LARGE RIVER MONITORING PROJECT: FISH SURVEYS 2016-2019

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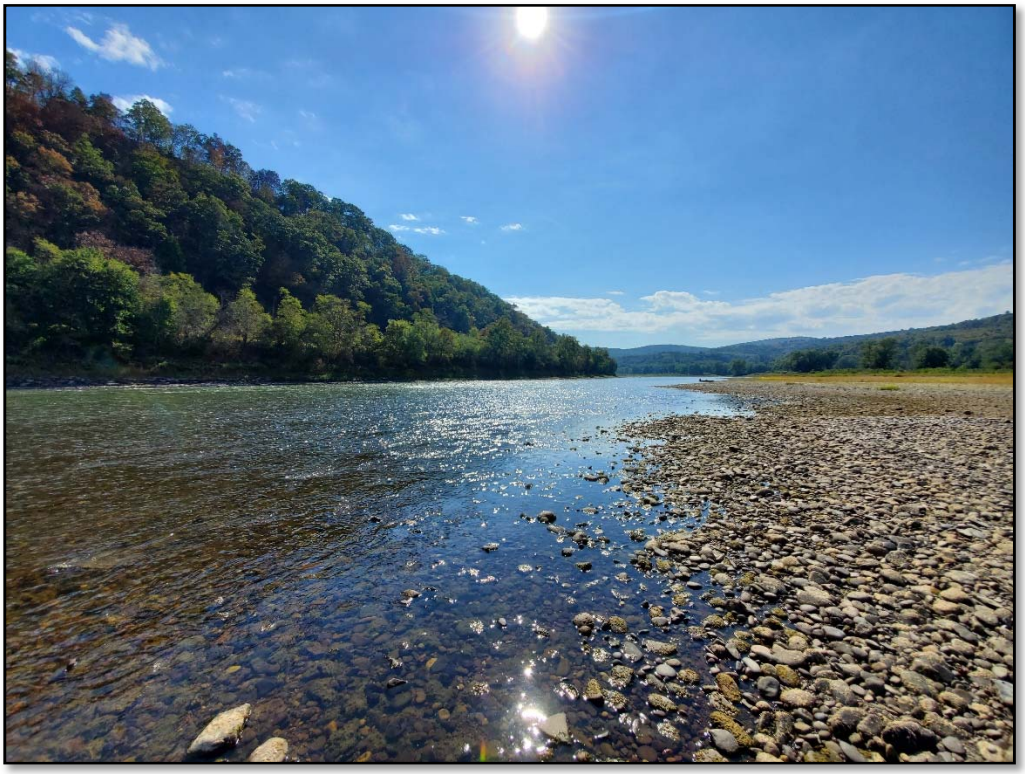

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INTRODUCTION

The Susquehanna River Basin Commission (Commission) has been monitoring the Susquehanna River and its major tributaries through the Large Rivers monitoring program since 2007. Since 2005, considerable attention has been focused on the health of the river's fish populations, particularly smallmouth bass (*Micropterus dolomieu*) as the Pennsylvania Fish and Boat Commission (PFBC) has documented previous declines in long-term population indices (Smith, 2014). In 2012, the Pennsylvania Department of Environmental Protection (PADEP) began an intensive investigation of the Susquehanna River as a result of public concern regarding the overall health of the river (Shull and Pulket, 2015). The Commission has been supportive of the efforts of PADEP, lending technical, analytical, and quality assurance/quality control assistance throughout the development and execution of their studies. The Commission actively seeks to assist and support its member jurisdictions in any identified areas of need. Through consultation with PFBC and PADEP, the upper 250 miles of the mainstem Susquehanna River has been identified as an area in need of routine monitoring. As a result, the Commission focused its Large River monitoring in this region to complement other agency efforts to study smallmouth bass while assessing an understudied portion of the Basin.

STUDY AREA & HABITAT

The Susquehanna River originates from Lake Otsego in Cooperstown, NY, and flows for 89 miles in a south-southwest direction before entering Pennsylvania near Lanesboro, PA. For 15 miles (from RM 355 to RM 340), the river flows through Pennsylvania past Oakland, Hallstead, and Great Bend before turning north and re-entering New York near Conklin, NY. The Susquehanna then flows in a generally westward direction across the southern tier of New York through the metropolitan 'triple cities' of Binghamton, Johnson City, and Endicott. In Binghamton near RM 328, a major tributary, the 90-mile long Chenango River, enters and contributes an additional 60 percent of river flow. The Susquehanna then proceeds west-southwest before making a sharp turn due south near Barton, NY, and re-entering Pennsylvania near Waverly, PA. Immediately below Waverly, the Chemung River enters and contributes nearly 2,600 square miles of additional drainage area from western New York. From Waverly, the river meanders southeast towards the Scranton/Wilkes-Barre area before turning west and eventually arriving at its confluence with the West Branch Susquehanna River. Although lacking an official designation, this reach is commonly referred to as the "North Branch Susquehanna River" and contains about 41 percent of the Basin's total 27,510 square miles of drainage area.

The upper Susquehanna River has been the focus of the Large River Monitoring Project from 2016 through 2019. The Large River Project is completed annually in the late summer and early fall and involves collection of water quality, macroinvertebrate, and fish community data for various purposes. Monitoring locations were generally selected at locations with public boat access and spaced evenly across the major rivers of the Upper and Chemung subbasins. Site level challenges were frequently encountered, with sufficient water depth for safe boating often being a limiting factor. The river varies significantly in its characteristics through the study area. The site farthest upstream, SUSQ 428, is low gradient, highly forested, and still impounded by the Colliersville dam. Conversely, SUSQ 412 outside of Oneonta is a semi-wadeable riffle dominated stretch with significant areas of bedrock substrate. Sites downstream of SUSQ 383 were generally reliably boatable under most conditions but prominent riffles still occurred within proximity of the monitoring stations.

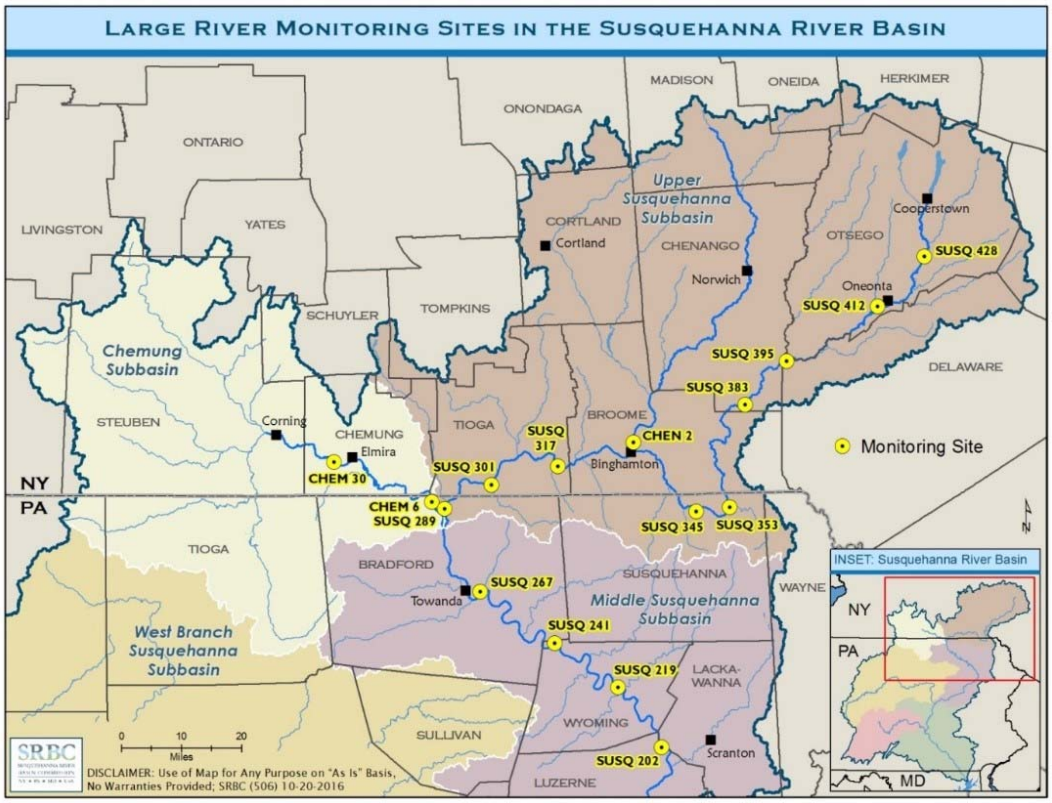

Figure 1. Monitoring Sites from 2016-2019

RESULTS

Overall Fish Community

Commission biologists surveyed fish communities at 13 of the 16 sites by boat electrofishing in the months of August and September from 2016-2019. Three sites (CHEN 2.0, SUSQ 412, and SUSQ 395) could not be sampled successfully for fish community assessment. More specifically, Commission biologists sampled best available habitat along 500 meters of shoreline at each site. Two netters worked to capture all fish observed, while an ETS electrofishing unit operated at 60 Hz and 25-percent duty cycle, with typical output ranging from 12-18 amps.

During the study period, 38 unique species were collected during 30 electrofishing events (Appendix A). Overall, diversity was relatively low for a large river system, ranging from 13 to 28 species per site. The most commonly encountered species were spotfin shiners (*Cyprinella spiloptera*), smallmouth bass, white sucker (*Catostomus commersonii*), bluegill (*Lepomis macrochrius*), and pumpkinseed sunfish (*Lepomis gibbosus*).

Smallmouth Bass

Smallmouth bass data were extracted from the fish community data collected from 2016-2019 through the completion of 34 boat-based electrofishing surveys. These surveys did not occur

at each site each year. A total of 1,208 smallmouth bass were collected, with 204 of those individuals (17 percent) displaying one or more negative health attributes, collectively denoted as DELTs. A DELT refers to any visible anomaly of the fish, namely one or more deformities, erosions, lesions, tumors, or parasites that are indicative of biological stress.

DELT proportion is a common metric found in many multi-metric indices used to address biological integrity (Emery, 2003). Generally, communities with less than 5 percent DELT occurrence are expected while many MMIs suggesting 5 to 10 percent DELTs is indicative of some environmental biostressor. An increased number of DELTs within a fish community has been associated with contaminant exposure, overcrowding, and dietary limitations.

From 2016 to 2019, DELT occurrence varied through time but remained ever present (Table 1). Similarly, DELT occurrence varied substantially at individual sites through time, but no site that was surveyed was ever perpetually free of DELT-impacted fish. Table 2 shows DELT frequency through time at routinely monitored electrofishing sites in the study area.

Table 1. Total Smallmouth Bass and DELT Occurrence at SRBC Boat Electrofishing Sites in the Upper and Chemung Subbasins

Year	# Sites	Total SMB	# DELT	% DELT
2016	5	148	48	32%
2017	13	291	83	29%
2018	6	263	19	7%
2019	10	506	54	11%
Total	**34**	**1208**	**204**	**17%**

Table 2. Annual Observed Smallmouth Bass DELT Frequency at Revisited SRBC Boat Electrofishing Sites in the Upper and Chemung Subbasins

	Waverly	Sayre	Nichols	Apalachin	Great Bend	Lanesboro
	CHEM 6	SUSQ 289	SUSQ 301	SUSQ 317	SUSQ 345	SUSQ 353
2016	-	40%	-	36%	25%	-
2017	0%	28%	50%	10%	0%	35%
2018	14%	7%	0%	10%	11%	0%
2019	27%	0%	18%	2%	0%	0%

Young-of-year Smallmouth Bass

Commission biologists also conducted juvenile smallmouth bass (or young-of-year (YOY)) surveys throughout the study area to monitor annual spawning success. Surveys were performed in July of each year by backpack electrofishing shoreline habitat where immature smallmouth bass would typically be residing. Commission biologists conducted YOY sampling by following an identical procedure as PFBC's juvenile black bass monitoring for comparability of results. No YOY sampling was performed in 2018 due to high flows during the monitoring period. These YOY smallmouth bass were measured for total length and examined for DELTs.

The average standardized capture rate of 4 fish per 50m (Table 3) was similar to PFBC's reported 5 fish per 50m long-term median for the region. The occurrence of DELTs in juvenile bass was relatively low (average of 0.14 percent) compared to the overall DELT prevalence observed by Commission biologists in the general fish population (17 percent) during the same time period (Tables 1 and 3). This very low DELT prevalence in YOY bass is consistent with the long-term PFBC observations for the region. PFBC surveyed YOY bass in the Upper Susquehanna in 2016 and found that 20 percent of the YOY had DELTs. Sampling by the Commission in 2016 in the region indicated a much lower proportion of distressed fish (2.42 percent).

Table 3. Young-of-year Smallmouth Bass Survey Results for the Chemung and Upper Susquehanna Rivers 2016-2019

Year	# sites	total n	shock time (s)	sampled length (m)	CPUE (n/min)	CPUE (n/50m)	mean length (mm)	% DELT
2016	10	206	11593	3078	0.97	3.3	66.1	2.42
2017	7	45	10645	2120	0.30	1.3	47.4	2.2
2018	0	NA	NA	NA	NA	NA	NA	NA
2019	6	321	11059	1800	1.74	8.91	41.6	0.34
Total	**23**	**572**	**33297**	**6998**	**1.03**	**4.08**	**50.9**	**0.14**

DISCUSSION

The results show a persistent 'background' level of DELT occurrence across all years of sampling. Over four years of sampling, the observed proportion of smallmouth bass with at least one DELT ranged from 7 to 32 percent. A 17-percent DELT occurrence over four years for a single species within a single watershed is notable, especially so for smallmouth in the Susquehanna. The Susquehanna River system has documented previous incidences of disease outbreak in the lower Susquehanna and Juniata Rivers (Shull and Pulket, 2015). However, the results of this study show the Upper Susquehanna and Chemung Rivers are experiencing a somewhat similar phenomenon. While the YOY fish in this study area generally appear less impacted than other regions of the Susquehanna, overall disease prevalence remains a concerning observation from the data. These results reinforce the need for continued investigation and monitoring of smallmouth bass abundance and health throughout the Susquehanna River Basin.

An examination of repeat visits to monitoring sites shows annual as well as site-specific variation in DELT occurrence. Discernable patterns in trends were limited, but a temporal component related to river flow may explain similar basinwide 'poor' years where DELT observations were consistently high across all regions. The timing of high flow events has been shown to affect year-class strength and may, to an unknown degree, impact DELT observations as well.

The study design intentionally sought to replicate the efforts of PFBC's black bass monitoring program in the understudied portion of the Susquehanna between Oneonta, NY, and Scranton, PA. Adoption of standardized sampling methods among basin states and the establishment of sentinel monitoring sites in the Upper Susquehanna and Chemung Rivers would beneficial to fisheries managers throughout the region.

REFERENCES

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Shull, Dustin and Molly Pulket. 2015. Causal Analysis of the Smallmouth Bass Decline in the Susquehanna and Juniata Rivers. Pennsylvania Department of Environmental Protection, Harrisburg, Pennsylvania.

Smith, Geoff. 2014. Susquehanna River and West Branch Susquehanna River: 2014 Young-Of-Year Black Bass Survey. Pennsylvania Fish and Boat Commission Biologist Report. Harrisburg, Pennsylvania.

APPENDIX A

Fish Species at 13 Sites (2016-2019)

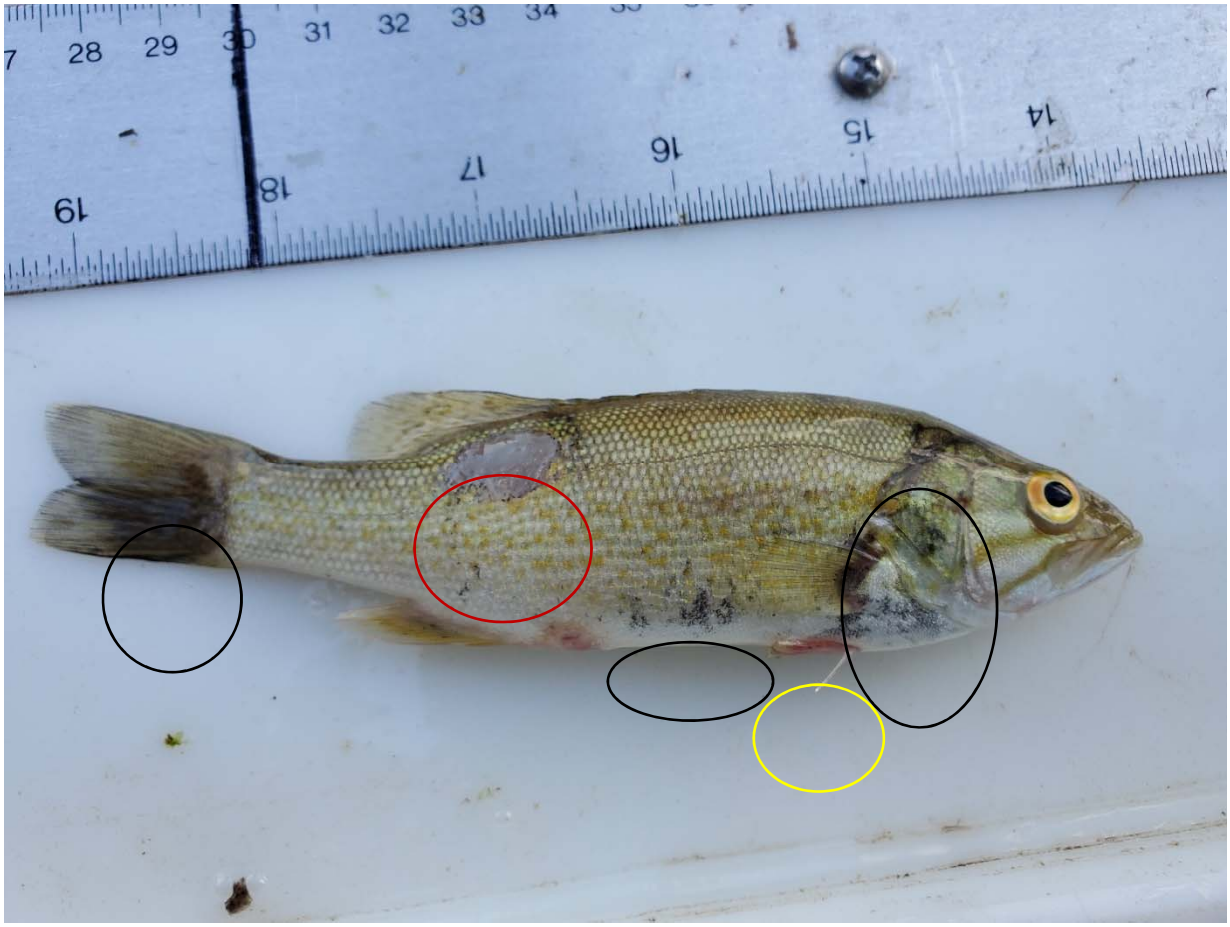
Select Sites in Upper Susquehanna and Chemung River Basins

	Locale	Elmira	S. Waverly	Portlandville	Afton	Lanesboro	Great Bend	Apalachin	Nichols	Sayre	Wysox	Laceyville	Tunkhannock	Ransom
	Site	CHEM 30	CHEM 6	SUSQ 428	SUSQ 383	SUSQ 353	SUSQ 345	SUSQ 317	SUSQ 301	SUSQ 289	SUSQ 267	SUSQ 241	SUSQ 219	SUSQ 202
Genus and Species	Common name													
Anguilla rostrata	American eel		X			X		X	X					
Carpiodes cyprinus	quillback		X					X		X		X	X	X
Catostomus commersoni	white sucker	X	X	X	X	X	X	X	X	X	X	X	X	X
Hypentelium nigricans	northern hog sucker	X			X	X	X	X	X	X	X	X	X	X
Moxostoma macrolepidotum	shorthead redhorse		X	X	X			X	X	X			X	
Ambloplites rupestris	rock bass	X	X	X	X	X	X	X	X	X	X	X	X	X
Lepomis auritus	redbreast sunfish	X	X				X	X	X	X	X	X	X	X
Lepomis cyanellus	green sunfish	X	X				X	X	X		X	X	X	X
Lepomis gibbosus	pumpkinseed	X	X	X	X	X	X	X	X		X	X	X	X
Lepomis macrochirus	bluegill	X	X	X	X	X	X	X	X	X	X	X	X	X
Micropterus dolomieu	smallmouth bass	X	X	X	X	X	X	X	X	X	X	X	X	X
Micropterus salmoides	largemouth bass			X	X	X	X	X	X	X		X	X	X
Pomoxis nigromaculatus	black crappie										X			X
Dorosoma cepedianum	gizzard shad							X					X	
Cyprinella spiloptera	spotfin shiner	X	X	X	X	X	X	X	X	X	X	X	X	X
Cyprinus carpio	common carp	X	X	X			X		X	X	X	X	X	X
Luxilus cornutus	common shiner						X							
Nocomis micropogon	river chub					X	X	X			X			
Notemigonus chrysoleucas	golden shiner			X			X							
Notropis hudsonius	spottail shiner	X			X		X	X	X	X				X
Notropis rubellus	roseyface shiner	X			X	X	X	X	X	X	X			X
Notropis volucellus	mimic shiner	X				X	X	X	X	X				X
Pimephales notatus	bluntnose minnow	X				X	X	X	X	X		X	X	X
Semotilus atromaculatus	creek chub								X					
Semotilus corporalis	fallfish	X	X	X	X	X	X	X	X	X		X	X	X
Esox lucius	northern pike					X			X	X		X	X	
Esox niger	chain pickerel			X	X	X	X	X						
Fundulus diaphanus	banded killifish	X												
Ameiurus natalis	yellow bullhead	X	X			X	X					X	X	X
Ameiurus nebulosus	brown bullhead						X							
Ictalurus punctatus	channel catfish		X					X	X	X	X	X		
Noturus insignis	margined madtom										X			
Etheostoma blennioides	greenside darter	X			X		X	X	X	X	X	X	X	
Etheostoma olmstedi	tessellated darter	X			X	X	X	X	X	X	X	X	X	X
Etheostoma zonale	banded darter	X						X		X	X	X	X	
Perca flavescens	yellow perch			X	X	X	X	X	X				X	
Percina peltata	shield darter	X			X		X	X	X	X				X
Sander vitreus	walleye		X		X	X	X	X		X	X	X	X	

APPENDIX B

Photo Documentation of Select DELTs (2016-2019)

Upper Susquehanna and Chemung River Basins

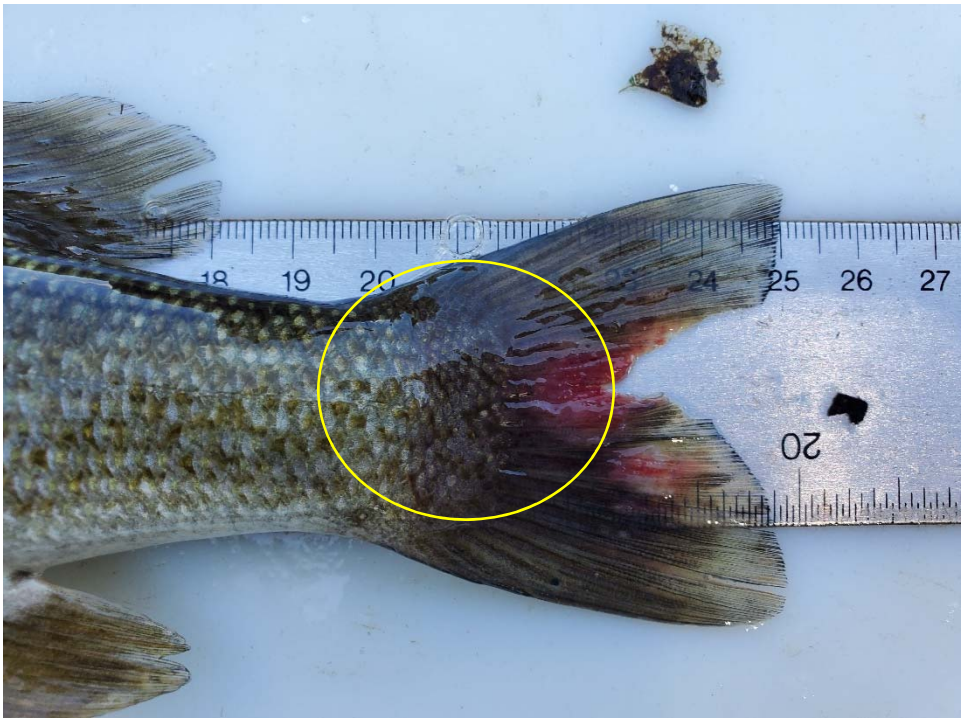


Multiple DELTs present on a young-of-year smallmouth bass collected from the Susquehanna River at Nichols, NY (August 21, 2019). Open wound and scale loss on posterior of dorsum (red), near complete fin erosion (yellow) of the pelvic fins. Melanistic spotting (black) is present on the caudal fin, nape, and abdomen.

Extreme example of fungal growth coating the entire anterior portion of the head of a sub-adult (age 1-year) smallmouth bass, Susquehanna River at Sayre, PA (2016). Beneath the fungal layer was a massive open wound enveloping the entire mouth. Note the encroachment of fungal growth on the otherwise unaffected portion of the eye.

Two visible DELTs in this sub-adult smallmouth bass from the Susquehanna River near Tunkhannock (August 2019). Fungal growth (gray) developing on the eroded edge of opercele consistent with prior observations of apparent fungus establishing on open wounds.

Adult smallmouth bass with caudal fin erosion captured from the Chemung River (August 22, 2019)



Close up photo of erosion of the caudal fin (August 22, 2019)

Melanistic spotting on the upper and lower jaws (black) of an adult smallmouth bass from the Susquehanna River at Tunkhannock, PA (August 30, 2017)

Hemorrhage (white) in left eye of adult smallmouth bass collected at Nichols, NY (2019)