

# Biomarker Benchmarks: Reproductive and Endocrine Biomarkers in Largemouth Bass and Common Carp from United States Waters

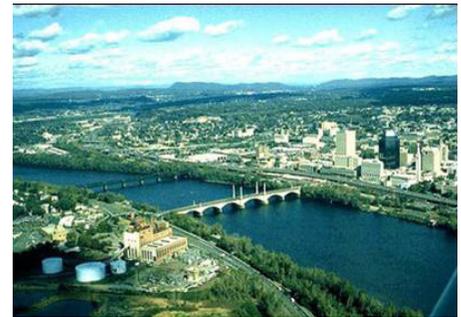
The U.S. Geological Survey (USGS) has developed a national database and report on endocrine and reproductive condition in two species of fish collected in U.S. streams and rivers. This information provides scientists with a national basis for comparing results of endocrine measurements in fish from individual sites throughout the country, so that scientists can better ascertain normal levels of biomarkers. The database includes information on several measures of reproductive and endocrine condition for common carp and largemouth bass. Data summaries are provided by reproductive season and geographic region. The report's authors are Steven Goodbred (USGS), Stephen Smith (USGS), Patricia Greene (USGS), Richard H. Rauschenberger (FWS), and Timothy Bartish (USGS).

A national-scale reconnaissance investigation was initiated in 1994 by the USGS that utilized a suite of biological assays (biomarkers) as indicators of reproductive health, and potentially, endocrine disruption in two widely distributed species of teleost (bony) fish, largemouth bass (*Micropterus salmoides*)

and common carp (*Cyrinus carpio*). The suite of assays included plasma sex-steroid hormones, stage of gonadal development, and plasma vitellogenin, an egg protein that indicates exposure to estrogenic compounds when found in male fish. More than 2,200 common carp and 650 largemouth bass were collected at 119 rivers and streams (Figure 1). **The full report and database** can be found at [http://fisc.er.usgs.gov/Endocrine\\_Data\\_Report.pdf](http://fisc.er.usgs.gov/Endocrine_Data_Report.pdf).

To establish national and regional baselines for land use, researchers selected sites that represented a diverse range of land uses and levels of disturbance. The sites were sampled during both non-reproductive and reproductive seasons to include this source of variation in the data. Fish in many aquatic ecosystems were sampled, including the Mississippi, Columbia, Colorado, Willamette, Potomac, Red River of the North, Platte, Hudson, Missouri, and Connecticut rivers.

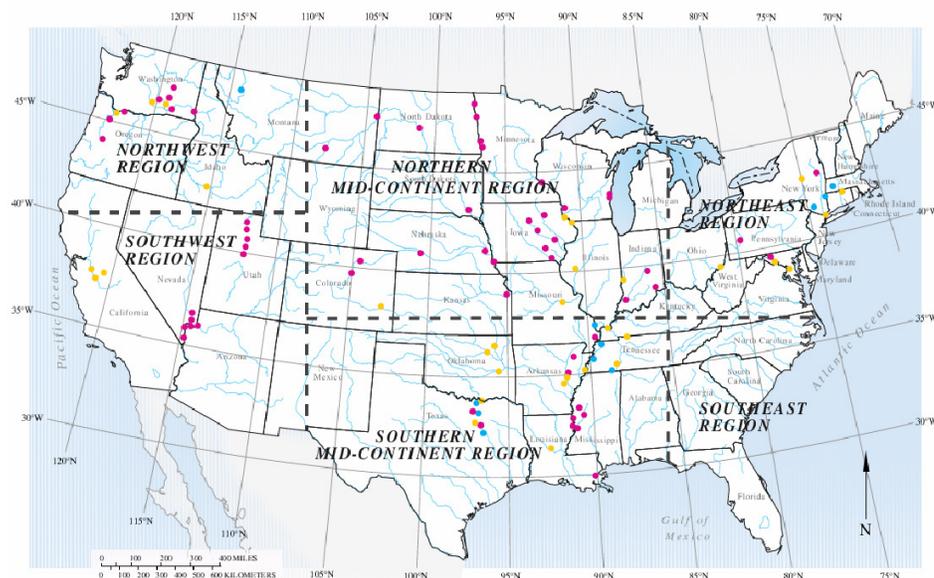
Carp and bass have different exposures to contaminants, and thus, could be expected to have different responses. Carp are a bottom-dwelling fish whose feeding habits expose them to many



different types of environmental contaminants found in water, sediments, and food. Largemouth bass, an important recreational species, are predators and thus are also exposed to contaminants that accumulate in higher trophic levels. Additionally, the toxicological response of the two species to chemicals in the environment differs because of their disparate physiology and genetics. As a result, the two fish species represent different types of sentinels of environmental quality in the aquatic ecosystem.

The fish biomarkers measured in this database are important regulators of critical life-history functions. They help to control spermatogenesis, egg production, hatchability, fertility, fertilization, behavior, viability of young, and development into a sexually mature fish. Although many of these important endpoints can be measured, they require a larger commitment of resources and are not practical to measure in a national study such as this one. This work is a geographically extensive survey of a subset of biomarkers that are physiologically associated with these life-history changes.

—By Steven L. Goodbred and others



**Figure 1. National map with regional boundaries and collections sites for common carp (magenta), largemouth bass (blue), and both common carp and largemouth bass (gold).**