Physiological Anomalies in Bullhead *(Ameiurus)* of Killbuck Creek and the Cuyahoga River

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Objectives

- Comprehensively examine anomalies related to pollution in the Cuyahoga and Killbuck Creek.
- Identify potential unknown factors revealed by anomalies in fish.
- Demonstrate the value of physiological examination in aquatic pollution monitoring.

Abstract

Physiological biomarkers are an important but underused aspect of monitoring for aquatic ecosystem health and pollution. In this study, brown and yellow bullhead (*Ameiurus nebulosus* and *Ameiurus natalis*) were captured from three sites. One site (Site 1) located on the Cuyahoga River ship channel in Cleveland, Ohio, one mile downstream of a combined sewer overflow (CSO), and two sites located on Killbuck Creek in Wooster, Ohio. Of the two locations on Killbuck Creek, one was contaminated (Labelled 3), being located directly downstream of a wastewater treatment plant (WTP), the other was a reference site (Labelled 2), located 2.5 miles upstream of that contaminated site. All fish taken were examined for external abnormalities, as defined by the *Field Manual for Assessing Internal and External Anomalies in Brown Bullhead (Ameiurus Nebulosus)* (2) and the *Illustrated Field Guide for Assessing External and Internal Anomalies in Fish* (1). Yellow bullhead were then released, while brown bullhead were euthanized via pithing and examined internally. On average, each fish had 5.94 abnormalities (n=16), the fish from the Cuyahoga ship channel had 6.27 abnormalities (n=11), the fish from the contaminated Wooster site had 6.25 abnormalities (n=4), and the fish from the reference Wooster site had 1 abnormality (n=1). In the test sites, some signs of a carcinogenic environment were observed, along with evidence of an epidemic of fin-rot, likely caused by poor water quality and bacterial infection.

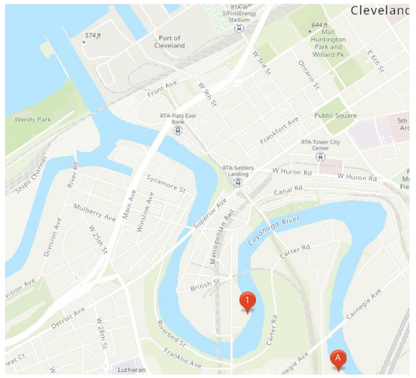
Methods 1

Locate Collection Sites

The Cuyahoga River Ship Channel

1: Cuyahoga River test site, approximately one mile downstream of a combined sewer overflow.

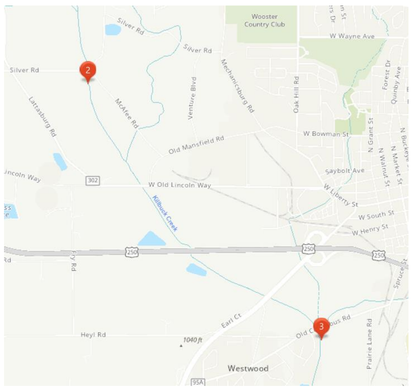
A: Walworth Run, a combined sewer overflow. Was once a free-flowing creek but was enclosed as a sewer due to heavy pollution in 1897.



Killbuck Creek

2: The Wooster reference site.

3: The Wooster test site. At the Wooster Water Resource Recovery and Bioenergy Facility.



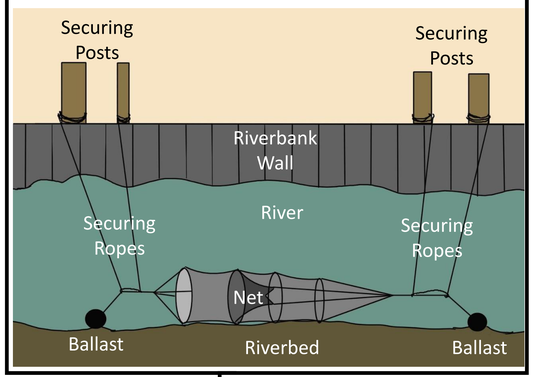
Site Selection

Sites were selected based on safety, legality, species present, and proximity to locations of interest like wastewater treatment plants and combined sewer overflows.

Methods 2 **Collect Fish**

Net setup

- The net was set up at the bottom of the Cuyahoga River Ship Channel as below.
- Killbuck Creek is shallow, and has natural banks, so the securing lines and posts were unnecessary there.

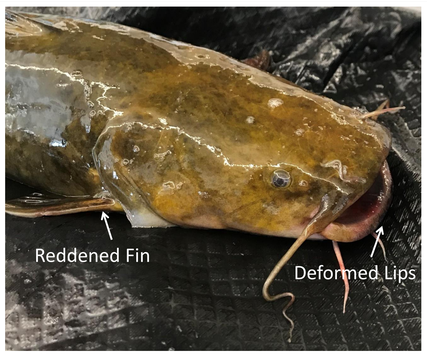


Methods 3 **Examine Fish**

- During examinations we looked for a variety of physiological abnormalities as defined by the USGS (1) and researchers from Penn State (2).
- During external examinations, visible abnormalities on the body surface or gills, like those above, were noted.
- During internal examinations, a more tactile approach was needed, noting both visible things like discoloration, and tactile qualities like texture, and whether any organs had hard lumps that weren't supposed to be there.

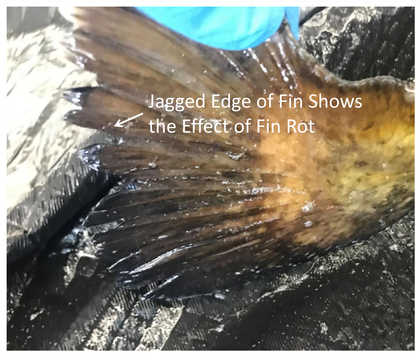
Methods 4

Analyze Data



Fish with oral lesions

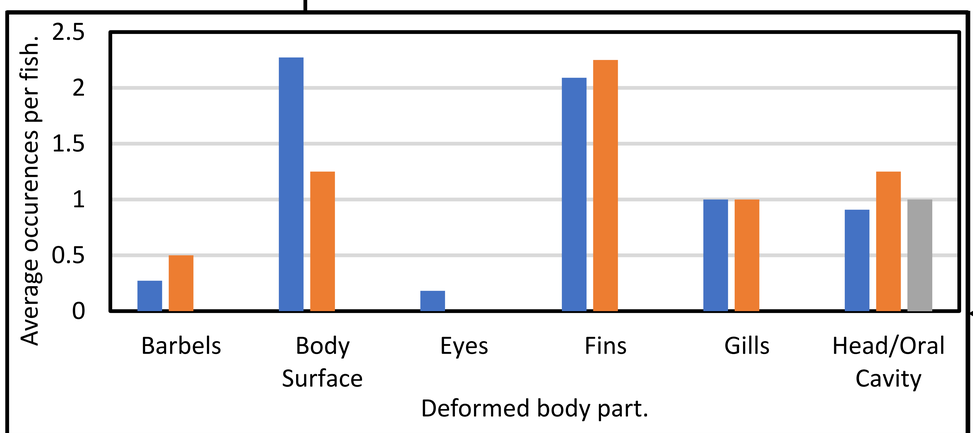
- Oral lesions are an external indicator of a carcinogenic environment in fish.
- Reddened base of fin indicative of dermal hemorrhage



Frayed tailfin

- Frayed tailfin of a bullhead.
- Fin fraying is one of the most common abnormalities observed in this study and is characteristic of fin rot.

Conclusions 1 **Findings**



Average rate of external deformities arranged by collection site and affected part

- This graph gives a decent idea of the proportion of different abnormalities at different sites.
- Important to note is that the fish from the reference site only showed one abnormality.
- Its also interesting to note the difference between the Wooster and Cuyahoga test sites when it comes to body surface abnormalities.
- Most of the body surface and fin abnormalities are things like fin fraying and dermal hemorrhage, which are indicative of fin rot (3)(4).

Conclusions 2 **Future Directions**

- Data was insufficient to draw statistically significant conclusions.
- Despite this, many abnormalities accepted as signs of pollution were observed in our limited sample size.
- About half of these abnormalities were symptoms of fin rot, and most of the rest were cancerous lesions or parasites.

- Gather more samples, at least up to 30 per site, which is the population sample size (2).
- Vary collection methods, to eliminate potential artifacts of net fishing.
- Introduce bacterial analysis, to look for bacteria implicated in fin rot, or disrupted microbiomes in fish, indicating poor water quality.

Citations

1) Smith, S. B., Donahue, A. P., Lipkin, R. J., Blazer, V., Schmitt, C. J., & Geode, R. W. (2002). *Illustrated Field Guide For Assessing External And Internal Anomalies In Fish.* United States Geological Survey Information and Technology Report.
2) Rafferty, S., & Grazio, J. (2005). *Field Manual For Assessing Internal And External Anomalies In Brown Bullhead* (Ameiurus nebulosus). Pennsylvania State University.
3) Bernardet, J. F. (1989). 'Flexibacter columnaris': First Description In France And Comparison With Bacterial Strains From Other Origins. Diseases Of Aquatic Organisms, 6, 37-44.
4) Centre for Agriculture and Bioscience International: Invasive Species Compendium. (2019, November 22). Aeromonas Infection In Fish. CABI.org.