Marine pollution and environmental Issues in the Gulf of Thailand

2026 SEAFDEC Training Program (2026-05-19)

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What is Pollution?

Environmental pollution occurs when harmful substances or energy—like chemicals, waste, heat, noise, or radiation—are released into the environment faster than nature can safely break them down or make them harmless

Marine pollution occurs when harmful substances or energy—like chemicals, waste, heat, noise, or radiation—are released into the MARINE environment faster than nature can...

~80% of marine pollution comes ***from land-based sources***

https://www.britannica.com/science/pollution-environment

https://pngtree.com/freepng/pollution-of-gas-pollution-water-plant_3148580.html

http://static1.squarespace.com/static/55c9eab7e4b080aed53aafb2/t/55ebd9d8e4b08279fc0b8a03/1441520106932/?format=1500w

Where does pollution come from?

While natural events like forest fires or volcanoes can cause pollution, the term usually refers to pollution **caused by human activities**

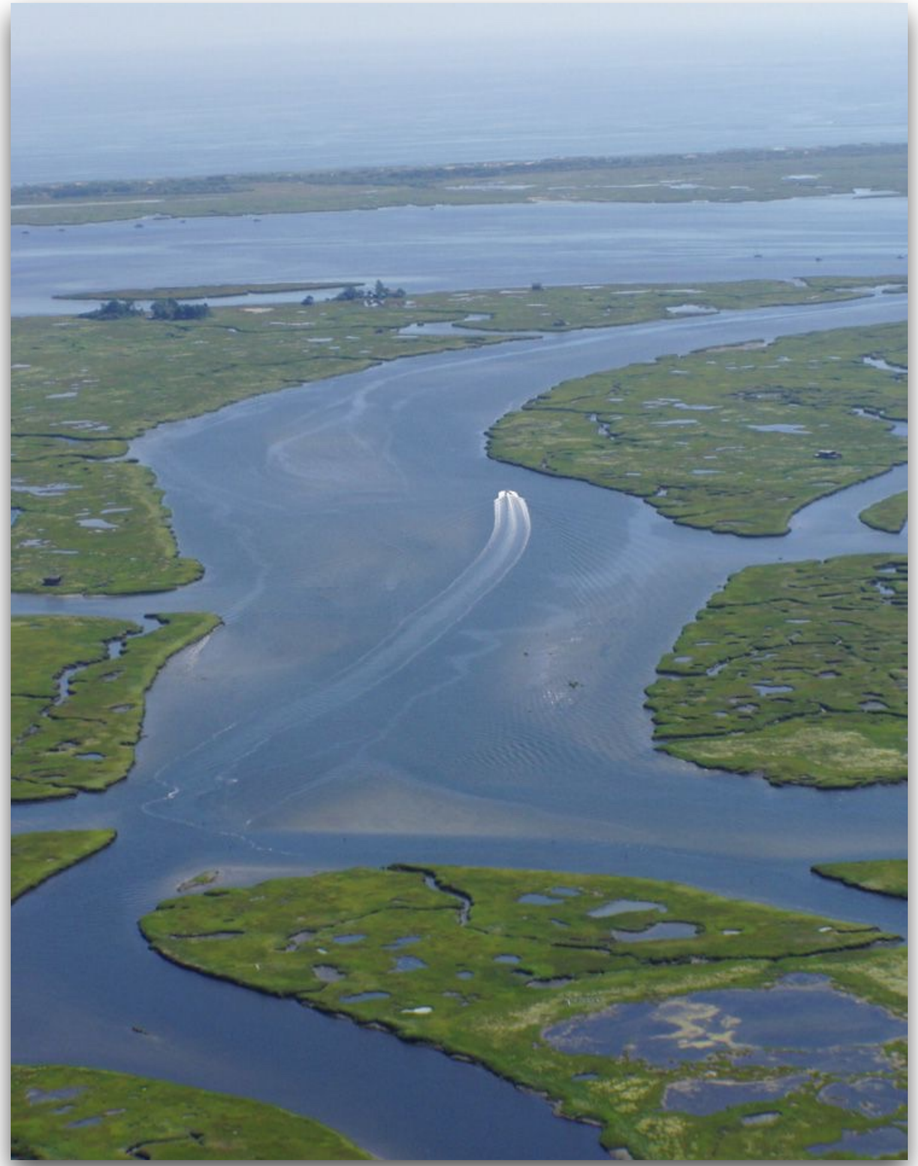
*pollution can be **visible** and it can be **invisible***

http://www.theplaidzebra.com/wp-content/uploads/2015/04/2_villagers-live-volcano.jpg

The Marine Environment

- **Oceans**
- **Estuaries**

An estuary is where a river or stream meets the ocean. Here, freshwater mixes with salty seawater, creating **brackish** water—which is less salty than ocean water but saltier than freshwater



https://www.nationalgeographic.org/encyclopedia/estuary/

Major sources of marine pollution

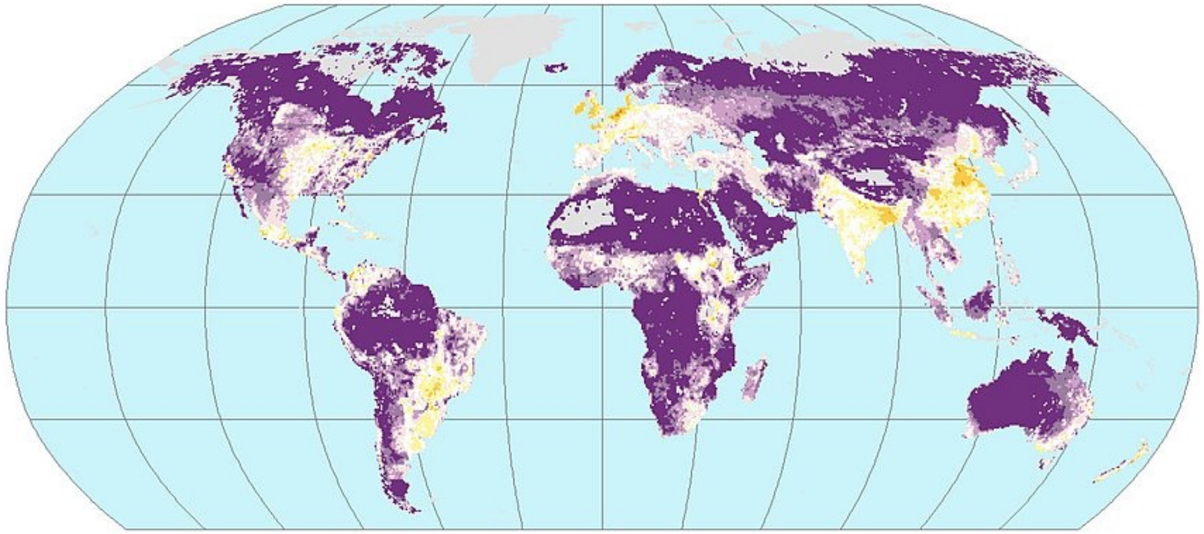
- Nutrients (Eutrophication)
- Marine Debris
- Oil & Related Chemicals
- Metals
- Pesticides and Industrial Organic Chemicals
- Emerging concerns
- Bioaccumulation & Biomagnification
- Climate Change & Ocean Acidification
- Biological Pollution

https://www.greenpeace.org/international/story/44923/oil-is-leaking-all-over-the-world/

https://1.bp.blogspot.com/-_FDct7fdcfM/VsMKlsbumZI/AAAAAAAAAK4/iBIQt1xQVWU/s1600/ocean%2Bpollution.jpg

Global Nitrogen Fertilizer Application

Global Fertilizer and Manure, Version 1



Robinson Projection

Amount of nitrogen fertilizer applied averaged over all crops within the 0.5 deg grid cell. Grid cell values are expressed in kilograms per hectare (kg/ha) ranging from 0 to 370. The data values were computed by fusing global maps of harvested areas for 175 crops with national information on fertilizer use for each crop.

Kg/ha of Nitrogen Fertilizer applied per grid cell:

Publication Date: 1/24/2011

Center for International Earth Science Information Network
EARTH INSTITUTE | COLUMBIA UNIVERSITY

Copyright 2011. The Trustees of Columbia University in the City of New York.
Source: Potter, P., and N. Ramankutty, et al. (2010). Global Fertilizer Application and Manure Production.
Data distributed by the NASA Socioeconomic Data and Applications Center (SEDAC): http://sedac.ciesin.columbia.edu/data/collection/fertilizer-and-manure

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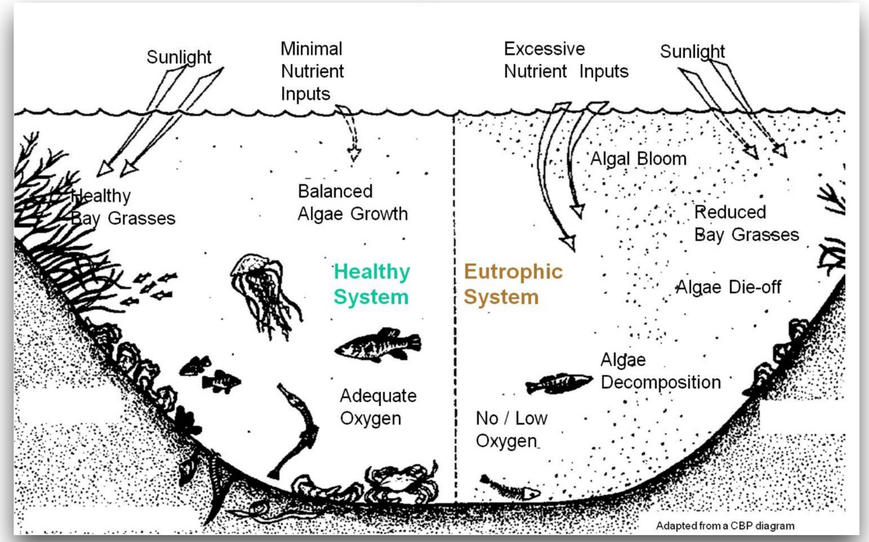
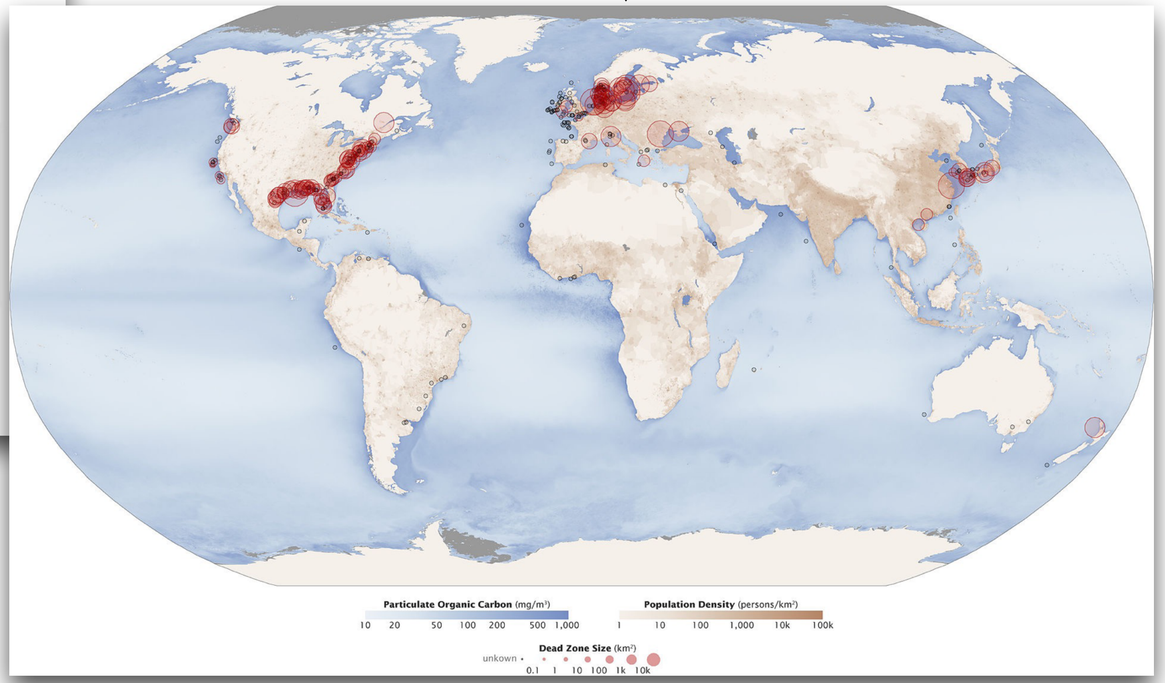
http://sedac.ciesin.columbia.edu/downloads/maps/ferman-v1/ferman-v1-nitrogen-fertilizer-application/nitrogen-fertilizer-global.jpg





https://gulfenvironmentnews.files.wordpress.com/2014/10/aquatic_dead_zones.jpg

NUTRIENT POLLUTION

https://www.dailypioneer.com/2019/trending-news/scientists-track-indian-ocean-s--missing--plastic-waste.html

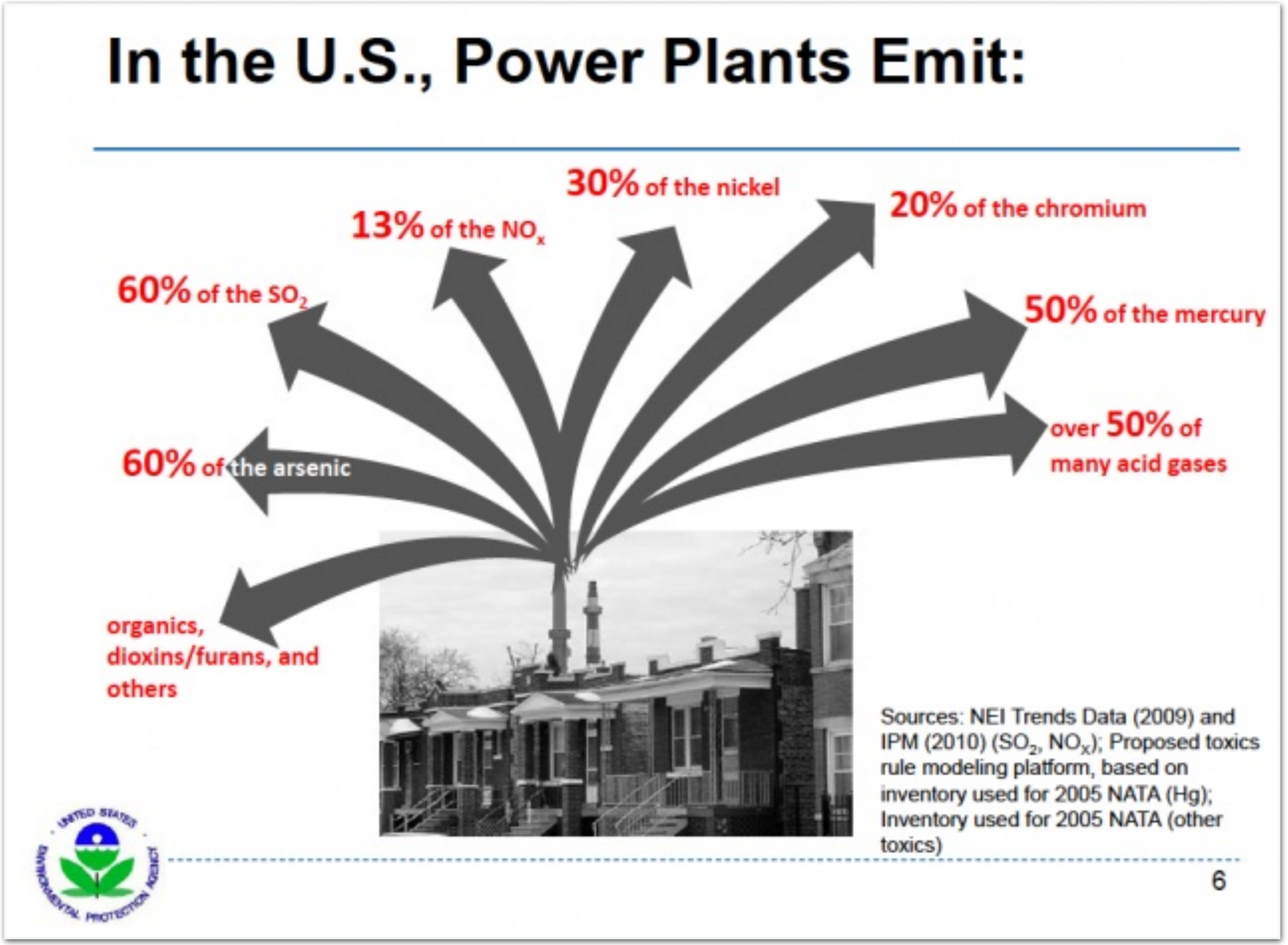
MARINE DEBRIS

https://oxfamblogs.org/fp2p/wp-content/uploads/2014/06/BP-oil-spill.jpg

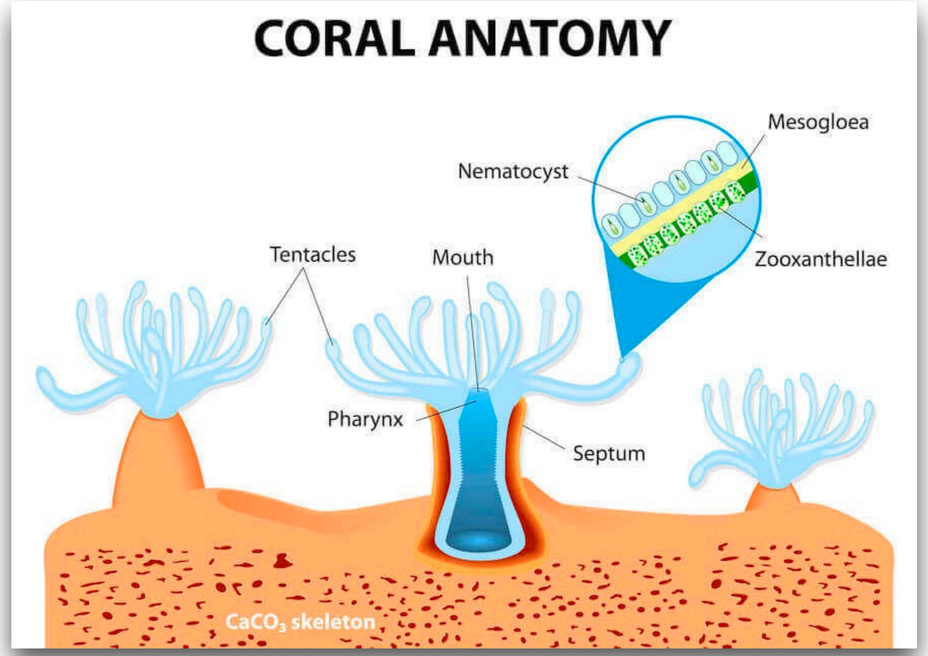
https://fortunedotcom.files.wordpress.com/2015/01/ap10060312648.jpg?quality=80

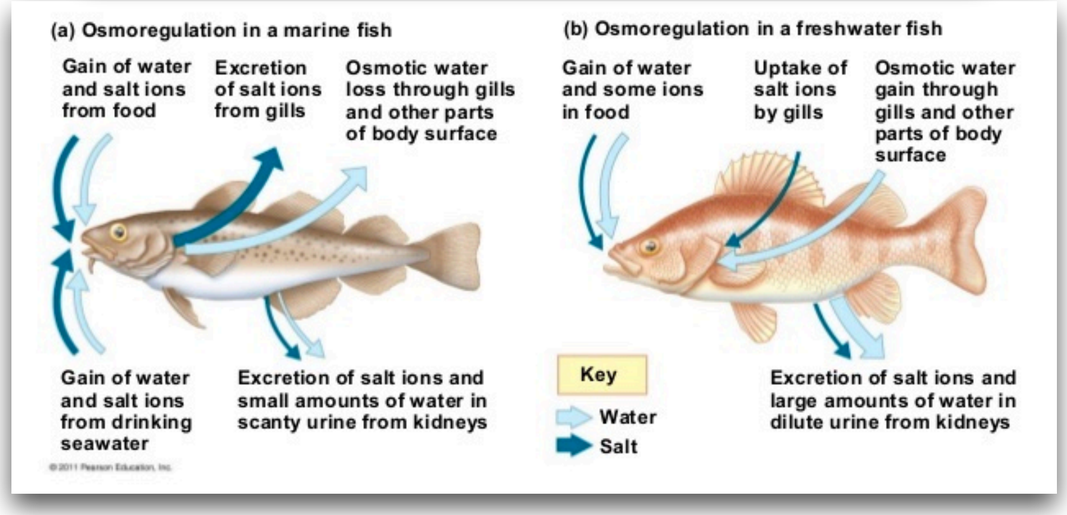
http://www.gannett-cdn.com/-mm-/a1059ca0bfe0aeb953c0a2a7e5690c5ed92b30f9/c=0-132-4746-2813&r=x1683&c=3200x1680/local/-/media/2015/05/21/USATODAY/USATODAY/635678380139028553-AP-California-Oil-Spill.3.jpg

OIL & RELATED CHEMICALS

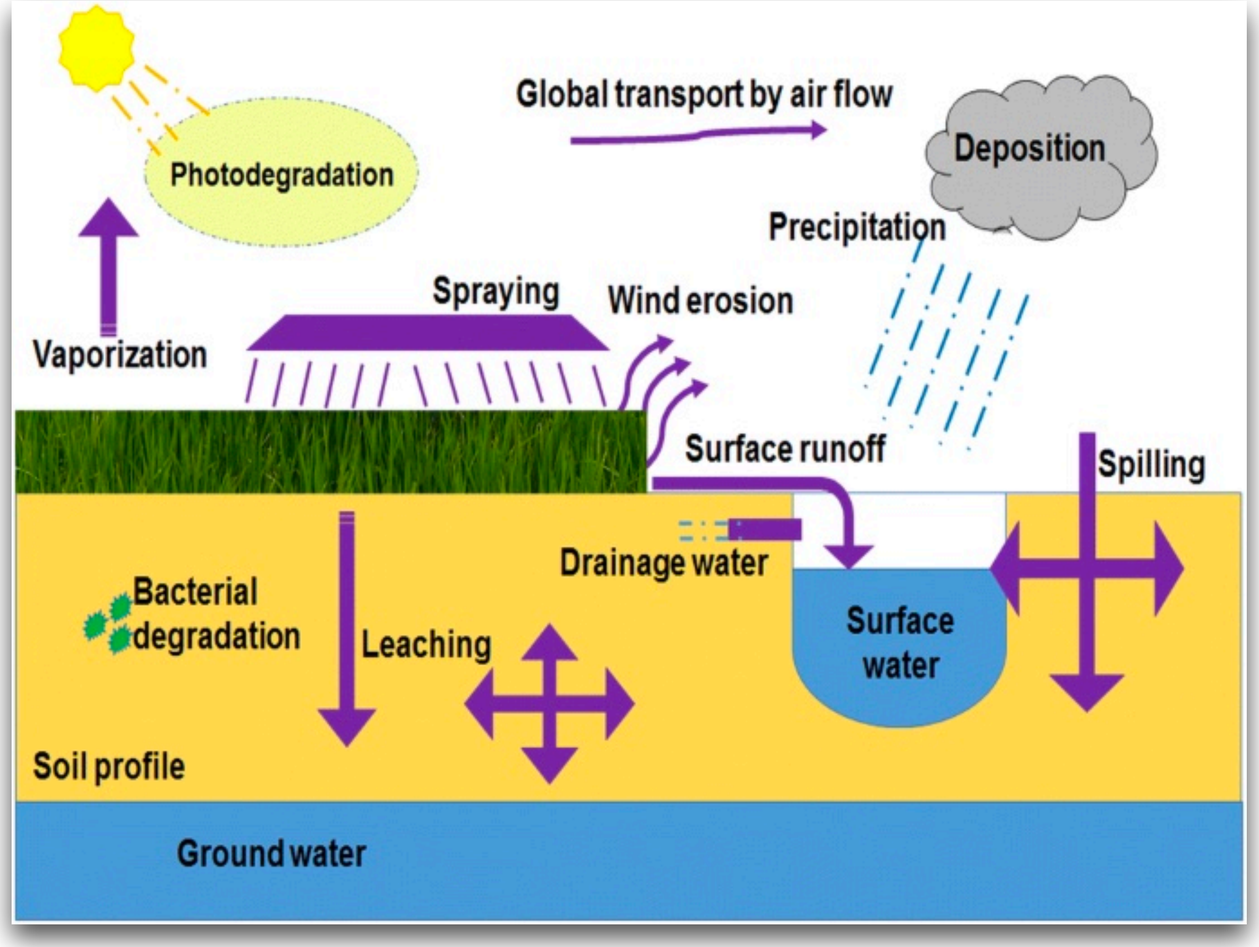


http://crooksandliars.com/files/imagecache/node_primary/primary_image/16/03/epa_power_plants.png





(HEAVY) METALS



PESTICIDES & INDUSTRIAL ORGANIC CHEMICALS

ASIA PACIFIC

The New York Times

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In the Pacific, Outcry Over Japan's Plan to Release Fukushima Wastewater

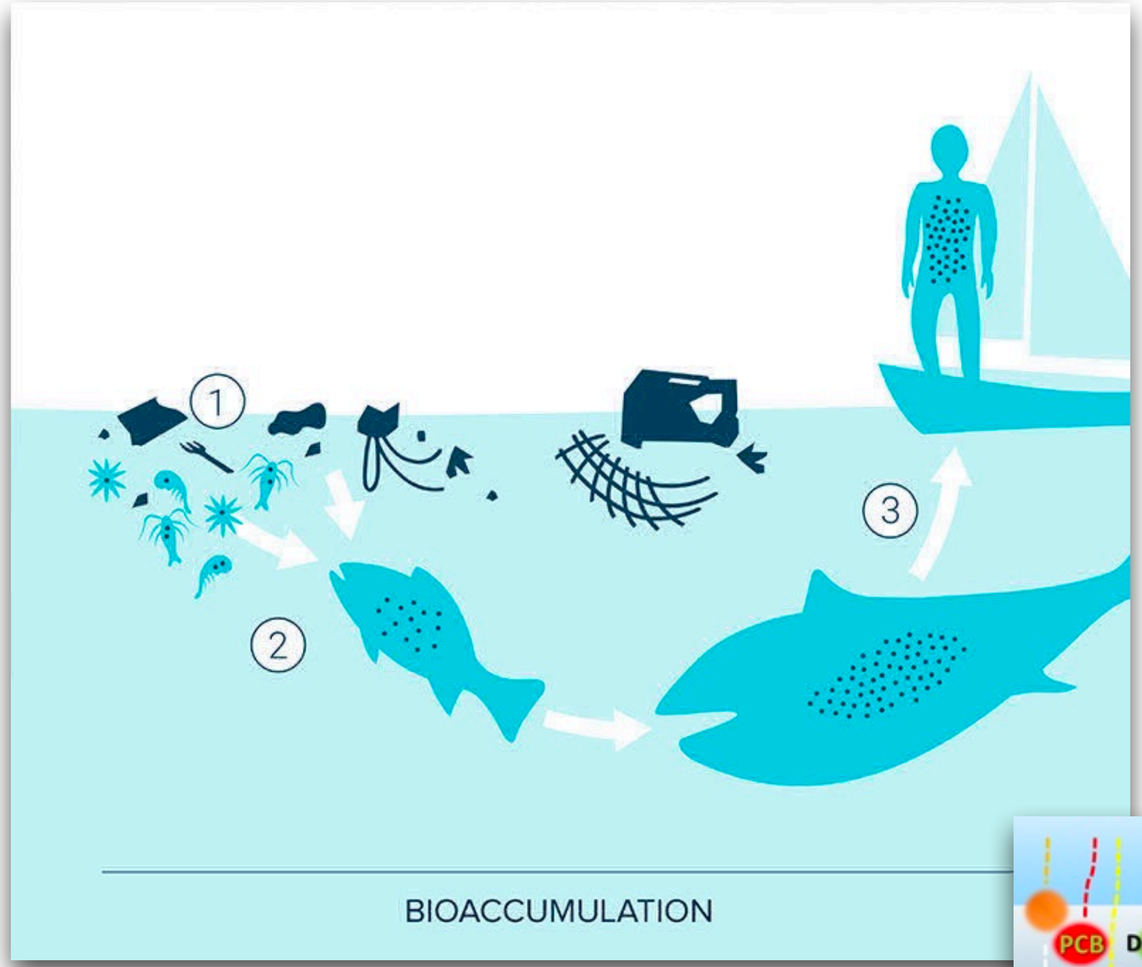
The proposal has angered many of Japan's neighbors, particularly those with the most direct experience of unexpected exposure to dangerous levels of radiation.

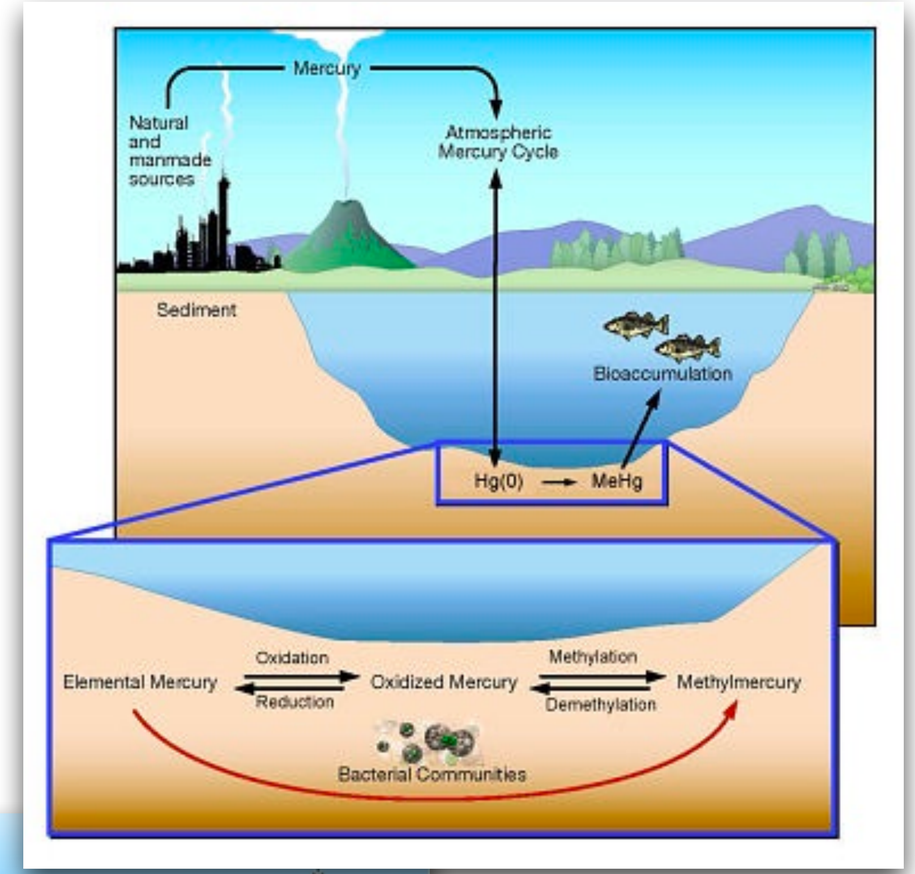
Give this article

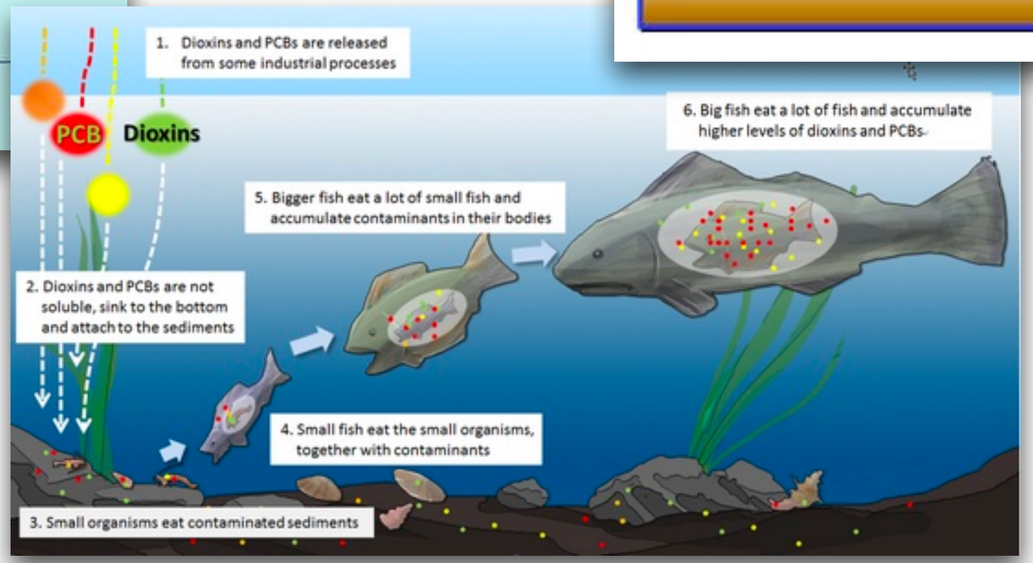
Tanks storing radioactive water at the Fukushima Daiichi nuclear power plant in Japan. The government plans to release the water, treated, but still slightly radioactive, into the Pacific starting in spring 2023. Ko Sasaki for The New York Times

By Pete McKenzie
Dec. 30, 2022

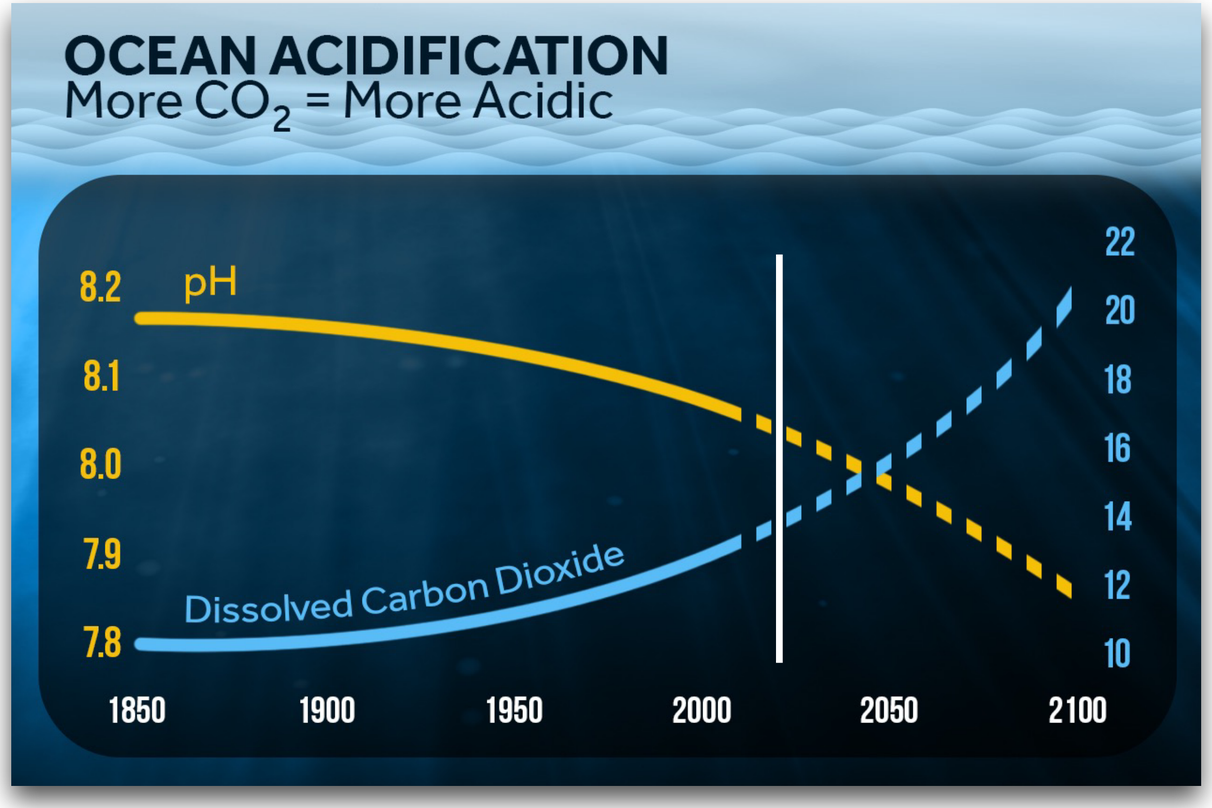
EMERGING CONCERNS



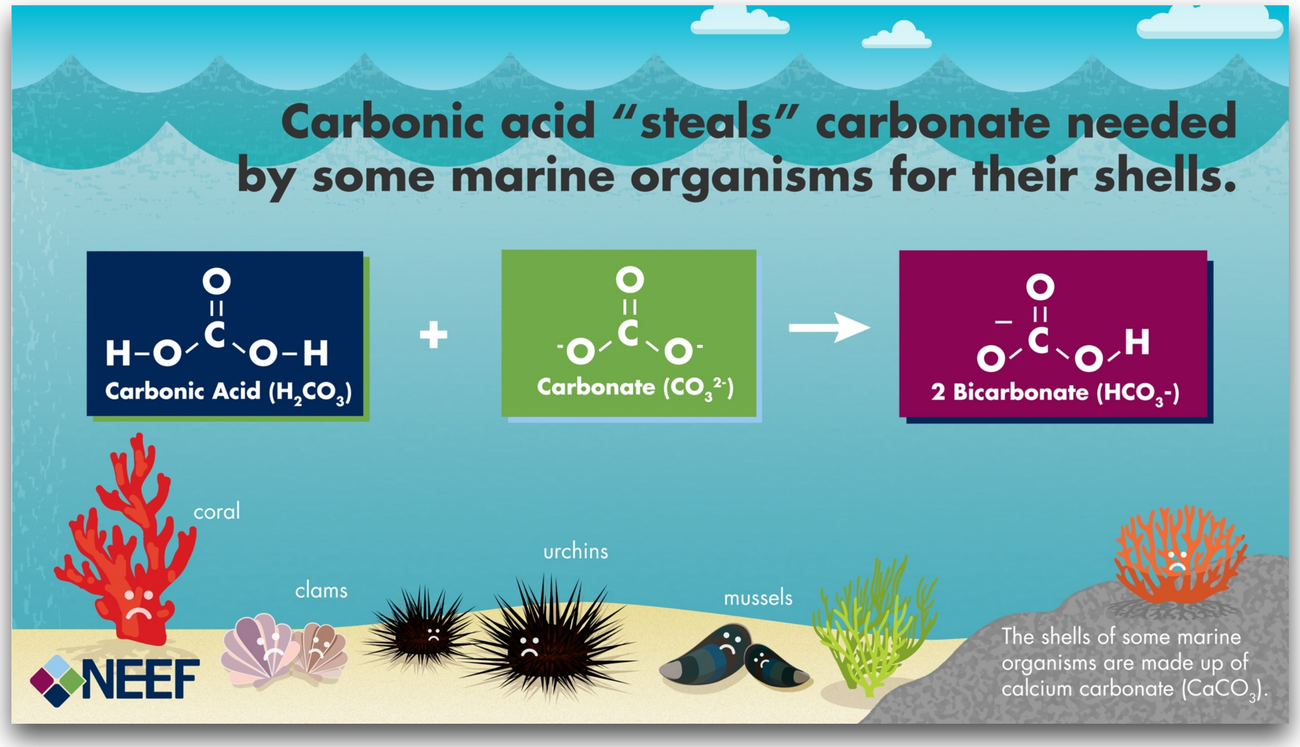




BIOACCUMULATION & BIOMAGNIFICATION



http://ccimgs.s3.amazonaws.com/2015OceanAcidification/2015OceanAcidification_CO2Graph.jpg



https://www.epa.gov/sites/production/files/2016-11/ocean_acidification_2.jpg

CLIMATE CHANGE & OCEAN ACIDIFICATION

http://mediad.publicbroadcasting.net/p/northwestnews/files/styles/x_large/public/201405/052914TB_TsunamiDebris.jpg

BIOLOGICAL POLLUTION

Why do we need healthy marine ecosystems? (1)

Coastal habitats account for ~30% of all marine biological productivity

Estuarine systems—like salt marshes, seagrass beds, and mangrove forests—are among the most productive ecosystems on Earth

https://natgeoeducationblog.files.wordpress.com/2016/10/belize-mangroves.jpg?w=1200

Why do we need healthy marine ecosystems? (2)

Some marine ecosystems, like coral reefs, support the highest variety of ocean life by providing **food** and **shelter**

The ocean also plays a vital role in the **cycling** of carbon, nitrogen, phosphorus, and other key **nutrients**

https://media.nationalgeographic.org/assets/photos/000/289/28979_r646x485.jpg?6f324ede0d87396ce502b4d0ba86a86f23ea2d88

Declining health of our marine ecosystems (1)

Human activities have **changed ocean chemistry** in both coastal areas and the open sea

These changes—especially in carbon, nitrogen, and oxygen levels—**affect how marine life functions**

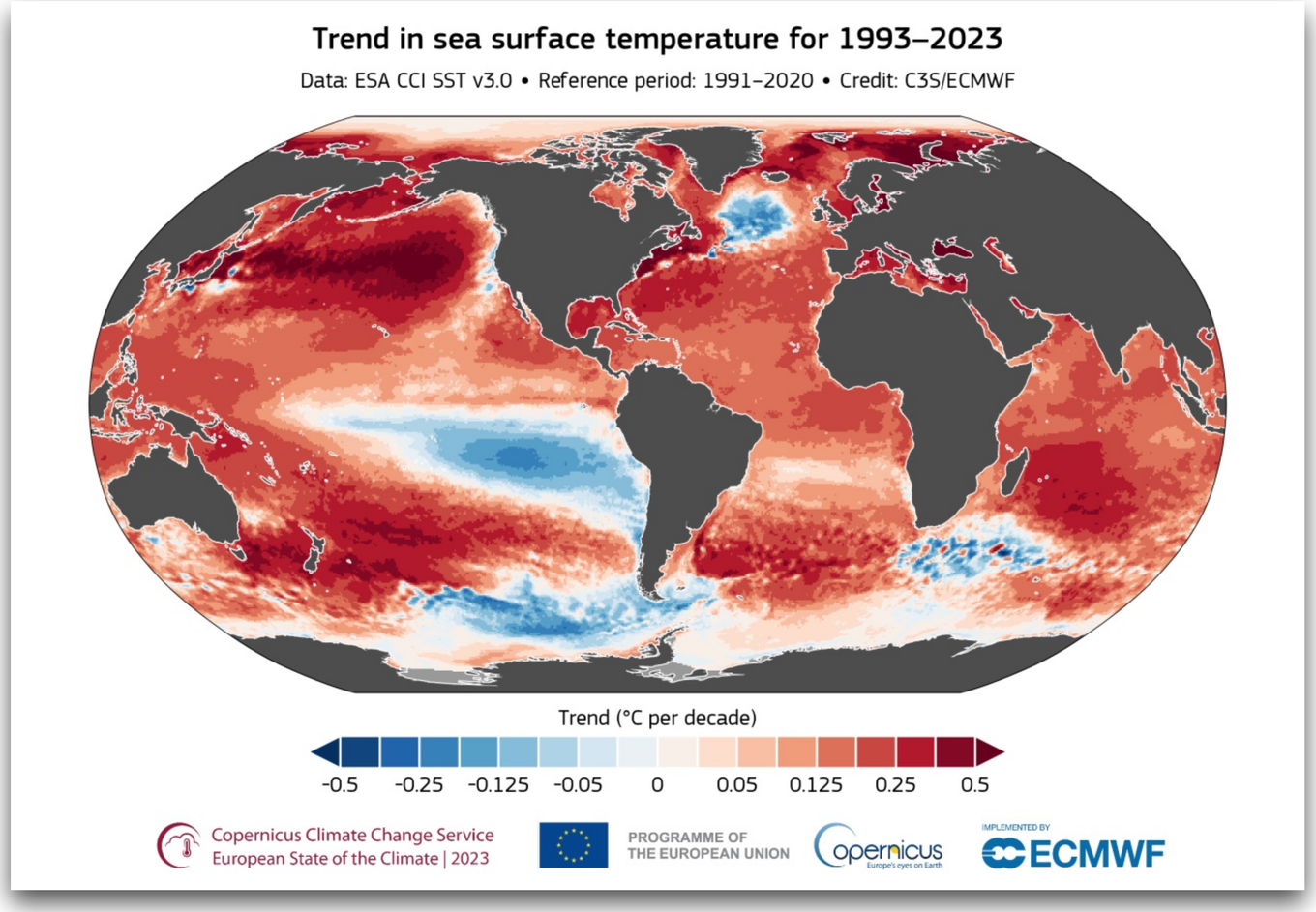
Years of pollution, habitat destruction, and overfishing have severely **harmed ocean biodiversity and ecosystems**

https://draggarwal.files.wordpress.com/2012/05/582323-26.jpg?w=604

Declining health of our marine ecosystems (2)

Rising global demand for seafood has reduced many fish populations and hurt the economies of some coastal communities

At the same time, **climate change** is affecting the oceans in ways we are only starting to understand



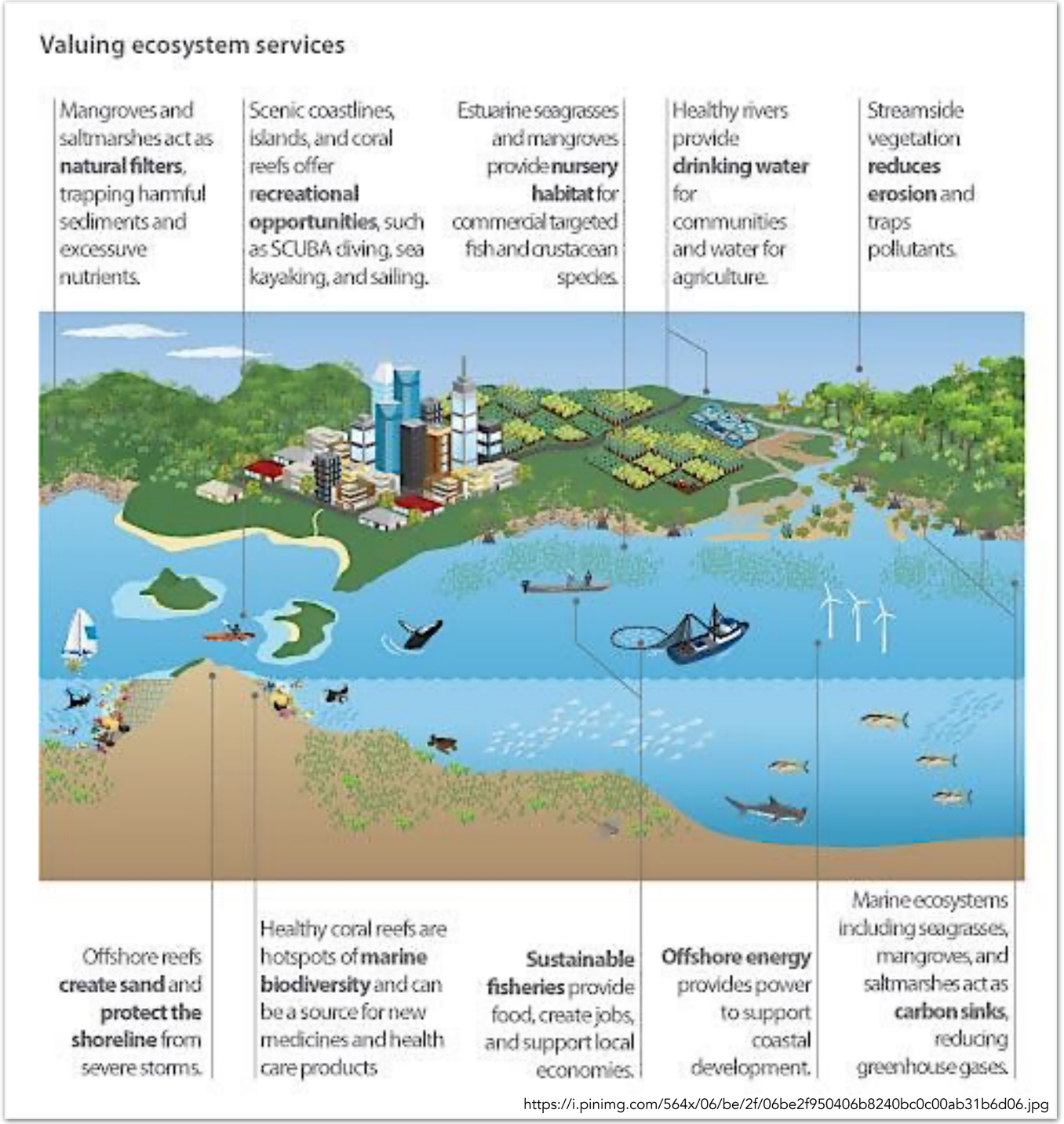
Declining health of our marine ecosystems (3)

The most harmful pollutants are those that spread everywhere, stay in nature for a long time, build up inside living things, and can cause damage even in very small amounts.

http://www.seychellesnewsagency.com/media/images/2017-02/photo_verybig_6788.jpg

Ecosystem services

Ecosystem services are the benefits people get for free from nature and healthy ecosystems



https://i.pinimg.com/564x/06/be/2f/06be2f950406b8240bc0c00ab31b6d06.jpg

No ocean, no life.

No ocean, no us.

Sylvia Earle

Environmental & Marine Pollution Issues in Thailand

The Gulf of Thailand

The Gulf of Thailand is one of 21 enclosed coastal seas recognized by the International EMECS Center

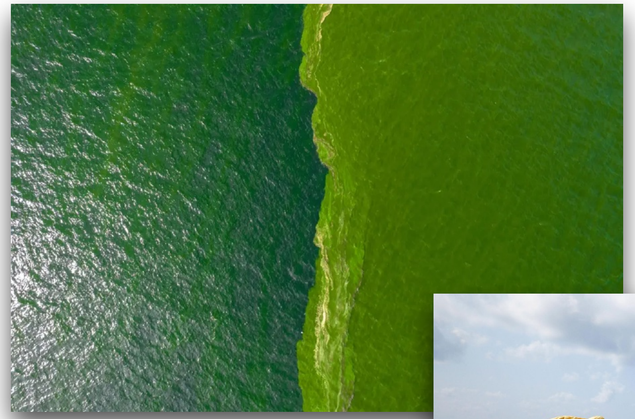
It is located in Southeast Asia, just west of the South China Sea, and is bordered by Thailand, Cambodia, Malaysia, and Vietnam

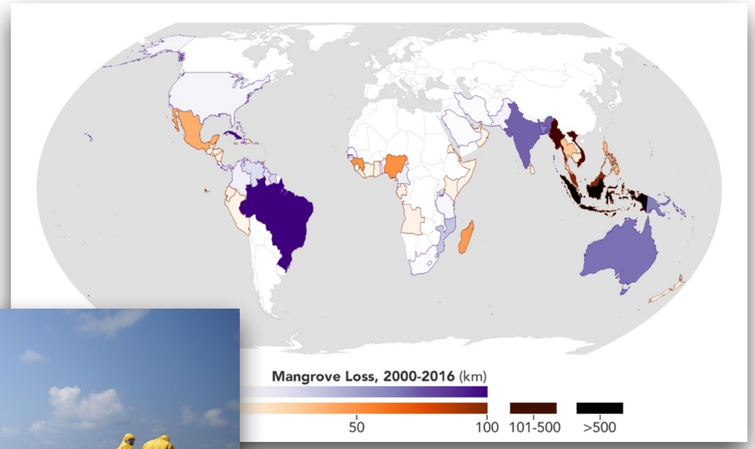
Millions of people rely on the gulf's fish and marine resources for their livelihoods, and many more are affected by changes in its environment

https://www.google.com/maps/place/Gulf+of+Thailand/@9.00953,97.8254186,6z/data=!4m6!3m5!1s0x30556d048276d88f:0x2a0223bc562eaf80!8m2!3d9.7121198!4d101.3431058!16zL20vMDFjNGR6?entry=ttu

Major Environmental & Marine Pollution Issues

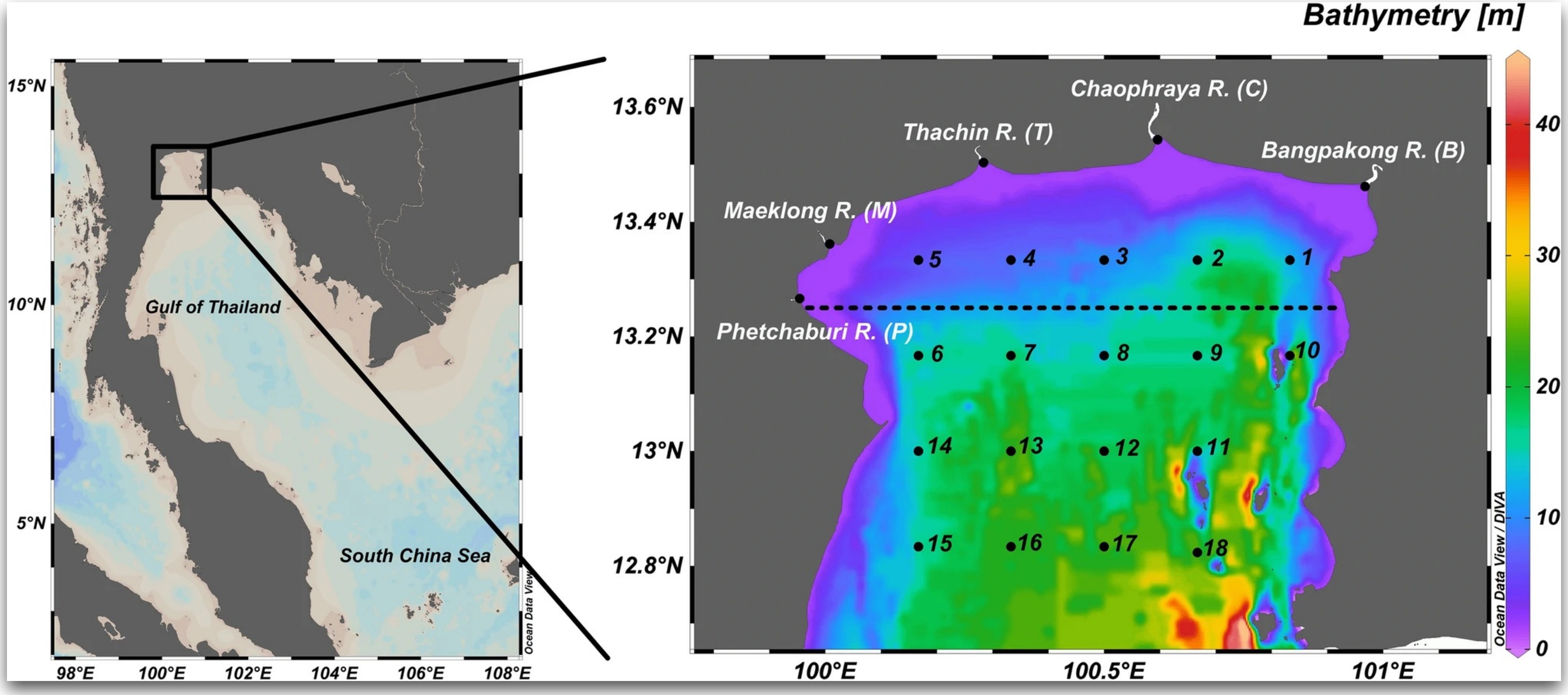
1. Nutrient / Eutrophication
2. Mangrove conversion and destruction
3. Persistent Chemicals
4. Coastal Erosion
5. Marine Litter (Debris)





https://www.nasa.gov/centers-and-facilities/goddard/nasa-study-maps-the-roots-of-global-mangrove-loss/

Gulf of Thailand (Inner Gulf)



https://link.springer.com/article/10.1007/s10872-021-00609-2

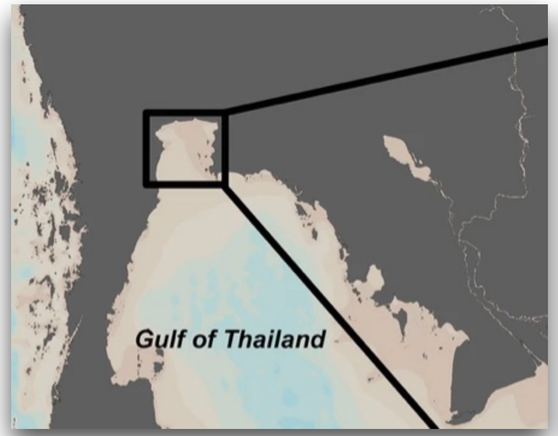
1. Nutrient / Eutrophication

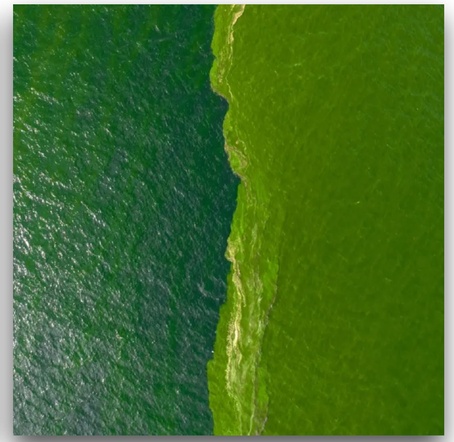
Among the rivers flowing into the Gulf of Thailand, the **Chao Phraya is the most polluted**, especially near its estuary, because of growing cities and industries

The main pollutants are **organic wastes** that increase oxygen use, bring harmful bacteria, make the water cloudy, and add too many nutrients (causing eutrophication)

Since the upper gulf is partly closed off, these wastes tend to **stay and build up**

Breaking down the organic waste can quickly lead to **harmful algal blooms**, like red or brown tides





Plankton infests Rayong beach waters

PUBLISHED : 4 OCT 2022 AT 06:00
NEWSPAPER SECTION: NEWS WRITER: APINYA WIPATAYOTIN

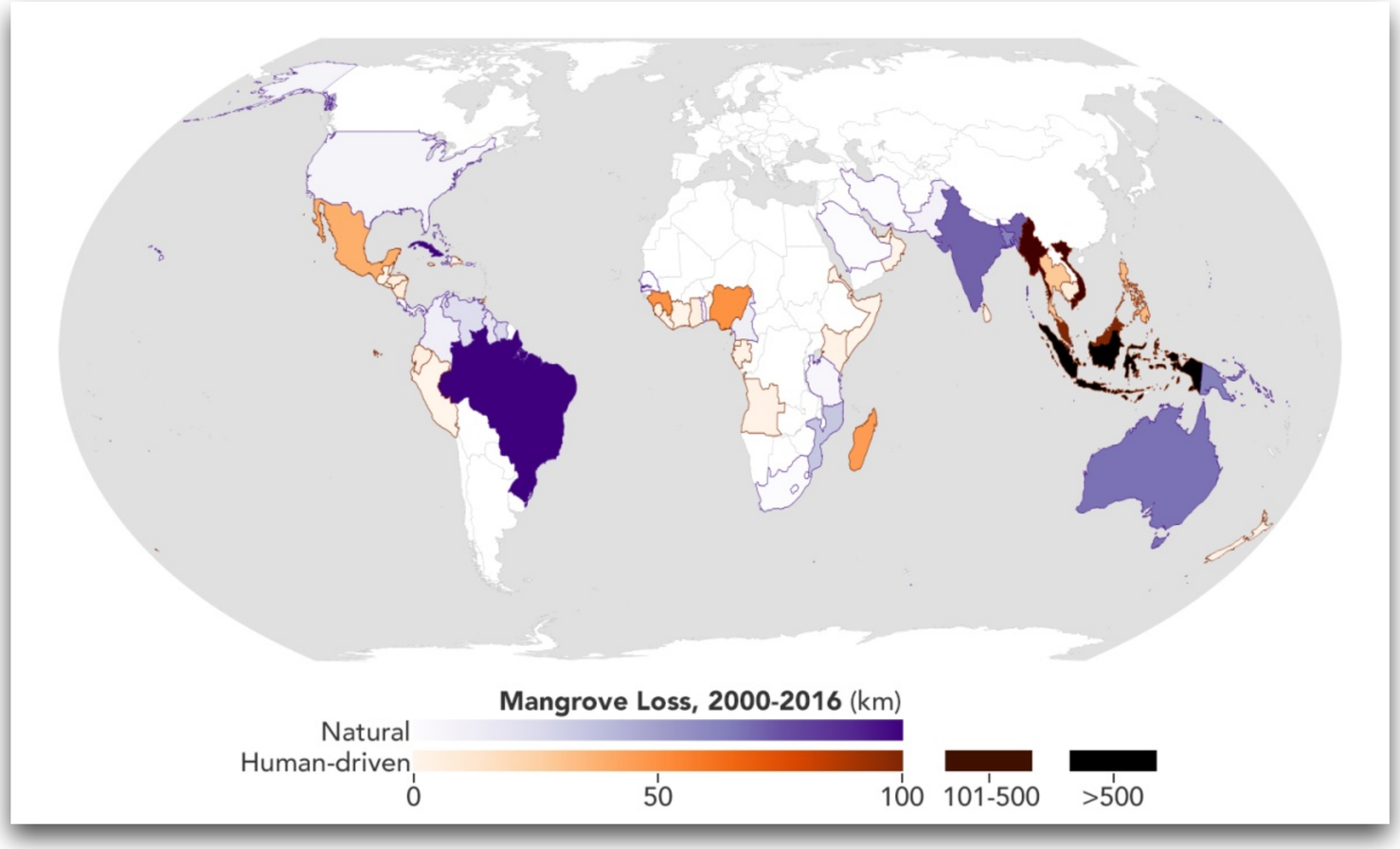
Algal bloom is seen along a 3-km stretch of the coast in Rayong, emitting a foul odour. (Photo by Department of Marine and Coastal Resources)

2. Mangrove conversion and destruction

Mangrove areas **are being changed into** rice fields, coconut farms, fish and shrimp ponds, salt ponds, cities, landfills, and factories

Mangroves are also being **overused** for timber, firewood, and charcoal

There is **not enough effort** to help mangroves grow back after they are cut down



https://www.nasa.gov/centers-and-facilities/goddard/nasa-study-maps-the-roots-of-global-mangrove-loss/

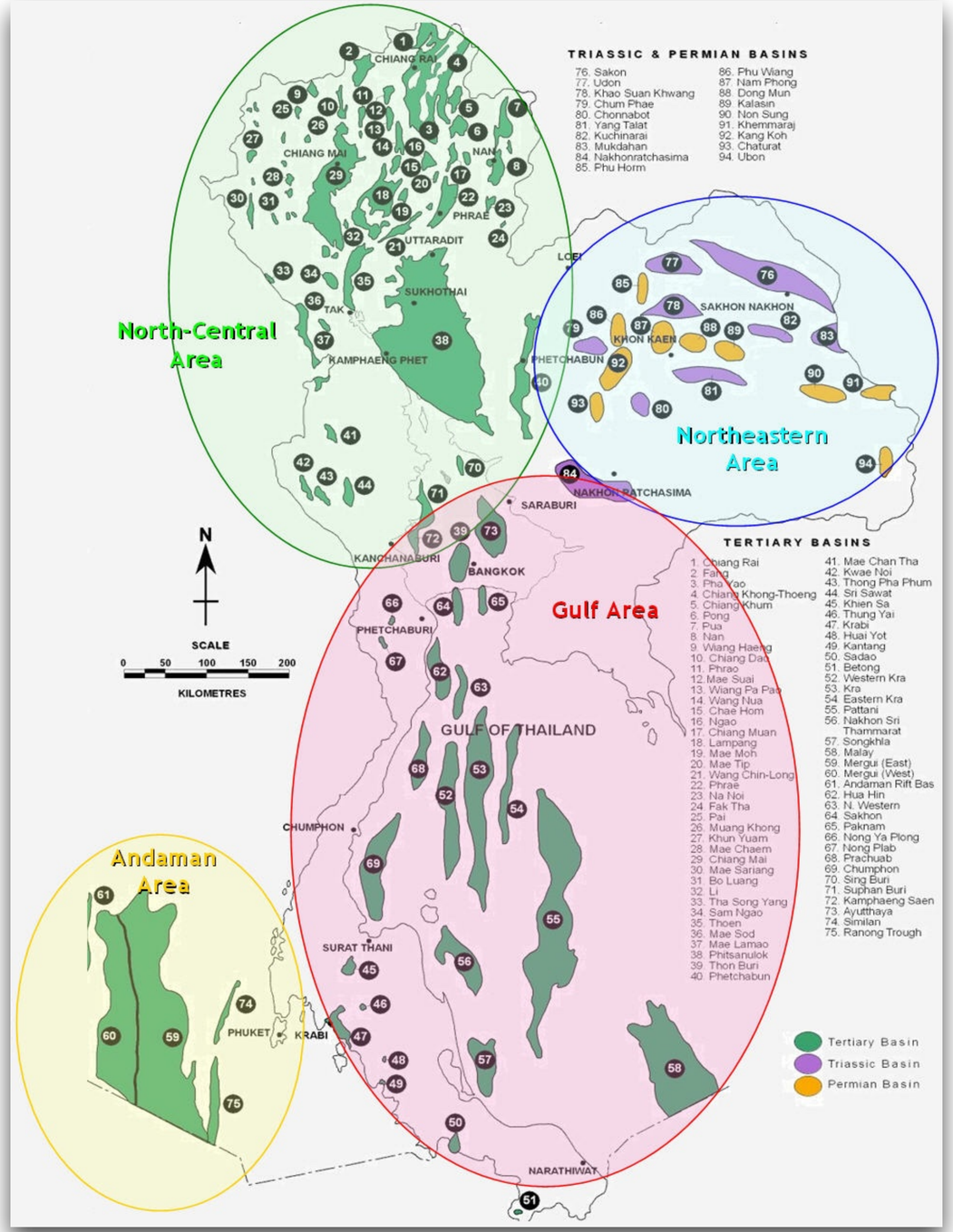
3. Persistent Chemicals

Thailand produces oil and natural gas, mostly from offshore fields in the Gulf of Thailand

Oil spills and other pollution often happen along shipping routes and near oil company operations, especially in the Gulf

Since 1974, there have been at least 240 oil spills in Thai waters

https://www.greenpeace.org/southeastasia/story/45124/thailands-oil-pollution-at-sea-the-fossil-fuel-industrys-liability/



https://www.dmf.go.th/bid20/images/001.jpg

4. Coastal Erosion

Thailand has over 3,000 km of coastline across 23 provinces, and more than **800 km of it is being damaged by sea erosion**

Some of this erosion is caused by **human activities** like building on the coast, turning mangroves into shrimp farms, industrial growth, and actions that lower the land, such as pumping water or digging soil

Natural forces like waves, strong tides, and storms also cause erosion

Solving the Problems of Erosion on the Thai Coast

https://www.huahintoday.com/thailand-news/solving-the-problems-of-erosion-on-the-thai-coast/

5. Marine Litter (Debris)

Marine debris **affects ecosystems, fishing, aquaculture, human health, and food safety**

Many marine animals like mammals, reptiles, and birds get tangled in or eat this debris, causing **injuries and often death**

Debris also **collects in shallow coral reefs**, carried by winds and tides, which damages the reefs

https://www.thailand.go.th/issue-focus-detail/001_04_027

https://news.cornell.edu/stories/2018/01/oceanic-plastic-trash-conveys-disease-coral-reefs

Marine Litter (Debris)

Thailand is ranked as the sixth largest source of marine debris in the world

Many types of trash are found along its coastlines, often linked to local economic activities

Most of the debris includes plastic bottles, caps, lids, food and drink containers, rubber bands, and cigarette butts

https://southeastasiaglobe.com/saving-koh-samui/

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Microplastic contamination in edible marine fishes from the upper Gulf of Thailand

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Exposure assessment
Health impacts

ABSTRACT

Seafood consumption is a major source of microplastic exposure for humans. Here, we demonstrated microplastic contamination in marine food fishes from the upper Gulf of Thailand. Microplastics were found in gastrointestinal tracts of 46.9 % of fishes sampled, with a mean concentration of 1.6 ± 0.5 pieces per fish or 0.04 ± 0.01 pieces/g of fish tissue. Demersal fishes had higher contamination rates than pelagic fishes. Fibrous-type and blue-colored materials were the most abundant microplastics, while the most common polymers were polyester and polyethylene. No associations between microplastics and histopathological changes were detected. Estimated daily microplastic exposure for human marine fish consumers was 0.03 to 0.1 pieces per person. Although we expect a low risk of microplastic contamination in fish muscle because of very low calculated transfer rates, we recommend continuing surveillance, including evaluations of contamination in the food chain to ensure future seafood safety in this region.

ABSTRACT

Seafood consumption is a major source of microplastic exposure for humans. Here, we demonstrated microplastic contamination in marine food fishes from the upper Gulf of Thailand. Microplastics were found in gastrointestinal tracts of 46.9 % of fishes sampled, with a mean concentration of 1.6 ± 0.5 pieces per fish or 0.04 ± 0.01 pieces/g of fish tissue. Demersal fishes had higher contamination rates than pelagic fishes. Fibrous-type and blue-colored materials were the most abundant microplastics, while the most common polymers were polyester and polyethylene. No associations between microplastics and histopathological changes were detected. Estimated daily microplastic exposure for human marine fish consumers was 0.03 to 0.1 pieces per person. Although we expect a low risk of microplastic contamination in fish muscle because of very low calculated transfer rates, we recommend continuing surveillance, including evaluations of contamination in the food chain to ensure future seafood safety in this region.

2022). Most virgin microplastics are chemically inert and cause little direct chemical harm to fishes (Jovanović, 2017; Jovanovic et al., 2018), such as causing increased oxidative stresses in shrimp by polyethylene

fish than plastics or contaminants alone. These effects included alteration of liver gene expression and hepatic vacuolation. As a spillover effect, toxicity and accumulation of these contaminants in fish may be

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E-mail address: thanida.h@chula.ac.th (T. Haetrakul).

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https://www.sciencedirect.com/science/article/pii/S0025326X23012201?via%3Dihub

Microplastics

In Thailand, plastic use grows by about 7–8% each year

On average, each person uses around eight plastic bags daily, adding up to about 200 billion bags every year

Dangers of Microplastics

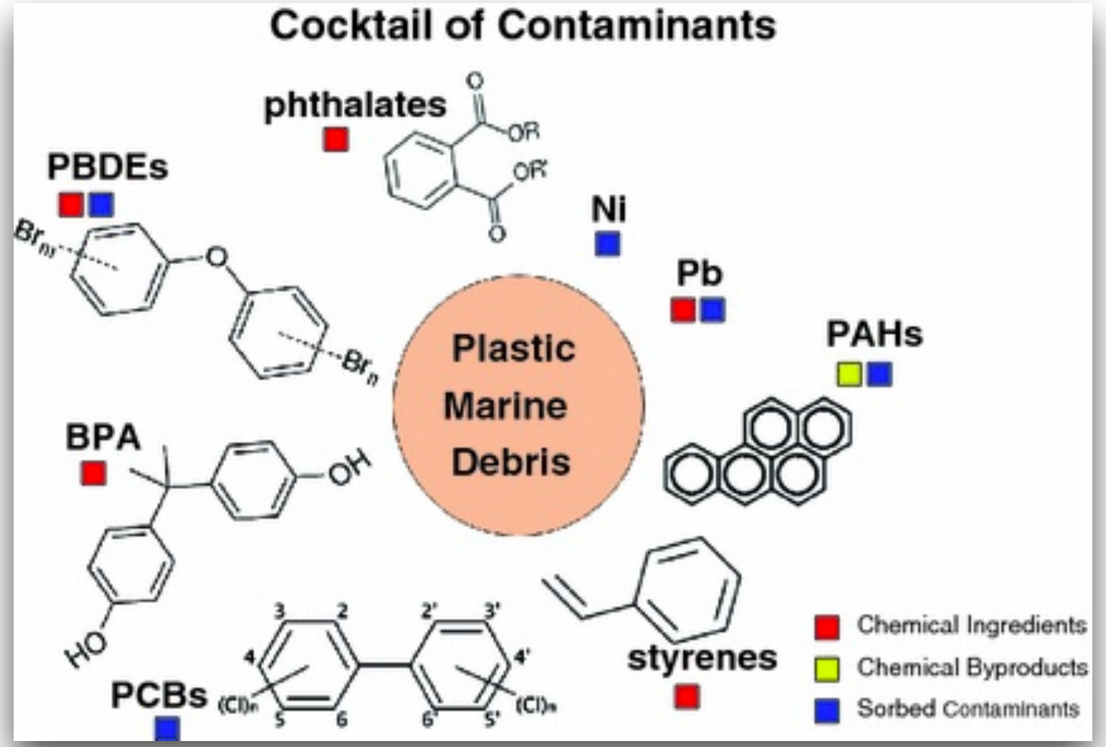
Microplastics can hold **harmful chemicals** called POPs

These toxins can enter **the food chain and cause problems** like reproductive issues and behaviour changes in marine animals

All sea turtle species, 45% of marine mammals, and 21% of sea birds have been affected by marine debris.

A study of microplastics in the North Pacific found that 50% contained PCBs, 40% had pesticides, and 80% had PAHs

"Persistent Organic Pollutants (POPs), Polychlorinated Biphenyls (PCBs), Polycyclic Aromatic Hydrocarbons (PAHs)



Marine plastic debris carries a mix of contaminants. These include chemicals used in making the plastics (red squares), byproducts from manufacturing (yellow squares), and pollutants picked up from the ocean water around them (blue squares)."

https://link.springer.com/chapter/10.1007/978-3-319-16510-3_5

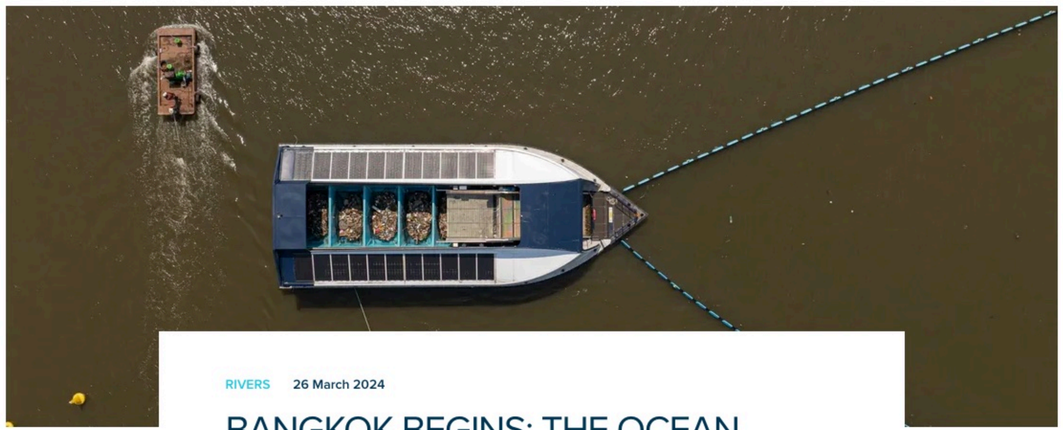
What can be done about this pollution?

1. Eutrophication
2. Mangrove conversion and destruction
3. Persistent Chemicals
4. Coastal Erosion
5. Marine Litter (Debris)

About 80% of plastic litter comes from land

It reaches the ocean through rivers, drains, storm runoff, factories, beachgoers, poor waste management, and illegal dumping

The main reasons are: (1) lack of political will to make changes, (2) **poor waste management systems**, and (3) not enough responsibility taken by both public and private sectors to reduce plastic waste



RIVERS 26 March 2024

BANGKOK BEGINS: THE OCEAN CLEANUP'S INTERCEPTOR 019 COMES TO THAILAND

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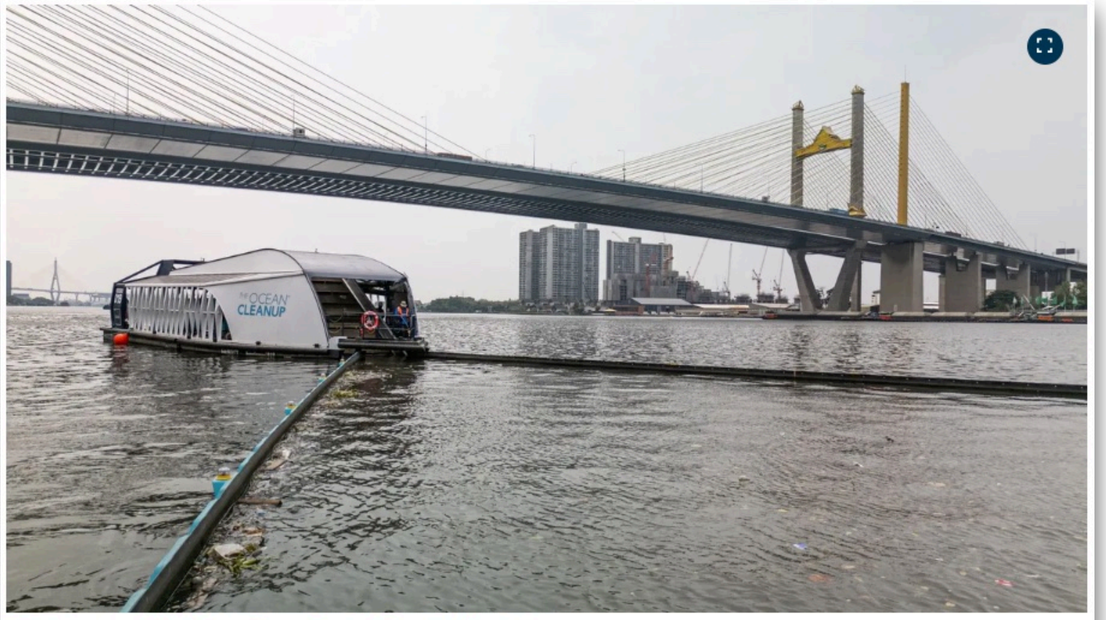
Interceptor 019 in Chao Phraya River in Bangkok, Thailand.



Interceptor 019 in Chao Phraya River in Bangkok, Thailand.

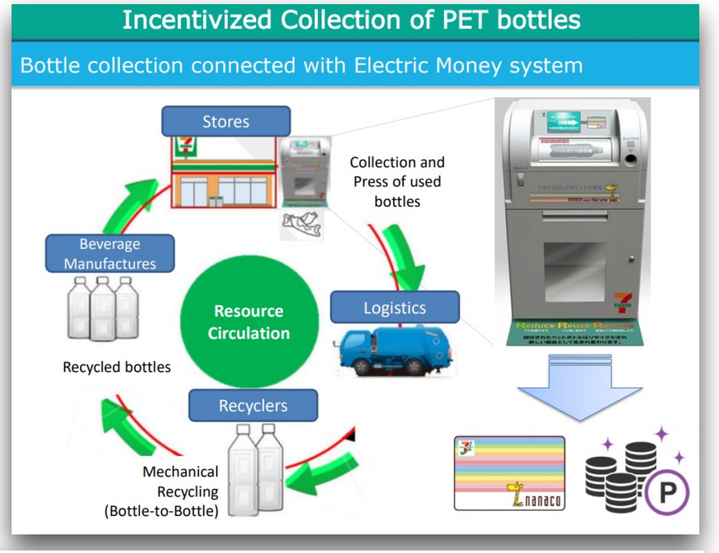
https://theoceancleanup.com/updates/bangkok-begins-the-ocean-cleanups-interceptor-019-comes-to-thailand/

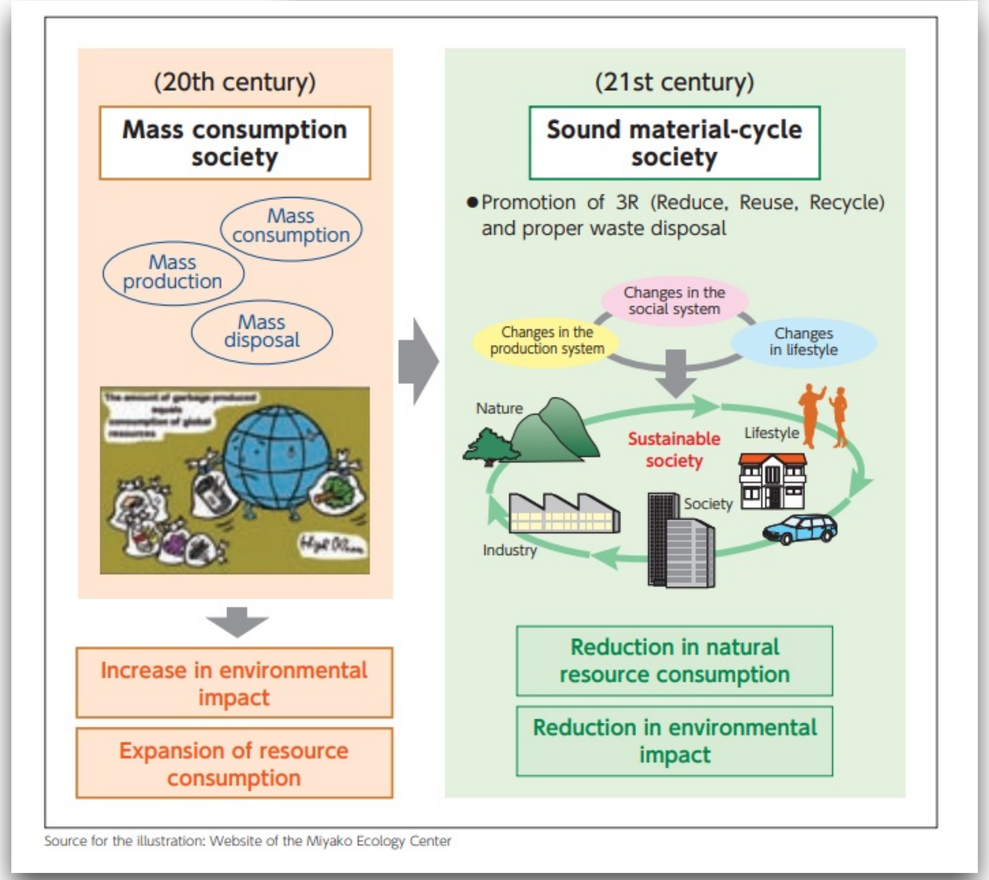
Could Thailand learn from Japan??

- **Japan is also high-producing plastic country, but its successful waste management system has kept plastic discharge into marine environments relatively low**. By contrast 80% of Thailand's marine plastic pollution is linked to land-based waste that is inefficiently managed

- **There is currently no civic culture** to support the sorting and cleaning of plastic waste. The head of the Thai Plastic Club lamented that 'if Thais were taught properly like the Germans and Japanese, they would separate and clean their waste

- Unlike Japan, the **Thai government does not have a coordinating national-level waste management agency**





Source for the illustration: Website of the Miyako Ecology Center

How about Japan?

Japan faces three primary marine pollution crises:

1. pervasive **plastic and microplastic contamination**,
2. the transboundary drift of **debris**,
3. **radioactive wastewater** management.

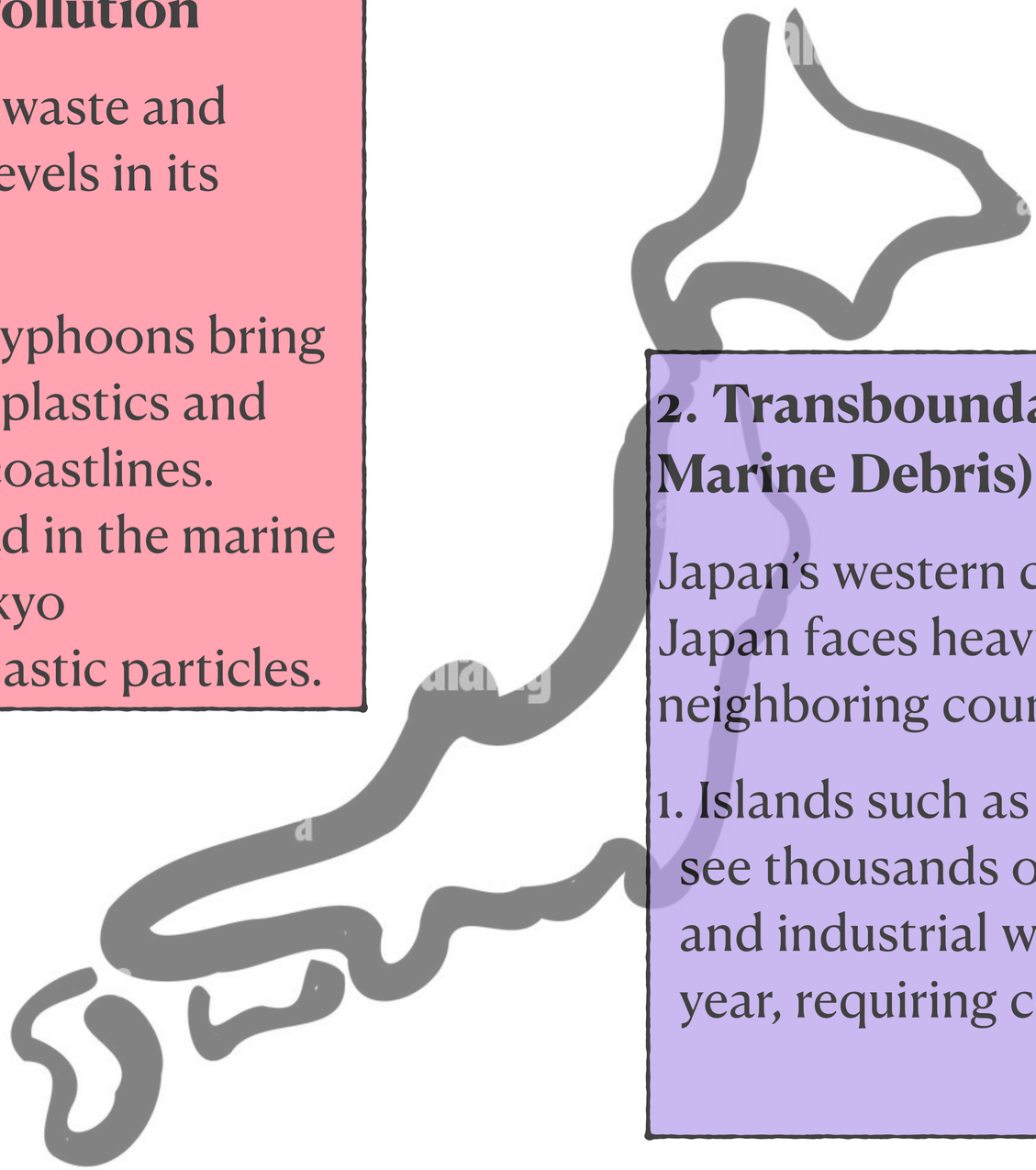
Additionally, two secondary issues:

4. **legacy industrial pollutants** like heavy metals, and PCBs, and
5. **coastal eutrophication** continue to pose localized threats to the marine ecosystem.

1. Plastic and Microplastic Pollution

Japan produces a lot of plastic waste and suffers from high microplastic levels in its waters.

1. The Kuroshio Current and typhoons bring large amounts of single-use plastics and abandoned fishing gear to coastlines. Microplastics are widespread in the marine food chain, with 80% of Tokyo Bay anchovies containing plastic particles.



2. Transboundary Waste (Drifted Marine Debris)

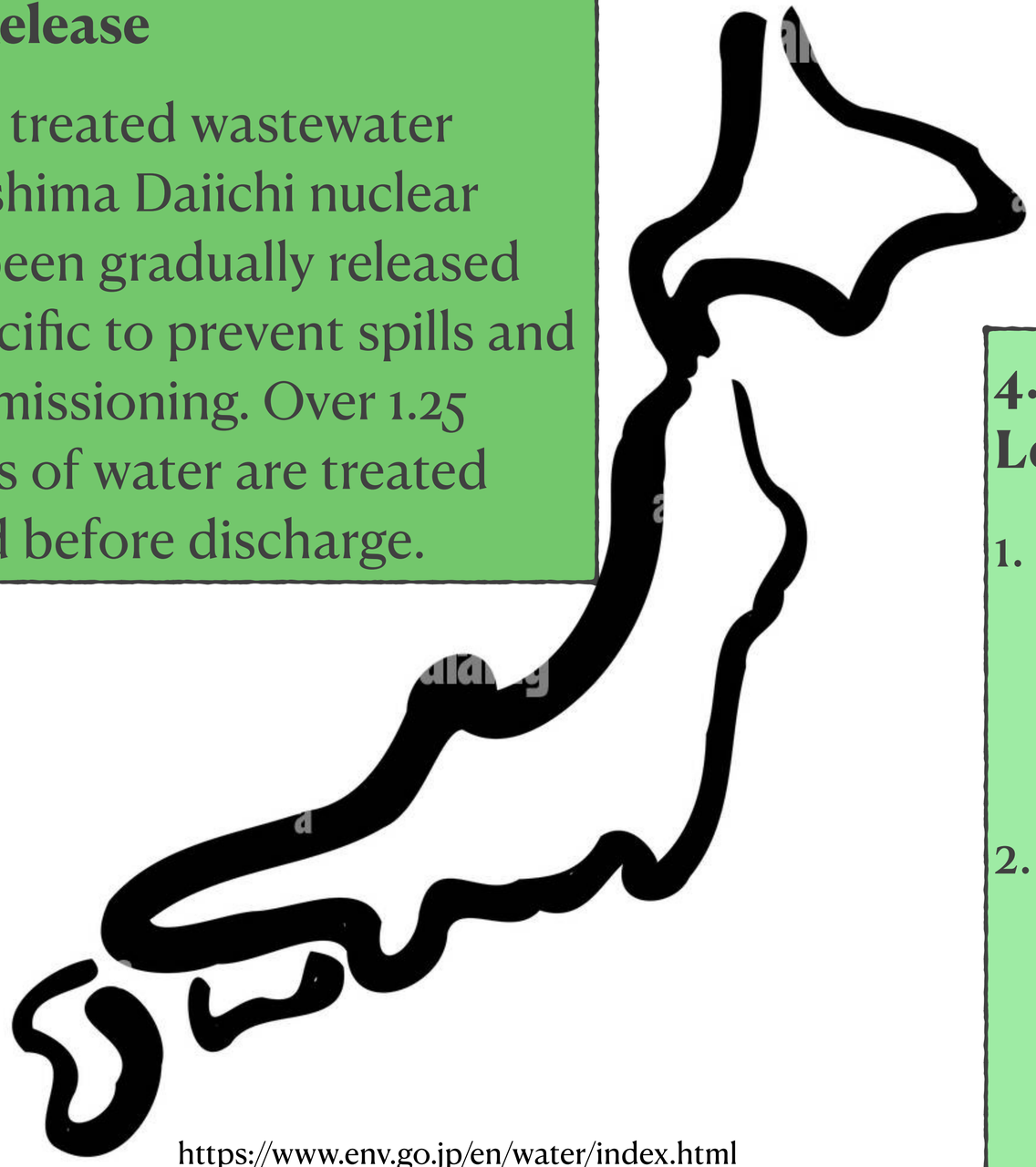
Japan's western coast along the Sea of Japan faces heavy marine debris from neighboring countries.

1. Islands such as Tsushima in Nagasaki see thousands of tons of plastic bottles and industrial waste wash ashore every year, requiring constant clean-ups.

https://www.env.go.jp/en/water/index.html

3. Fukushima Radioactive Wastewater Release

1. Since 2023, treated wastewater from Fukushima Daiichi nuclear plant has been gradually released into the Pacific to prevent spills and aid decommissioning. Over 1.25 million tons of water are treated and diluted before discharge.



https://www.env.go.jp/en/water/index.html

4. Coastal Eutrophication and Legacy Pollutants

1. Enclosed waters like Tokyo Bay, Ise Bay, and the Seto Inland Sea face eutrophication from nitrogen and phosphorus runoff.
2. Legacy chemicals such as PCBs, dioxins, and agricultural chemicals remain in sediments and marine life, requiring ongoing government monitoring.

Thank you for your attention