

# **Bioaccumulation: An Example of the Human Impact on Biodiversity**

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## **The Benefits of Biodiversity**

The variety of life on Earth is called **biodiversity**. Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). An ecosystem or community with a large variety of species and relatively equal populations is considered to have high biodiversity, while either a low variety of species or unequal population sizes can cause an ecosystem or community to have low biodiversity. High biodiversity in an ecosystem means:

- Increased productivity
- A greater variety of food sources
- Increased sustainability for the species within the ecosystem
- Better ability to withstand and recover from disasters

Why is biodiversity important? Each species in an ecosystem has an important role. Disruption or removal of a single species can cause a domino effect that impacts the entire ecosystem. For example, in 1969 the zoologist Robert T. Paine conducted a research study that involved removing a species of sea star, *P. ochraceus*, from a portion of Mukkaw Bay in Washington. The sea star primarily fed on mussels. The area contained 15 species at the start of the experiment, but over time only 8 species remained and the mussel population sky-rocketed, making up over 80% of the population of all organisms in the area.

In addition, a higher biodiversity can benefit humans. The following is only a short list of ways in which biodiversity can benefit us:

- Formation and protection of soil resources
- Contributes to a relative stability in climate
- Breakdown and absorption of pollution
- Recycling and storage of nutrients
- Ecosystem maintenance
- Recovery from natural disasters
- Food resources
- Source of pharmaceuticals
- Building products
- Genetic diversity
- Tourism and recreation
- Cultural and aesthetic value

## **Anthropogenic Changes**

Humans depend on the living world for the resources and other benefits provided by biodiversity, but human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and contribution to climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing human life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. Moreover, **anthropogenic changes** (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species, initiating the domino effect of impact.

## **Biomagnification & Bioaccumulation: An Example of Anthropogenic Change**

Pollutants that exist in small amounts in the environment (such as certain heavy metals and organic agents found in pesticides) become concentrated in organisms near the top of the food chain. In an estuary, for example, microorganisms called plankton absorb small amounts of pollutants such as PCBs (polychlorinated biphenyls); the fish that eat lots of plankton retain the pollutants in their tissues; then birds or people that eat the fish concentrate the pollutants in their own cells and tissues. This process is

called **biomagnification**, and can eventually result in health issues when pollutant levels in the body become toxic. The actual building up of these pollutants in the body is called **bioaccumulation**.

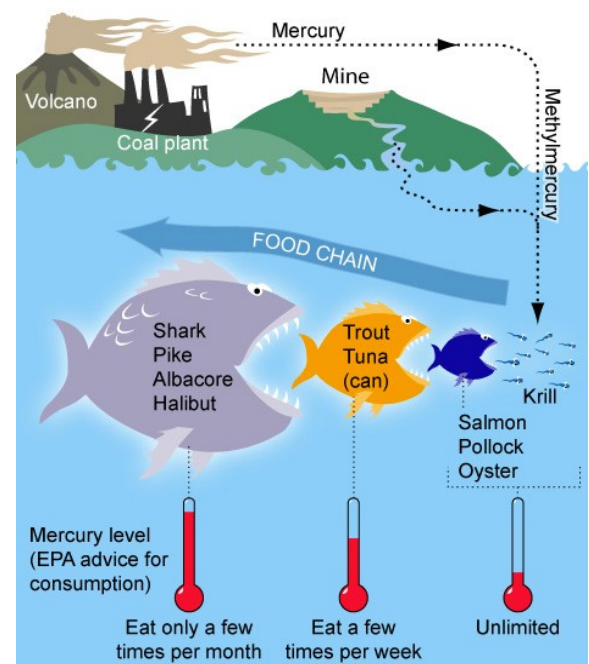
Not all bioaccumulation is harmful. It is a normal and essential process for the growth of organisms. All animals bioaccumulate vital nutrients daily, such as vitamins, trace minerals, essential fats, and amino acids. What concerns toxicologists is the bioaccumulation of certain substances to levels in the body that cause harm. Some of the harmful substances that are capable of bioaccumulating include PCBs, fluoride, dioxins, boron, DDT (pesticides), and mercury. Where bioaccumulation occurs in the body depends on the substance. It could build up in a specific organ, such as the liver or kidneys. It could also build up in specific tissues, like fat, and every time fat is broken down in the body the toxin is released and makes the individual sick. The biggest health concern for these substances is that the body is not able to efficiently break down and/or remove them from the body. This causes them to build up over time and eventually reach toxic levels that can result in poisoning.

Substance	Cause	Source for Human Contamination	Symptoms
<b>PCBs</b> (polychlorinated biphenyls)	Used as coolants and lubricants in transformers, capacitors, electrical equipment	Found in fish, surface soil, and drinking water	Stored in fatty tissues; liver damage, brain disorders, skin problems, cancer, hormone imbalance, birth defects
<b>Dioxins</b>	By-product of chlorine bleaching, burning plastics, pesticide production	Found in contaminated beef, pork, chicken, fish, milk, and eggs	Skin lesions, hormone imbalance, sterility, nervous system dysfunction, cancer
<b>Mercury</b>	Coal burning power plants (most common cause)	Found in seafood, especially tuna, shark, and swordfish	Neurological effects: tremors, blindness, numbness, pain, memory loss, seizures, death

### Mercury Poisoning: An Example of Bioaccumulation

Ocean organisms ingest a form of mercury called methyl mercury. This pollutant is produced in several industrial processes and is found in run-off into streams and rivers. These rivers eventually lead to the ocean where the mercury builds up and is ingested by small organisms. Methyl mercury can cause sickness if inhaled, eaten, or placed on the skin for long periods of time. Usually mercury causes problems over years or decades, not immediately. In other words, being exposed to small amounts of mercury every day for years will likely cause symptoms that appear later. Long-term exposure will likely cause neurological symptoms, including:

- Numbness or pain in certain parts of the skin
- Uncontrollable shaking or tremors
- Inability to walk well
- Blindness and double vision
- Memory problems
- Seizures and death (large exposures)



Medical evidence suggests that being exposed to large amounts of methyl mercury while pregnant can permanently damage the baby's developing brain. Most doctors will recommend eating less fish—and avoiding shark and swordfish—while pregnant. These recommendations are made to be extremely cautious. Small and occasional exposures are unlikely to cause any problems. However, for anyone with a certain level of mercury found in the body, treatment of organic mercury exposure usually consists of medicines called **chelators** to remove it from the blood and draw it away from the brain and kidneys. Often, these medications will have to be used for weeks to months.