



## **Current and future impacts of climate change on marine fisheries and biodiversity**

I am a veterinarian servicing the health needs of aquatic animals in many aquaculture enterprises throughout Australia, in addition to providing support to wild fisheries for commercial and recreational use.

I run my own private veterinary consulting business, in addition to playing a teaching and research role at The University of Sydney (amongst many institutes) specifically on aquatic animal health. I have a detailed academic and field based understanding of the impacts of climate change metrics on aquatic animals.

The negative impacts of climate change are already being felt in aquaculture and wild fisheries.

The hottest water temperatures in recorded history in Tasmania took place last summer at some of my client's farms. The result was very substantial on salmon production, with fish pushed to the edge of their thermal tolerance. The industry was fortunate not to suffer a widespread disease epidemic, but losses were elevated across the board, and growth substantially impacted as fish could not be fed as much as usual. Whilst the salmon industry has been the centre of much growth in recent years, with considerable Government support, these investments are very much threatened by the climate change processes which are underway.

From this end of the country to the other- some of my prawn farming clients in North Queensland experienced pond water temperatures that were amongst the highest ever. Equally pushing their black tiger prawns towards their upper threshold temperature tolerance. The prawn farming industry has shown strong growth and has great potential for expansion in Australia, however such growth is predicated on suitable climatic conditions.

Heat waves in the water have impacted kelp forests, abalone distribution and fisheries in WA, where widespread fish kills were reported, well beyond what has been historically documented.

Sudden and unprecedented cold spells are equally becoming more of a problem, leading to stress and death in aquatic animals who become pushed outside their tolerance.

The silver perch aquaculture industry has suffered from mass mortalities due to fungal disease outbreaks as a consequence. Barramundi stocked in dams throughout Qld have suffered mass mortality events in recent years.

Aquatic ecosystems thrive on stable moderate climatic conditions, not on extreme conditions. The predicted increased frequency and intensity of rainfall events, deliver more negative impacts to the aquatic environment with large plumes of sediment coming off human-modified landscapes.

Fossil fuel industries have driven direct impacts on the Great Barrier Reef World Heritage Area, through their demands for port facilities in Gladstone and other areas. A direct consequence of the flawed development in Gladstone led to the loss of nearly 50% of the inshore dolphins, hundreds of sea turtles and most of the resident dugongs. Thousands of hectares of seagrass and inshore coral

reef were lost, and have not recovered from the impacts in 2010-2013 of this project. My peer reviewed paper (Landos et al 2016 DAO 121.3) in one of the premier Aquatic Animal Health Journals in the world, documents the losses experienced as a direct consequence of the support of fossil fuel industries. It is of importance, as it demonstrates that the conclusions reached by State and Commonwealth Reviews into why events in Gladstone transpired were flawed. Permanent losses to productivity are the consequence. Seagrass is conservatively valued at between \$50-200K/ha/year for the commercial seafood it generates (Costanza).

The reef bleaching has been well documented and is again a clear consequence of climate change with tight correlations to the hottest ocean temperatures recorded in those areas. The loss of the reef will inevitably lead to a crash in viability of many reef dependent fisheries. And with those will go much of the associated tourism, recreational fishing industry and commercial sectors. Somewhere around \$6 billion of economic activity is tied to the viability of the GBR. It is unequivocally in mortal danger of joining many of the already decimated coral reefs around the world.

Internationally the impacts of changes to pH are documented to affect shellfish hatcheries and shellfish industries in the US. <http://www.sfchronicle.com/bayarea/article/Oyster-farmers-worried-as-climate-change-lowers-6445523.php>

Climate change is attributed with driving the pH change through oceanic absorption of ever greater amounts of carbon dioxide.

<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.585.4028&rep=rep1&type=pdf>

Australia has already lost most of its natural oyster reefs. (Diggles 2013). Many groups are working hard to try and restore them. Their efforts will be for nothing, unless appropriate and concerted action is taken to address climate change.

Australia also has some of the best farmed oysters in the world in SA, Tasmania, NSW and SE Qld. These are all threatened under current trajectories for climate change. With loss of oysters from an ecosystem, comes the loss of substantial ecosystem services for filtering water and assimilating nutrient loadings. Inevitably there is a decline in the productivity of surrounding fisheries.

The Great Barrier Reef developed over tens of thousands of years, if we kill it off, it won't spontaneously just regenerate to its former glory within a human lifetime or two. The scale of loss taking place, under our watch, is unprecedented.

There is a clear body of work, including some from CSIRO, demonstrating that climate change will alter the bioavailability of many environmental pollutants including pesticides and persistent organic pollutants, resulting in wider movements and more inadvertent toxic exposures.

Already wild fish are contaminated with serious levels of pollutants such as heavy metals, PCB's dioxins flame retardants and other persistent organic pollutants. This situation will worsen under climate change scenarios of warming. Export of these land-based pollutants will increase for most East Coast fisheries.

Australia is rapidly moving from having one of the world's cleanest sources of nutritionally essential high-value seafood to a position of having a toxic contaminated resource.

The situation could hardly be more serious. The time for radical policy shifts is now. This shift would be to move from a position supported by lobbyists with vested interests in maintenance of the status quo, to a position which uses the evidence base generated by global and vast scientific endeavour.

A rapid and expensive transition from fossil fuels is warranted- for the cost of inaction far outweighs the short term cost of acting.

Some of the available solutions to substantially contribute to reduction of climate change risk include:

Change political donation rules to remove the power of lobbyists to unduly influence politicians and political parties.

Cessation of new coal mine/gas/oil development approvals

Shutting down of coal fired power stations

Ending coal exports

Subsidies for development of renewable energy transitions into establishment of localised networks.

Transition away from industrial pesticide dependent agriculture, which generates substantial emissions into agro-ecological farming, with significant investment in research to drive this change.

Investment into improved battery storage technologies.

Re-Positioning Australia as a global leader in responding to climate change, rather than an international laggard. Leading nations can bring others with them- and such global efforts are laudable.

I'm happy to provide the senate with additional volumes of peer reviewed literature to support the claims made in this submission, or speak with them. A transition towards tangible action on climate change action by the Australian Government will require it to find an appetite for evidence-based science, and back it over the power of vested interests and their lobbyists.

Should the status quo remain, then further scientific documentation of the trends established are pointless and amount to little more than rearranging chairs on the titanic- managing the inevitable decline in productivity.

It is difficult to encourage some of our brightest young minds in University to pursue aquatic scientific endeavours, as vital as they are, when the behaviour of our Government demonstrates little appreciation and respect for the work they produce, by acting contrary to the work they produce.

Please choose an alternative future for my family, future generations of students, my country and all the wondrous creatures which have evolved to live here.

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