Turbidity in the Great Barrier Reef

Abstract

Turbidity in the Great Barrier Reef is often considered to be one of the primary contributors to coral bleaching events. This is cause for great concern among the Queensland and Federal Government. The ever growing trade economy in North Queensland is required to expand in coming years to accommodate for increasing demand. The Great Barrier

Reef stands as an obstacle to the smooth and controversy free development of coastal ports and trade routes to satisfy this demand whilst also serving as Australia's primary tourist attraction and nature sanctuary. Therefore, as a result, strategies and management systems need to be employed to allow for the co-existence of both the GBR and the economic powerhouse that is international trade. Solutions and the associated risks and benefits provided included the construction of an offshore port that would service most of the North Queensland shipping demands or the complete ban of sediment dumping near reef waters with sediment to be buried inland, both these solutions were evaluated to be scientifically in the best interests of all involved parties.

Introduction

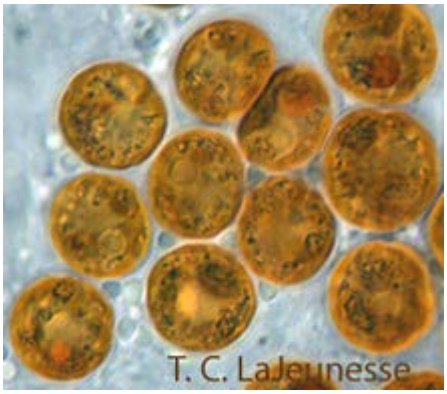

Figure 1 - A microscopic image of a subspecies of Symbiodinium (Zooxanthella)

Turbidity is defined as the measure of suspended particles within a fluid, in this case water. The apparatus used to measure turbidity measures refracting light and the accompanying time it takes to return to the sensor in a given liquid. This measuring apparatus takes advantage of the effect turbidity possesses that negatively affects reefs, the blockage of light particles. Coral organisms are well known around the world for their vibrant colours and amazing abilities for self-preservation. The colours produced by the coral and what keeps them alive is in fact another organism all together. Known as Zooxanthella, these micro-organisms use photosynthesis to keep both themselves and the coral alive. Herein lies the problem with turbidity, as explained above turbidity is the measure of solid particles within a fluid. When more particles are suspended within a fluid then it comes to reason that less light will be able to reach depths directly related to how turbid the water is (BE, Brown, 2000). The result of this means that if reef system is sufficiently turbid, it starves the Zooxanthella of the light they need to provide for the symbiotic relationship corals and the micro-organism maintain (BE, Brown, 2000).

Trade in North Queensland has long been in a period of steady growth with coal and LNG exports steadily rising with expectations of a peak around the year 2025 (Braemar Seascope, 2013). This has indirect implications for the GBR and its coral communities. The expansion of demand also necessitates the growth of supply either in product itself or the delivery mechanisms which it utilises depending on location and type of product. This means that in coming years increased ship traffic and port developments will put a strain on reef communities through the amount of sediment they move off the bottom of the ocean floor

(C, Rogers 1990). It is estimated by D. Kuhlmann (1988) that sediment that is dumped into coral water systems can remain suspended for anywhere up to 5 years given the right self-sustaining currents produced by the reef breaks and islands (D. Kuhlmann, 1988). The Capesize vessels that move through these trade channels are considered deep water vessels and the mere notion of them moving through the relatively shallow areas causes the sediment that has settled on the seabed to be stirred up and thus, in some cases, trigger the situation mentioned above.

This dilemma is quickly going to become one of major contention between the stakeholders involved with the development and conversely, the protection, of the Great Barrier Reef as one of the last major natural attractions remaining on Earth.

Body

Commercial activity in North Queensland is expected to grow by almost 200 percent leading up until 2025 (Braemar Seascope, 2013). This means that strategies and management solutions need to put under serious debate in order to best balance the interests of nature and Queensland's tourism industry with the needs of the trade sector. Tourism specifically targeting the Great Barrier Reef is believed to be generating around 7 billion dollars per annum directly for the government and is considered one of the most recognisable world icons to exist. However when compared to the booming trade industry that Queensland currently maintains as a result of its coal ports it becomes obvious that the profits brought into government funds is far less than that provided by the trade industry (Braemar Seascope, 2013).

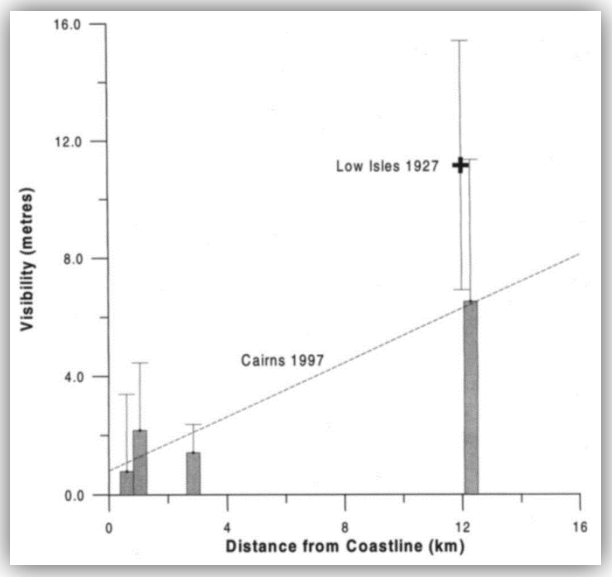

Figure 2 - A graph showing distance from the coastline measured against visibility in meters. (E. Wolanski, S. Spagnol, 2000)

As shown by the studies conducted by Wolanski and Spagnol (2000) shows a clear correlation between distances from the coastline and their corresponding visibility levels. It should also be explicitly stated that visibility is a direct indicator of the level of turbidity in the water. Excess turbidity can be put down to a number of factors that directly affect the amount of sediment in the water. These are direct interference as a result of human interference, natural currents and water flow and also fauna disruption. It is widely believed that human interference is the biggest contributor to the coral bleaching events that are caused by turbidity. As mentioned in the introduction turbidity blocks the ability of the zooxanthella to maintain energy production through their processes of photosynthesis thus resulting in the breakdown of the symbiotic relationship between these microscopic organisms and their coral hosts (C. Rogers, 1990). The graph on the right shows the measured visibility at different distances from the coastline and it is shown by that proximity to the coast has an effect on the level of turbidity in the water. As shown by the Cairns 1997 projection line it is clear that reef visibility is on an overall decline and this

correlates with the ever so rapid decline of coral communities on the coastline of North Queensland (Wolanski, Spagnol, 2000).

A practical example of a coral bleaching event that was the result of human interference would be the coral population at Double Island near Gladstone. After the development of a port near the island almost 1 million metric tonnes of sediment were dumped in current systems located within 1km of the reef. Over the next 5 months the coral population declined at this location by almost 90 percent when compared to measurements made in 1927 and 60 percent when compared to measurements made before the dredging and dumping activity began. Wolanski and Spagnol attributed this decline specifically to turbidity due to it being the only factor which had changed significantly in the period between measurements.

Figure 4 - A coral which has died as a result of turbidity.

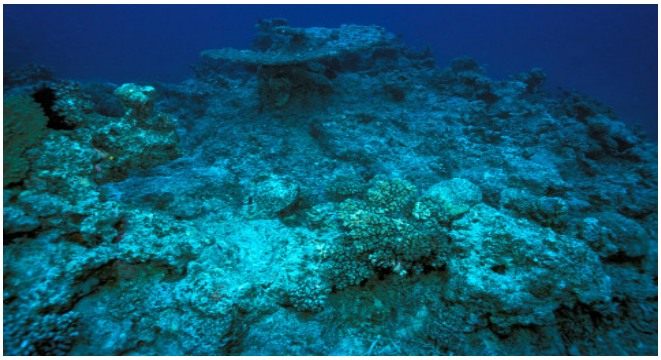

Figure 3 - 4 - Images taken from the Double Island case study of the results of the reef population decline at the hands of turbidity

With the above evidence of the growth of Queensland trade it becomes clear that with this growth comes the need for infrastructure and development to accompany it. When one pairs this with the information about the threat that turbidity poses to our reef systems then the issue of where to accommodate the needs of both constitutes becomes apparent. One cannot devote measures to one side of the problem without causing damage or loss from the other and this is where the main source of debate originates for solutions to trade and turbidity in the reef. Solutions for the protection of the reef through the use of no dig zones and protection under state law means that trade routes cannot be sufficiently expanded to accommodate for growth. Similarly, if one allows for full trade expansion and full scale development of reef waters to occur then the large masses of sediment which would be dumped in reef waters would do substantial damage to the coral and animal communities residing there (D. Haynes, 2001).

Solutions to turbidity in the reef have been suggested and analysed by bodies such as the CSIRO for many years. The most prominent of these solutions was the proposal by a research body to relocate dredged reef sediment onto land and bury it there as to avoid unnecessary contamination of the reef. Their research showed that if all dredging activity in the reef was to relocate their sediment inland then it would reduce turbidity climb rate by around 58 percent (G. Kelleher, R. Kenchington, 1982).

In conclusion, it is clear that the science behind turbidity in the reef is directly tied to trade growth and through the discussion in this paper it was determined that the removal of

dredged sediment from the reef is the only way to ensure that reef systems do not suffer negatively from the indiscriminate relocation of these materials as they did in the past. The management solution proposed by the research team regarded inland dumping of turbidity appears to be the most practical route for a sustainable process of contamination containment. Although almost entirely in the hands of those who fund the port and trade route development programs, it is certain from a scientific point of view that turbidity cannot be allowed to rise further if the people and government of Queensland wish to maintain both the quality of life within the reef and also the trade routes that sustain the Queensland and Australian economies.

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