Lipid biomarkers to diagnose algal bloom mediated fish kills

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Raphidophyte Flagellates

Chattonella marina/ antiqua

Port Lincoln 1996
$45M loss bluefin tuna aquaculture

Tuna gill pathology

control

Fixed dying fish

Heterosigma akashiwo
Karenia brevis

Karlenodium veneficum

Gymnodinioid Dinoflagellates

Cochlodinium

Tasmania 2003
$4M loss salmonid aquaculture

Swan River
Fragile Algal Cells; Fish Gill Cell Contact Critical

Sometimes neurotoxins involved (BTX, KTX), more often not.
REACTIVE OXYGEN SPECIES?


Analytical methods for highly destructive hydroxyl radical OH* under development
Prof. David Waite, University of NSW

Superoxide as electron shuttle for iron acquisition.

ROS on its own does not kill fish
Polyunsaturated Fatty Acids

C18:5n3
- Octadecapentaenoic acid (OPA)
- Gymnodinioids 15-28%
- Ichthyotoxic at ~3ppm
- 1.5-2 ppm in dense culture

C22:6n3
- Eicosapentaenoic acid (DHA)
- Raphidophytes 15-25%

C20:5n3
- Ichthyotoxic at ~3ppm

C18:4n3
- Double Bonds
- Position Terminal Double Bond
- No Carbon Atoms
Eicosapentaenoic acid (EPA) can cause necrosis in fish gills, but EPA toxicity was significantly enhanced in the presence of ROS.

Malonyldialdehyde (MDA)

Mopping up of ROS by catalase; superoxide dismutase

Search for lipid biomarkers for algal bloom ROS insult

Fish gill cell lines

Gill epithelium damage
Reduction of $\text{PaO}_2$
Osmoregulatory dysfunction

ROS, Lipid peroxidation, FFA

Hyperventilation

Chattonella cell rupture

Fish Death