# Why and how has the rising sea temperature in The Great Barrier Reef area had such a damaging effect on coral and wildlife and what is being done to combat it?

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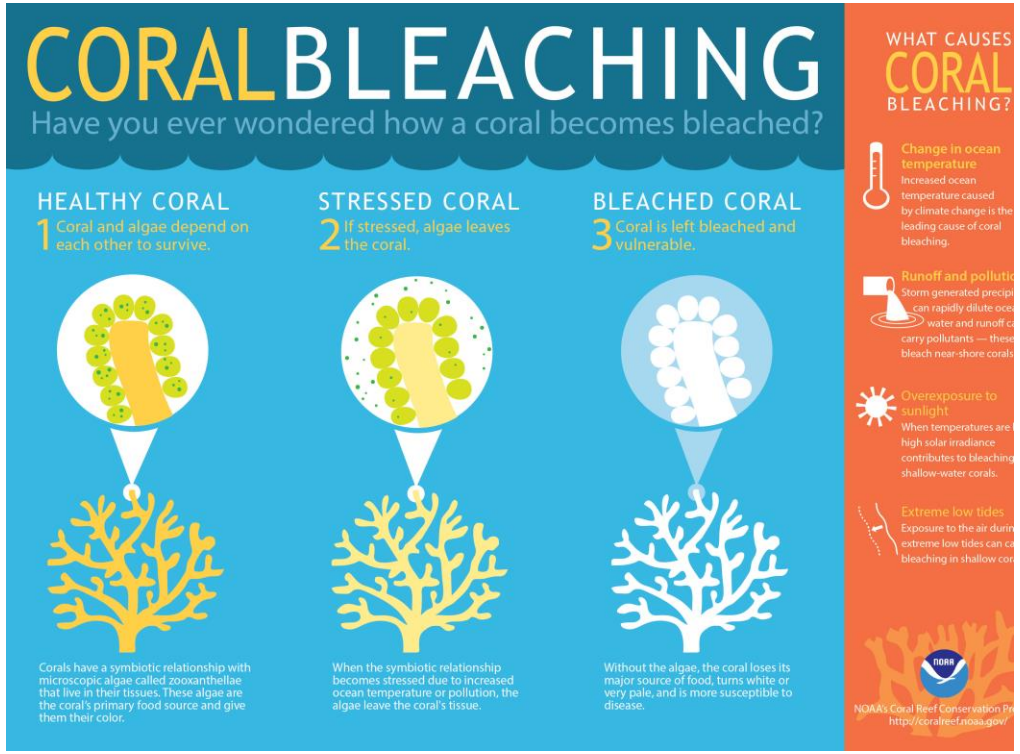
**Theale Green Scholars Project**

# What is The Great Barrier Reef?

- The Great Barrier Reef, located in The Coral Sea which is off the coast of Queensland, Australia, is home to one third of the world's coral population, which means it has the largest coral reef system too and has 2,900 individual reefs.  Due to the action of humans, many of the species that live in this natural wonder of the world are endangered, may it be due to Coral bleaching or the creation of bigger ports or water pollution.
- The Coral Reef is currently home to hundreds of species that could also be endangered soon. One factor that has killed over half of the population is Coral Bleaching.

# What is Coral Bleaching?

- Climate change is the greatest threat to the Great Barrier Reef and coral reefs worldwide. One effect of Climate Change is Coral Bleaching which occurs when coral polyps expel algae that live inside its tissues.
- These algae produce about 90% of the food the coral needs to grow. This bleaching happens when sea temperatures either are too low or too high which causes the algae to get stressed out and leave the corals. This then turns the coral white, and with its main source of food gone, it is left very vulnerable.



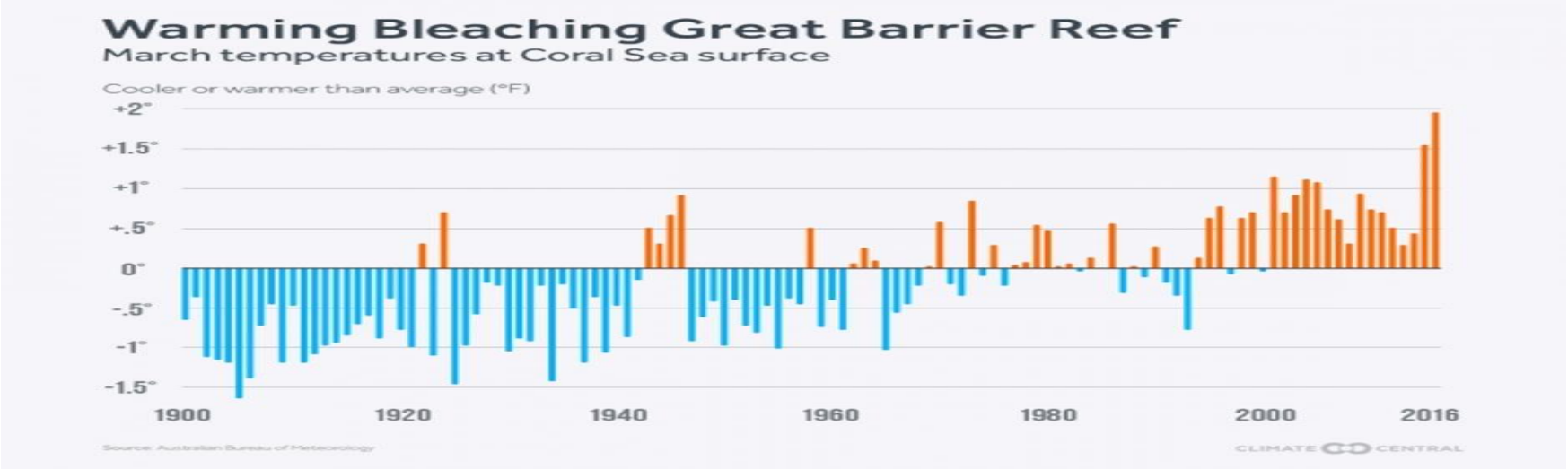
# Changes in the sea water temperature and how this has led to mass coral bleaching

- One of the main reasons, why most of The Great Barrier Reef is becoming destroyed, is due to the effects of coral bleaching. It's caused by Climate Change, primarily the changes in ocean and sea water temperatures. In the picture you can see how rapid the water temperature has changed over the past 120 years. Graph 1 in the slide on the next page shows how temperature in the 20$^{th}$ century is cooler than average by 1.7 degrees Celsius, however in the 21$^{st}$ century it has become 2 degrees Celsius warmer. This affects coral and other life habiting in the Reef. Mass bleaching on the Great Barrier Reef has occurred with increased frequency in recent decades. Widespread bleaching occurred in 1998 and 2002, however over the last 5 years this has increased at an alarming rate. Three mass coral bleaching events have occurred in 2016, 2017 and 2020.
- Similarly graph 2 shows how, if the trend of warmer waters in the reef continues, then the reef is at real risk of disappearing altogether. It is crucial that this is addressed if we are to keep this natural wonder.

# Graphs showing the changes in coral sea temperatures

**Graph 1**

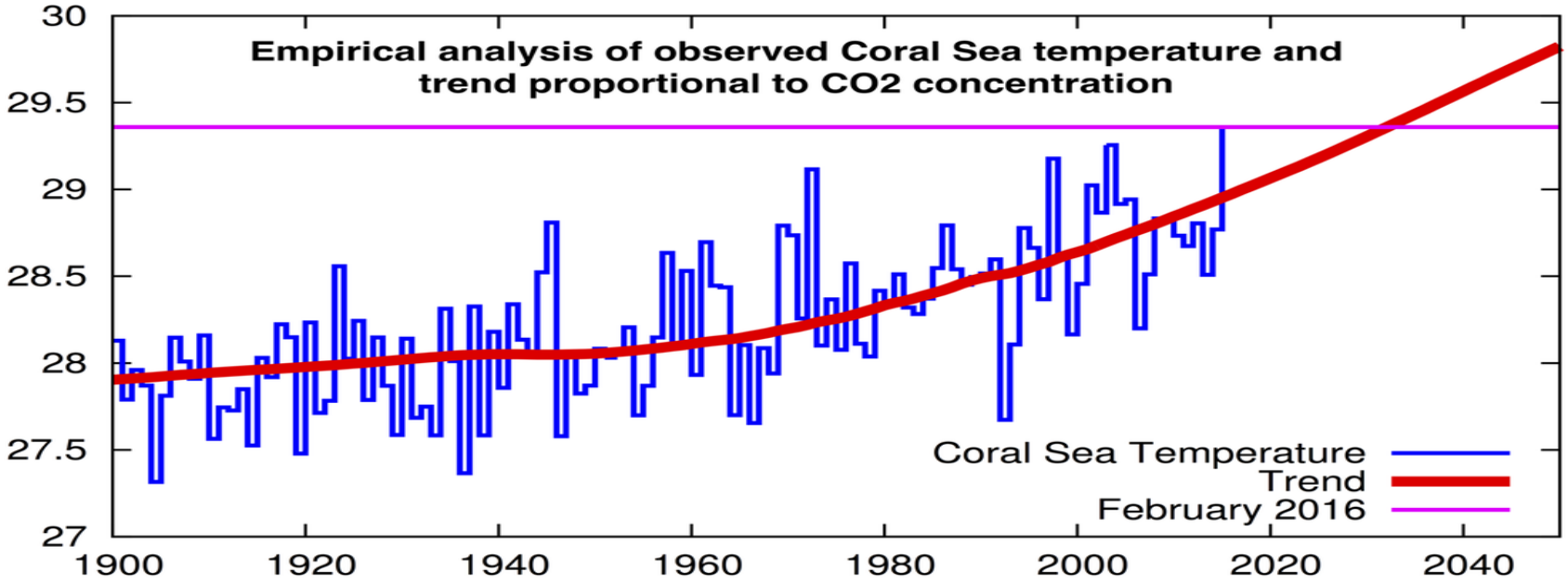
Graph 1 visually explains how there is a direct correlation between warmer oceans caused by increased emissions and the impact on coral and how this has become an alarming problem since 2010



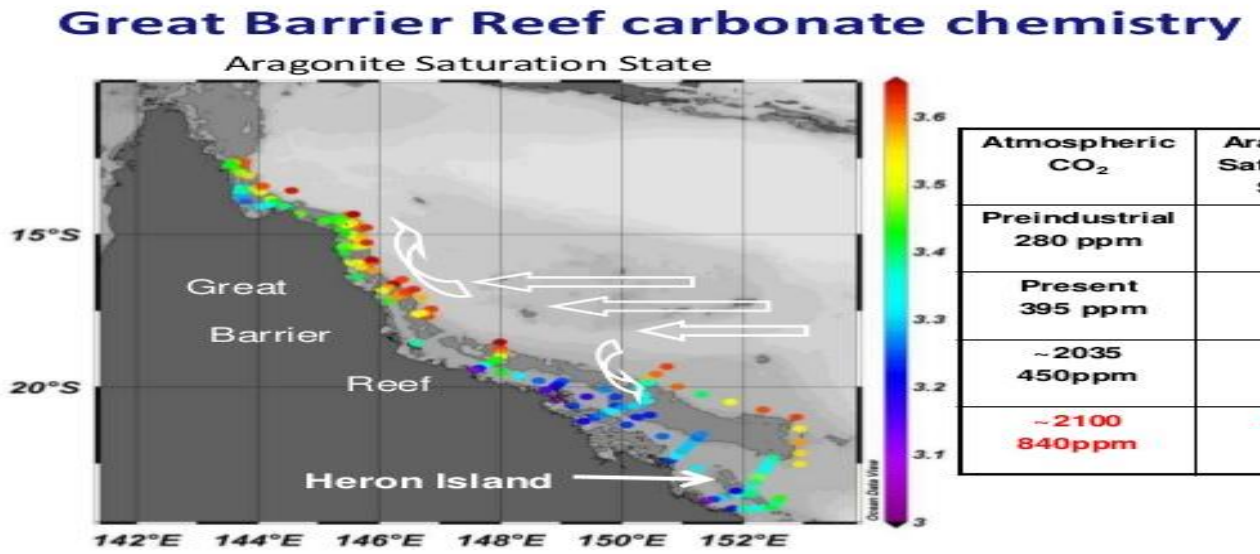
# Graphs showing the changes in coral sea temperature

**Graph 2**

Increase in CO2 emissions over the years as shown in the graph below, has led to increased concentration in the ocean levels which has contributed to the degradation of coral and therefore sealife, in the Reef.  It is a global problem, and nations are working together to decrease emissions. The Paris Climate Agreement, is one such example of this.



# The devastating effect of Ocean Acidification

- The increase in acidity levels in oceans particularly in The Great Barrier Reef is very concerning.
- Scientists have predicted that if CO2 emissions stay at high levels then the Ph levels in the surface oceans could also fall by 0.2-0.4 units by the end of the century. This is worrying as when more CO2 dissolves in the water it becomes hard for coral and other organisms to build hard structures that protect them and makes the water less alkaline. If there is less calcium carbonate and decreased aragonite in the water due to acidification, then the skeletons dissolve faster than when they can be built.
- 


| Atmospheric $CO_2$ | Aragonite Saturation State | pH |
|---|---|---|
| Preindustrial 280 ppm | 4.5 | 8.20 |
| Present 395 ppm | 3.7 | 8.09 |
| ~2035 450ppm | 3.3 | 8.05 |
| ~2100 840ppm | ~2.3 | ~7.8 |

# Before and After Coral Bleaching

- Before Climate Change had impacted The Great Barrier Reef, it was colourful and clean but now most coral has lost it colour due to bleaching. An example is in the picture below where it shows the difference before and after Climate Change bleaching. This has damaged nearly all animals and nature living there. Only 7% of it has not been affected.

# Before and after coral bleaching 2

Globally, the average air temperature of the Earth's surface has warmed by over 1 degree Celsius going back to at least 1850 which has caused the sea environment to change. Each decade since 1980 has seen increasingly warmer temperatures than the ones preceding them, with 2010–19 being around 0.2 degrees Celsius warmer than 2000–09. This has affected a multitude of living creatures habiting the Barrier Reef causing some to die and be on the endangered list. Ultimately, 50% of all living creatures in the reef has unfortunately died.

Climate change have also affected the Earth by:

- Rising sea temperature (which has affected The Great Barrier Reef)
- Increased storms and cyclones
- Increased flood activity
- High ocean acidity
- Rising sea level
- High ocean currents

# Endangered animals in the Great Barrier Reef

## Dugong

- The dugong is a manatee that can swim for six minutes without having to catch its breath on the water surface. These herbivore mammals live in the Pacific Ocean, feeding on underwater grass which is where you'll usually find them. Due to their location around the shallow inter-reefal waters, they have been an easy target for fishermen and hunters, who have found their meat, teeth and oil a precious trade. Moreover, they are also threatened due to increased CO2 emissions, water pollution and sea dumping in the area, making them one of the most endangered animals in the Great Barrier Reef, Australia and the whole world.

# Endangered animals in The Great Barrier Reef

Marine Turtles

- Another of the most endangered animals in the Great Barrier Reef is the marine turtle. In fact, the World Conservation Union has classified 4 out of the 6 species of marine turtles as endangered.
- The other two species are also vulnerable to being endangered.

# Endangered animals in The Great Barrier Reef

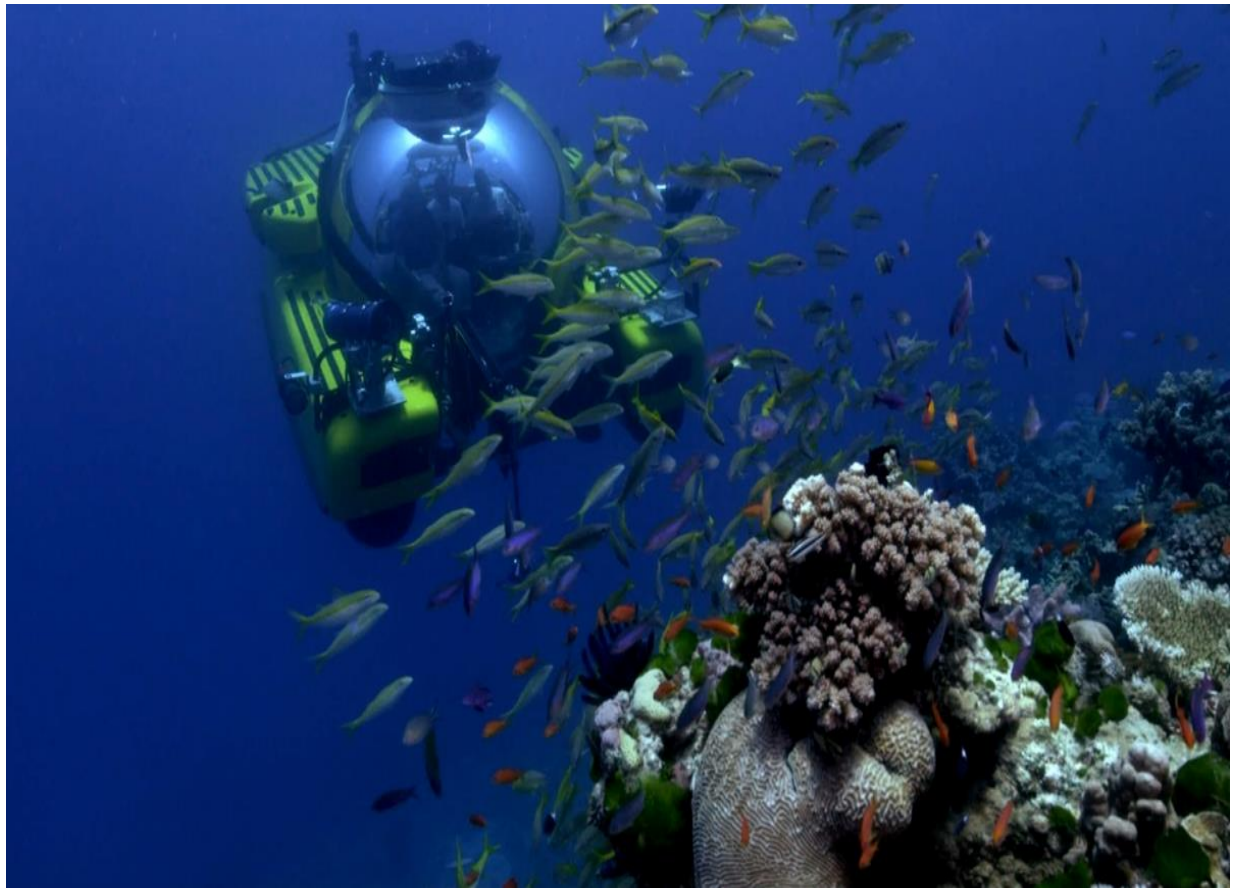
## Whales

- Whales have long been one of the most important animals of the reef for the aboriginal people. Though they are currently under strict protection, whales became endangered due to the high rate of whaling, i.e whale hunting. The humpback whale was down to as little as 500 specimens in the 1960's.
- The population is slowly growing thanks to the Great Barrier Reef Marine Park Authority (GBRMPA), who makes sure that the Barrier is the safest nursery area they can have.


# *Thoughts of Sir David Attenborough on the potential loss of one of the worlds most beautiful ecosystems*

***'The reef is around 40,000 years old, but the changes that are threatening the reef now are not going to happen in 20,000 years – they are going to happen in five or 10 years. This gives you an idea of the severity and swiftness of these changes and why we must act now.***

***'The reef is in grave danger. The twin perils brought by climate change, an increase in the temperature of the ocean and its acidity, if they continue to rise at the present rate the reefs will be gone within decades and that would be a global catastrophe'.***



# What is being done to combat the effects of rising ocean temperatures and coral bleaching

- Work of The Great Barrier Reef foundation includes the ground breaking Coral IVF programme

https://youtu.be/TSSfyh5bdWk

A contact at The Great Barrier Reef Foundation media department referred me to the coral IVF programme and articles detailing the successes of it. Coral IVF planting in 2016 according to a recent visit at the end of last year, has been successful.

Peter Harrison in December visited Heron Island where he reported to see healthy branching Acropora colonies that are on track to start reproducing themselves in the coral larval restoration sites we settled larvae in four years ago during the first small scale pilot study

Other projects include:-

- Reef forecasting
- Saving endangered turtles and
- Restoring habitats

Work of The Great Barrier Reef Marine Park Authority (GBRMPA)

The International Coral Reef Iniative is an iniative which is designed to protect coral reefs across the globe and is led by scientists from GBRMPA. The video below gives an insight as to what is being done.

GBRMPA - International Coral Reef Initiative (ICRI)

# What is being done to combat the effects of rising ocean temperatures and coral bleaching

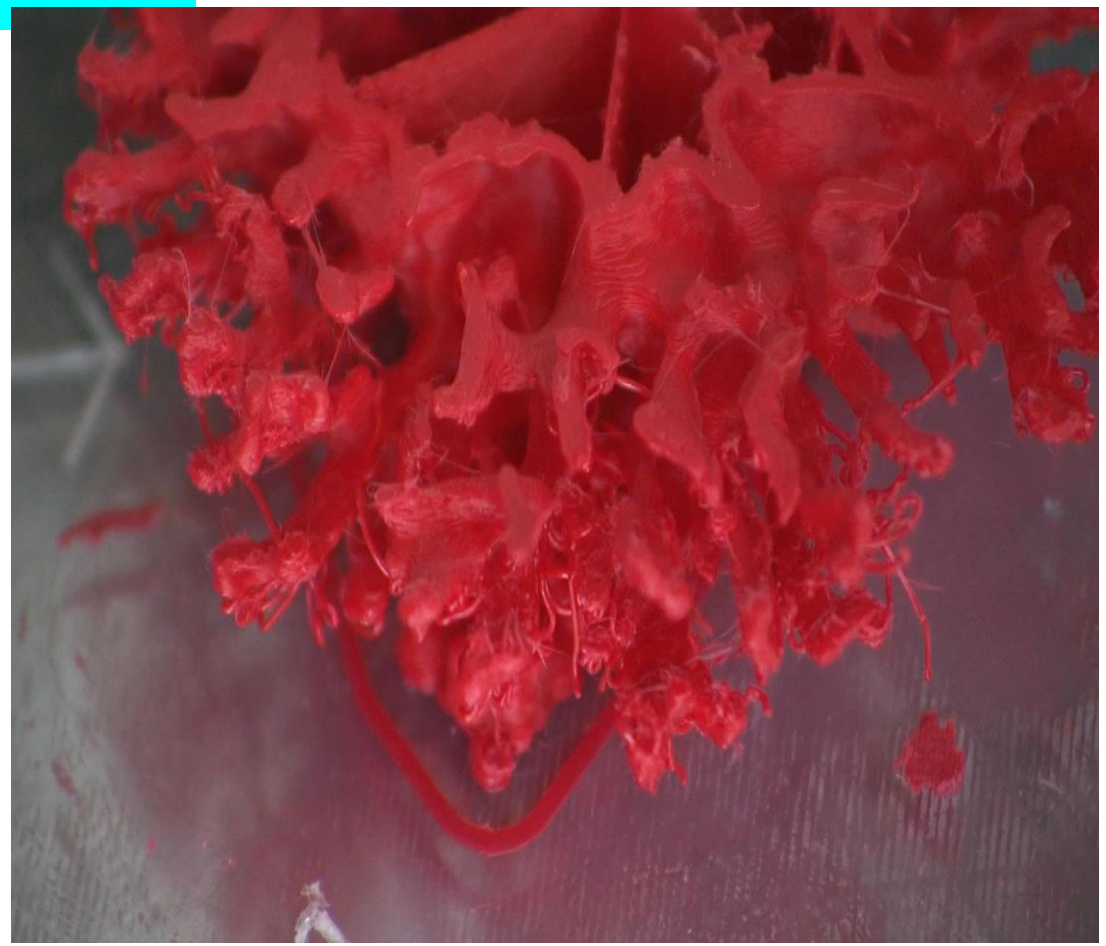
- Work by scientist David Suggett (a marine Biologist) from the University of Technology, Sydney to grow new healthy coral to replant in the Great Barrier Reef is pioneering the work to stop coral being endangered.

***'Under the programme, coral spawn has been collected, coral nurseries established and new corals grown and replanted on reefs that needed to be repaired'***

Quote taken from The Times article on 23rd April 2021

# Other pioneering work – involving 3D printers!

- Other projects to improve the future of coral, and therefore habitats for sealife, is the pioneering work by students at The university of Exeter.
- Genetically modified bacteria is used to make calcium carbonate which is then shaped into coral backbones using a 3d printer. The calcifEXE project is aiming to attach live coral to these backbones before placing them in coral reefs.
- Carbon is being taken straight from the atmosphere and no harmful emissions are created when creating the calcium carbonate.



I hope that this project has
made you want to find out more about
this amazing natural wonder
and how it must be protected for
future generations

David Attenborough's 2015 series on the Great Barrier Reef is an excellent visual journey on how climate change has affected the reef and is a good place to start in understanding how our actions have an impact.

# Bibliography


- **Slide 2**
- Information gathered from research from The Great Marine Park Authority website www.GRPMPA.gov.uk

- **Slide 3**
- Information and images on coral bleaching found on The National Ocean Service website www.oceanservice.noaa.gov

- **Slide 4**
- Conclusions made on water temperature changes made from analysing graphs on slides 5 and 6

- **Slide 5**
- Graph – www.climaterealityproject.org

- **Slide 6**
- Graph – www.mondrianmashable.com

- **Slide 7**
- Research on Ocean Acidification
- www.oceanbrief.org

- **Slide 8**
- Pictures showing before and after effects of bleaching from www.12wp.com/www.trifinity.com

- **Slide 9**
- Information gathered from The Great Marine
- Park Marine Authority website (www.GBRMPA.gov.au)

# Bibliography


- **Slides 10,11 and 12**
- Information and images found on Dugong, Marine Turtles and whales on www.animalwised.com

- **Slide 13**
- Quote 1 – David Attenborough in The Express online newspaper article 26th December 2015
- Quote 2 – David Attenborough in www.theconversation.com on 24th April 2016

**Slide 14**

- Projects to protect the Reef:

www.barrierreef.org

www.GBRMPA.gov.org

Contact at The Great Barrier Reef Foundation Media department – Sarah Henderson provided a good insight into work on the IVF coral programme.

- **Slide 15**
- Research from The Times online newspaper article on 23rd April 2021
- Picture of coral being replanted from The Sydney Morning Herald online newspaper article March 19th 2021

# Bibliography


- **Slide 16**
- Research from The Sky online article on 24th January 2021