N.C. Division of Water Quality

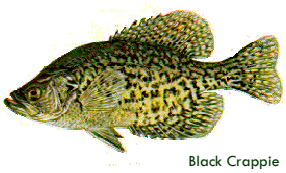
Bioaccumulation in North Carolina Fish

How do chemical pollutants end up in fish?

From a chemical standpoint, a fish acts like a biological sponge. Fish absorb chemicals via 3 pathways - by water (and indirectly the atmosphere), by the food they ingest, and by their association with sediments . These contaminants build up in the fish's tissue or **bioaccumulate** and may reach unhealthy levels over time.

The rate and degree to which chemicals bioaccumulate within fish is dependent on any number of chemical, physical, biological, and environmental factors. These include the amount of chemicals available for uptake by fish and other organisms, water chemistry and temperature, and food chain length. As a result, the extent of bioaccumulation is highly variable and hard to predict from one waterbody to another.

The highest levels of chemical contaminants are usually found in large predatory fish and other piscivorous (fish eating) animals. A typical aquatic food chain includes algae (small plants) eaten by zooplankton and aquatic insects eaten by minnows eaten by a bass and finally consumed by an osprey. If each step results in increased bioaccumulation, an animal living at the top of the food chain, through its regular diet and longer lifespan, may accumulate a much greater concentration of a chemical than the organisms found lower in the food chain.

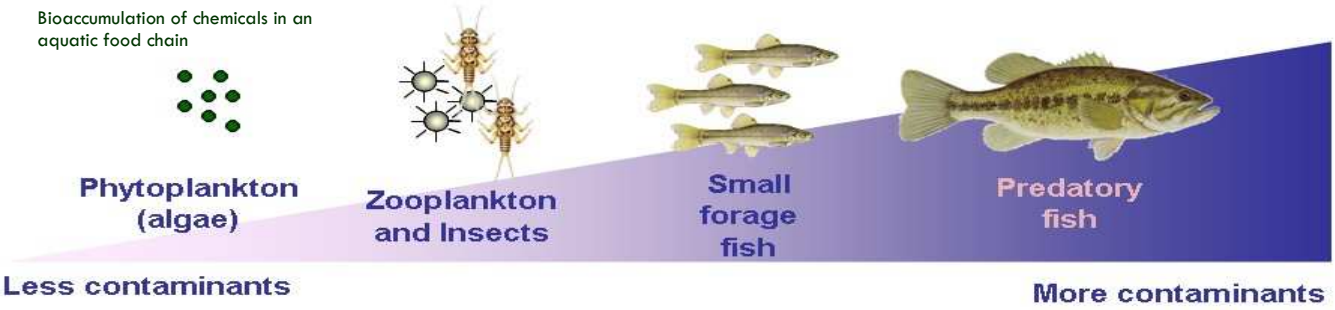


Black Crappie

Common Freshwater Predatory Fish in North Carolina

- Bowfin
- Chain Pickerel
- Crappie
- Largemouth Bass
- Warmouth
- Yellow Perch
- Flathead Catfish

Bioaccumulation of chemicals in an aquatic food chain



Chemicals identified in North Carolina fish.

Fish samples collected by the North Carolina Division of Water Quality (DWQ) and other agencies have shown bioaccumulative chemicals that fall into two categories - heavy metals (including mercury) and organic compounds.

Mercury is by far the most common metal detected in North Carolina fish. It has been detected statewide in nearly all species, but accumulates at higher levels in older predatory species. For example, Largemouth Bass is an apex species in NC for which there is a state-wide fish consumption advisory because of mercury.

Other metals such as cadmium, copper, lead, and zinc, are generally detected less frequently and at lower levels than mercury.

Organic chemicals found in fish include Polychlorinated Biphenyls (PCBs), dioxins, Polybrominated diphenyl ethers (PBDEs), and pesticides. At least 24 organic chemicals have been identified in North Carolina fish. Historically, DWQ data show fish samples from the Tar/Pamlico, Neuse, Cape Fear, Yadkin, and French Broad basins contain the highest organics contamination.

Bioaccumulative Chemicals in North Carolina fish

- Mercury
- Pesticides
- PCBs
- Dioxins
- PBDEs

Bioaccumulation in North Carolina Fish

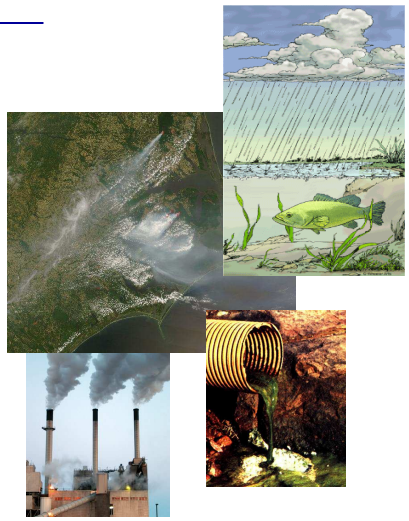
Where do chemical pollutants in fish come from?

Mercury is a metal that occurs naturally at low levels in rock, soil and water throughout North Carolina. Mercury is also released into the air when fossil fuels (coal, oil, and natural gas) are burned, when municipal solid waste or medical waste is incinerated, during forest fires, and during some manufacturing processes. Atmospheric deposition of air-borne mercury occurs at varying distances from sources, depending on weather patterns.

Dioxins are not intentionally manufactured by industry. Instead, they are the byproduct of other industrial processes. Dioxin fish contamination has historically been associated with the state's pulp and paper mills. All of the state's paper mills have made substantial changes to their processes to reduce or prevent dioxin formation resulting in a significant reduction in dioxin contamination of North Carolina streams.

PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence that they build up in the environment and can cause harmful health effects. PCBs do not readily break down and tend to bioaccumulate in fish. PBDEs are structurally similar to PCBs and are used as flame retardants in plastics, furniture and electronic equipment.

Pesticides are widely used each year in North Carolina to control insects, and other organisms. Organochlorine pesticides such as DDT are still detected in many streams today, more than 25 years after their use in agriculture was prohibited. Pesticides continue to enter North Carolina streams from application, atmospheric deposition, and erosion of soils contaminated from past use.



Chemical pollutants in NC fish come from a wide variety of human and natural sources.

What is the Division of Water Quality doing?

The DWQ continues to monitor mercury in fish across NC and has several studies under way. Fish surveys near Riegelwood, North Carolina monitor fish tissue after the removal of a known atmospheric mercury source - a dismantled chlor-alkali plant. Mercury monitoring in fish is also underway at selected sites across the state in cooperation with the NC Division of Air Quality as part of newly adopted clean air rules and as part of a long term effort to monitor mercury trends at specific locations.

DWQ staff are in the final stages of a statewide fish tissue organic contaminant survey begun in 2003. The primary goal is to identify mainstem inland waterbodies where organic contaminants exceed specified screening values for edible fish.

DWQ fish tissue results are routinely forwarded to the NC Department of Health and Human Services (DHHS) for fish consumption risk assessments and support for fish advisories. For more information on DHHS fish advisories see the link below.

OTHER RESOURCES

On the Web:

Information on NCDWQ fish tissue monitoring and other programs: http://www.esb.enr.state.nc.us/

Information on NC fish advisories and health questions regarding fish tissue: http://www.epi.state.nc.us/epi/fish/

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