



Tumors in Brown Bullhead Catfish in the Anacostia and Potomac Rivers

Survey Results 2009-2011

Background

The brown bullhead catfish (*Ameiurus nebulosus*) lives in rivers, lakes and ponds. In tidal rivers, it tolerates salinities up to 8 parts per thousand (about one quarter of the salinity level in the ocean). Bullheads, which have a small home range, are bottom-dwellers, feeding on worms, insect larvae and small crustaceans in the mud where contaminants accumulate. Bullheads often develop liver and skin tumors after exposure to cancer-causing chemicals.

Since 1992, the U.S. Fish and Wildlife Service, Chesapeake Bay Field Office (CBFO) has studied skin (Fig. 1) and liver (Fig. 2) tumors in bullheads from the Potomac and Anacostia Rivers and other Chesapeake Bay tributaries (Fig. 3). CBFO has been investigating whether the percentage of bullheads with tumors can be used to monitor the quality of their habitat.

The Anacostia River flows through Maryland and Washington, D.C. to the Potomac River. Contaminants enter the river through releases from waste sites, storm water, combined sewer overflows, nonpoint source runoff, atmospheric deposition, and from tributaries. It is one of three Chesapeake Bay Program Regions of Concern and the focus of a multi-agency cleanup.

For many years, people fishing along the Anacostia River noticed that brown bullheads often had red, fleshy bumps along their lips (Fig. 1). From surveys conducted in 1996 and 2001, we calculated that the probability of a 280 mm (11 inch) fish having a skin tumor was 28 percent for females and 20 percent for males. Liver tumor probabilities were 78 percent for females and 43 percent for males, equivalent to the highest reported in North America.



Fig. 1. Brown bullhead from the Anacostia River with lip lesions (lower: 1.5 x 0.8 cm, upper: 1.0 x 0.5 cm) later diagnosed as squamous cell carcinomas.

Liver tumors in fish are caused by exposure to polynuclear aromatic hydrocarbon (PAH)-contaminated sediments. PAHs are found in pavements, coal, oil and gasoline; cancer-causing PAH compounds are formed when fuels are burned. PAHs enter rivers through runoff from roads and storm sewers, from waste sites, and from the atmosphere.

The New Study

We conducted five bullhead tumor surveys from 2009 through 2011. Results from the three Anacostia surveys showed that liver tumor probabilities significantly



Fig. 2. Liver of brown bullhead from the Potomac River with a granular white lesion (8 mm diameter; 3-4 mm thick), later diagnosed as a cholangiocarcinoma.

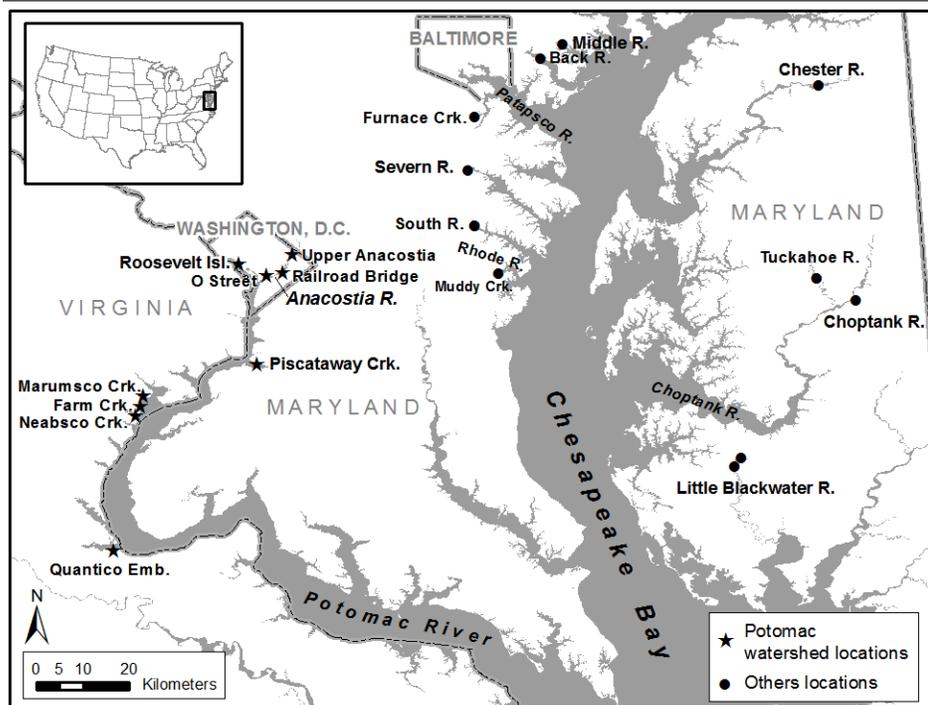


Fig. 3. Brown bullhead (*Ameiurus nebulosus*) survey locations

declined to 42 percent in females and 14 percent in males, about half that of the 1996–2001 sampling period. Skin tumors also decreased to 17 percent in females and 12 percent in males, about 40 percent lower than the previous period, although this decrease was not statistically significant (greater than 5 percent probability that the change was due to chance).

The 2009–2011 tumor probabilities in the Anacostia surveys were similar to those in a survey on the Potomac River near Roosevelt Island and one at Piscataway Creek (Fig. 3). Despite the improvement, liver tumor prevalence from all of these locations was still significantly higher than the estimated Bay-wide background (see Questions and Answers).

Questions and Answers

Has the percentage of liver tumors in bullheads from the Anacostia River decreased?

Yes. The percentage in 2009–2011 surveys decreased significantly to about half that from the 1996–2001 period.

Has the percentage of skin tumors in bullheads from the Anacostia River decreased?

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Yes, by about 40 percent, but this change was not statistically significant.

How do the percentages compare between the Anacostia and Potomac River?

Bullheads from the Anacostia, Potomac (near Roosevelt Island), and Piscataway Creek had nearly equal percentages of liver and skin tumors.

How do these percentages compare with more rural areas?

We compared the tumor probabilities with the “Chesapeake Bay Reference Group,” 390 bullheads collected from mostly rural areas between 1992 and 2011. The percentages of liver tumors in bullheads from the Anacostia, Potomac, and Piscataway Creek locations were significantly higher than that in the Reference Group. The percentage of skin tumors in the Anacostia bullheads was also significantly higher than in the Reference Group.

What causes liver and skin tumors in brown bullheads?

Exposure to sediments contaminated with PAHs and other chemicals causes liver tumors in brown bullhead and other fish species. We are less certain of the causes of skin tumors. In laboratory studies, PAHs and another class of chemicals (alkylating agents such as nitrosamines) caused both liver and skin tumors. But in the

environment, we have not observed a consistent relationship between sediment contamination and skin tumors.

Why have liver tumors decreased in Anacostia bullheads?

It is possible that exposure to PAHs has decreased. However, because the last Anacostia sediment chemistry survey was in 2000, there are no current data to evaluate. Recent actions coordinated by the U.S. Environmental Protection Agency and District Department of the Environment have reduced contamination in the watershed. These include: requiring a facility to capture PAH-contaminated ground water from a waste site before it enters the river; controlling oil inputs to the Hickey Run tributary; and reducing sediment erosion in the Watts Branch tributary.

Followup

We need more information to show a cause-effect relationship between actions that may have reduced PAH exposure and the decrease in liver tumors. Because we still don’t know what causes skin tumors to occur in certain Bay tributaries, we are working with U.S. Geological Survey biologists to try to discover whether a virus may be involved in the tumor process.

Tumor surveys should be repeated on a 5-year cycle, along with sediment chemistry analyses, to help environmental managers focus actions aimed at improving the quality of the Anacostia and Potomac Rivers.

For More Information:

Pinkney, Alfred E., John C. Harshbarger, and Michael A. Rutter. 2013. Temporal and spatial patterns in tumor prevalence in brown bullhead (*Ameiurus nebulosus*) in the tidal Potomac River watershed. U.S. Fish and Wildlife Service, Chesapeake Bay Field Office, Annapolis, MD. CBFO-C13-02.

Contact:

Fred Pinkney, Ph.D.
 U.S. Fish and Wildlife Service
 Chesapeake Bay Field Office
 177 Admiral Cochrane Drive
 Annapolis, MD 21401
fred_pinkney@fws.gov
<http://www.fws.gov/chesapeakebay>

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