Correspondence to peter-ridd@yahoo.com

Vol. 2.1 (2022)

pp. 78-82

Is the Great Barrier Reef Threatened?[1]

Peter Ridd

Independent scientist, Australia

Submitted 19-12-2021, Accepted 29-12-2021. https://doi.org/10.53234/scc202203/20

The popular news media have in recent years been deluged with stories claiming that the Great Barrier Reef (GBR) is severely damaged and has a very poor outlook for the future[2]. Major threats to the reef supposedly include rising temperatures, ocean 'acidification', and pollution (sediment fertiliser and pesticides) from agriculture on the adjacent coast.

Government regulations aimed to 'save the reef' now affect every major industry in north Queensland - mining, sugar, beef cattle and others[3]. In addition, bad publicity about the reef affects the tourist industry because Queensland's biggest tourist attraction, the Great Barrier Reef, is constantly maligned in the media.

In fact, the outlook for the Great Barrier Reef, and its present condition, is far more encouraging than the public has been led to believe.

A good indication of the condition of the reef is the fraction of the reef that is covered by living coral, which has been surveyed by the Australian Institute of Marine Science (AIMS) each year since the mid 1980s (Figure 1). The quantity of coral fluctuates dramatically from year to year, falling mainly due to hurricanes, the waves of which smash large amounts of coral. Hot water events, and crown of thorns starfish plagues also periodically kill large amounts of coral. The latest data shows that the amount of coral has never been higher despite the reef supposedly having three unprecedented bleaching events in the last five years.

The other important statistic about the health of the reef is the coral calcification data. This is effectively the rate at which coral grows. Large corals have growth rings similar to tree rings, and thus drilling a core into the coral gives a record of its growth. Very large, and therefore old, corals record their growth rate back a few centuries. AIMS has collected this data and claimed that the coral growth rates suddenly started to decline in about 1990 (Figure 2). However, this has been disputed by Ridd et al (2013) who demonstrated instrumental measurement errors in the AIMS measurements. In addition, AIMS made a methodology change in 1990 changing from sampling only large corals to including mainly small corals from 1990-2005. Correcting these errors shows that coral growth rates have not reduced over the last century. AIMS has not

---

[1] The talk can be seen here: https://www.youtube.com/watch?v=gSSNXjPbpOY (Recorded by Yngvar Engebretsen).

[2] https://www.bbc.com/news/world-australia-57938858

[3] https://www.legislation.qld.gov.au/view/html/bill.first/bill-2018-008/lh

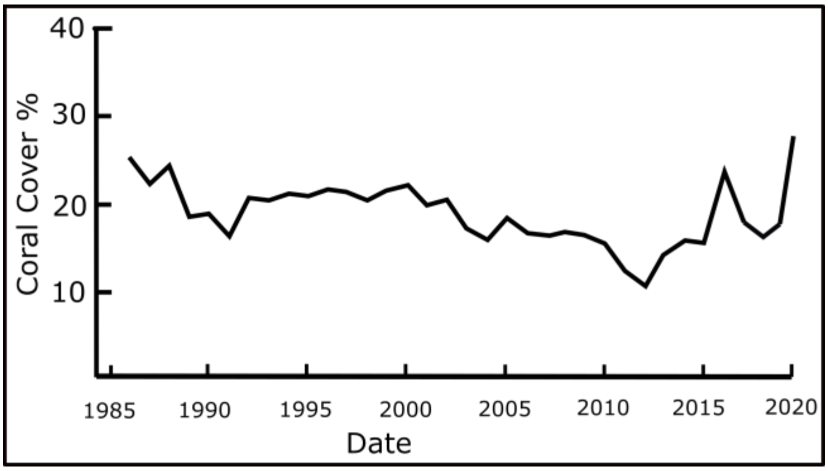

Figure 1. Coral cover for the Great Barrier Reef compiled from AIMS long term monitoring data. Note that this has been updated since the conference, which was in 2019, and the figure shows the updated data. Data was weighted from the three major regions of the reef according to the number of reefs surveys in each region

produced any data of the average reef growth rate since 2005. This is a serious oversight which needs to be remedied as soon as possible.

The influence of sediment (mud), fertilizers and pesticides from farms has also been demonstrated to be completely insignificant. For example, mud from farms almost never reaches the Great Barrier Reef because the reefs are mostly between 30 and 100 kilometres from the cost (Larcombe and Ridd, 2015). The white coralline sand on all the reefs (see Figure 3) is

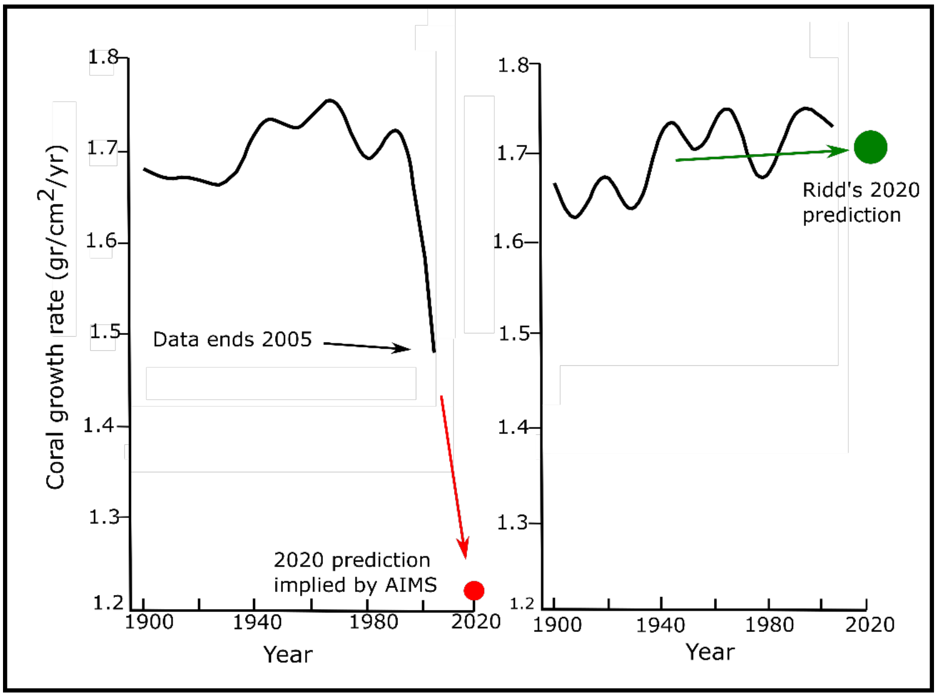

Figure 2.Coral growth rate (calcification rate) on the GBR for the 20th century. (Left) Calculated by De'ath et al. (2009) showing drastic reduction after 1990 and prediction (red dot) for 2020 implied by the Australian Institute of Marine Science. (Right) Reanal Reanalysed to account for measurement errors and sampling problems (Ridd et al., 2013). Green dot is the alternative prediction for 2020. ***Note****: There is no data of the GBR-average growth rate since 2005.*

Figure 3.White sand typical of all 3000 of the reefs of the Great Barrier Reef. This demonstrates that sediment from land has no effect on the reef, as would be expected as the reef is 30 to 100 km from the coast.

composed almost entirely of calcium carbonate sand which is derived from broken coral that lived and died over millennia. Sediment from the land, which has a completely different chemical composition, is almost entirely absent. It is thus inconceivable that the Great Barrier Reef is being directly affected by mud from farms.

Close to the coast adjacent to the Great Barrier Reef, and therefore a long distance from the reef, pesticides are almost always in extremely small concentrations and have never been detected in concentrations harmful to biota (Gallen et al., 2019). On the Great Barrier Reef, measurements are rarely even attempted as concentrations are so low that they cannot be detected with even the most sensitive scientific equipment.

Climate Change

Although it is often claimed that coral reefs are very susceptible to a warming climate, corals are a species that grows faster in warmer climates. (see Figure 4). Corals growing in the colder waters south of the Great Barrier Reef, such as in Moreton Bay, are far smaller than those of the Great Barrier Reef and grow relatively slowly. They are regularly stressed by a water temperature which is far colder than the ideal conditions for coral.

There is no doubt, however, that on occasions large amounts of coral are killed in years when the water temperature is well above average. Under such conditions, corals 'bleach" – they eject the symbiotic algae, called zooxanthellae, that lives inside them. The zooxanthellae give the coral energy via photosynthesis. Most corals that bleach do NOT die (Marshall and Schuttenberg, 2006).

The following is a useful summary of facts about the bleaching process (Baker et al., 2003; Buddemeier and Fautin, 1993; Guest et al., 2003; Marshall and Baird, 2000)

- With high temperature and light, photo-systems in the Zooxanthellae break down.
- Zooxanthellae leaves or is ejected by the coral.
- Bleaching is not a death sentence it is a strategy for life – it will usually stop the coral from dying.
- A rough analogy is some arid-zone trees that lose leaves during a drought to save water.

- Bleaching occurs when the water temperatures is higher than usual.
- A species of coral that might bleach at 28 °C in one location may not bleach until a much higher temperature is reached if it lives in a warmer climate. The *change* in temperature from average is important, not the absolute temperature.
- Infant corals have no zooxanthellae - they are captured from the water and surroundings.
- By changing zooxanthellae, corals can adapt extremely quickly to changing temperatures – they do this by bleaching.
- After a coral bleaches, it may take on a different species of zooxanthellae which will make it less susceptible to bleaching in the future
- Different species of zooxanthellae affect coral growth rates and susceptibility to bleaching.
- Some “low octane” species of zooxanthellae will give resistance to bleaching but the coral will grow slowly.
- “High octane” zooxanthellae will allow the coral to grow quickly but a hotter-than-average year will cause bleaching and possible death of the coral.
- There is no hard threshold temperature. The same coral will bleach at different temperatures with different zooxanthellae.

The proposition that most corals on earth are very close to their upper thermal limit, and are extremely sensitive to small changes in climate is not supported by data. In fact, corals are among the best adapted species to changing temperature because of their ability to change zooxanthellae with bleaching.

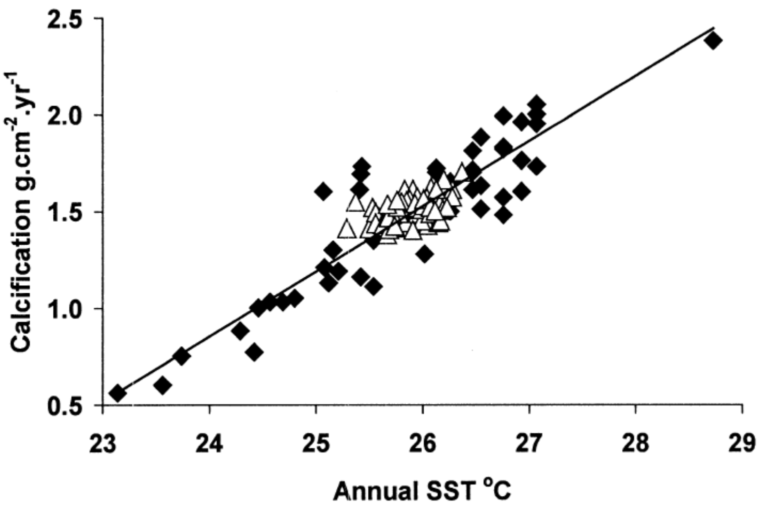

Figure 4. Coral calcification rate (growth rate) as a function of temperature. (after Lough and Barnes (2000)). Solid diamonds - Indo-Pacific reef data. Open triangles – Great Barrer Reef data. Corals grow faster in hotter water.

References

AIMS (2021) https://www.aims.gov.au/docs/research/monitoring/reef/latest-surveys.html

Baker, A.C. 2003. *Flexibility and Specificity in Coral-Algal Symbiosis: Diversity, Ecology, and Biogeography of Symbiodinium*. Annual Review of Ecology, Evolution, and Systematics, 34:1, pp.661–689.

Buddemeier, R.W. and Fautin, D.G. 1993. *Coral Bleaching as an Adaptive Mechanism.* BioScience, 43:5, pp.320–326.

De'ath, G., Lough, J.M. and Fabricius, K.E. 2009. *Declining Coral Calcification on the Great Barrier Reef.* Science, 323:5910, pp.116–119.

Gallen, C., Thai, P., Paxman, C., Prasad, P., Elisei, G., Reeks, T., Eagleham, G., Yeh, R., Tracey, D., Grant, S. and Mueller, J. 2019. *Marine Monitoring Program. Annual Report for inshore pesticide monitoring 2017–18. Report for the Great Barrier Reef Marine Park Authority,* Townsville: Great Barrier Reef Marine Park Authority, p.118.

Guest, J.R., Baird, A.H., Maynard, J.A., Muttaqin, E., Edwards, A.J., Campbell, S.J., Yewdall, K., Affendi, Y.A. and Chou, L.M. 2012. *Contrasting Patterns of Coral Bleaching Susceptibility in 2010 Suggest an Adaptive Response to Thermal Stress.* PLoS ONE, 7:3, p.e33353.

Larcombe, P. and Ridd, P. 2015. *The Sedimentary Geoscience of the Great Barrier Reef Shelf - context for Management of Dredge Material.* Brisbane: Queensland Port Association.

Lough, J.M. and Barnes, D.J. 2000. *Environmental controls on growth of the massive coral Porites.* Journal of Experimental Marine Biology and Ecology, 245:2, pp.225–243.

Marshall, P.A. and Baird, A.H. 2000. *Bleaching of corals on the Great Barrier Reef: differential susceptibilities among taxa.* Coral Reefs, 19:2, pp.155–163.

Marshall, P. and Schuttenberg, H. 2006. *A Reef Manager's Guide to Coral Bleaching.* Townsville, Australia, Great Barrier Reef Marine Park Authority

Ridd, P.V., Da Silva, E.T. and Stieglitz, T. 2013. *Have coral calcification rates slowed in the last twenty years?* Marine Geology, 346, pp.392–399.