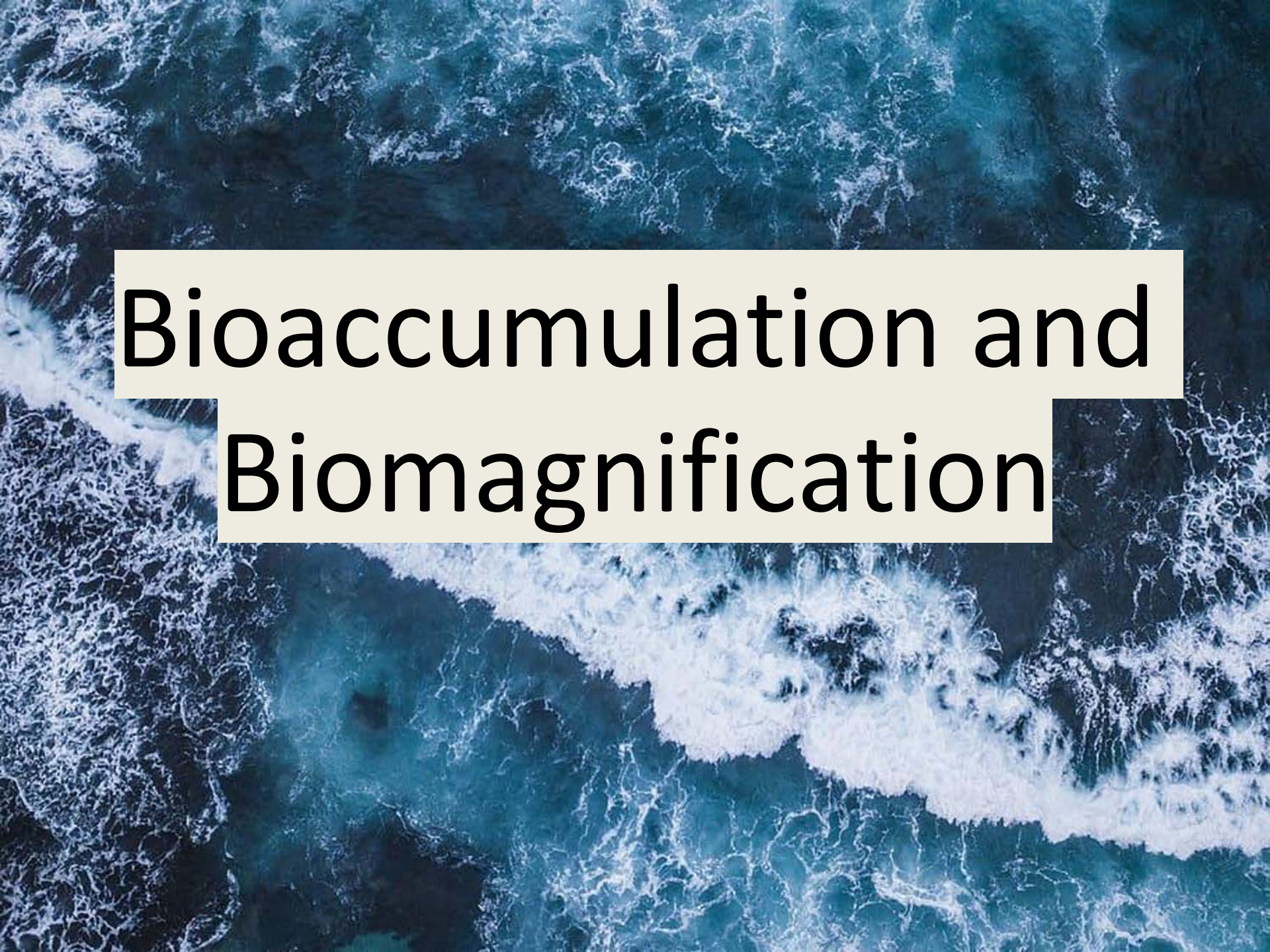
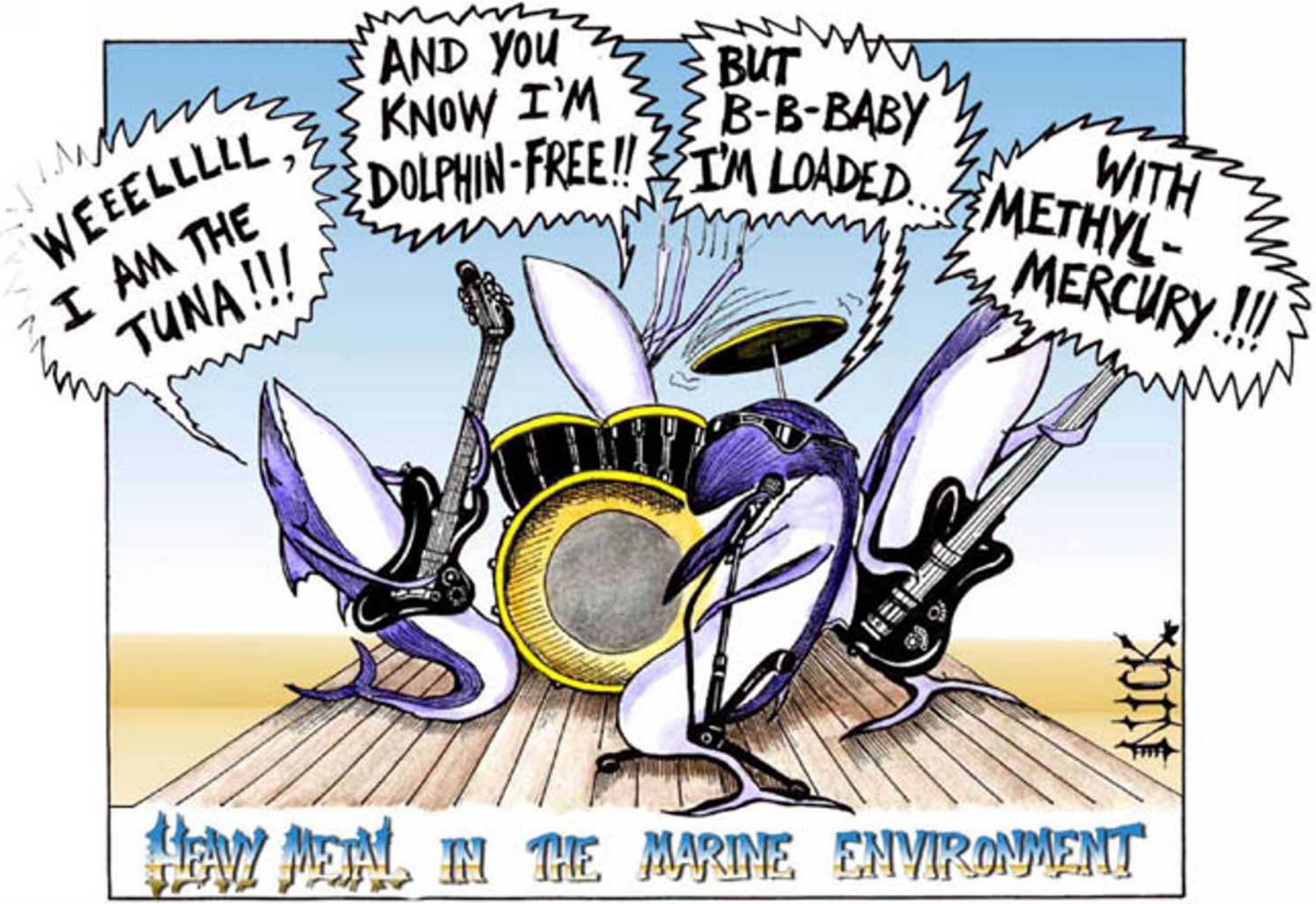


Bioaccumulation and Biomagnification


WEEELLLLL, I AM THE TUNA!!!
AND YOU KNOW I'M DOLPHIN-FREE!!
BUT B-B-BABY I'M LOADED...
WITH METHYL-MERCURY!!!
HEAVY METAL IN THE MARINE ENVIRONMENT

Video: What are you toxin about?

Definitions

- **Bioaccumulation** is the process by which substances not readily broken down or excreted can build up and be stored in living tissue (usually in fat).

- **Biomagnification** is the process by which substances become more concentrated in the bodies of consumers as one moves up the food chain (trophic levels).

Definitions

- A **Contaminant** is a substance that makes something less pure or makes it poisonous.

  Most contamination is caused by human activities such as industrial waste, spills, run-off, wastewater and sewage. Contaminants can cause harm to organisms living in a polluted environment as well as throughout the food chain.

FACTORS AFFECTING BIOACCUMULATION

1. Some chemicals bind to specific sites in the body, particularly in fat tissue, prolonging their stay.

http://extoxnet.orst.edu/tibs/bioaccum.htm

FACTORS AFFECTING BIOACCUMULATION

2. Chemicals that are immediately eliminated do not bioaccumulate.

http://extoxnet.orst.edu/tibs/bioaccum.htm

FACTORS AFFECTING BIOACCUMULATION

3. Duration of exposure is also a factor in bioaccumulation. Most exposures to chemicals in the environment vary continually in concentration and duration, sometimes including periods of no exposure.

http://extoxnet.orst.edu/tibs/bioaccum.htm

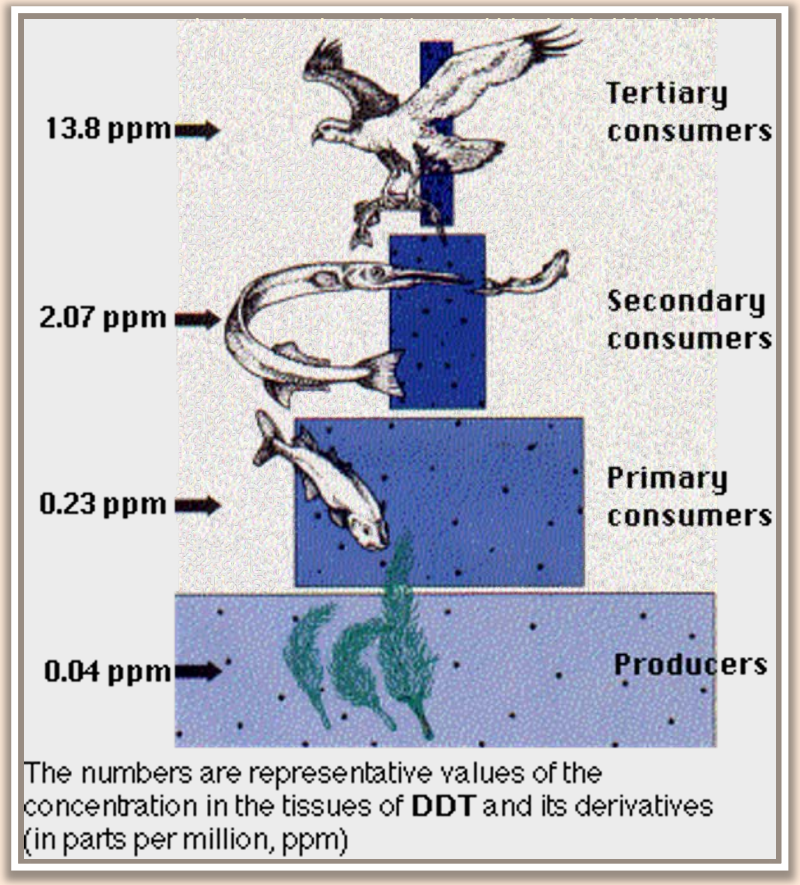
FACTORS AFFECTING BIOACCUMULATION

4. Bioaccumulation varies between individual organisms as well as between species. Large, fat, long-lived individuals or species with low rates of metabolism or excretion of a chemical will bioaccumulate more than small, thin, short-lived organisms.
   - Thus, an old lake trout may bioaccumulate much more than a young bluegill in the same lake.

http://extoxnet.orst.edu/tibs/bioaccum.htm

Case Study: DDT

- DDT is a pesticide that was widely used until being banned in the U.S. in 1972
- DDT accumulates in living tissue, particularly in fat tissue
- High concentrations in some bird species caused failure of eggs by thinning the shells



The numbers are representative values of the concentration in the tissues of **DDT** and its derivatives (in parts per million, ppm)

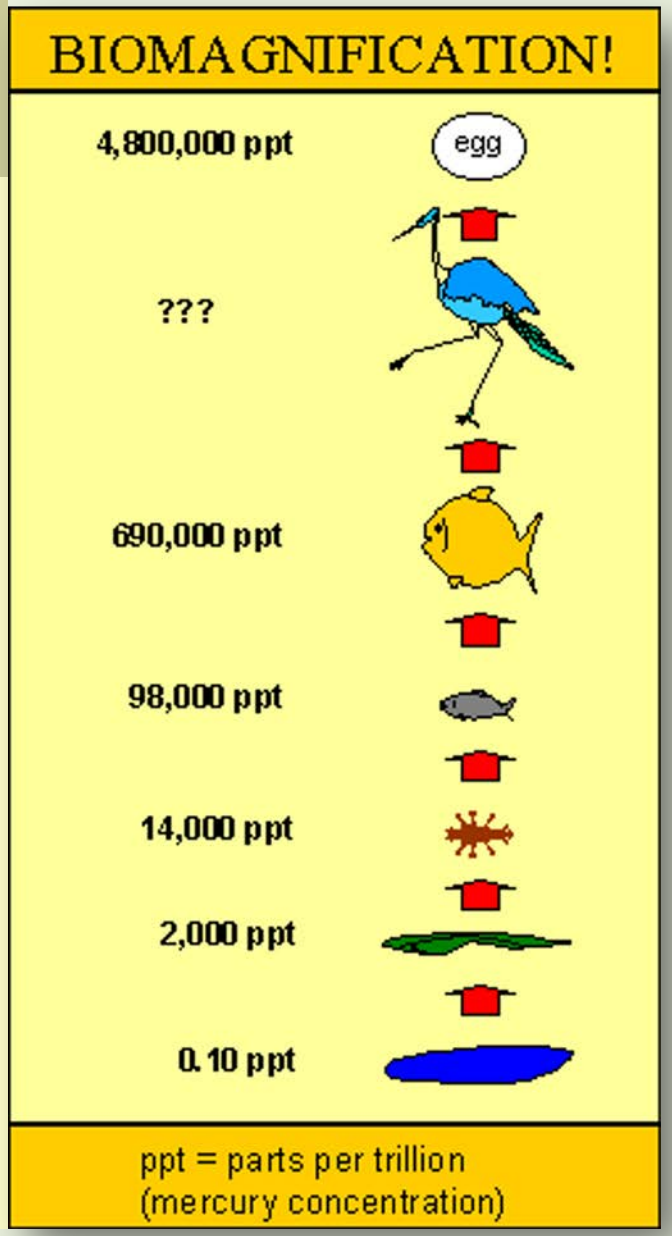
Case Study: Methyl Mercury

What makes methylmercury so dangerous?

Methylmercury is rapidly taken up but only slowly eliminated from the body by fish and other aquatic organisms, so each step up in the food chain (bio)magnifies the concentration from the step below.

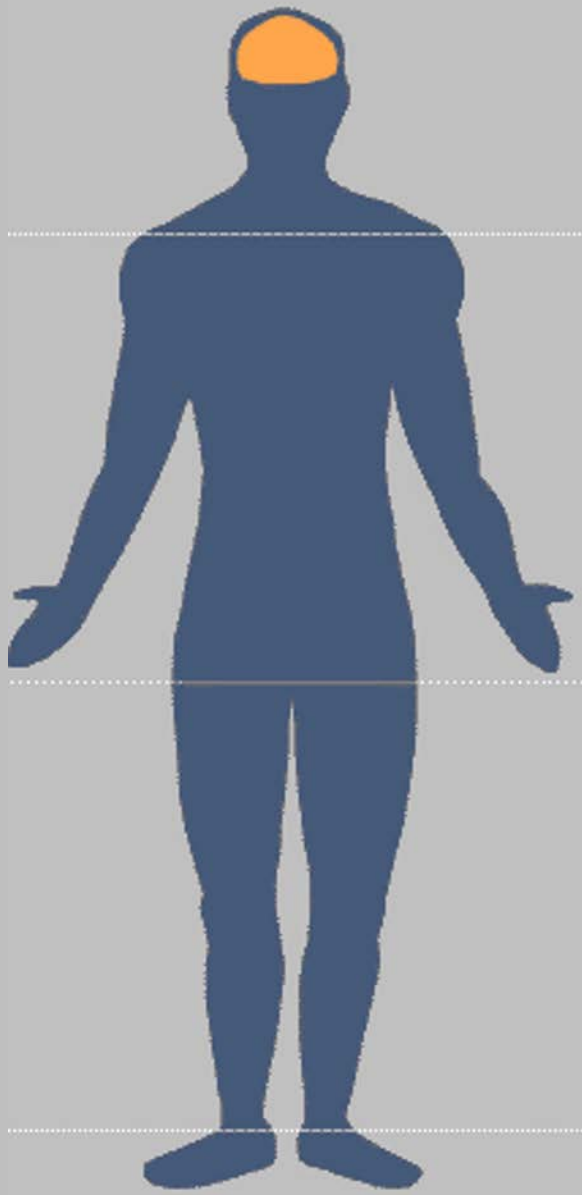
Bioaccumulation factors (BAF's) of up to **10 million in largemouth bass** have been reported for the Everglades.

Fish-eating birds, otters, alligators, raccoons and panthers can have even higher bioaccumulation factors.



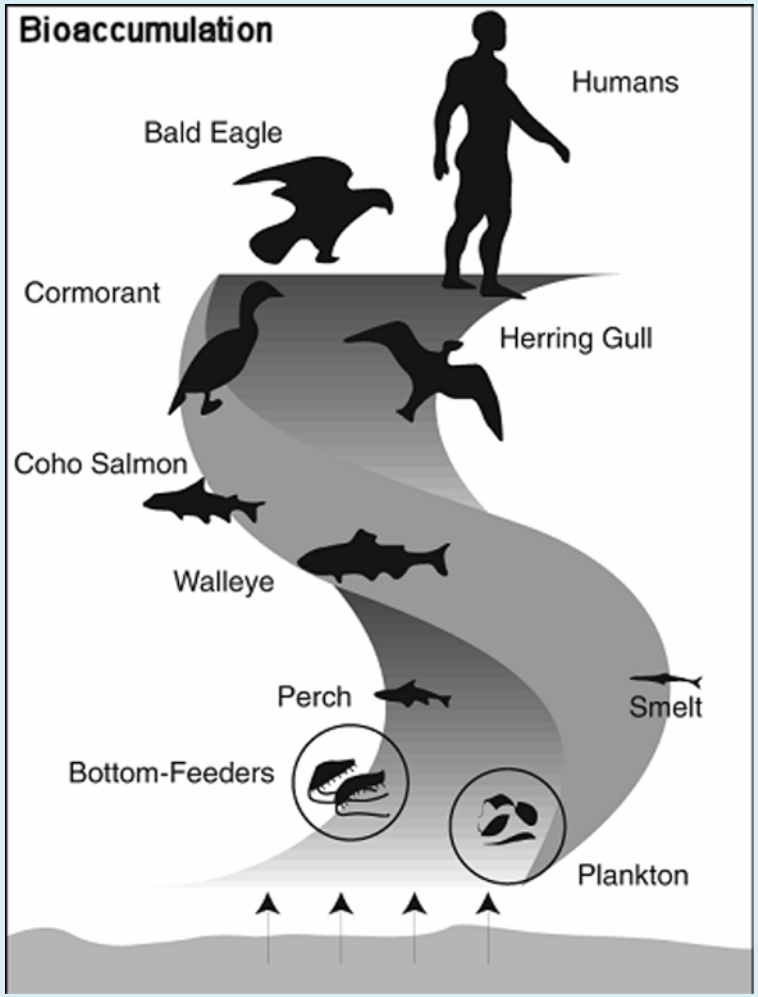
U.S. Department of the Interior, U.S. Geological Survey, Center for Coastal Geology
This page is: http://sofia.usgs.gov/sfrsf/rooms/mercury/achilles_heel/cause.html

MERCURY
HEALTH EFFECTS



- Deteriorates nervous system
- Impairs hearing, speech, vision and gait
- Causes involuntary muscle movements
- Corrodes skin and mucous membranes
- Causes chewing and swallowing to become difficult

Case Study: PCBs



- PCBs, or polychlorinated biphenyls, are a group of man-made chemicals.
- Introduced in 1929 and widely used in electrical transformers, cosmetics, varnishes, inks, carbonless copy paper, pesticides and for general weatherproofing and fire-resistant coatings to wood and plastic.
- The federal government banned the production of PCBs in 1976
- PCBs can affect the immune system, fertility, child development and possibly increase the risk of certain cancers

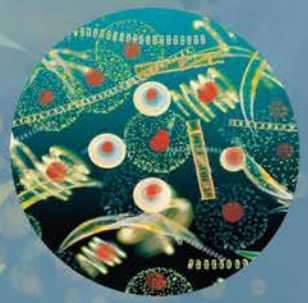
BIOMAGNIFICATION AND BIOACCUMULATION

How can pollutants have long-term effects on organisms?

Even when pollutants are not dangerous enough to kill animals outright, their presence can have lasting effects on food webs through **bioaccumulation** and **biomagnification**.

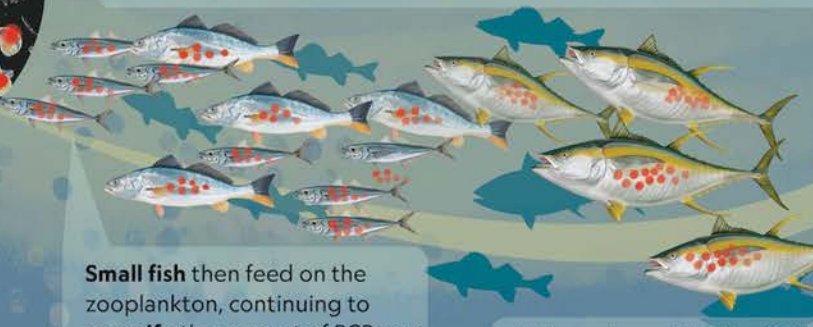
Toxins may increase in concentration as they are passed up the food chain, a process called **biomagnification**.

Pollutants such as **polychlorinated biphenyls (PCBs)** enter the ocean as industrial waste and are absorbed by microscopic **phytoplankton** at the bottom of the food chain.



PCBs

Even though phytoplankton absorb only a tiny amount, small creatures called **zooplankton** eat large quantities of the phytoplankton, taking in all the PCBs from what the phytoplankton eat.



Small fish then feed on the zooplankton, continuing to **magnify** the amount of PCBs up the food chain.

In the waters of the Pacific Northwest, **apex predators** like the killer whale (Orcinus orca) end up with the highest concentrations of toxins due to biomagnification.

Bioaccumulation occurs when pollutants build up in a single organism's body over time. Mercury, for example, is a pollutant that has entered waterways and lakes through industrial processes. Fish and shellfish absorb the mercury directly from their environment, and although they may only absorb small amounts at a time, the mercury can remain in the fish's body for months or even longer. This leads to the mercury building up, or **accumulating**, in the fish's body, posing a danger to any organism that eats the fish.

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