Global Marine Life and Oceans Warming

For Prelims: Tropicalisation, Climate Change, Oceans Heating, Mediterranean Sea, Greenhouse Gas Emissions, **Coral Bleaching**, Solar Radiation.

For Mains: Impact of **ocean warming** and sea level rise on marine biodiversity.

Source: BS

Why in the News?

Recently, a study published in the journal **'Trends in Ecology and Evolution'** highlighted that **climate change** is making the **oceans warmer**, and as a result, **tropical marine species** are shifting from the **equator towards the poles.**

- The **temperate species** are receding as it gets too warm, they face **increased competition** for **habitat,** and **new predators.**

How Does Climate Change Cause Tropicalisation as per the Study?

- **Tropicalisation:**
  - **Climate change** is causing a **marine phenomenon** known as **tropicalisation,** where **tropical species** expand their range while **temperate species retract.**
    - **Temperate species** are receding as it gets too warm, they face **increased competition** for **habitat**, and **new predators** arrive on the scene.
  - This **global shift** is altering ocean ecosystems**,** biodiversity, and could **impact the global economy.**
  - The first instance of this process was identified in the **Mediterranean Sea.**
  - The **Mediterranean Sea** is considered as a **"tropicalisation hotspot"** due to an increase in tropical species.
- **Species Dispersal due to Climate change:**
  - **Climate change** has altered the **physical factors** that affect species dispersal, such as ocean currents in areas that **separate tropical/subtropical** and temperate regions.
  - These **warm-water boundary** currents are heating faster than the global seawater average, facilitating the **poleward movement of species**, and reinforcing the **retraction of temperate species.**
  - **Example:** Range-expanding tropical damselfishes and temperate reef fishes have been documented altering their feeding and social behaviors to allow for coexistence,
- **Evolution of New Traits:**
  - Changes in how species interact can result in the evolution of new traits or behaviors due to the close connection between **ecology** and **evolution**.

What is Ocean Warming?

- **About:**

    - The **ocean absorbs** most of the excess heat from **greenhouse gas emissions,** leading to **rising ocean temperatures.**
- **Reason:**
    - **Greenhouse Gas Emissions:** The burning of **fossil fuels (coal, oil, and natural gas)** for **energy**, **deforestation**, and **industrial processes** releases significant amounts of **greenhouse gasses,** including **carbon dioxide (CO_2)**, **methane (CH_4)**, and **nitrous oxide (N_2O),** into the atmosphere. These gases trap heat, leading to a **warming effect** on both the atmosphere and the oceans.
    - **Carbon Dioxide Absorption:** Oceans act as a vast reservoir that absorbs a significant portion of the excess **carbon dioxide** from human activities. While this absorption helps mitigate climate change on land, it also results in the **warming of the ocean itself.**
    - **Solar Radiation:** Changes in **solar radiation**, though a **minor contributor** compared to **human-induced factors**, can influence **ocean temperatures** over long periods.
- **Impact:**
    - **Coral Bleaching: Elevated temperatures** can cause **corals** to expel the symbiotic algae living in their tissues, leading to **coral bleaching.** Prolonged bleaching weakens corals and makes them more susceptible to diseases, posing a significant threat to **coral reef ecosystems.**
    - **Sea Level Rise**: **Warmer ocean temperatures** contribute to the **thermal expansion of seawater.** This, along with the melting of polar ice caps and glaciers, leads to rising sea levels, which can result in coastal erosion and increased **vulnerability of coastal communities.**
    - **Disruption of Marine Food Webs:** Changes in **ocean temperatures** can alter the **distribution** and abundance of marine species, affecting the structure of marine food webs. This can have cascading effects on fisheries and the **livelihoods of communities** dependent on them.
    - **Ocean Acidification:** The absorption of **excess carbon dioxide** by the oceans leads to **ocean acidification**. Acidification can harm marine organisms with **calcium carbonate skeletons or shells,** including **corals, mollusks,** and some **plankton,** affecting the entire marine food chain.

Conclusion

Global marine species shift due to climate-induced tropicalization, exemplified in the Mediterranean as a "hotspot." Ocean warming from factors like greenhouse gasses causes coral bleaching, sea level rise, and disruptions to marine food webs. Threatening biodiversity, coastal communities, and economies, urgent climate mitigation is crucial to preserve ocean health.

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Mains

Q1. Assess the impact of global warming on the coral life system with examples. **(2017)**

Q2. ‘Climate change’ is a global problem. How India will be affected by climate change? How Himalayan and coastal states of India will be affected by climate change? **(2017)**

Q3. Discuss global warming and mention its effects on the global climate. Explain the control measures to bring down the level of greenhouse gases which cause global warming, in the light of the Kyoto Protocol, 1997. **(2022)**