

WRAP Exams · wrapexams.com

Prelims PYQ, Mains model answers, and copy evaluation. Write to the desk for this paper, a doubt, or the AI waitlist.

ask@wrapexams.com · +91 85951 84903 · wrapexams.com

Q4

Assess the impact of global warming on the coral life system with examples.

UPSC Civil Services Mains 2019 · GS I · 10 marks · World's Physical Geography

Salient features of world's physical geography.

Core demand of the question

- Assess the impact of global warming on the coral life system with examples
- Assess both the living reef and the wider coral system, using named examples
- Keep the answer within a 10-mark length

Revision summary

Corals bleach when heat forces them to expel **zooxanthellae**.

The Great Barrier Reef and many Indian Ocean reefs have had repeated mass bleaching since 1998.

Ocean acidification thins aragonite skeletons and raises breakage.

Storms, sediment, and disease follow heat and stop recovery.

Indian examples include Lakshadweep, **Gulf of Mannar**, and the Andaman reefs.

Introduction

Corals live near an upper heat limit and depend on **zooxanthellae** algae for food and colour. Global warming raises sea-surface temperature and also shifts chemistry and storms, so the coral life system bleaches, sickens, and can collapse into algae-dominated rubble.

Body**Heat stress and bleaching**

- When water stays about 1°C above the local summer maximum for weeks, corals expel **zooxanthellae**, turn white, and starve if the heat does not break.
- Mass bleaching hit the Great Barrier Reef in 1998, 2002, 2016, 2017, and later years, killing large stretches of shallow branching coral.
- El Niño years raise heat in the central and eastern Pacific and the Indian Ocean, which bleached reefs in the Maldives, Seychelles, Lakshadweep, and parts of Indonesia.
- India's **Gulf of Mannar**, Andaman and Nicobar reefs, and Kachchh-Okha patches have recorded bleaching when the summer monsoon heat stays high.

Acidification, storms, and ecology

- Extra carbon dioxide makes seawater more acidic and lowers **aragonite saturation**, so skeletons of Acropora and other reef builders grow thinner and break more easily.
- Warmer seas feed stronger cyclones and wetter floods, which smash reefs and dump sediment and nutrients that let macroalgae take the space of coral.

- Disease and outbreaks such as crown-of-thorns starfish worsen on stressed reefs, which cuts fish nursery habitat and coastal protein.
- Some deeper or upwelling reefs bleach less, but they cannot replace the lost shallow system that protects islands and feeds artisanal fisheries.

Scale of reef damage

- The impact is not a slow even fade; it is repeated mortality pulses after marine heatwaves, with only partial recovery.
- Local sewage and overfishing make warming deadlier, so the coral life system fails first where heat and human pressure meet.

Flow diagram

Warmer seas -> Bleaching starvation
CO2 acidification -> Weaker skeletons
Bleaching starvation -> Lost reef habitat
Weaker skeletons -> Lost reef habitat
Examples GBR Maldives Mannar -> Lost reef habitat

Conclusion

Global warming is the main new driver of coral bleaching, weaker skeletons, and lost reef fisheries. Cutting greenhouse gases is the core remedy; local protection of the **Gulf of Mannar**, Lakshadweep, and similar reefs can only buy time.

Facts & figures

Zooxanthellae

Symbiotic algae that feed and colour reef corals; their loss is bleaching.

Great Barrier Reef heatwaves

Repeated mass bleaching from 1998 onward on the world's largest reef system.

Lakshadweep and Maldives atolls

Indian Ocean coral islands highly exposed to El Niño marine heatwaves.

Gulf of Mannar

Tamil Nadu reef biosphere reserve that has recorded bleaching and fishing pressure together.

Aragonite saturation

A chemistry measure that falls as oceans acidify, making coral skeletons harder to build.