Threat to Mesophotic Coral Ecosystems

For Prelims: Coral bleaching, La Niña, El Niño, Red Sea, Indian Ocean, carbon sequestration, Rising ocean temperatures, greenhouse gas emissions, renewable energy, global warming.

For Mains: Impact of Coral bleaching, Environmental factors affecting the mass coral bleaching, Climate change and its impact on marine bodies.

Source: SD

Why in News?

Researchers from the Max Planck Institute for Chemistry have found that **mesophotic coral ecosystems** in the **Eastern Tropical Pacific** face a **two-pronged threat**, with bleaching from warm water above and cold-water exposure from below.

- Published in Science of the Total Environment, the **study highlights the increasing risks to these reefs' health and functionality**.

What are Mesophotic Coral Ecosystems?

- **About:**
  - Mesophotic coral ecosystems are **found in tropical and subtropical regions** at depths between 100 and 490 feet.
    - **Key organisms** in these ecosystems include **corals, sponges, and algae,** which provide structural habitat.
- **Significance:**
  - These **ecosystems may help replenish shallow coral reefs** and serve as essential habitats for fish species crucial for spawning, breeding, and feeding.
  - Mesophotic corals contain organisms with specialised defences that could lead to the **development of natural products for medical use.**
- **Limited Research:**
  - Limited research on these ecosystems existed due to technological barriers, **as they are too deep for conventional scuba diving** and **too shallow for deep-sea equipment.**
  - Recent **advances in underwater technology** have now made it possible to study these ecosystems.

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Coral Reefs

(Rainforests of the seas)

Drishti IAS

About

- **Large underwater structures** – made of skeletons of **colonial marine invertebrates 'coral'** – individually called **polyp**
- **Symbiotic** Relationship with **algae 'zooxanthellae'** (responsible for beautiful colours of corals)
- Support over 25% of marine biodiversity

Hard Corals vs Soft Corals

- **Hard Corals** - Rigid skeleton **made of $CaCO_3$ - reef-building** corals
- **Soft Corals** - Non reef-building

Great Barrier Reef (Australia)

- Largest Coral Reef in the World
- World Heritage Site (1981)
- Endures Mass Coral Bleaching

Corals in India

- Present in the areas of Gulf of Kutch, Gulf of Mannar, Andaman & Nicobar, Lakshadweep Islands and Malvan

Significance

- Coral reefs **protect coastlines from storms/erosion**, provide jobs, offer opportunities for recreation
- Source of **food/medicines**

Threats

- **Natural:** Temperature, Sediment Deposition, Salinity, pH, etc.
- **Anthropogenic:** Mining, Bottom Fishing, Tourism, pollution, etc.

Coral Bleaching

- Corals under stress - expel algae – thus turning white (bleached)
- Bleached corals - not dead – but, more risk of starvation/disease

Initiatives to Protect Corals

Technology

- Cyromesh: Storage of the coral larvae at (-196°C) - Can be later reintroduced to the wild
- Biorock: Creating artificial reefs on which coral can grow rapidly

Global

- International Coral Reef Initiative
- The Global Coral Reef R&D Accelerator Platform

Indian

National Coastal Mission Programme

What are the Implications for Mesophotic Coral Reefs Under Climate Change?

- **Increasing Intensity and Frequency of La Niña Events:** Recent research indicates that **major La Niña events**, characterized by **strong easterly winds**, are projected to become both stronger and more frequent in the near future.
    - This **change in climatic patterns** can have **direct consequences on marine ecosystems.**
- **Sequential Events:** Climate models predict that extreme La Niña events will increasingly follow extreme **El Niño events.** This could lead to **rapid shifts in environmental conditions**, impacting coral health.
- **Cold-Water Exposure:** If these predictions hold true, **deep and mid-depth coral reefs in the Eastern Tropical Pacific could face** increased **exposure to unusually cold water** immediately **after experiencing warm thermal stress** from the surface.
    - This dual exposure may lead to compounded stress on coral ecosystems.
- **Long-Term Impacts of Cold-Water Bleaching:** The observed cold-water bleaching is particularly concerning, as it suggests that the impacts of such events on deep coral reefs **may not be transient**.
    - Given the severity of the observed bleaching and the associated coral mortality, these cold-water events could **significantly disrupt the health and functionality** of mesophotic coral ecosystems for extended periods.
- **Broader Context of Coral Bleaching:** The concerns are **amplified by** similar reports of **warm-water bleaching affecting mesophotic reefs in other regions**, including the **Red Sea** and the **Indian Ocean**. This indicates that coral ecosystems worldwide may be increasingly vulnerable to temperature-related stressors due to climate change.

What are the Implications of Coral Bleaching?

- **Loss of Biodiversity:** Coral reefs are **home to a vast array of marine species**. Bleaching disrupts these ecosystems, leading to **the decline or extinction of species** that **depend on corals for shelter and food.**
- **Economic Impact:** Coral reefs **support fishing, tourism, and coastal protection**. Bleaching reduces fish populations and damages the beauty of coral reefs, negatively impacting tourism and fisheries, which are major economic drivers in many regions.
- **Coastal Erosion:** Coral reefs act as **natural barriers that protect coastlines** from storm surges, erosion, and waves. Bleached and **dying reefs lose their structural integrity**, making coastal areas more vulnerable to damage.
- **Climate Change Feedback Loop:** Coral reefs play a **role in carbon sequestration.** When they die due to bleaching, they no longer absorb **carbon dioxide**, contributing to the acceleration of climate change.
- **Decline in Natural Medicines:** Coral reefs are **sources of compounds used in developing medicines**. The loss of coral reefs reduces opportunities to discover new medicinal compounds that could benefit human health.

What are the Various Ways to Save Coral from Bleaching?

- **Reduce Global Warming:** The primary cause of coral bleaching is **rising ocean temperatures driven by climate change**.
    - Reducing **greenhouse gas emissions** by transitioning to **renewable energy**, increasing energy efficiency, and promoting sustainable transportation can help slow down **global warming** and protect coral reefs.
- **Restore Coral Reefs:** Active restoration programs, such as **coral gardening** and **transplanting healthy corals to degraded areas**, can help revive damaged reefs.
    - These initiatives also involve **breeding resilient coral species** that can better withstand rising temperatures.
- **Enhance Marine Protected Areas (MPAs):** Expanding and effectively managing MPAs can provide coral reefs with a safe environment to thrive. MPAs **help protect coral ecosystems**

from human activities and allow them to recover from bleaching events.
    - For example, **Overfishing and harmful fishing practices damage coral reefs.** Sustainable methods, like **marine protected areas**, can safeguard coral ecosystems and aid reef recovery.
- **Support Scientific Research:** Investing in research to **better understand coral resilience and developing coral species** that are **more tolerant to warmer waters** can be key in saving coral reefs.
    - Scientists are studying heat-resistant corals and methods to promote their growth.
- **Encourage Eco-friendly Tourism:** Limiting harmful tourism activities like anchoring boats on reefs, touching corals, or walking on them can help preserve these fragile ecosystems. Sustainable tourism guidelines can minimize human impact on coral reefs.

Drishti Mains Question:

Q. Discuss the causes and implications of coral bleaching, and suggest measures to mitigate its impact and promote coral conservation.

UPSC Civil Services Examination, Previous Year Question (PYQ)

Prelims:

Q. Which of the following have coral reefs? (2014)

1. Andaman and Nicobar Islands
2. Gulf of Kachchh
3. Gulf of Mannar
4. Sunderbans

Select the correct answer using the code given below:

(a) 1, 2 and 3 only
(b) 2 and 4 only
(c) 1 and 3 only
(d) 1, 2, 3 and 4

Ans: (a)

Q. Consider the following statements: (2018)

1. Most of the world's coral reefs are in tropical waters.
2. More than one-third of the world's coral reefs are located in the territories of Australia, Indonesia and Philippines.
3. Coral reefs host far more number of animal phyla than those hosted by tropical rainforests.

Which of the statements given above is/are correct?

(a) 1 and 2 only

(b) 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Ans: (d)

Mains:

Q. Assess the impact of global warming on the coral life system with examples. **(2019)**