

Introduction to Marine Pollution

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Key concepts, sources, impacts, and mitigation strategies

1. What Is Marine Pollution?

Definition	The introduction of harmful substances or energy into the ocean that degrades water quality, harms marine life, and disrupts ecosystem services.
Scope	Includes chemical, physical, biological, and noise contaminants that originate from land, sea, and atmospheric sources.
Why It Matters	Oceans cover ~71% of Earth's surface, regulate climate, provide food, and support biodiversity. Pollution threatens these functions and human well-being.

2. Major Types of Marine Pollution

Type	Typical Sources	Common Pollutants	Primary Effects
Plastic debris	River runoff, coastal litter, fishing gear, maritime transport	Microplastics, macroplastics, polymer fibers	Ingestion/entanglement of wildlife, habitat smothering, chemical leaching
Oil pollution	Offshore drilling, tanker spills, bilge water, urban runoff	Crude oil, refined products, petroleum hydrocarbons	Surface slicks, shoreline contamination, acute toxicity to fish & birds
Nutrient enrichment (eutrophication)	Agricultural fertilizers, sewage, animal waste	Nitrogen (NO ₃ ⁻ , NH ₄ ⁺), phosphorus (PO ₄ ³⁻)	Algal blooms, hypoxia, dead zones
Chemical contaminants	Industrial discharge, mining, pesticide use	Heavy metals (Hg, Pb, Cd), PCBs, PAHs, DDT	Bioaccumulation, reproductive failure, carcinogenic effects
Sewage & pathogens	Untreated/partially treated wastewater, stormwater	Bacteria (E. coli, Vibrio), viruses, parasites	Human health risks, shellfish contamination, ecosystem stress

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Type	Typical Sources	Common Pollutants	Primary Effects
Noise pollution	Shipping, seismic surveys, sonar, construction	Underwater acoustic energy (decibels)	Disruption of marine mammal communication, navigation, breeding
Thermal pollution	Powerplant cooling water, industrial effluents	Elevated water temperature	Metabolic stress, altered species distribution, coral bleaching
Radioactive waste	Nuclear power plants, medical isotopes, weapons testing	Radioisotopes (Cs-137, Sr-90)	Genetic mutations, long-term ecosystem damage

3. Pathways Into the Ocean

1. **Riverine transport** – Carries land-based waste, plastics, and nutrients downstream.
 2. **Atmospheric deposition** – Airborne particles (e.g., mercury, microplastics) settle on the sea surface.
 3. **Direct discharge** – Ports, offshore platforms, and ships release effluents directly into water.
 4. **Coastal runoff** – Stormwater sweeps urban and agricultural pollutants into coastal zones.
 5. **Marine activities** – Fishing gear loss, anchoring, and seabed mining generate in-situ debris.
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4. Ecological & Socio-Economic Impacts

Impact	Description
Biodiversity loss	Species mortality, reduced reproductive success, invasive species advantage.
Foodweb disruption	Trophic transfer of toxins leads to contaminated seafood and altered predator-prey dynamics.
Habitat degradation	Coral reef bleaching, mangrove smothering, seagrass die-off.
Human health risks	Consumption of contaminated fish, beach closures, waterborne diseases.

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Impact

Description

Economic costs

Fisheries loss, tourism decline, cleanup expenses (estimated billions USD annually).