

EPA Environmental Justice Small Grant

Closeout Report

Project Title: GCWA FY Fish Mercury Study

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Executive Summary

The Gills Creek Watershed Association, in partnership with the University of South Carolina Aiken, and the Bible Way Church of Atlas Road, completed the Gills Creek Fish Mercury Study as of July 15, 2017. It was believed that the fish of Gills Creek contained a deleterious amount of mercury but no extensive sampling on Gills Creek had taken place prior. It was also known that many of the fishers on Gills Creek were consuming their catch.

This project worked with local fishers on Gills Creek to identify fishing hot spots and targeted fish species. Through surveys we learned what fish species were being caught, how frequently people were fishing on Gills Creek, and how often they were eating their catch. As expected, most of the fishers on Gills Creek were consuming their catch or giving the fish to friends and family. Once we had established which sites along Gills Creek were being frequented by fishers, Dr. Virginia Shervette from USC Aiken began the fish sampling portion of the project.

Dr. Shervette and her team sampled a total of nine sites and collected 596 fish samples. These samples were then processed for the presence and concentration of mercury in the fish tissue. The sampling took place over a ten month period, around the Columbia area and across the Gills Creek Watershed. Special attention was paid to those areas identified in the surveys by the fishers as common fishing locations. The results were then compared to EPA consumption advisory thresholds. Overall the mercury concentrations in the fish from Gills Creek were low, with only three species that exceeded EPA thresholds.

Once the preliminary results from the fish survey were available, the public education and outreach effort was implemented. Two public meetings were held at the Bible Way Church of Atlas Road to convey the results of the fish survey. A video was also produced that details the project and the results of the study. The video and literature will be used to continue the public education and outreach in the affected areas of Gills Creek Watershed.

Activities and Milestones

All of the major activities and milestones detailed in the project proposal were completed as of the grant end date of July 15, 2017. Surveys were administered to fishers in Gills Creek which helped establish a baseline for fishing locations and fish consumption rates. Two public meetings were held in conjunction with the Bible Way Church of Atlas Road. A short (six minute) video was produced on this project and the results of the study. Other education and outreach efforts will continue and will rely on the information generated through grant project.

Tools Used

The GCWA created and used several tools throughout the duration of the grant project. An educational video was produced for outreach and educational purposes. We also created a brochure and factsheet with preliminary results from the fish survey.

Partnerships

This project was completed using key partnerships. The University of South Carolina Aiken completed the technical portion of the project. Dr. Virginia Shervette and her team were responsible for the collection and analysis of fish from Gills Creek.

The Bible Way Church of Atlas Road helped by identifying community leaders that can help us spread the results of this project. The Church also hosted the two public meetings.

Fish Survey and Mercury Results

Two academic presentations have resulted from this study so far:

Shervette VR, Garlick K, Parker F, Reed L. 2016. Conservation Biogeography of Freshwater Fishes: Community Dynamics and Shifts in Response to 1000-year Rainfall Event. University of South Carolina Flood Conference, Columbia, SC.

Parker F, Shervette V, Reed LA. 2017. Spatial and Temporal Variation in Mercury Bioaccumulation of a Commonly Consumed Freshwater Fish Redbreast Sunfish *Lepomis auritus*. SC American Fisheries Society Annual Meeting, Hickory Knob, SC.

Trends in the total Hg concentrations in fishes from Gills Creek Watershed

We sampled a total of nine sites from February – November 2016 and collected a total 596 samples from 17 fish species (Table 1; Figure 1). For data analyses and summary purposes, the nine sampling sites were combined into four main areas: Crowson (includes sites Crowson Rd and Midlands Tech), Bluff (includes sites Beltline Highway, Shop Rd, and Bluff Rd), Congaree (includes sites Bicentennial Park, Granby Park, and Congaree River), and Cedar Creek. The top three most abundant fish species in our Gills Creek Watershed sampling were Redbreast Sunfish, Bluegill Sunfish and Largemouth Bass (Tables 1 and 2).

Overall, total Hg concentrations were low in fishes collected from Gills Creek Watershed sites (Table 2). For comparison, we also collected fish samples from an adjacent creek system that also drains into Congaree River, Cedar Creek. Two out of the five species that were caught in Cedar Creek had mean total Hg levels that exceeded the EPA consumption advisory threshold (Table 2). From Gills Creek Watershed sampling areas, three out of 15 species had mean values that also exceeded the EPA threshold concentration (Largemouth Bass from Crowson and Bluff; Warmouth from Bluff; Yellow Perch from Congaree; Table 2).

Figure 1. Map of the fish sample collection sites.

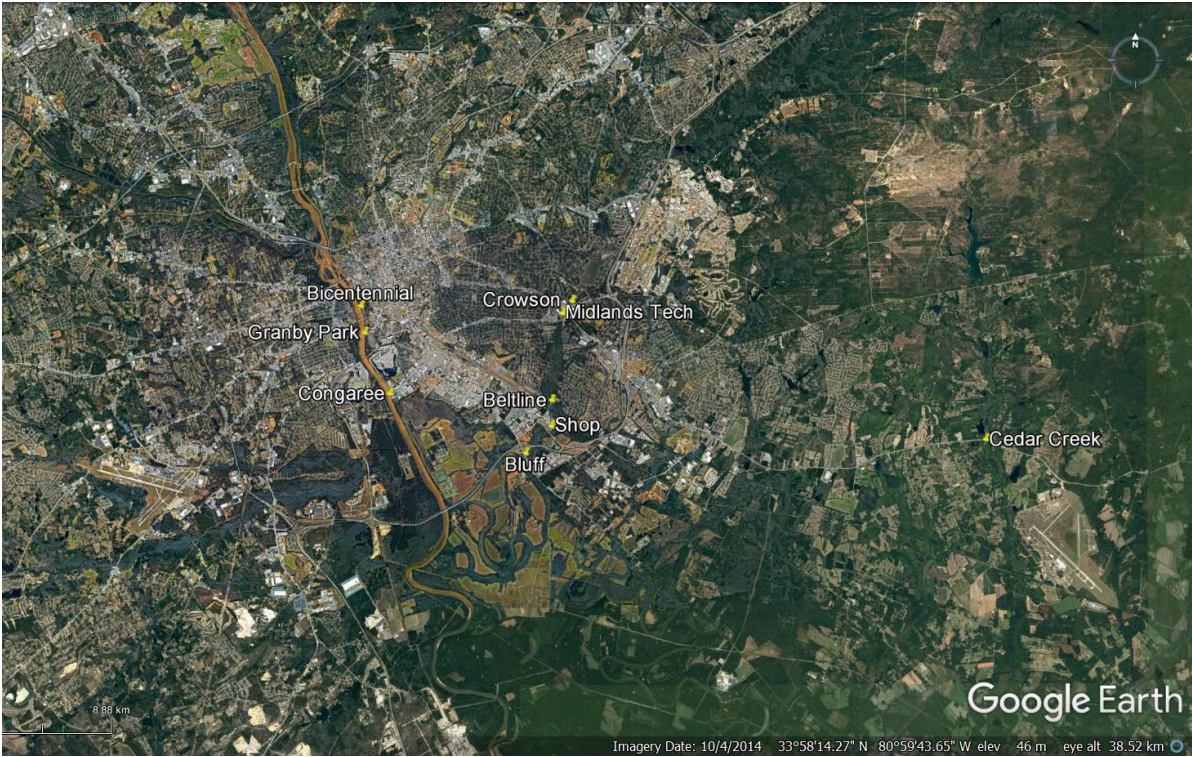


Table 1. Summary of fish species sample collections from all sites relating to the Gills Creek Watershed. Blue highlights indicate that a species is one of the top three most abundant species to be caught across the Gills Creek Watershed sampling areas.

Species	Crowson Rd	Midlands Tech	Bluff Rd	Beltline Highway	Shop Rd	Congaree River	Bicentennial Park	Granby Park	Cedar Creek
Cyprinidae (Minnows)									
Golden Shiner <i>Notemigonus crysoleucas</i>				1					
Ictaluridae (Catfishes)									
Blue Catfish <i>Ictalurus furcatus</i>						1			
Flathead Catfish <i>Pylodictis olivaris</i>								1	
Esocidae (Pickerels)									
Redfin Pickerel <i>Esox americanus</i>									1
Chain Pickerel <i>Esox niger</i>						1			
Moronidae (Temperate Basses)									
White Perch <i>Morone americana</i>						3	2	1	
Centrarchidae (Sunfishes)									
Bluespotted Sunfish <i>Enneacanthus gloriosus</i>									1
Redbreast Sunfish <i>Lepomis auritus</i>	8	21	21	1	14	77		1	
Pumpkinseed Sunfish <i>Lepomis gibbosus</i>	2	5	12				3	2	

Species	Crowson Rd	Midlands Tech	Bluff Rd	Beltline Highway	Shop Rd	Congaree River	Bicentennial Park	Granby Park	Cedar Creek
Warmouth <i>Lepomis gulosus</i>				1					
Bluegill Sunfish <i>Lepomis macrochirus</i>	40	79	17	61	38	53	1		13
Dollar Sunfish <i>Lepomis marginatus</i>		5			1				10
Redear Sunfish <i>Lepomis microlophus</i>						11			
Spotted Sunfish <i>Lepomis punctatus</i>		1							
Largemouth Bass <i>Micropterus salmoides</i>	9	8	1	31	4	5		1	1
Black Crappie <i>Pomoxis nigromaculatus</i>	2	4		8			3		
Percidae (Darters and Perches)									
Yellow Perch <i>Perca flavescens</i>	4		2			4			

Table 2. Summary of fish sample size ranges and mean Hg concentrations (ppm – mg/kg) by sampling area for each species. Cedar Creek is near Gills Creek Watershed sites, but represents a different kind of creek system and was sampled in order to provide a comparison with the Gills Creek sites. Blue highlights indicate that a species is one of the top three most abundant species to be caught across the Gills Creek Watershed sampling areas. Yellow highlights indicates that the mean Hg concentration for a particular species was above the EPA advisory threshold of 0.30 ppm.

Species	Crowson		Bluff		Congaree		Cedar Creek	
	Size Range TL mm	Hg ppm (no. of samples)	Size Range TL mm	Hg ppm (no. of samples)	Size Range TL mm	Hg ppm (no. of samples)	Size Range TL mm	Hg ppm (no. of samples)
Golden Shiner <i>Notemigonus crysoleucas</i>			155	0.26 (1)				
Blue Catfish <i>Ictalurus furcatus</i>					821	0.04 (1)		
Flathead Catfish <i>Pylodictis olivaris</i>					492	0.23 (1)		
Redfin Pickerel <i>Esox americanus</i>							158	0.24 (1)
Chain Pickerel <i>Esox niger</i>					325	0.13 (1)		
White Perch <i>Morone americana</i>					121-292	0.09 (6)		
Bluespotted Sunfish <i>Enneacanthus gloriosus</i>							50	0.48 (1)
Redbreast Sunfish <i>Lepomis auritus</i>	72-179	0.17 (29)	36-178	0.17 (35)	44-160	0.05 (54)		

Species	Crowson		Bluff		Congaree		Cedar Creek	
	Size Range TL mm	Hg ppm (no. of samples)	Size Range TL mm	Hg ppm (no. of samples)	Size Range TL mm	Hg ppm (no. of samples)	Size Range TL mm	Hg ppm (no. of samples)
Pumpkinseed Sunfish <i>Lepomis gibbosus</i>	131-198	0.16 (7)	45-90	0.15 (10)	150-181	0.11 (5)		
Warmmouth <i>Lepomis gulosus</i>			193	0.44 (1)				
Bluegill Sunfish <i>Lepomis macrochirus</i>	60-217	0.12 (118)	35-193	0.18 (108)	65-191	0.07 (52)	59-112	0.22 (12)
Dollar Sunfish <i>Lepomis marginatus</i>	71-98	0.07 (5)	71	0.18 (1)			49-73	0.22 (10)
Redear Sunfish <i>Lepomis microlophus</i>					84-225	0.08 (9)		
Spotted Sunfish <i>Lepomis punctatus</i>	103	0.20 (1)						
Largemouth Bass <i>Micropterus salmoides</i>	117-464	0.40 (17)	102-413	0.45 (36)	61-371	0.18 (6)	98	0.55 (1)
Black Crappie <i>Pomoxis nigromaculatus</i>	92-179	0.09 (6)	181-205	0.25 (8)	131-177	0.09 (3)		
Yellow Perch <i>Perca flavescens</i>			88-97	0.09 (2)	220-274	0.37 (4)		

The three most abundant species collected (Redbreast Sunfish, Bluegill Sunfish, and Largemouth Bass, all popular foodfish species in South Carolina) had increasing total Hg concentrations with age (Figures 2-4). Redbreast Sunfish collected from Gills Creek sites, reached a maximum age of 4 yr. Overall, Hg levels were low in this species; 0% of fish collected from the Congaree sampling area had Hg levels above the EPA threshold (Figure 2). The Bluff and Crowson sampling areas had less than 3% and 7% of fish samples with Hg concentrations exceeding the EPA threshold level, respectively (Figure 2). Bluegill Sunfish collected from the Gills Creek Watershed sites reached a maximum age of 5 yr. For Congaree samples, 0% exceeded the EPA threshold concentration (Figure 3). For Crowson and Bluff sites, less than 2% of Bluegill samples collected exceeded the EPA threshold value. Largemouth Bass samples from the Gills Creek Watershed sites reached a maximum age of 6 yr. The majority of Largemouth Bass collected exceeded the EPA Hg consumption advisory threshold level (Figure 4).

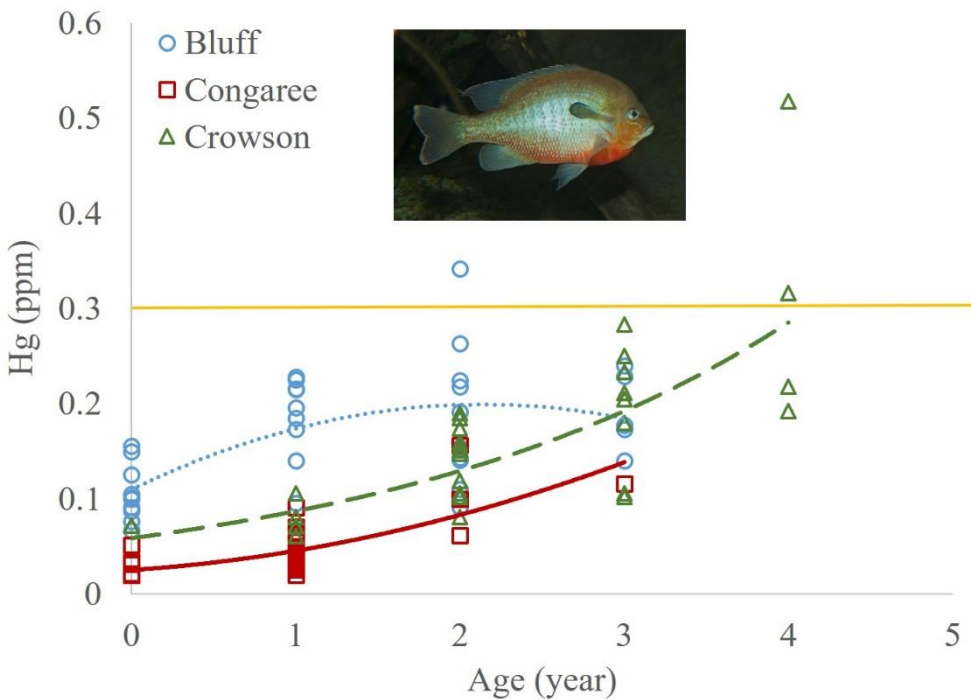


Figure 2. The relationship between Redbreast age and total Hg concentration. Note that the EPA Hg concentration consumption threshold level is denoted by an orange line. Total Hg concentration increased with fish age for Redbreast collected from the three main sampling areas in Gills Creek Watershed. Overall, total Hg levels were low in Redbreast Sunfish with over 97% of fish collected having Hg concentrations less than the EPA threshold level.

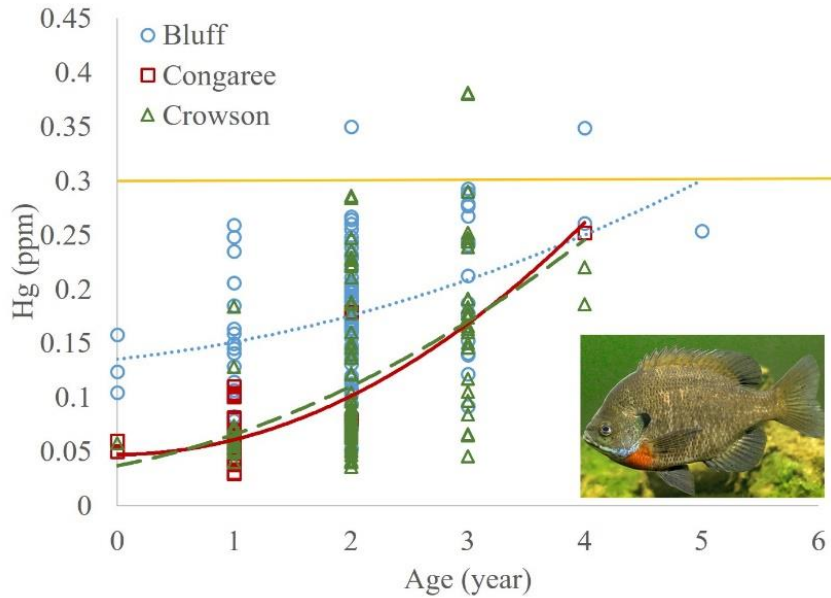


Figure 3. The relationship between Bluegill age and total Hg concentration. Note that the EPA Hg concentration consumption threshold level is denoted by an orange line. Total Hg concentration increased with fish age for Bluegill collected from the three main sampling areas in Gills Creek Watershed. Overall, total Hg levels were low in Bluegill Sunfish with over 98% of fish collected having Hg concentrations less than the EPA threshold level.

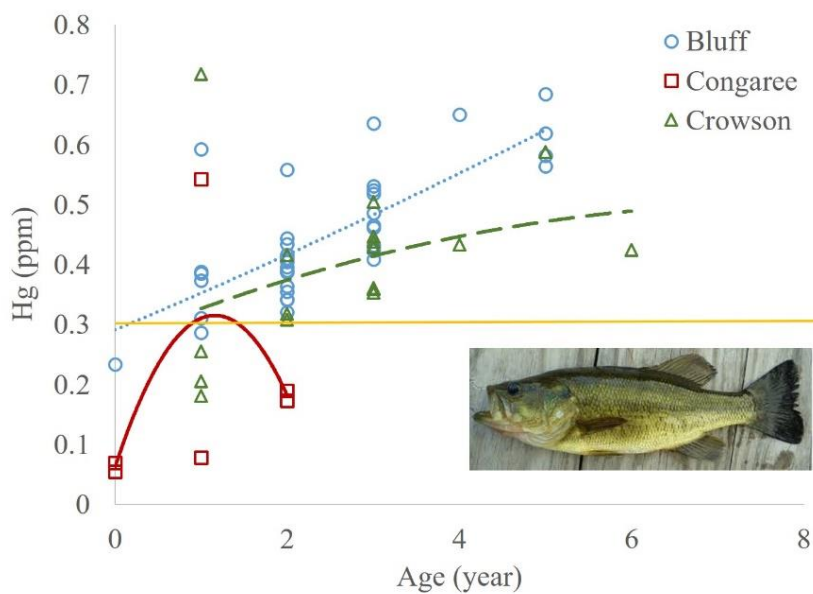


Figure 4. The relationship between Largemouth Bass age and total Hg concentration. Note that the EPA Hg concentration consumption threshold level is denoted by an orange line. Total Hg concentration increased with fish age for Largemouth Bass collected from the three main sampling areas in Gills Creek Watershed. Overall, total Hg levels were higher in Largemouth Bass with 83% of fish collected having Hg concentrations higher than the EPA threshold level.

A few other studies from the eastern USA have reported on the total Hg concentrations in Bluegill and Redbreast sunfishes and the results of those studies are summarized in Table 3. Redbreast Sunfish from Gills Creek Watershed had the lowest mean Hg concentration compared to the other studies, although the mean size of fish was also smaller in the current study. Bluegill Sunfish from Gills Creek had a mean Hg concentration lower than most of the other studies from this region (Table 3). Both of these species, in general, have low levels of Hg and are often listed as safe for consumption when considering Hg concentrations.

Table 3. Comparison of total Hg concentrations for Bluegill and Redbreast that have been published for other areas in the eastern USA.

Species	Location and Aquatic habitat	Sampling period (sample number)	Mean Hg ppm (range)	Mean size (range)	Mean age (range)	Source
Redbreast Sunfish	Savannah River, southeastern US; Main river channel	Late 1990s (n = 35)	0.13 (max: 0.63)	Mean wt = 126 g	Not reported	Burger et al. 2001
	Across the state of SC	1993-2007 (n = 656)	0.27 (max: 2.4)	Mean TL = 190 mm	Not reported	Glover et al. 2010
	Across the state of NC	1990-2006 (n = 57)	0.19 (0.02-0.58)	Mean TL = 185 mm	Not reported	Sackett et al. 2009
	Gills Creek Watershed Columbia, SC	2016 (n = 118)	0.11 (0.02-0.52)	Mean TL = 102 mm	1 yr	Current Study
Bluegill Sunfish	Savannah River, southeastern US; Main river channel	Late 1990s (n = 30)	0.14 (max: 0.67)	Mean wt = 162 g	Not reported	Burger et al. 2001
	Across the state of SC	1993-2007 (n = 1625)	0.22 (max: 2.4)	Mean TL = 197 mm	Not reported	Glover et al. 2010
	NC; six different lakes	Mar-Apr 2010 (n = 90)	0.09 (0.05-0.18)	Mean TL ~ 150 mm	~3 yr	Sackett et al. 2010
	Across the state of NC	1990-2006 (n = 128)	0.17 (0.01-0.54)	Mean TL = 181 mm	Not reported	Sackett et al. 2009
	Reservoirs across MD	2000-2001 (n = 94)	Range of means: 0.04-0.10	Range of mean wt: 78-129 g	Not reported	Sveinsdottir and Mason 2005
	Gills Creek Watershed Columbia, SC	2016 (n = 278)	0.13 (0.03-0.38)	Mean TL = 127 mm	2 yr	Current Study

Burger, J., Gaines, K.F., Boring, C.S., Stephens, W.L., Snodgrass, J. and Gochfeld, M., 2001. Mercury and selenium in fish from the Savannah River: species, trophic level, and locational differences. *Environmental Research*, 87(2), pp.108-118.

Glover, J.B., Domino, M.E., Altman, K.C., Dillman, J.W., Castleberry, W.S., Eidson, J.P. and Mattocks, M., 2010. Mercury in South Carolina fishes, USA. *Ecotoxicology*, 19(4), pp.781-795.

Sackett, D.K., Aday, D.D., Rice, J.A. and Cope, W.G., 2009. A statewide assessment of mercury dynamics in North Carolina water bodies and fish. *Transactions of the American Fisheries Society*, 138(6), pp.1328-1341.

Sackett, D., Cope, W., Rice, J., Aday, D., 2013. The influence of fish length on tissue mercury dynamics: implications for natural resource management and human health risk. *International journal of environmental research and public health* 10.2: 638-659.

Sveinsdottir, A.Y. and Mason, R.P., 2005. Factors controlling mercury and methylmercury concentrations in largemouth bass (*Micropterus salmoides*) and other fish from Maryland reservoirs. *Archives of environmental contamination and toxicology*, 49(4), pp.528-545.

Moving Forward and Lessons Learned

Although the results of the fish sampling concluded mercury levels were lower than expected in the fish of Gills Creek, there is at least one species of concern that is targeted by fishers in Gills Creek – largemouth bass. This information, along with information on safe consumption levels and the effects of mercury on human health, has already been shared with the community through the public meetings. GCWA will continue this education and outreach with our project partner, the Bible Way Church of Atlas Road. GCWA will also share these results with South Carolina Department of Health and Environmental Control so they can continue fish sampling in Lower Gills Creek and, if necessary, establish an official fish consumption advisory on that stretch of creek. GCWA representatives will also be talking with fishers, one-on-one, and sharing the printed materials so that everyone fishing on Gills Creek understands the potential risks associated with eating largemouth bass.

This project helped the GCWA open up new lines of communication with an underserved population in the Gills Creek Watershed. However, we did experience difficulty getting some of the fishers to participate in the surveys at the beginning of the project. In some cases it seemed the fishers were skeptical of the surveyors' intentions or thought the surveyor was some type of law enforcement or regulator. We did complete enough fisher surveys to understand where the fishing hot-spots are located, what fish are being targeted, and how much of the catch is being consumed. However, we did not receive as many fully completed surveys as we originally intended.

Fisher attendance at the two public meetings was also an issue. We did not have the attendance numbers we expected at either of the public meetings and none of the fishers we surveyed were present. This is likely because most of the fishers we spoke with had limited transportation options. In many cases, these fishers relied on the public bus system to get to and from Gills Creek. Future education and outreach efforts will target neighborhood meetings. We will also be reaching out to the local bait shops and speaking one-on-one with the fishers on Gills Creek.

Fishing in Gills Creek remains a viable option for both recreational and subsistence fishers. The most frequently caught fish, the bluegill, does not contain a deleterious amount of mercury. One of our key messages is that bluegill is okay to eat without any consumption advisory. Fish can be a healthy source of protein, an especially important one for an underserved community such as those represented in this study. Our intent is not to scare people away from fishing in Gills Creek altogether, but to be more selective about the type of fish they are targeting and consuming.