See the Great Barrier Reef before you die ... or before it dies?

By Richard Hobson

Synopsis

This case study is set in the Great Barrier Reef region of Northern Queensland, Australia. The reef is made up of islands and individual coral reefs, and is one of the most complex ecosystems in the world. With its rich variety of wildlife it is a globally important natural area.

The reef attracts visitors from all around the world. The tourist industry is a highly developed sector and is important to the Australian economy.

Scientific research shows that the coral is dying. Climate change is leading to a rise in ocean temperature, leading to the phenomenon of coral bleaching. These mass bleaching events are occurring so frequently that the coral doesn’t get a chance to recover. An array of other threats, such as water pollution, is weakening the coral’s resilience to temperature rise.

There are different attitudes to the reef and the factors influencing its condition. This GeoFile includes a questionnaire to gather opinions surrounding this.

Key terms

Ecosystem, coral reef, mass bleaching, climate change, El Niño, resilience, conservation, ‘keep it in the ground’

Learning objectives

At the end of this case study you will have learned about:

- The links between the people, the economy and the natural environment.
- How physical processes have consequences.
- How different groups of people have different attitudes to the environment and to the economy.

In addition you should have an opinion, supported by facts, about the future of the Great Barrier Reef.

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See the Great Barrier Reef before you die … or before it dies?

Visiting the Great Barrier Reef (GBR), the world’s largest living structure, is probably on most people’s bucket list. It consists of about 1,000 islands and 3,000 individual coral reefs, extending for 2,300 km along the east coast of Australia from the Torres Straits to Gladstone. Among the waters of the GBR live a panoply of colourful plants and animals. With 1,600 species of fish, 130 types of sharks and rays, and more than 30 species of whales and dolphins, it is one of the most complex ecosystems on the planet. I went to Port Douglas in Northern Queensland to visit Low Isles and Opal Reef in February 2017 (Figure 1).

Tourism

A land use survey of the central business district of Port Douglas emphasised the provision of goods and services for visitors drawn to the GBR (Figure 2). The dependence here on tourism mirrors the sector’s importance to the economy of Queensland and Australia. In 2012, Deloitte estimated that the GBR region generated A$5.5 billion from tourism and kept 69,000 people in work. There are nearly twice as many jobs in tourism as there are in mining in Queensland.

I carried out a questionnaire survey:

1. Are you a resident of Port Douglas – Is your job dependent on the GBR?
2. Are you a visitor to Port Douglas – Are you here to visit GBR?
3. What’s your nationality?
4. Do you consider the GBR to be under threat?
5. If so, what are the threats, and how can they be alleviated?

Most people interviewed were visitors. The permanent population of the town recorded in the 2011 census was 3,205. It can double during the tourism season, which peaks in May–September. The Great Barrier Reef attracts visitors from around the world. A third of all people interviewed considered the

Figure 1 Location of the Great Barrier Reef (inset showing Low Isles on the Inner Reef and Opal Reef)

Figure 2 Pie chart showing goods and services provided along the main street of Port Douglas (drawn from fieldwork data)
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Extension

Reef to be facing threats. However, 7% suggested these weren’t as serious as experts said. Those who were aware of threats named the following:

- climate change
- rising sea temperatures
- surface runoff leading to silting
- divers and snorkelers standing on coral
- cyclones.

One person who said that the Reef wasn’t in danger reasoned that nature balances itself over time. Going green, smarter consuming, and reducing the material in runoff were given as options to lessen the dangers. Residents were more aware of the dangers than the visitors. While climate change and rising sea temperatures were mentioned, the particular damage caused by bleaching wasn’t acknowledged. Tour guides I spoke to played down the risk of people breaking coral by standing on it. They did, however, refer to surface runoff and the impacts of the residual load being deposited. The results of the questionnaire survey are shown in Figure 3.

Figure 1 includes an inset block diagram of the GBR showing Low Isles on the Inner Reef and Opal Reef on the Outer Reef, and Figure 4 is a photograph of the quayside in Port Douglas showing advertisements for the many excursions to the Reef.

**Threats from runoff and bleaching**

Port Douglas is in Queensland’s tropical monsoon zone, and when I sailed to the Far Reef it was the rainy season and conditions were stormy. While I was at sea there was so much rain on land that the town flooded. Returning to port, there was a huge plume of brown water spreading from the Dickson Inlet into the otherwise blue sea. The guide had seen nothing like it before. However, these plumes of sediments have happened both before and since. At the end of March 2017, after cyclone Debbie hit the Queensland coast, pictures were published showing flood plumes from the Burdekin, Fitzroy and Gregory rivers carrying sediment and nitrogen pollution out to sea, obscuring waters. Runoff from every catchment area deprives corals of light, damaging the ecosystem. The Inner Reef is most at risk from this.

The bleaching process is a threat to the ecosystem, caused when ocean temperatures exceed the tolerance levels for coral. This used to be a rare event; the first on the GBR was reported in 1929. Only a few local events, affecting isolated stretches of coral, were recorded in the next 50 years. Coral reefs over a wide area experienced bleaching during the first extreme El Niño, recorded in 1982/83. El Niño is a forceful flow of warm water that spreads across the Pacific Ocean at intervals, perhaps once every five years. It warms the world, meaning that an extreme El Niño disturbs global weather patterns. The surge bleached coral in a stretch from the GBR through to Indonesia, and from Japan to the Caribbean.
Five years later, after another worldwide bleaching event, Ernest H. Williams and Lucy Bunkley-Williams warned that the events were caused by climate change and bleaching would probably continue until coral-dominated reefs cease to exist. 1°C of warming caused extreme events in 1998, 2002, 2016 and 2017. Bleached corals are not necessarily dead, but it takes at least a decade for a full recovery, so mass events in quick succession offer no chance for coral to recuperate. Even without the El Niño effect, temperatures continue to rise, so the corals will experience these events more often.

**Scientific work**

Scientists recorded the back-to-back bleaching using aerial surveys. In 2016, bleaching was most severe in the northern third of the Reef, while a year later the middle third was affected most. The combined impact zone stretches for 1,500 km (900 miles), leaving only the southern third unharmed. The surveys were extensive, matched the same area as previously and were carried out by the same two observers.

Satellites collect data about water temperature. The US National Oceanographic and Atmospheric Administration predicts coral bleaching. Ocean temperatures have been increasing on the GBR over the 34 years that satellite data has been available.

The surface temperature of water around the GBR over the last 100 years shows the role of climate change. In April 2016 researchers from the University of Melbourne showed how the warm conditions on the GBR are a result of carbon emissions. They ran climate models simulating a world with human CO₂ emissions compared to a world without them. They demonstrated that in the world without humans, the conditions on the GBR causing the current bleaching would have been impossible. It is predicted that conditions will get worse. In the current climate they are unusual but not exceptional, but by the mid 2030s they will be average. Beyond then they will be cooler than normal if they were as warm as 2016. So the GBR is likely to be hit with similar conditions every second year in fewer than 20 years.

**Other threats**

Other threats prevent the GBR building resilience to present or future temperatures. Cyclone Debbie struck parts of the GBR in March 2017, causing damage along a path about 100 km wide. Any cooling effects due to the cyclone were negligible compared to the destruction caused. However, water pollution is the biggest threat to resilience. Sediments in suspension block light. Fertilisers cause outbreaks of seaweed and of crown of thorns starfish that eat coral. Starfish numbers have increased due to the overfishing of their natural predators, and starfish lavae thrive in the contaminated water. The coral’s symbiotic algae are poisoned by herbicides.

**Can the coral survive?**

Maybe, coral is more resilient than biologists think. It might be able to adapt and evolve.

Unknown strains of zooxanthellae, able to cope with heat, could form a partnership with the coral. Types of fast-growing coral might outpace bleaching. Coral from deeper waters might be agents of renewal. The strongest corals may be able to spread and take over. Perhaps, reefs will migrate further from the equator.

Meanwhile a plan for survival is required. Action should include an increase in the funding to deal with runoff. The management of coastal zones preventing overfishing and pollution would create ecosystems better equipped to deal with thermal stress. A$10bn spread over 10 years is required: a worthwhile investment, given estimates of the GBR’s real worth. The Government’s commitment of A$1bn over ten years and the Opposition’s
A$500 m over 5 years is insufficient to protect the GBR.

The worldwide change in climate is overwhelming, so a moratorium on coal mining would cut greenhouse gas emissions. The United Nations Convention on Climate Change in Paris in 2015 agreed that limiting global warming to 1.5°C is the best hope of conserving ecosystems. Australia has the opportunity to set an example by keeping coal in the ground and stopping foreign developments that will lead to increased CO₂ emissions globally.

The Great Barrier Reef Marine Park Authority needs to be independent. Its powers have diminished. Budget cuts, staff redundancies and the yielding of responsibility to state agencies enthusiastic about the economic benefits of coal extraction are not in the interests of the reef.

A stronger link between science and government is needed. Decision-making should be supported by science. The checks and balances within the scientific community are rigorous – hypotheses are tested and evaluated. Government provides funding for research into the economic or environmental concerns of society, and the outcomes should provide the basis for decision-making.

Save the Reef

‘Save the Reef’ has been a campaigning slogan for at least 60 years. The GBR has faced many dangers. Attitudes towards it, and the factors influencing its condition, have varied over time. In the 1960s, owners of sugar cane plantations wanted to mine the reefs for limestone. In recent years the Queensland Government wanted to drill for oil on the GBR. Politicians had shares in the oil companies. Individuals campaigned for the Reef’s protection. They were seen as troublemakers with their ideas that the GBR had value beyond the profits it might produce. ‘Intrinsic value’ and ‘ecological fragility’ were emotional and outlandish concepts. Gradually, over a decade or more, the conservationists began to win the argument. The oil companies’ involvement was ended by a blockade of their ships by trade unionists. A Marine Park was declared in 1975, and the Reef attained World Heritage status in 1981. Even so, the range of threats has decreased the coral cover by half over the last 30 years.

State and Federal government members want to exploit the world’s largest coal deposit in the Galilee Basin and to create coal terminals in the GBR Marine Park. Their support for fossil fuel initiatives undermines reef protection. Compare 2016’s conditional approval for a $1bn loan for Adani’s mine and rail project with the $1bn reef fund announced six months earlier. The production of 60 m tons of coal each year for 60 years would compromise the 2015 Paris Agreement on Climate Change. Scientists and others are, therefore, concerned about the effects of a potential 2°C rise in global temperatures, as well as dredged sediment, on the coral’s health.

Some people in the tourism industry also believe that scientists and the media are overstating the case. They think that the opponents of coal mining in the Galilee Basin are using the imminent death of the GBR as a weapon in their argument. Media coverage of the bleaching is considered to be a bigger risk to the industry than the actual bleaching. The public will think that the situation is hopeless. They will stop coming to towns like Port Douglas.

Figure 5 A flow chart to show the effect of dying coral in a changing ecosystem

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Conclusion

The GBR is important to Australia, both ecologically and economically. Why would a government ignore it? Surely, now is the time for action. The symbiosis in coral is breaking down. Bleaching signals that a wild location is in danger and that the climate is changing. The GBR is the canary in the coal mine and a pointer to the planet’s future.
Focus questions

1. Do you think the Great Barrier Reef has any intrinsic value? What would you say to the leader of an organisation that wanted to profit financially from the Great Barrier Reef?
2. Why would a government ignore a physical feature that is important ecologically and economically?
3. Do you agree that the Great Barrier Reef is the canary in the coal mine and an indicator of the planet’s future?

Learning checkpoint

After working through this unit consider the following questions:

- Use your atlas to locate Queensland, the Great Barrier Reef, Cairns, Port Douglas, The Torres Straits and Gladstone.
- Construct a topic web, A-map or similar, showing the Great Barrier Reef and the factors influencing its condition. Be careful to create links and overlaps between the different threats.
- What are the threats to the Great Barrier Reef?
- How are the threats linked?
- How are scientists monitoring the changes to the Great Barrier Reef?
- List ways scientists have made sure their work on coral bleaching is valid.
- What profits can be made from the Great Barrier Reef?
- What surprises you about the value that different groups of people put on the Great Barrier Reef?
- What could the Australian Government do to conserve the Great Barrier Reef?