

# Lecture 11: Biomagnification

Lydia R. Leonardo, DrPH

Professor Emeritus, UP Manila

Director, UE Office of Research Coordination

Professorial Lecturer, UP Diliman



# Definition of Biological Magnification

Also known as biomagnification; increase of substances that occurs in the food chain

Substances concerned usually found in contaminated environments

These include pesticides and mercury which are absorbed by organisms from their environment or the food they consume which eventually accumulate inside the cells.

When the organism higher in the food chain eats multiple organism from the lower trophic level, each of which contains the toxin, the toxins become more and more concentrated as one goes higher in the food chain.

Since this tendency continues throughout the food chain, the highest in the food chain ends up with the greatest amount of the toxins.

# Bioaccumulation

---

Related to biomagnification

---

Increase of toxic substances in an organism's body

---

Accumulation refers to harmful substances in a living organism's body and its harmful effects.

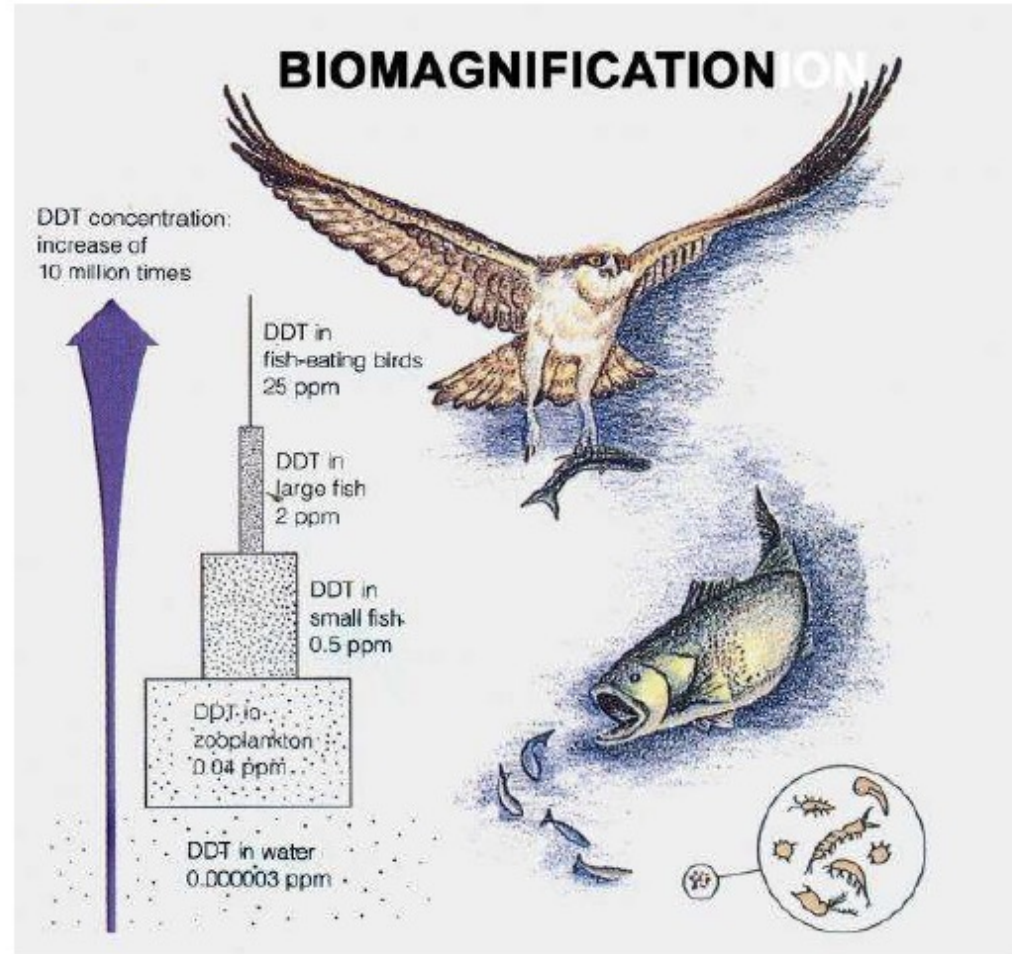
---

Magnification refers to substances being passed along the food chain.

---

Bioaccumulation will lead to a number of problems in the organism which harbors the toxic substances.

# Biomagnification



# Toxins that Biomagnify

- DDT and mercury
- PCBs (polychlorinated biphenyls) used in insulators such as plasticizer and fire retardants; impairs reproduction and can be widespread in the aquatic systems
- Cyanide used in leaching gold and in fishing; dangerous toxin with harmful effects on coral reefs
- Selenium concentrated by farming desert soils; toxic and causes reproductive failures in organisms
- Heavy metals such as mercury, copper, nickel, zinc and lead affecting the nervous system and reproduction

# How Biomagnification Affects Animals

DDT or dichlorodiphenyltrichloroethane was extensively used in the 1960s to the 1970s and found its way into the environment.

DDT and other toxins eventually climbed up the food chain and affected the bald eagles seriously almost causing their extinction.

DDT was absorbed by organisms such as fish and carrion which bald eagles feed on.

DDT accumulated in the eagles' bodies, sterilized the birds or caused them to produce eggs which had fragile eggs.

Populations of bald eagles dwindled rapidly almost to extinction.

## Effects on Humans

---

Biomagnification and bioaccumulation are caused by humans and have profound effects on them.

---

Neurological effects such as mental retardation in infants who get toxic substances from their mothers.

---

Weakened immune system

---

Some forms of cancers

---

Organ failure in both animals and humans

A blue ribbon graphic with a 3D effect, featuring a dark blue shadow on the left side. The ribbon is horizontal and contains the text "The Story of DDT" in white.

# The Story of DDT



# What is DDT?

---

Dichlorodiphenyltrichloroethane – chlorinated hydrocarbon

---

Developed in the 1930s by Paul Muller, a Swiss scientist

---

Inexpensive, broad spectrum persistent chemical extremely toxic to insects but not to humans and other mammals

---

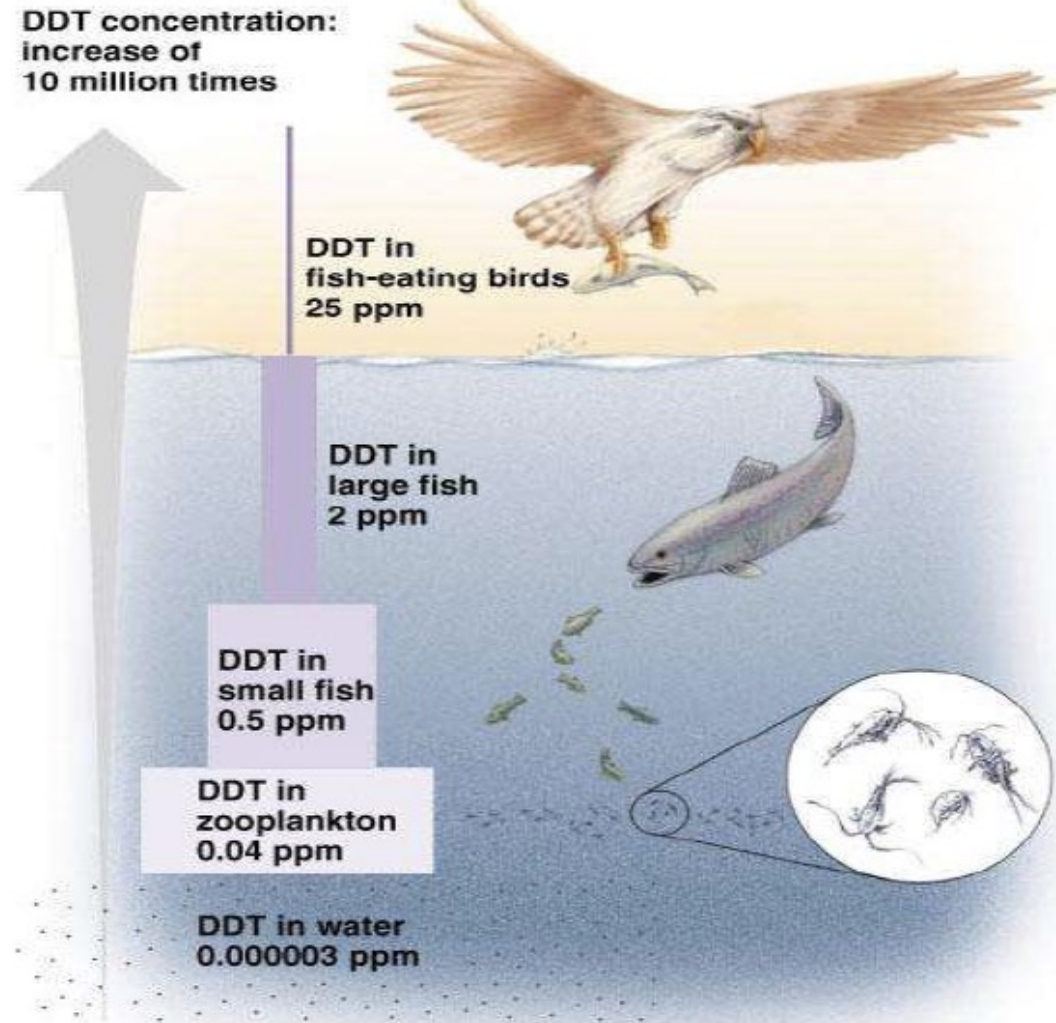
Used to control lice, mosquitoes, cockroaches, spruce budworm and beetles

---

Also used against insect pests to grow more economically productive crops

- The study of DDT provides a good example of **biological magnification** or “**biomagnification**” of the chemicals in the ecosystem
- Biomagnification is the accumulation of higher and higher concentrations of chemicals in individual organisms.
- It occurs when a chemical is ingested and cannot be broken down or excreted, leading to accumulation of chemical that they pass along a food chain.

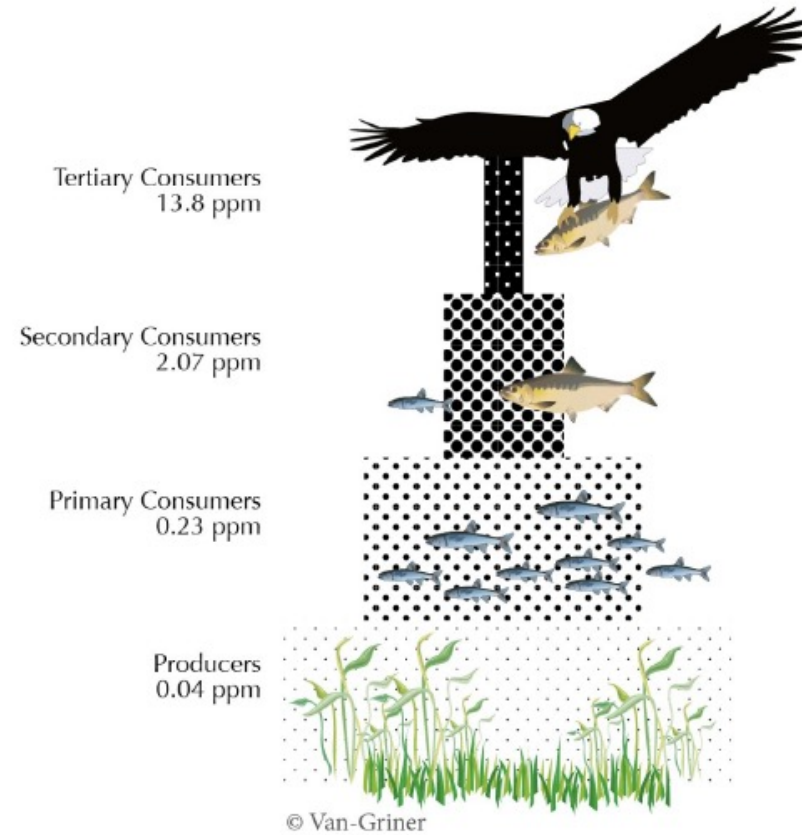
- How DDT climb up the food chain and biomagnified



Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.

# Ecological Pyramid

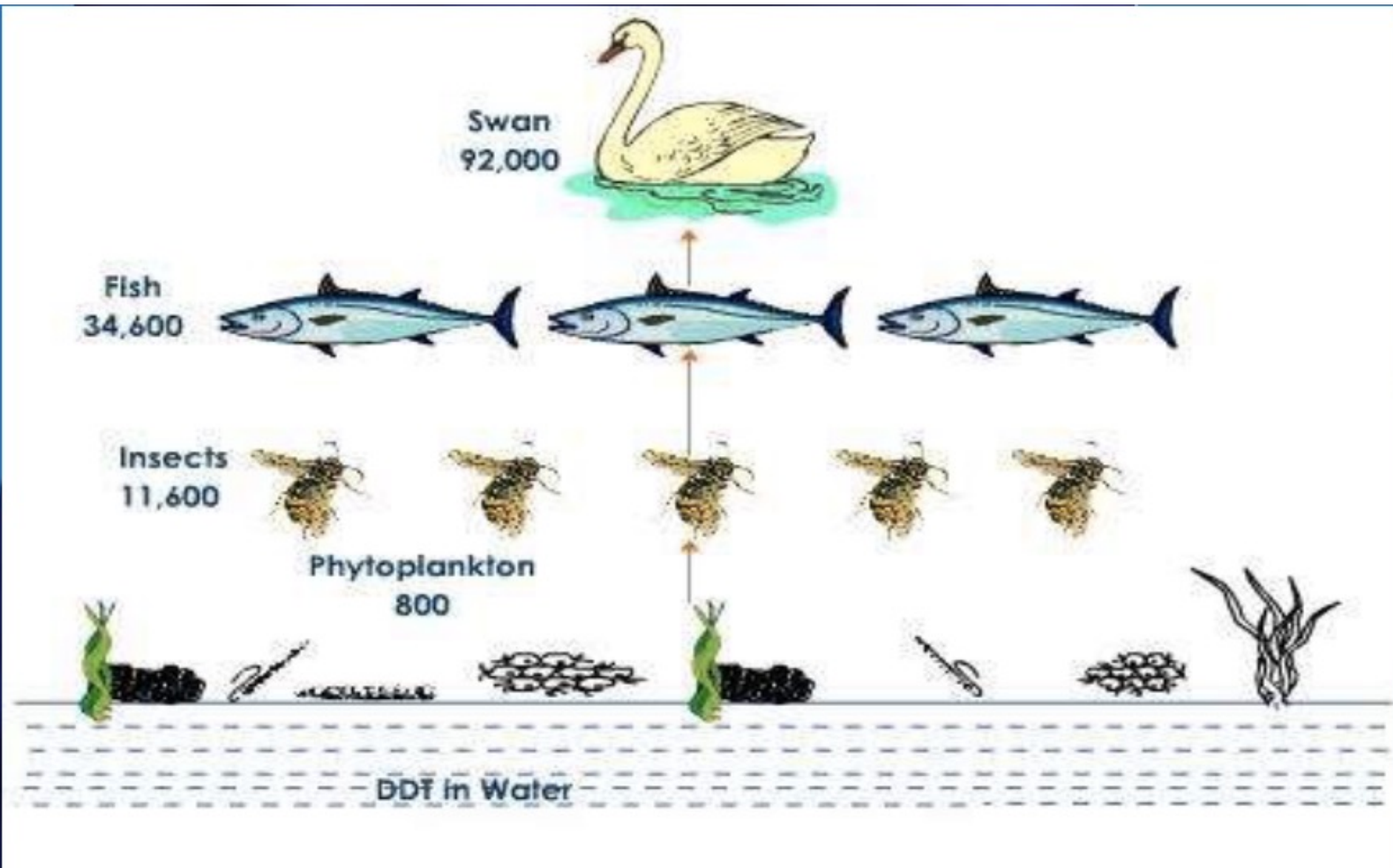
- Parts per million
- Explains how the accumulation increases because Secondary Consumers eat more than one Primary Consumer



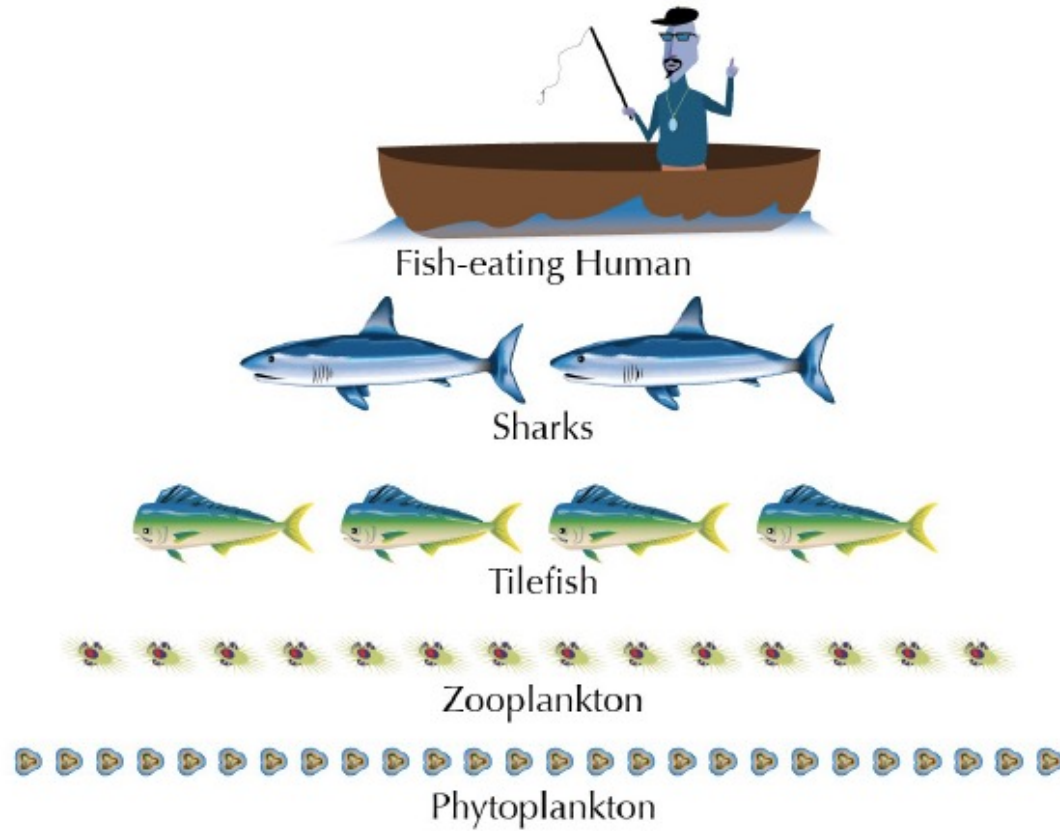
- DDT affected eggs had thin shells that were easily crushed when the mother bald eagle sat on them



© Van-Griner



# How does this affect us?

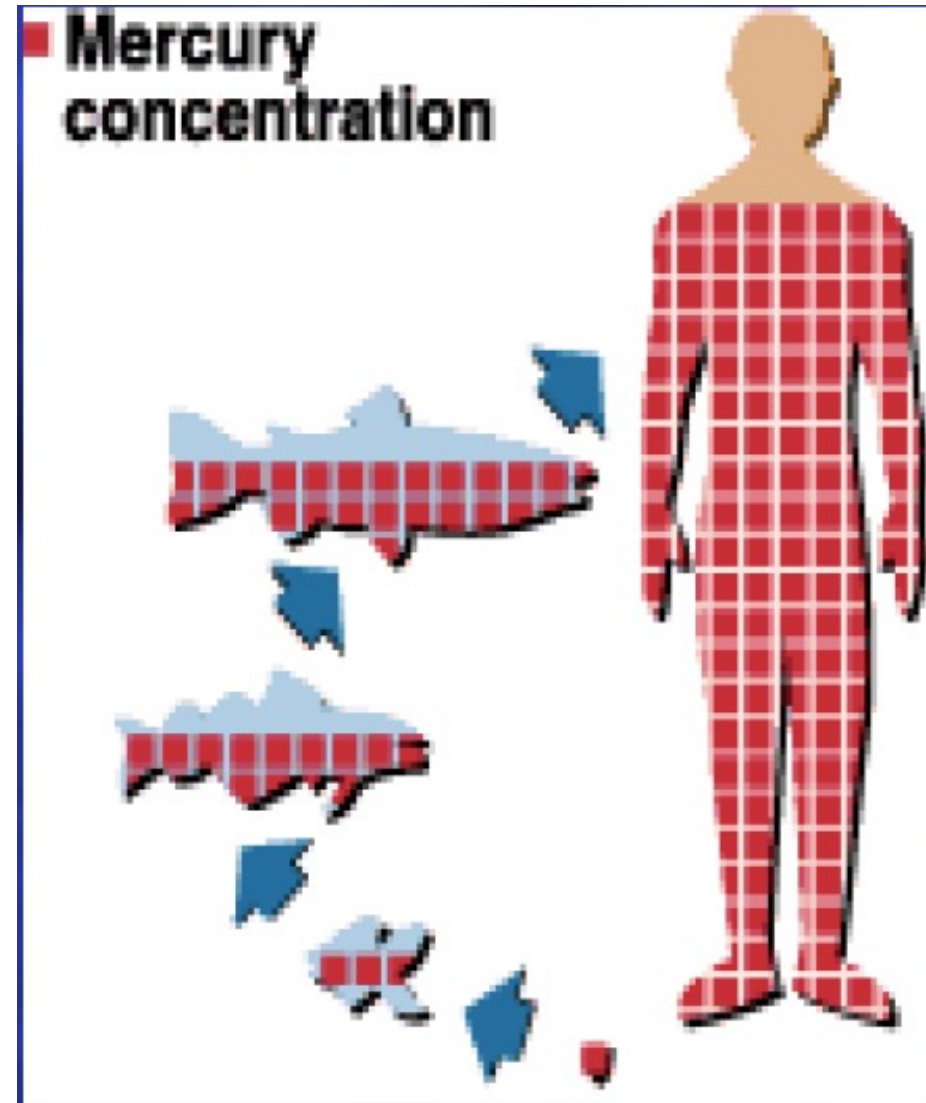


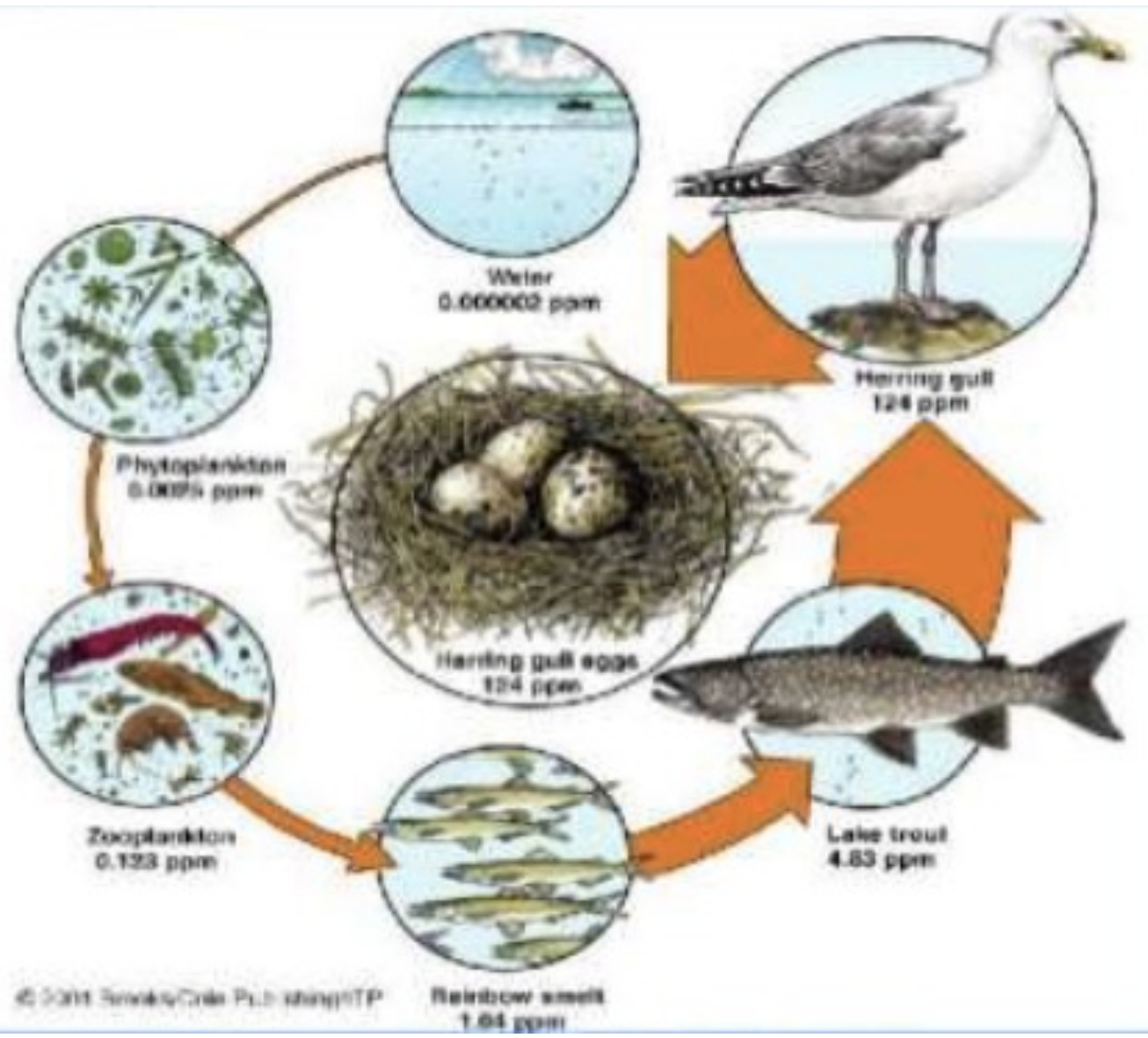
# Mercury

- Natural substance found in very small quantities in the ocean
- Human interference with environment causes increase in mercury levels in the ocean.
- Algae consistently absorb mercury found in the environment but excretes this very slowly back into the environment.
- Zooplankton consume algae and the mercury contained in them.
- Plankton consumed by small fish in turn consumed by a larger fish.
- Large fish end up in dinner tables.
- Humans become ill because of the toxic levels of mercury they eventually acquire from eating fish.

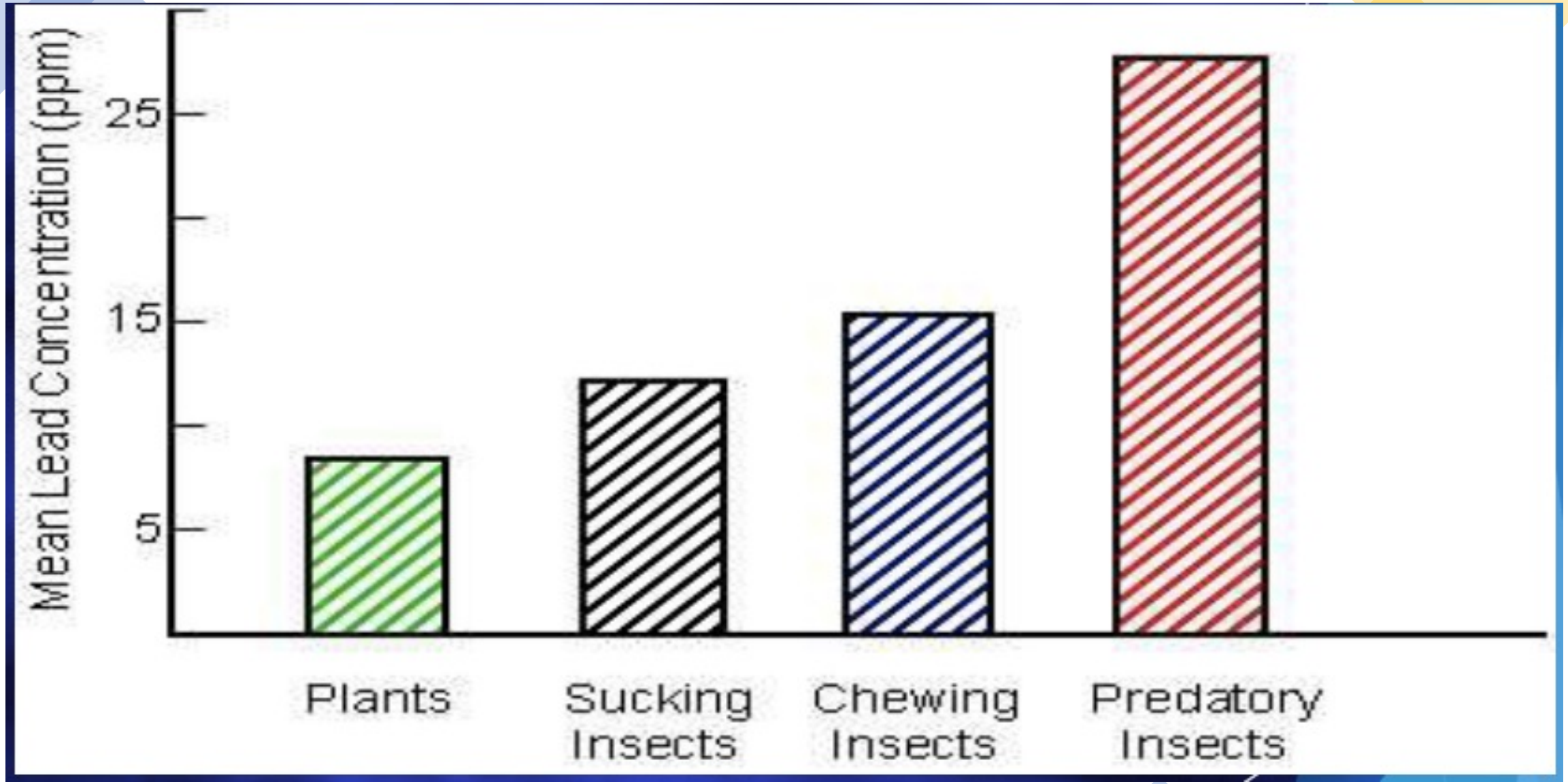


- Biological Magnification of Mercury





© 2011 Brooks/Cole Publishing/TP



# Prevention of Biomagnification

- US and several countries banned the use of DDT.
- Harmful substances such as oil are prevented from being dumped into the environment.
- Landfills also getting rid of these substances because of their ability to seep into ground water.
- Many new pesticides are biologically-based and break down readily upon contact with soil or reaction to sunlight.
- They are much more target specific and less harmful to non-target organism.
- Long term effects and overall impact of new and existing chemicals on ecosystem are evaluated by laboratory procedures.
- Persistence of chemical is tested during the pesticide registration process by the US Pest Management and Regulatory Agency.



Thank you.