Lipid biomarkers to diagnose algal bloom mediated fish kills

GM Hallegraeff[1], JA Marshall[1], PD Nichols[2], B Mooney [1,2], AR Place[3] & D.Waite[4]

[1] School of Plant Science, University of Tasmania; [2] CSIRO Marine & Atmospheric Research ; [3] Marine Biotechnology Institute, University of Maryland, USA; [4] University of New South Wales

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Raphidophyte Flagellates

Chattonella marina/ antiqua

Port Lincoln 1996
$45M loss bluefin tuna aquaculture

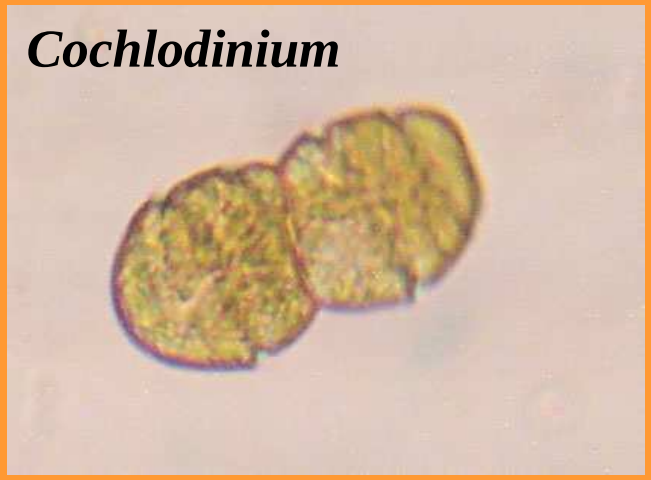
Heterosigma akashiwo

Karenia brevis

Karlodinium veneficum

Gymnodinioid Dinoflagellates

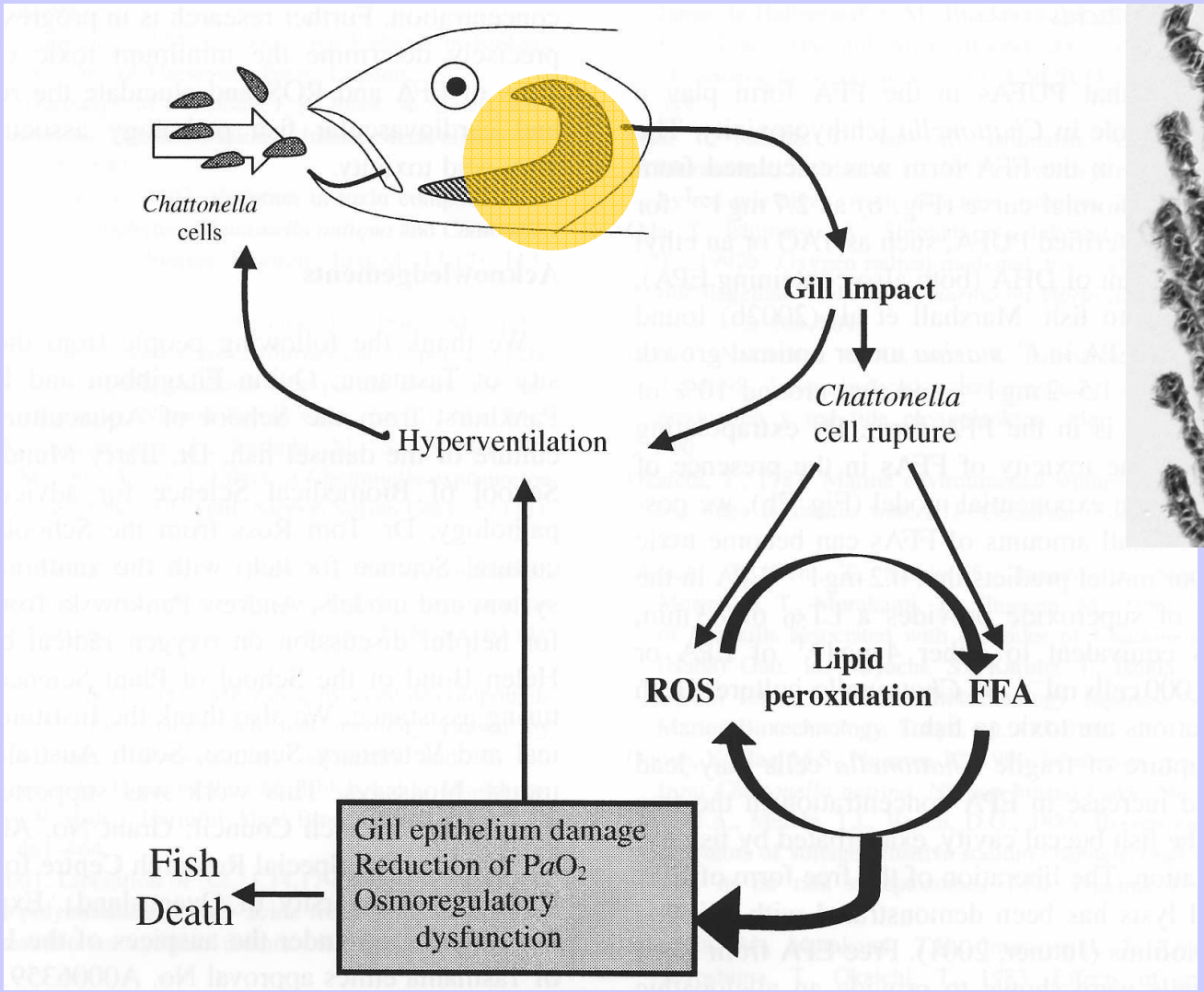
Cochlodinium

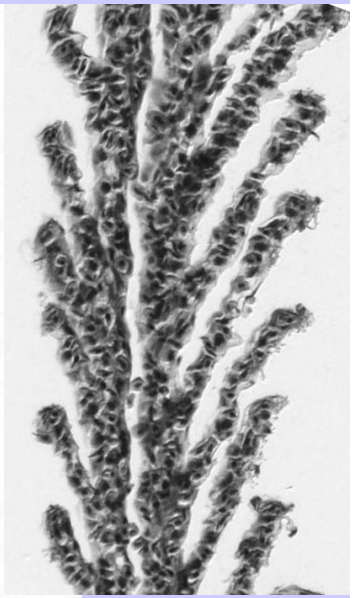


Tasmania 2003

$4M loss salmonid aquaculture

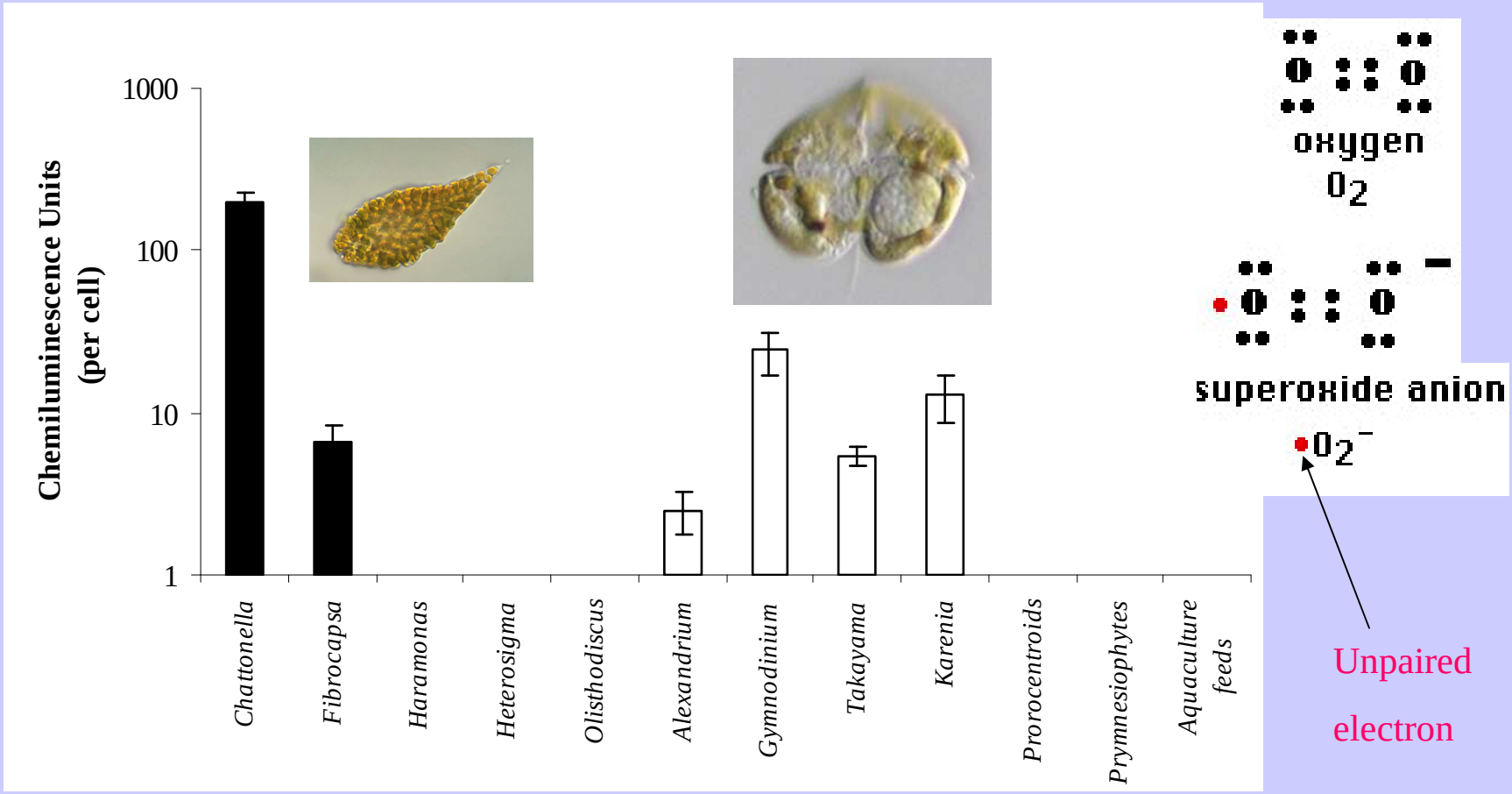
Fragile Algal Cells; Fish Gill Cell Contact Critical





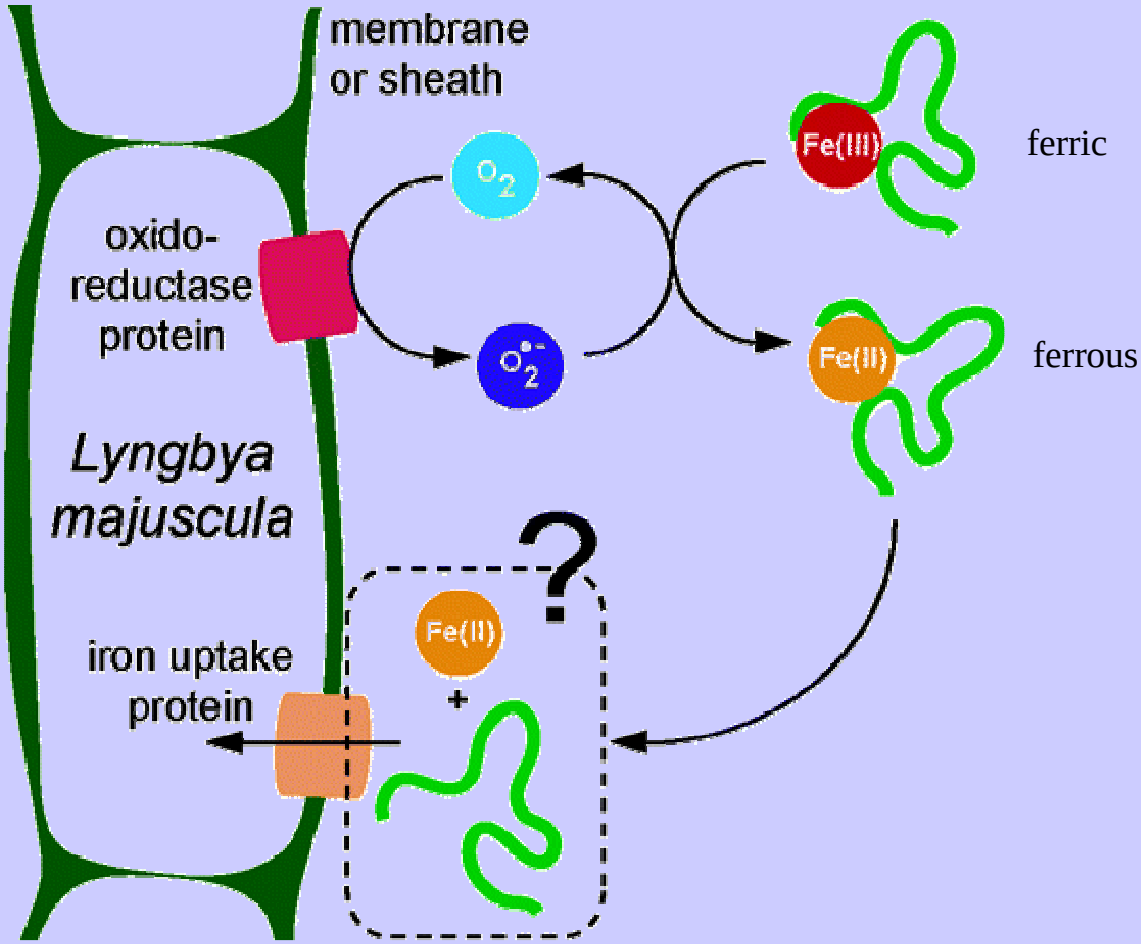
Sometimes neurotoxins involved (BTX, KTX), more often not

REACTIVE OXYGEN SPECIES ?



JA Marshall, M de Salas, T Oda, GM Hallegraeff (2005). Superoxide production by marine microalgae. 1. Survey of 37 species from 6 classes. *Mar. Biol.*147, 533-540

Analytical methods for highly destructive hydroxyl radical OH* under development

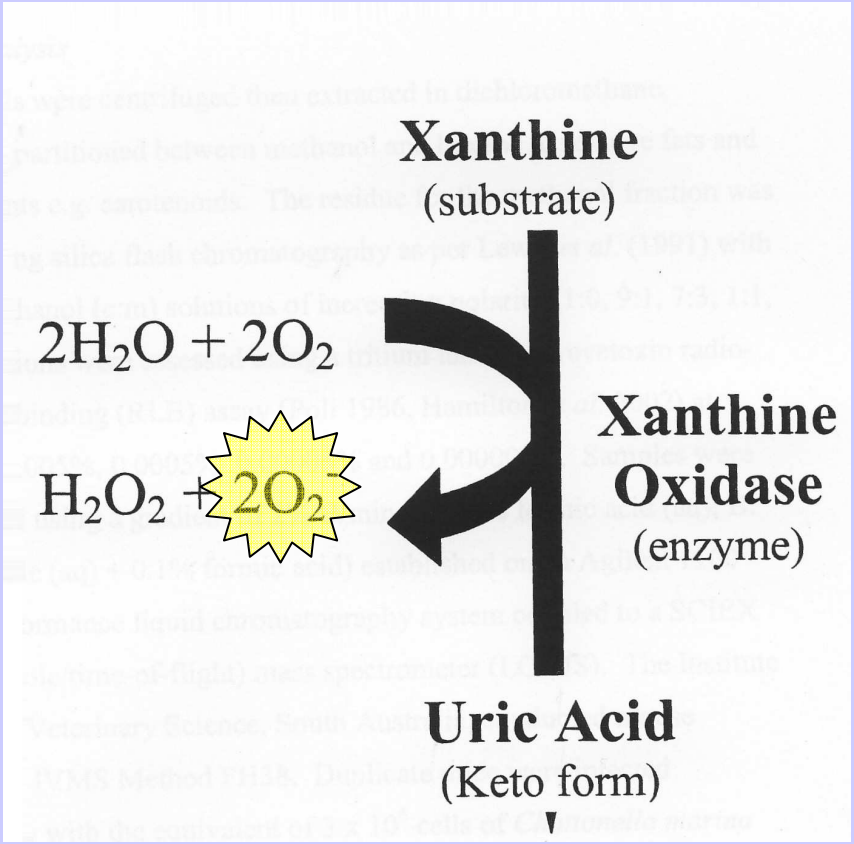


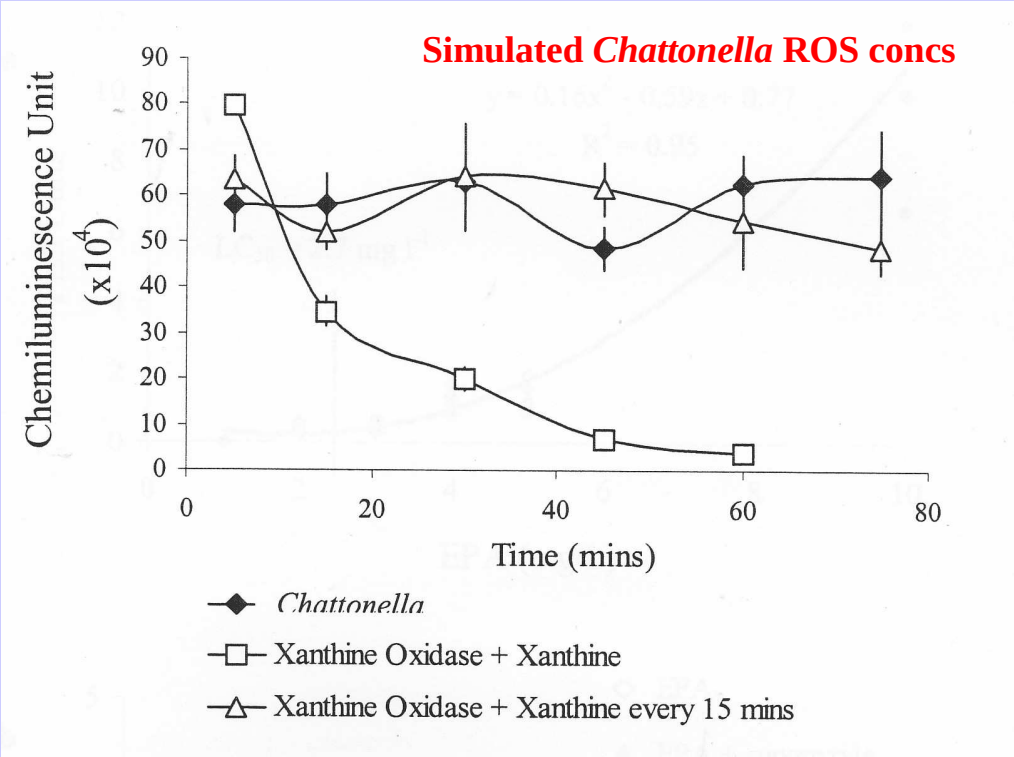
Prof. David Waite, University of NSW

Superoxide as electron shuttle for iron acquisition.

Environ. Sci & Technol. 39, 3708-3716 (2005); *J.Phycol.*43, 978-991 (2007)

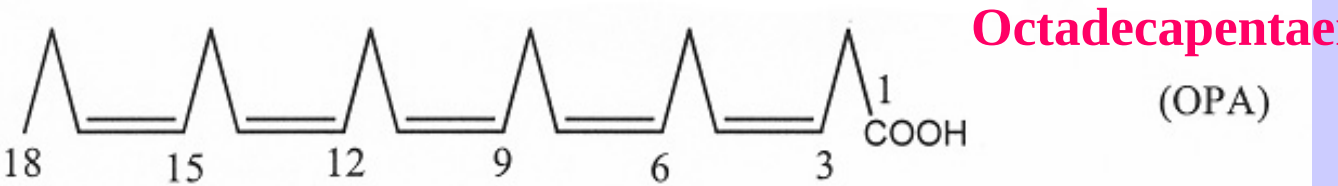
ROS on its own does not kill fish





Polyunsaturated Fatty Acids

C18:5n3

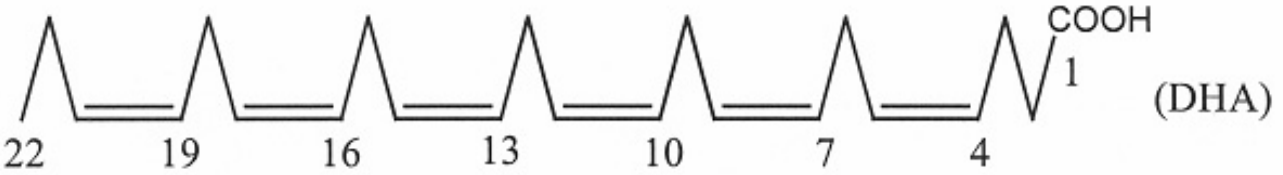


Octadecapentaenoic acid

(OPA)

Gymnodinioids 15-28%

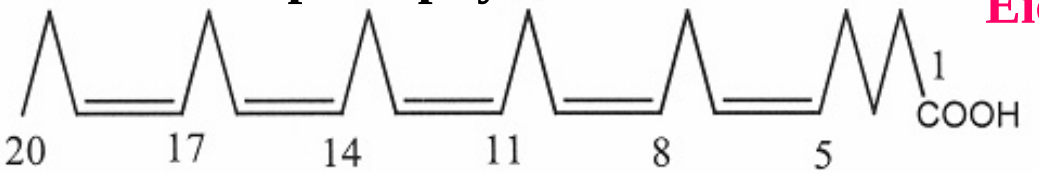
C22:6n3



(DHA)

Raphidophytes 15-25%

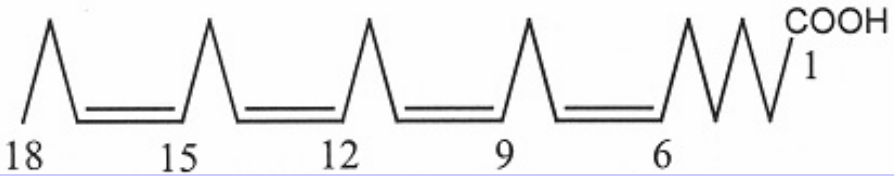
C20:5n3



Eicosapentaenoic acid

(EPA)

C18:4n3



(ODTA,OTA)

No Carbon Atoms

Double Bonds

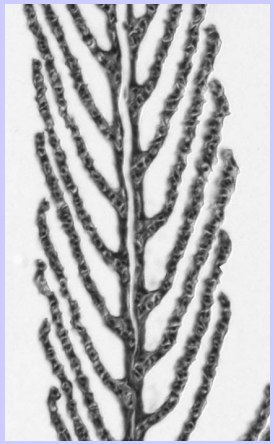
Position Terminal Double Bond

Ichthyotoxic at ~3ppm

1.5-2 ppm in dense culture

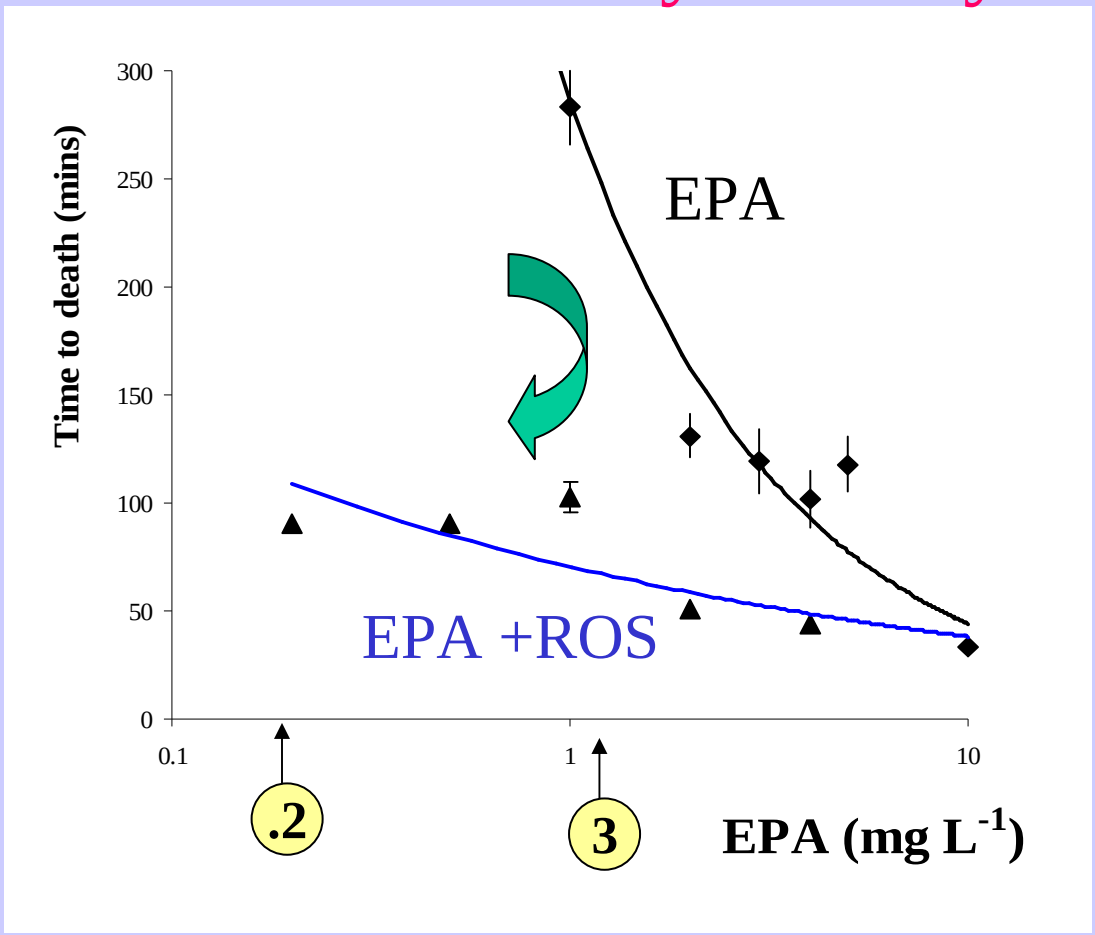
Damselfish Ichthyotoxicity

Control



ROS

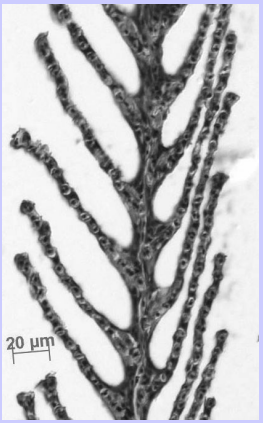
184 min



3mg/L EPA

111min

0.5mg/L EPA+ROS

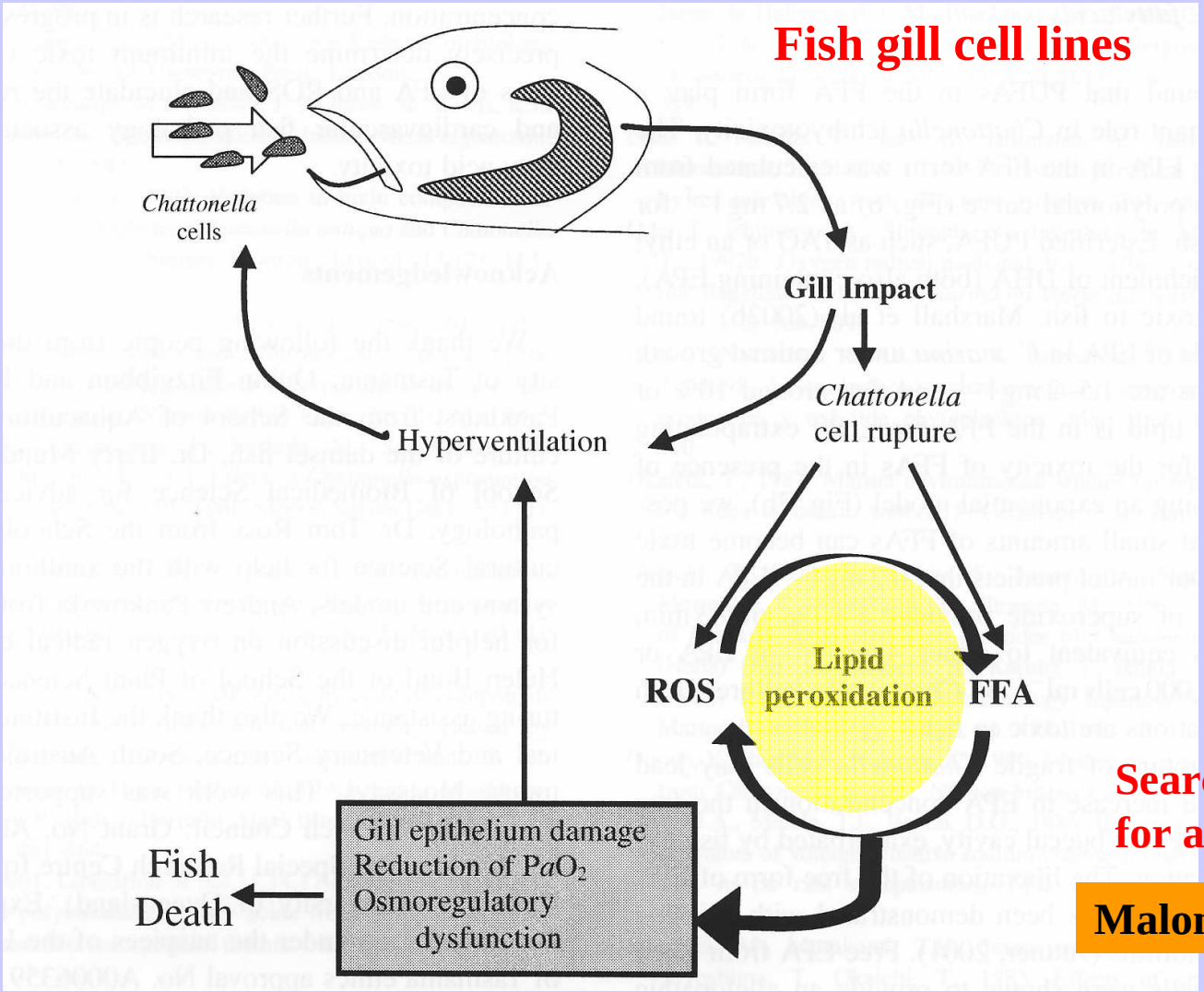


90min

Eicosapentaenoic acid (EPA) can cause necrosis in fish gills, but EPA toxicity was significantly enhanced in the presence of ROS

JA Marshall, P Nichols, BHamilton, R Lewis, GM Hallegraeff (2003).
Synergistic role of reactive oxygen species and free fatty acids. *Harmful Algae* 2, 273-281.

Fish gill cell lines



Search for lipid biomarkers for algal bloom ROS insult

Malonyldialdehyde (MDA)

Mopping up of ROS by catalase; superoxide dismutase