

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**.



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