



## FACT SHEET: 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.

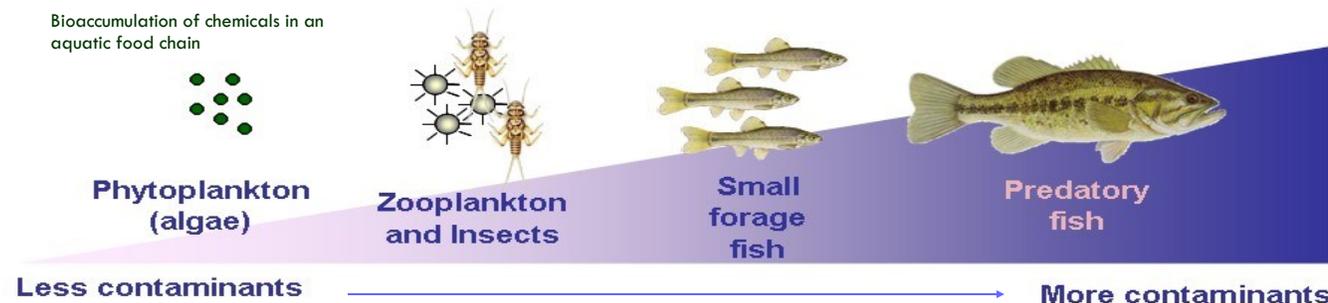
The highest levels of chemical contaminants are usually found in large predatory fish and other piscivorous (fish eating) animals. A typical aquatic food chain includes algae (small plants) eaten by zooplankton and aquatic insects eaten by minnows eaten by a bass and finally consumed by an osprey. If 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

- BASS (LARGEMOUTH/SMALLMOUTH)
- CHAIN PICKEREL
- CRAPPIE
- BOWFIN
- WALLEYE
- WARMOUTH
- YELLOW PERCH
- FLATHEAD CATFISH



### Chemicals identified in North Carolina fish.

Fish samples collected by the North Carolina Division of Water Resources (DWR) 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 legacy pesticides. At least 24 organic chemicals have been identified in North Carolina fish. Historically, DWR data show fish samples from the Tar/Pamlico, Neuse, Cape Fear, Yadkin, Catawba, and French Broad basins contain the highest organics contamination.

#### Bioaccumulative Chemicals in North Carolina fish

- MERCURY
- SELENIUM
- PESTICIDES
- PCBs
- DIOXINS
- PBDEs

# Bioaccumulation in North Carolina Fish

## Where do chemical pollutants in fish come from?

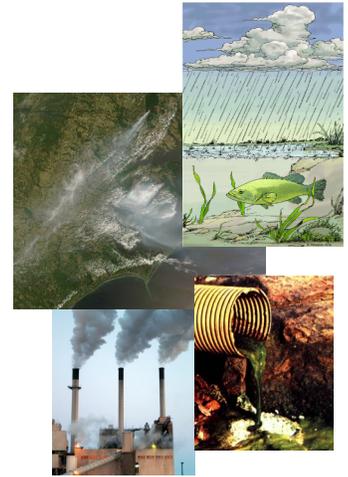
**Mercury** is a heavy metal that occurs naturally at low levels in rock, soil and water throughout North Carolina. Mercury is also released into the air when fossil fuels (coal, oil, and natural gas) are burned, when municipal solid waste or medical waste is incinerated, during forest fires, and during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

**Dioxins** are unintentional byproducts of some industrial manufacturing processes. Dioxin fish contamination has historically been associated with North Carolina'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 since they are good insulators and don't burn easily. The manufacture of PCBs was stopped in the U.S. in 1977 due to 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 furniture, plastics and electronic equipment.

**Pesticides** are widely used each year in North Carolina to control insects, and other organisms. Organochlorine pesticides such as DDT have been detected in many of the state's streams, 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 fish come from a wide variety of human and natural sources.

## What is the Division of Water Resources doing?

The DWR continues to monitor total mercury levels in fish across NC. Annual surveys occur at selected sites in support of human health risk assessments and to monitor long term mercury trends. The DWR routinely assists the NC Wildlife Resources Commission with fish-mercury testing in managed waterbodies stocked for recreational fishing.

Since the Dan River coal ash spill in early 2014, the DWR has been monitoring 16 heavy metals (including mercury, selenium, and arsenic) in fish collected from three locations downstream of the spill site. Data from four DWR surveys covering the 15 months following the spill show very little evidence of heavy metals being as-

simulated into fish tissues from affected areas of the river. A fifth Dan River assessment will be complete by spring 2017.

In 2008, the DWR completed a five-year statewide survey of organic contaminants in fish tissues. Results show that organic pollutants remain bioavailable in NC's freshwaters several decades after their discontinued use, but at concentrations that pose few health concerns for humans who consume local fish.

DWR fish tissue results are routinely forwarded to the NC Department of Health and Human Services (DHHS) for risk assessments and fish consumption advisory support. For more information on fish tissue monitoring in NC or DHHS fish advisories, see the links below.



## OTHER RESOURCES

### Division of Water Resources Contact:

Jeff DeBerardinis (DWR Fish Tissue Program Coordinator): [jeff.deberardinis@ncdenr.gov](mailto:jeff.deberardinis@ncdenr.gov) 919.743.8473

### On the Web:

Information on DWR fish tissue monitoring and other programs: <https://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/intensive-survey-branch>

Information on NC fish advisories and fish tissue health questions: <http://epi.publichealth.nc.gov/oe/programs/fish.html>