
Marine Ecosystems Crises

In spite of getting multiple warnings, we are still destroying our Marine Ecosystems in **5 highly destructive ways** with **Overfishing, Oil Spills, Plastic Pollution, Agricultural Runoff** and **Radiation Releases due to Atomic Power Plant Accidents. Aquaponics, can help alleviate our dependence on Marine Fish to give our Marine Ecosystems time to recover.**

Click the above Image to See A Short Video.

"Beneath the ocean's surface, an unprecedented crisis is unfolding. Our marine ecosystems—home to millions of species and essential to human survival—are experiencing biodiversity loss at an alarming rate. Recent studies indicate that over 50% of marine populations have declined since 1970, with some species facing extinction within our lifetime." (Quote from the **Marine Biodiversity & Sustainability Learning Center**)

How did we get here? Ignoring the obvious, which is a total lack of appreciation for the fragility of our Oceans that appear on the surface to be ubiquitous and indestructible. Oceans cover 71% of Earth so it's no wonder we have the misconception that they are endless and beyond destruction.

Overfishing: But we are so wrong. Allowing Industrial-scale fishing at unsustainable levels is one of the most destructive things we are doing in spite of statistics put out by the FAO (Food & Agriculture Organization) of the United Nations), which monitors marine fishery stocks and have reported that In the mid-1970s (around 1974), about 90% of stocks were fished at biologically sustainable levels. Those were the good old days.

As of the **FAO Report in 2020**, stocks that were fished at biologically sustainable levels have dropped to around 62-65% meaning **35%-38% of our fish stocks are being overfished at unsustainable levels.** Modern fishing techniques, including bottom trawling, damage seafloor habitats and capture numerous non-target species as bycatch. Dolphins, which are not fish at all, are often among the bycatch victims of trawling. This shift in the percentages of industrial fishing maintained at sustainable levels indicates **widespread reductions in abundance for many key commercial species (e.g., cod, tuna, herring, and other table fish**).

The most recent **FAO Report in 2024** explains that while some stocks (like many tuna) have recovered through better management, the overall trend for assessed stocks remains concerning, with overfishing persisting in regions like the Mediterranean and Southeast Pacific. Here is the Understanding ocean biodiversity loss is crucial not just for marine scientists but for everyone who depends on healthy oceans—which is all of us. The decisions we make today will determine whether future generations inherit vibrant, resilient oceans or sick dying seas.

The bright side of this story is the success of the Pacific Bluefin Tuna, which shows strong recovery due to international measures from the Western and Central Pacific Fisheries Commission (WCPFC) and the Inter-American Tropical Tuna Commission (IATTC). Together these two agencies created reduced catch numbers (especially of small fish), enacted effort controls, size-based limits and enforced monitoring.

Oil Spills: The good news about Oil Spills into our Oceans is in the last 20 years, there has been a dramatic decline in both the frequency and volume of large incidents compared to earlier decades. This is due to improved tanker design (e.g., double hulls), stricter international regulations, better navigation technology, and enhanced response capabilities. According to the International Tanker Owners Pollution Federation (ITOPF), which tracks tanker spills globally, the number of major spills of over 700 tons has stabilized at low levels averaging about 7 spills per year during the 2020s with total oil lost from tankers in recent years being in the thousands of tons annually rather than in the hundreds of thousands as was the case in the 1970s - 1990s.

At the time of this writing, the **most recent Oil Sill happened in March 2026 in the Gulf of America** on the Mexico side impacting the Veracruz/Tabasco Coastline. A vessel owned by an unnamed private company spilled a unspecified amount of Oil that is coating beaches, mangroves, fish, turtles, and manatees along 143 miles of coastline. Following is a List of Oil Spill that have occurred in the last 20 years starting with 2025:

2025

- **2025 incidents (various, per ITOPF)**: Three large spills (>700 tonnes) and three medium (7–700 tonnes) from tankers, totaling ~4,000 tonnes lost globally (mostly crude/fuel oil in Asia and Europe). Specific names/locations not detailed in summaries, but no single "mega-spill" reported.
- **2025 Johor Strait palm oil spill (Malaysia)**: Spill into marine waters off Kampung Pasir Putih; details limited.
- **2025 Singapore incidents**: Multiple small-medium leaks/collisions (e.g., Marine Dynamo/Flag Gangos collision in Singapore Strait, PCG Brani base leak ~23 tonnes).

2024

- **Singapore oil spills**: Multiple at Bukom refinery/Pulau Bukom (pipeline leaks ~30–40 tonnes) and Pasir Panjang (Vox Maxima/Marine Honour collision ~400 tonnes).
- **Manila Bay (Philippines)**: MT Terra Nova capsized/sank; unknown to ~1,500 tonnes.
- **Tobago (Trinidad and Tobago)**: Gulf Stream spill; unknown to ~4,773 tonnes.
- **ITOPF total for tankers**: ~10,000 tonnes lost globally.

2023

- **Undersea pipeline near Louisiana (USA)**: ~3,500 tonnes into Gulf of Mexico.
- **Princess Empress (Philippines)**: ~881 tonnes off Oriental Mindoro.

2022

- **Callao oil spill (Peru)**: Repsol refinery spill in Ventanilla/Callao; ~1,626–1,862 tonnes into Pacific.

2021

- **Orange County (USA)**: ~424 tonnes off California coast.

2020

- **Wakashio grounding (Mauritius)**: Bulk carrier struck reef; ~1,300–4,300 tonnes into Indian Ocean lagoon, severe impact on marine life and pristine areas.
- **New Diamond tanker fire (Sri Lanka)**: Supertanker fire; potential large spill averted, but one fatality.

2018

- **Sanchi tanker collision (East China Sea)**: Suezmax tanker with Iranian condensate collided and burned; ~113,000–138,000 tonnes lost (one of the largest recent tanker incidents, though condensate is lighter/less persistent than crude).

2010 (largest in period)

- **Deepwater Horizon (Gulf of Mexico, USA)**: BP-operated rig explosion/blowout; ~492,000–627,000 tonnes (≈4.9 million barrels) released over months. **Worst accidental marine spill in history; massive ecological/economic damage to Gulf Coast.**

Earlier in the 20-year window (2005–2009, for context)

- **Ongoing Taylor oil spill (Gulf of Mexico, since 2004)**: Platform damage from Hurricane Ivan; cumulative ~490,000 tonnes **(ongoing leak, one of the longest)**.
- **Hurricane Katrina-related (2005, Gulf of Mexico)**: Multiple sources; ~7 million gallons (~166,000 barrels) from facilities/tanks.

Overall trends (2006–2026): No spills on the scale of Deepwater Horizon (2010) or Sanchi (2018) have occurred recently. Volumes are down sharply—ITOPF reports tanker losses in the 2020s total ~42,000 tonnes so far (through 2025), with 2025 at ~4,000 tonnes. Most incidents now involve smaller tanker collisions/leaks or non-tanker sources like pipelines/platforms. Positive progress reflects industry/government efforts, though risks remain from aging infrastructure, extreme weather, and offshore expansion.

One thing to pay attention to is two of these Oil Spills (red font) were either the worst ever recorded like the Deepwater Horizon Spill, or Ongoing like the Taylor Oil Spill that has an ongoing leak, and 3 of them have occurred in the Gulf of America. (Resources used to acquire this data include: **ITOPF Oil Tanker Spill Statistics 2025**, **Wikipedia List of Oil Spills**, and **NOAA/USA-focused Spills**)

Oil spills typically have devastating, multi-level effects on marine ecosystems, ranging from immediate acute impacts to long-term chronic damage. The severity depends on factors like the type and volume of oil, spill location (e.g., open ocean vs. sensitive coastal areas), weather, and response speed. Most oils float, forming slicks on the surface, which block sunlight, reduce oxygen exchange, and expose surface-dwelling or shoreline organisms first.

Oil affects marine life through two main pathways (per NOAA and scientific consensus).

1. **Physical fouling/smearing/coating** — Oil coats feathers, fur, skin, gills, or shells, leading to:
    - Loss of insulation/water repellency → Hypothermia in birds and mammals.
    - Reduced mobility, drowning, or starvation.
    - Smothering of small organisms (e.g., plankton, invertebrates).
2. **Chemical toxicity** — Petroleum hydrocarbons (especially polycyclic aromatic hydrocarbons or PAHs) are poisonous, causing:
    - Internal exposure via ingestion, inhalation, or absorption.
    - External irritation to skin, eyes, or gills.
    - Sublethal effects like impaired reproduction, growth stunting, immune suppression, behavioral changes, organ damage (e.g., enlarged livers, heart issues), or genetic damage.

All living organisms in the vicinity of the Oil Spill are affected including Seabirds, Marine Mammals, Sea Turtles, Plankton and microorganisms. But what we're concerned with in this document are the Fish and Shellfish, which we depend on as major food sources.

Adult Fish and Shellfish may show reduced growth, fin erosion, or gill damage. Larvae/eggs are highly vulnerable (mortality, developmental abnormalities). Bottom-dwellers and filter feeders (e.g., oysters, clams) accumulate toxins in their bodies from the Oil sediments. These effects are both short term and long term.

Acute/short-term affects result in mortality. Coated animals die quickly causing mass die-offs and immediate food web disruption. Chronic/long-term affects result in persistent residues in sediments that cause ongoing toxicity, reduced reproduction, population declines, altered community structure (e.g., loss of key species, invasion by opportunists), and cascading effects up the food chain. Some ecosystems (e.g., salt marshes, mangroves) take decades to recover fully or may not return to pre-spill conditions.

Therefore, there is overall Ecosystem Disruptions which can alter biodiversity, nutrient cycling, and food webs, sometimes leading to "ecosystem-level injury" (as seen in Deepwater Horizon). While some areas recover in months to years with good natural degradation and cleanup, sensitive or heavily oiled sites show lasting changes.

Aquaponics Farms all over America could help alleviate the loss of Fish and Shellfish by raising Tilapia, Cat Fish, Perch, other popular eating Fish and Fresh Water Cray Fish to supplement the loss of Fish and Shellfish caused by Oil Spills.

Plastic Pollution: Of all of the tons of waste that end up in our Oceans, Plastic is the worst. It is estimated that 75-200 million metric tons of plastic waste is currently in our Oceans. In terms of pounds, that's somewhere between **165-430 Billion Pounds**.

These figures appear consistent in sources like Recycling Industry Reports, Condor Ferries Compilations (Ferries that travel from the UK to France) and updates referencing UNEP (United Nations Environment Program).

The Annual inflow is often estimated at 8-12 million metric tons, which is **18-26 Billion Pounds per year**, most of it remains in tact for centuries, breaking down into smaller pieces rather than disappearing. That means this Plastic Pollution catastrophe only gets worse.

A Non-Profit Group called "**Ocean Cleanup**" has removed tens of millions of pounds in recent years, but it's a tiny fraction compared to the total accumulation and annual inflow.

This subject would be sorely incomplete without mentioning the GPGP (Great Pacific Garbage Patch), which is the largest known accumulation of floating plastic debris in the world's oceans, located in the North Pacific subtropical region between California and Hawaii. "Patch" isn't even close to descriptive when it comes to this mass of Plastic debris that is about 620,000 sq. miles, which is twice the size of Texas. There are about 176-220 million pounds of Plastic in the Patch, and the sight of it is beyond disturbing and consider banning plastic for the first time.

Plastic pollution, particularly in the form of **plastic waste** (macroplastics like bags, bottles, nets, and fishing gear, as well as **microplastics** smaller than 5 mm), causes extensive and multifaceted harm to marine ecosystems. It affects organisms at every level—from tiny plankton to large whales—and disrupts entire food webs, habitats, and ecological processes. Below are the main ways this occurs, based on extensive scientific consensus from organizations like NOAA (National Oceanic and Atmospheric Administration) UNEP (United Nations Environment Program), IUCN (International Union for Conservation Of Nature) and peer-reviewed studies.

1. Entanglement

Large plastic debris, especially **abandoned, lost, or discarded fishing gear** (known as "ghost gear"), ropes, nets, and packaging, entangles marine animals. This restricts movement, causes injuries (cuts, infections, amputations), impairs feeding and breathing, and often leads to drowning, starvation, or predation vulnerability.

- Affects hundreds of species, including marine mammals (e.g., seals, whales), sea turtles, sharks, and seabirds.
- Ghost nets continue "fishing" indefinitely, killing wildlife long after abandonment.
- Impacts endangered species disproportionately, such as the Mediterranean monk seal, where entanglement is a leading cause of death after human hunting.

2. Ingestion

Many marine animals mistake plastic for food (e.g., plastic bags resemble jellyfish to sea turtles, bottle caps or fragments look like plankton or fish eggs to seabirds and fish). Ingestion leads to:

- **Physical harm** — Blockages or tears in the digestive tract, preventing nutrient absorption and causing starvation (a false sense of fullness from indigestible plastic).
- **Internal injuries** — Sharp edges cause scarring (e.g., "plasticosis" in seabirds, a newly identified disease involving stomach fibrosis and scarring).
- **Starvation or suffocation** — Common in seabirds (adults feed plastic to chicks, reducing chick survival), sea turtles (even 14 pieces can increase mortality risk), and marine mammals (e.g., whales with stomachs full of bags and nets).
- Affects at least 800–914 species, including 86% of sea turtles, 44% of seabirds, and 43% of marine mammals.

3. Chemical Toxicity and Bioaccumulation

Plastics act as **sponges** for pollutants (e.g., PCBs, DDT, heavy metals), concentrating them up to a million times higher than surrounding seawater. Additives in plastics (e.g., BPA, phthalates) also leach out.

- When ingested, these toxins transfer to tissues, causing **endocrine disruption** (hormone interference affecting reproduction and development), immune suppression, inflammation, gene damage, and reduced growth/reproduction.
- **Bioaccumulation and biomagnification** occur as toxins build up in organisms and increase up the food chain (plankton → fish → predators → top predators like whales or humans via seafood).
- Microplastics and nanoplastics translocate beyond the gut into organs (liver, brain, etc.), exacerbating effects.

4. Habitat Damage and Ecosystem Disruption

- Plastics smother or break **coral reefs** (vital for 25% of marine biodiversity), increasing disease risk by 89% when plastic contacts coral (introducing pathogens).
- Derelict gear damages sensitive seafloor habitats.
- Floating plastics transport invasive species across oceans, altering local ecosystems (e.g., coastal organisms thriving in open ocean garbage patches like the Great Pacific Garbage Patch).
- Microplastics disrupt foundational species:
  - **Phytoplankton** (e.g., Prochlorococcus) show reduced photosynthesis, oxygen production, and reproduction—threatening ocean oxygen and carbon cycles.
  - **Zooplankton** ingest microplastics, leading to less efficient carbon sinking (impairing the biological carbon pump), altered behavior, reduced feeding, and lower survival.

Broader Ecosystem-Level Impacts

These individual harms cascade:

- Reduced populations of key species disrupt food webs and biodiversity.
- Altered nutrient cycling, oxygen production, and carbon sequestration worsen climate change effects.
- Combined with other stressors (e.g., warming, acidification), plastic pollution accelerates ecosystem degradation, dead zones, and biodiversity loss.

In summary, plastic pollution doesn't just kill individual animals— it undermines the health and balance of entire marine ecosystems, with effects rippling to human food security (via contaminated seafood) and global processes like climate regulation.

While estimates vary, the consensus is that hundreds of millions of animals are affected annually, with no full recovery possible without major reductions in plastic pollution. (Resources used include **UNEP** (United Nations Environment Programme), **IUCN** (International Union for Conservation of Nature), **OECD** (Organisation for Economic Co-operation and Development))

Agricultural Run Off: Agricultural run off primarily consists of excess nutrients like nitrogen (from fertilizers and manure) and phosphorus, along with pesticides, sediments, and other chemicals, and it represents one of the largest sources of pollution entering the Oceans.

Agricultural Run Off accounts for a significant portion of land-based marine pollution (which itself makes up about 80% of total ocean pollution, as per NOAA and UNEP sources).

Exact global figures are approximate and vary by source/study (due to challenges in measuring diffuse/non-point sources), but here are the most commonly cited estimates for the scale of Agricultural Nutrient Runoff reaching the oceans annually:

Nitrogen (N) from Agriculture/Runoff

- Human activities (largely agriculture via fertilizers, manure, and fixation in crops) produce around **120 million metric tons** (or tonnes) of reactive nitrogen per year globally.
- Of this, a substantial portion enters aquatic systems: Estimates indicate that roughly **35%** of anthropogenic nitrogen inputs ultimately reach the oceans (through river runoff, leaching, and some atmospheric deposition), equating to tens of millions of tonnes annually.
- More specific models (e.g., from river export studies) put total riverine nitrogen to seas at around **40 million tonnes** per year, with agriculture/diffuse sources dominating (often 70–95% in many regions).
- For context: In the U.S. alone (e.g., Mississippi River Basin contributing to the Gulf of Mexico dead zone), agricultural sources deliver about **1–1.6 million metric tons** of nitrogen annually to coastal waters.

Phosphorus (P) from Agriculture/Runoff

- Globally, about **20 million metric tons** of phosphorus are mined/extracted annually for fertilizers.
- Nearly half (**~10 million metric tons**) enters the world's oceans each year—about 8 times the natural rate—mostly via agricultural runoff and erosion (carried as particle-bound forms in rivers).
- River export models estimate total phosphorus to seas at around **1.8 million tonnes** per year in some recent assessments, but broader fluxes (including burial in sediments) align with higher figures when including anthropogenic boosts.

Other Components of Agricultural Runoff

- **Pesticides**: Around **710 tonnes** of active pesticide ingredients leach into the oceans annually (from UN research on common agricultural pesticides), a small but toxic fraction.
- **Sediments and other pollutants**: Agriculture contributes heavily to sediment loads that smother habitats, but quantified globally in billions of tonnes of eroded soil (much carrying bound nutrients/pollutants).

Broader Impacts and Context

These nutrient inputs drive **eutrophication. Eutrophication** is the process where water bodies become overly enriched with nutrients, primarily nitrogen and phosphorus, leading to excessive growth of algae and aquatic plants. This can result in reduced oxygen levels in the water, harming aquatic life and degrading water quality. It fuels harmful algal blooms, oxygen-depleted **dead zones** (now over 500 documented globally), biodiversity loss, and ecosystem disruption in coastal and marine areas. Major hotspots include the Gulf of Mexico (from Midwest U.S. farms), Baltic Sea, Chesapeake Bay, and parts of the Great Barrier Reef.

In summary, Agriculture is often the dominant source of pollution in these cases (e.g., 48% of Nitrogen in Chesapeake Bay, 70%+ in Gulf excess nitrogen).

Projections suggest worsening Agricultural Run Off without major changes in fertilizer use, precision agriculture, buffer zones, and manure management. Organizations like **UNEP** (via its Global Partnership on Nutrient Management), **FAO**, and **OECD** highlight these as part of the "triple planetary crisis" (pollution, biodiversity loss, climate change), with calls for better nutrient stewardship to curb ocean inflows.

(These are estimates from scientific models, river monitoring, and reports (e.g., UNEP, FAO, USGS, peer-reviewed studies). Actual amounts fluctuate with weather, farming practices, and regional differences, but the scale is massive—equivalent to fertilizing vast ocean areas unintentionally each year)

Radiation Releases: There have been two major Atomic Power Plant Accidents in the last 40 years starting with Chernobyl in Northern Ukraine in 1986 and ending with Fukushima in Japan, 2011.

Chernobyl and Fukushima have both been labeled “Level 7”, highest on the International Nuclear Event Scale (INES), but their affects on the Ocean were very different. Even though the Chernobyl accident, which resulted in an actual Melt Down, was much larger and spread across continents heavily affecting Europe, the Radiation contaminated land, but did not affect the Ocean.

Fukushima’s Radiation contamination was lower than Chernoblyl’s but deposited radionuclides in the Pacific Ocean rather than on land. Radionuclides are unstable isotopes of elements that undergo radioactive decay, emitting radiation in the process.

In fact, Fukushima is still releasing radiation into the ocean, but it's controlled, intentional, and at very low levels according to international monitoring. The primary source today is the ongoing discharge of treated (ALPS-processed) water from the site into the Pacific Ocean, which began in August 2023 and continues in batches.

ALPS-treated water refers to water that has undergone treatment through the Advanced Liquid Processing System (ALPS), which is designed to remove radioactive contaminants from water, particularly in nuclear facilities. This process ensures that the water is safe for discharge or reuse, significantly reducing environmental and health risks. The International Atomic Energy Agency (IAEA) has an ongoing presence at the site, independently samples batches, and confirms compliance with international safety standards.

While the IAEA and many experts deem it safe, some groups (e.g., environmental NGOs, local fishers, neighboring countries like China) criticize it due to past TEPCO transparency issues, the presence of trace other radionuclides (even if below limits), and prefer alternatives like long-term storage. However, independent data consistently shows no detectable harm to ocean ecosystems or human health from current releases.

Both of these accidents were tragic, but the Nuclear Energy Companies learned valuable lessons from them. The first big lesson was the importance of having Containment structures, which are a part of Western-designed reactors that limit the dire consequences of accidents dramatically compared to Chernobyl that had no Containment.

At Fukushima, a tsunami overwhelmed the backups bringing the importance of having layers of backups to the forefront. These discoveries led to major U.S. safety reforms like better operator training and NRC (Nuclear Regulatory Commission) oversight. Unlike Chernobyl, it is believed that Fukushima had virtually no lasting radiological impact in spite of the fact that ALPS Water is still being released and will be for the next 20 years. Nevertheless, many experts view nuclear power as safe when properly designed and managed.

In the early days after the Fukushima accident, it is believed that 137,368,400 gallons of untreated water contaminated with radionuclides was released into the Pacific Ocean. But there is good news. High cesium levels were seen in some fish species near Fukushima in 2011–2012 particularly bottom-feeders due to sediment uptake. However, concentrations decreased rapidly offshore due to ocean currents and dilution in the vast Pacific. By a few years post-accident, most seafood off northeast Japan was below safety limits, with no persistent widespread mortality. For the most part, it appears we dodged the Fukushima Pacific Ocean contam-ination bullet.

But there are roughly 10-15 Reactors at 6-8 sites that are or could be operational and have direct Atlantic (or Atlantic-connected) proximity with potential for Ocean contamination via cooling water or fallout pathways. And there are about 3 reactors (primarily Diablo Canyon's 2) with direct or high-risk Pacific contamination potential in a meltdown. The “about” qualifier has to do with whether the Reactors are or are not operational at any given time.

So we’re not out of the Radiation Releases Woods in the U.S. at this time, and given the new positive attitude regarding Nuclear Power as a viable source of energy for the U.S. and the World, we may never be.

If you haven’t met Aqui, our Aquaponics Emoji, yet, here he is to remind you that you can help solve the whole Marine Eco-systems Crises by growing your own Fish!

Thank You for Viewing

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