter-feeding molluscs, sponges and ascidians which are crucial for water quality and provide shelter and food for other species, is a significant concern.
- **Deoxygenation:** Dense algal blooms can reduce dissolved oxygen in the water as the algae die off and decompose, further harming marine life.

Human Health Effects

The algal bloom does not cause long-term harmful effects in humans. Aerosolized toxins and exposure to seafoam have caused throat/eye irritation, coughing, respiratory discomfort, including coughing or shortness of breath among beachgoers and surfers. These symptoms usually resolve within several hours of leaving the beach.

Some areas of the coast may have substantially higher concentrations of *Karenia* and present higher health risk. Coastal currents and conditions are likely to increase concentrations of the algae along the shore where wind and waves drives the bloom into shallow water. This is a dynamic situation governed by a variety of factors, but does suggest that some areas of the coast may present higher health risks especially for those in direct contact with the water.

Pet Health Effects

Let's face it, most dogs are going to eat or roll in something when they go to the beach. The evidence of human health effects suggests similar impacts could be experienced by dogs. Exposure to high concentrations of toxins through ingestion of dead sea creatures is likely to have higher health effects on pets.



Economic Effects

The *Karenia* algal bloom has had significant economic repercussions for South Australia:

- **Fisheries and Aquaculture:** The commercial fishing, aquaculture, and charter boat industries have been severely impacted. A similar effect can be predicted for recreational fishing suppliers. Some oyster and pipi harvesting areas have been closed due to the bloom and the detection of brevetoxins, halting operations and causing substantial income loss. Commercial fishers have reported severe reductions in catch and bait availability.
- **Tourism:** Tourist organizations have faced mass cancellations due to the presence of discolored water, foam, and dead marine life on popular beaches.
- **Government Response:** The state government's Emergency Management Committee of Cabinet signed off on a **\$28 million harmful algal bloom support package**. The comprehensive package covers industry support, science and research, communications, community support and clean up. The state government will contribute \$14 million, matching the Australian Government's contribution, with the elements of the package to begin rolling out immediately.

The duration of the bloom is uncertain, with similar events globally lasting from weeks to months depending on environmental conditions. There is no known human intervention that can dilute or dissipate the bloom. The ongoing crisis highlights the complex interplay of environmental factors and the potential for climate change to amplify such events.