Ocean Darkening

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Ocean Darkening: A Growing Environmental Challenge

Context

The health of the world's oceans is crucial for maintaining ecological balance, supporting marine biodiversity, regulating climate, and enabling carbon cycling. However, in recent decades, a worrying phenomenon called **"ocean darkening"** has emerged. It refers to a **reduction in water clarity**, which limits the **penetration of sunlight** into ocean waters. This issue directly affects the **photic zone**—the sunlit upper layer of the ocean—responsible for sustaining over **90% of marine life** and facilitating photosynthesis.

This phenomenon has intensified over the past two decades, with major implications for marine ecosystems, global climate regulation, and planetary health.

Status of Ocean Darkening

- Over **21%** of the world's ocean area has significantly darkened in the past 20 years — this covers more than **75 million square kilometres**.
- Around **9%** of the ocean has experienced a **shrinkage of the photic zone by more than 50 metres**.
- In **2.6%** of the ocean, the decline in light penetration has exceeded **100 metres**.
- Only **10%** of the oceans have shown lightening trends, indicating a **dominant global trend of darkening**.
- The most affected regions include:
    - **Arctic and Antarctic zones**
    - Areas influenced by the **Gulf Stream**

Causes of Ocean Darkening

1. **Heavy Rainfall**
    - Increases **sediment runoff** into coastal waters.
    - Reduces transparency and increases turbidity of ocean water.
2. **Land Use Changes**
    - **Deforestation and urbanisation** near coastlines lead to more **sediments, nutrients, and organic matter** flowing into the sea.
    - This enhances water opacity and decreases clarity.
3. **Algal Blooms**
    - Triggered by **nutrient runoff** from agriculture, **industrial effluents**, and **urban sewage**.
    - These blooms block sunlight, reducing water transparency.
4. **Rising Sea Surface Temperatures**
    - Affects the **productivity and distribution of marine organisms**, especially **phytoplankton**, which influence ocean clarity.
5. **Altered Ocean Circulation**
    - Changes in **global ocean currents** redistribute particles that either absorb or scatter sunlight.
    - These shifts impact the vertical and horizontal clarity of ocean waters.

Impacts of Ocean Darkening

1. **Shrinkage of Photic Zone**
    - The **photic zone**, normally extending up to **200 metres**, is now shrinking in many areas.
    - This directly limits **photosynthesis** and affects marine food chains.
2. **Threat to Marine Biodiversity**
    - Over **90% of marine life** depends on the sunlit surface layer.
    - Darkening threatens the survival and reproduction of various marine organisms.
3. **Disruption of Marine Food Web**
    - Animals dependent on sunlight are forced closer to the surface.
    - Leads to **increased competition** for food and habitat.
4. **Planetary Impact**
    - The photic zone is central to **oxygen production and carbon cycling**.
    - Its decline hampers the ocean's role in **climate regulation**, oxygen generation, and **carbon sequestration**.

What Needs to Be Done

1. **Protection of Marine Ecosystems**
    - Safeguard both **coastal and open-water ecosystems** to maintain biodiversity and ecological balance.
2. **Regulation of Coastal Land Use**
    - Implement strict land-use controls near coastal areas to reduce **sediment and nutrient runoff**.

3. **Update Coastal Zone Regulations**

    - Incorporate **optical clarity parameters** into existing environmental laws and marine conservation frameworks.

4. **International Cooperation**

    - Foster **global collaboration** to monitor, share data, and act jointly on marine environmental issues, especially in **international waters**.