

Conewago Creek Initiative



The Conewago Creek Revisited Fish Survey Report

A compilation of historic fish survey data from 1972, 1973, 2007, 2012, and 2015 for three locations along the Conewago Creek

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July 2015

I. Background

This report highlights and compares fish survey data gathered from historic fish surveys of the Conewago Creek that were completed in 1972, 1973, June of 2007, June and October of 2012, and June 2015. The data collected in the 1970's was completed by York College of Pennsylvania. The 2007 survey was performed by the Tri-County Conewago Creek Association. The 2012 and 2015 surveys were coordinated by the Conewago Creek Initiative.

The Conewago Creek flows through Dauphin, Lebanon and Lancaster Counties of Pennsylvania before joining with the Susquehanna River. The Hershey Meadows sampling site is located between Route 283 and Route 743 and has been sampled all five years. Beginning in 2012, a sampling location was selected closer to the headwaters. This site is located within State Game Lands 145 across from Fieldcrest Drive. In the 1970's surveys, the sample site near the mouth of the Conewago was located on the section of stream that parallels Hillsdale Rd. In 2007, this sample site was moved further downstream to where Covered Bridge Rd crosses the Conewago. In summary, the current sample locations are at Hershey Meadows, State Game Lands 145, and Covered Bridge Rd (See the Appendix for maps and exact coordinates of the start and end locations).

Routine fish sampling is an essential component of ongoing monitoring to gauge effectiveness of restoration projects and overall water quality in the Conewago Creek Watershed. The provided data compares the number of species present in each of the five survey years at the locations that were surveyed, the number of species per fish family, the tolerance of the species identified, and the trophic level of each fish species. The method of fishing included electrofishing and seine netting for the 1972 and 1973 surveys, and electrofishing for 2007, 2012, and 2015 surveys. Two additional sites were sampled prior to 2012, however with the formation of the Conewago Creek Initiative in 2009 a monitoring plan was developed that eliminated those locations (near Koser Road and near Hertzler Road) and added the headwater site to create a more comprehensive monitoring plan for the entire watershed. The data from these additional surveys will not be included in this report.

The tolerance and trophic levels used in this report were compiled by RETTEW Associates prior to the 2007 survey using the EPA Rapid Bioassessment Protocol for use in Wadeable Streams (EPA 841-B-99-002) Appendix C: Tolerance and Trophic Guilds of Selected Fish Species. Tolerance designations that identify the level to which a species can adjust to physical and chemical changes in the environment were determined by the EPA using 7 selected literature sources. These same sources were also used by the EPA to establish the trophic designations of the recorded fish species.

II. Data

Headwaters

The survey, conducted on October 21, 2012, found 16 species of fish, out of the 187 fish collected. There was 1 Darter species, 3 Sunfish species, 7 Minnow species, 2 Catfish species, 2 Sucker species, and 1 trout species. There were 4 intolerant species, 7 intermediate species and 5 tolerant species recorded.

The survey conducted on June 30, 2015 found 13 species of fish, out of the 102 fish collected. There was 1 Sunfish species, 7 Minnow species, 2 Catfish species, 1 Sucker species, and 2 perch species. There were 2 intolerant species, 6 intermediate species and 5 tolerant species recorded.

Chart 1: Results of Fish Surveys in State Game lands 145				
Species	2012	2015	Tolerance	Trophic
Cyprinidae (Carp and Minnows)				
Campostoma anomalum (Central stoneroller)	3 – 2%		Intermediate	Herbivore
Exoglossum maxillina (Cutlips minnow)	6 – 3%	9 – 9%	Intolerant	Insectivore
Luxilus cornutus (Common Shiner)		1 – 1%	Intermediate	Insectivore
Notropis procne (Swallowtail shiner)	3 – 2%		Intermediate	Insectivore
Pimephales notatus (Bluntnose minnow)		1 – 1%	Tolerant	Generalist

Rhinichthys atratulus (Blacknose dace)	20 – 11%	19 – 19%	Tolerant	Generalist
Rhinichthys cataractae (Longnose dace)	1 – 1%	40 – 40%	Intermediate	Insectivore
Semotilus atromaculus (Creek chub)	3 – 2%	2 – 2%	Tolerant	Generalist
Semotilus corporalis (Fallfish)	14 – 7%	3 – 3%	Intermediate	Generalist
Catostomidae (Suckers)				
Catostomus commersoni (White sucker)	12 – 6%		Tolerant	Generalist
Hypentelium nigricans (Northern hog sucker)	4 – 2%	17 – 17%	Intermediate	Generalist
Ictaluridae (Bullhead catfishes)				
Ameiurus nebulosus (Brown bullhead)	1 – 1%	1 – 1%	Tolerant	Generalist
Ameiurus natalis (Yellow bullhead)		1 – 1%	Tolerant	Generalist
Noturus insignis (Margined madtom)	1 – 1%		Tolerant	Generalist
Salmonidae (Trouts)				
Salmo Trutta (Brown trout)	1 – 1%		Intolerant	Piscivore
Cyprinodontidae (Killifishes)				
Fundulus 3iaphanous (Banded killifish)			Tolerant	Insectivore
Centachidae (Sunfishes)				
Lepomis gibbosus (Pumpkinseed)	104 – 56%	3 – 3%	Intermediate	Generalist
Lepomis macrochirus (Bluegill)	3 – 2%		Tolerant	Generalist
Percidae (Perches)				
Etheostoma olmstedii (Tessellated darter)		3 – 3%	Intermediate	Insectivore
Etheostoma zonale (Banded darter)	3 – 2%	1 – 1%	Intolerant	Insectivore
Other				
*Hybrid Sunfish Lepomis gibbosus X L. Macrochirus	8 – 4%		Intermediate	Generalist

Chart 1: The number of fish per species identified and the percentage of that count compared to the total number of fish identified is shown for the 2012 and the 2015 survey at State Game Lands 145. The tolerance and trophic designations of each fish species is also shown.

*The Hybrid Sunfish species was given a tolerance level of intermediate to not skew the tolerance average.

Hershey Meadows

The 1972 survey found 18 species of fish, out of the 164 fish collected. There was 1 Darter species, 5 Sunfish species, 7 Minnow species, 1 Catfish species, 2 Sucker species, 1 Pike species and 1 Killifish species. There were 2 intolerant species, 9 intermediate species and 7 tolerant species recorded.

The 1973 survey found 18 species of fish, out of the 299 fish collected. There was 1 Darter species, 5 Sunfish species, 8 Minnow species, 1 Catfish species, 1 Sucker species, 1 Pike species and 1 Killifish species. There were 2 intolerant species, 9 intermediate species, and 7 tolerant species recorded.

The 2007 survey found 12 species of fish, out of the 123 fish collected. There was 1 Darter species, 3 Sunfish species, 4 Minnow species, 1 Catfish species, 2 Sucker species, and 1 Killifish Species. There were no intolerant species, 7 intermediate species and 5 tolerant species recorded.

The survey conducted on June 28, 2012 found 24 species of fish, out of the 882 fish collected. There were 2 Darter species, 11 Minnow species, 6 Sunfish species, 2 Catfish species, 2 Sucker Species and 1 Killifish Species. There were 3 intolerant species, 15 intermediate species and 6 tolerant species recorded.

The June 30, 2015 survey found 18 species out of the 181 fish collected. There were 6 Minnow species, 6 Sunfish species, 1 Catfish species, 2 Sucker species, 1 Killifish species, and 2 Perch species. There were 3 intolerant species, 9 intermediate species, and 6 Tolerant species recorded.

Chart 2: Results of Fish Surveys in Hershey Meadows

Species	1972	1973	2007	2012	2015	Tolerance	Trophic
Cyprinidae (Carps and Minnows)							
Campostoma anomalum (Central stoneroller)				9 - 1%		Intermediate	Herbivore
Cyprinella analostana (Satinfin shiner)	4 - 2%	1 - 0%				Intolerant	Insectivore
Cyprinella spiloptera (Spotfin shiner)	44 - 27%	16 - 5%		39 - 4%		Intermediate	Insectivore
Exoglossum maxillingua (Cutlips minnow)				9 - 1%	3 - 2%	Intolerant	Insectivore
Luxilus cornutus (Common Shiner)			C	18 - 2%		Intermediate	Insectivore
Nocomis micropogen (River chub)				8 - 1%		Intermediate	Insectivore
Notemigonus crysoleucas (Golden shiner)	1 - 1%	1 - 0%				Tolerant	Omnivore
Notropis amoenus (Comely shiner)	5 - 3%	1 - 0%				Tolerant	Insectivore
Notropis hudsonius (Spottail shiner)	5 - 3%	14 - 5%	C	26 - 3%	2 - 1%	Intermediate	Insectivore
Notropis rubellus (Rosyface shiner)				135 - 15%	2 - 1%	Intermediate	Insectivore
Notropis procne (Swallowtail shiner)	25 - 15%	157 - 53%		104 - 12%	4 - 2%	Intolerant	Insectivore
Pimephales notatus (Bluntnose minnow)				3 - 0%		Tolerant	Generalist
Pimephales promelas (Fathead minnow)			P			Tolerant	Generalist
Rhinichthys atratulus (Blacknose dace)		8 - 3%	A			Tolerant	Generalist
Rhinichthys cataractae (Longnose dace)		5 - 2%				Intermediate	Insectivore
Semotilus atromaculus (Creek chub)	2 - 1%			16 - 2%	3 - 2%	Tolerant	Generalist
Semotilus corporalis (Fallfish)				6 - 1%	4 - 2%	Intermediate	Generalist
Catostomidae (Suckers)							
Catostomus commersoni (White sucker)	11 - 7%	8 - 3%	A	188 - 21%	37 - 20%	Tolerant	Generalist
Hypentelium nigricans (Northern hog sucker)	1 - 1%		P	8 - 1%	1 - 1%	Intermediate	Generalist
Ictaluridae (Bullhead catfishes)							
Ameiurus natalis (Yellow bullhead)	2 - 1%		P	1 - 0%	1 - 1%	Tolerant	Generalist
Noturus insignis (Margined madtom)		1 - 0%		1 - 0%		Intermediate	Insectivore
Esocidae (Pikes)							
Esox niger (Chain pickerel)	2 - 1%	2 - 1%				Intermediate	Piscivore
Cyprinodontidae (Killifishes)							
Fundulus diaphanus (Banded killifish)	4 - 2%	16 - 5%	C	12 - 1%	19 - 10%	Tolerant	Insectivore
Centarchidae (Sunfishes)							
Ambloplites rupestris (Rock bass)	4 - 2%	3 - 1%	P	70 - 8%	32 - 18%	Intermediate	Piscivore
Lepomis auritus (Redbreast sunfish)	29 - 18%	40 - 13%	C	35 - 4%	38 - 21%	Intermediate	Generalist
Lepomis gibbosus (Pumpkinseed)		12 - 4%		142 - 16%	15 - 8%	Intermediate	Generalist
Lepomis macrochirus (Bluegill)	3 - 2%	8 - 3%		23 - 3%	2 - 1%	Tolerant	Generalist
Micropterus dolomieu (Smallmouth bass)	5 - 3%	1 - 0%	P	17 - 2%	4 - 2%	Intermediate	Piscivore
Micropterus salmoides (Largemouth bass)				2 - 0%		Intermediate	Piscivore
Percidae (Perches)							
Etheostoma blennioides (Greenside darter)					5 - 3%	Intolerant	Insectivore
Etheostoma olmstedti (Tessellated darter)	15 - 9%	5 - 2%	P	8 - 1%	5 - 3%	Intermediate	Insectivore
Etheostoma zonale (Banded darter)				2 - 0%		Intolerant	Insectivore
Other						Intolerant	Insectivore
*Crappie species	2 - 1%					Intermediate	Generalist

Chart 2: The number of fish per species identified and the percentage of that count compared to the total number of fish identified is shown for all 4 survey years at Hershey Meadows. The tolerance and trophic designations of each fish species is also shown. Note: The 2007 fish data for Hershey Meadows was recorded as a range, rather than specific count. The data was recorded as: Present: (1-4) Common: (5-24) Abundant: (25+).

*The unknown crappie species was given a tolerance level of intermediate and trophic level of generalist to not skew the averages.

Near the Mouth

The 1972 survey found 12 species of fish, out of the 50 fish collected. There were 2 Darter species, 2 Sunfish species, 7 Minnow species, and 1 Sucker species. There was 2 intolerant species, 8 intermediate species and 2 tolerant species recorded.

The 1973 survey found 18 species of fish, out of the 640 fish collected. There were 2 Darter species, 1 Sunfish species, 12 Minnow species, 2 Catfish species, and 1 Sucker species. There were 3 intolerant species, 12 intermediate species, and 3 tolerant species recorded.

The 2007 survey found 20 species of fish, out of the 402+ fish collected. There were 4 Darter species, 4 Sunfish species, 10 Minnow species, and 2 Sucker species. There were 3 intolerant species, 15 intermediate species and 2 tolerant species recorded.

The survey conducted on October 21, 2012 found 22 species of fish, out of the 287 fish collected. There were 4 Darter species, 9 Minnow species, 6 Sunfish species, 1 Catfish species, 1 Sucker Species and 1 Killifish Species. There were 3 intolerant species, 12 intermediate species and 7 tolerant species recorded.

The June 30, 2015 survey found 18 species of fish out of the 149 fish collected. There were 8 Minnow species, 4 Sunfish species, 2 Catfish species, 1 Sucker species, and 3 Perch species. There were 3 intolerant species, 9 intermediate species, and 6 tolerant species recorded.

Chart 3: Results of Surveys Near the Mouth of the Conewago Creek

Species	1972	1973	2007	2012	2015	Tolerance	Trophic
Cyprinidae (Carps and Minnows)							
Campostoma anomalum (Central stoneroller)		1 - 0%		2 - 1%	1 - 1%	Intermediate	Herbivore
Cyprinella analostana (Satinfin shiner)	1 - 2 %					Intolerant	Insectivore
Cyprinella spiloptera (Spotfin shiner)	29 - 58%	562 - 88%	18 - 4%	98 - 34%		Intermediate	Insectivore
Exoglossum maxillingua (Cutlips minnow)		1 - 0%			5 - 3%	Intolerant	Insectivore
Luxilus cornutus (Common Shiner)			5 - 1%		2 - 1%	Intermediate	Insectivore
Nocomis micropogen (River chub)	6 - 12%	18 - 3%	12 - 3%	4 - 1%		Intermediate	Insectivore
Notropis amoenus (Comely shiner)		1 - 0%				Tolerant	Insectivore
Notropis hudsonius (Spottail shiner)	3 - 6%	1 - 0%	8 - 2%			Intermediate	Insectivore
Notropis rubellus (Rosyface shiner)	2 - 4%	5 - 1%	13 - 3%	5 - 2%	5 - 3%	Intermediate	Insectivore
Notropis procne (Swallowtail shiner)		2 - 0%	25 - 6%			Intolerant	Insectivore
Notropis volucellus (Mimic shiner)				83 - 29%	38 - 26%	Intermediate	Generalist
Pimephales notatus (Bluntnose minnow)		10 - 2%		19 - 7%	1 - 1%	Tolerant	Generalist
Rhinichthys atratulus (Blacknose dace)	1 - 2%	1 - 0%	1 - 0%			Tolerant	Generalist
Rhinichthys cataractae (Longnose dace)		9 - 1%	15 - 4%	7 - 2%	25 - 17%	Intermediate	Insectivore
Semotilus atromaculus (Creek chub)				4 - 1%	6 - 4%	Tolerant	Generalist
Semotilus corporalis (Fallfish)	1 - 2%	2 - 0%	18 - 4%	6 - 2%		Intermediate	Generalist
Catostomidae (Suckers)							
Catostomus commersoni (White sucker)	2 - 4%		6 - 1%	5 - 2%	4 - 3%	Tolerant	Generalist
Hypentelium nigricans (Northern hog sucker)		2 - 0%	10 - 2%			Intermediate	Generalist
Ictaluridae (Bullhead catfishes)							
Ameiurus natalis (Yellow bullhead)				7 - 2%	7 - 5%	Tolerant	Generalist

Ameiurus nebulosus (Brown bullhead)					1 - 1%	Tolerant	Generalist
Ictalurus punctatus (Channel catfish)		1 - 0%				Intermediate	Piscivore
Noturus insignis (Margined madtom)		4 - 1%				Intermediate	Insectivore
Cyprinodontidae (Killifishes)							
Fundulus diaphanus (Banded killifish)				1 - 0%		Tolerant	Insectivore
Centachidae (Sunfishes)							
Ambloplites rupestris (Rock bass)			12 - 3%	9 - 3%	8 - 5%	Intermediate	Piscivore
Lepomis auritus (Redbreast sunfish)	1 - 2%	7 - 1%	3 - 1%	7 - 2%	2 - 1%	Intermediate	Generalist
Lepomis cyanellus (Green sunfish)				14 - 5%		Tolerant	Generalist
Lepomis gibbosus (Pumpkinseed)			14 - 3%	5 - 2%		Intermediate	Generalist
Lepomis macrochirus (Bluegill)				1 - 0%	1 - 1%	Tolerant	Generalist
Micropterus dolomieu (Smallmouth bass)	1 - 2%		7 - 2%	3 - 1%	7 - 5%	Intermediate	Piscivore
Percidae (Perches)							
Etheostoma blennioides (Greenside darter)				1 - 0%	17 - 11%	Intolerant	Insectivore
Etheostoma olmstedii (Tessellated darter)	2 - 4%	11 - 2%	25 - 6%	2 - 1%	17 - 11%	Intermediate	Insectivore
Etheostoma zonale (Banded darter)			6 - 1%	2 - 1%	2 - 1%	Intolerant	Insectivore
Stizostedion vitreum (Walleye)			2 - 0%			Intermediate	Piscivore
Other							
shield darter	1 - 2%	2 - 0%	2 - 0%	2 - 1%		Intolerant	Insectivore
*Cyprinella species			200- 50%			Intermediate	Insectivore

Chart 3: The number of fish per species identified and the percentage of that count compared to the total number of fish identified is shown for all 4 survey years near the mouth of the Conewago Creek. The tolerance and trophic designations of each fish species are also shown.

*The unknown Cyprinella species was given a tolerance level of intermediate to not skew the tolerance average.

III. Discussion

Fish survey results are compared to all available historical fish sample data in order to show changes in species diversity and tolerance. Since 2012 was the first year sampling was conducted close to the headwaters, older historical data is not available for comparison at that site.

The 2015 survey was conducted after significant rainfall. The month of June recorded 6.84 inches of rain with 1.54 inches of that during the week of June 21, 2015-June 27, 2015. Regardless of the consistent rain fall during the season, researchers felt that the survey needed to be done at this time, despite the conditions, if it was to be completed during the spring of 2015. At the Hershey Meadows and Mouth locations the water was muddy and difficult to see the fish. This could be an explanation for the downward trend in species numbers, especially the minnows which are small and difficult to see in muddy water.

Headwaters

For the first time since beginning sampling, headwaters data is available to compare. The following charts display various data from 2012 and 2015. Figure 1 compares the number of fish species per family identified at the Headwaters site for the 2012 and 2015 surveys. Minnow species stayed stable at 7, while Sunfish and Sucker species both dropped in 2012. Perch species increased in the 2015 survey, while Trout species were not found.

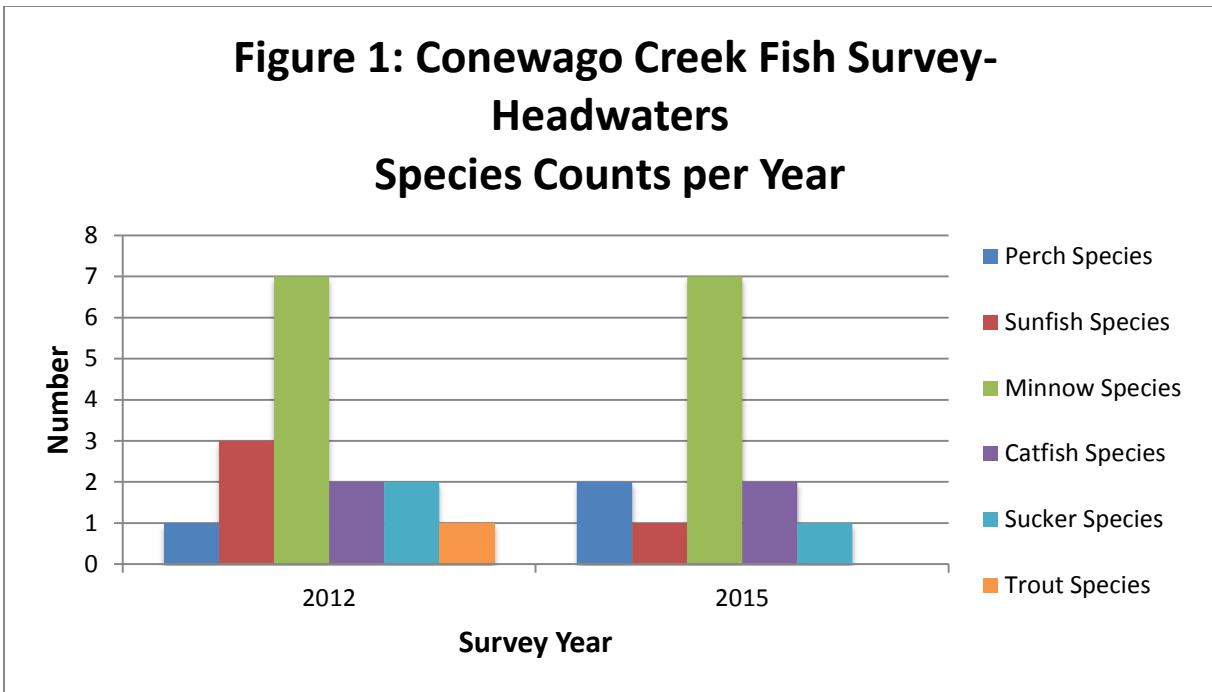


Figure 1: This graph compares the type and number of species within each family found at the headwaters site from the 2012 and 2015 surveys.

Figure 2 shows the number of fish per tolerance level found in the Headwaters from 2012 and 2015. Overall two fewer species were found in 2015 and they both happened to be intolerant species. Intolerant species are signs of good stream health because it means that stream temperature and chemical composition are at healthy and stable levels.

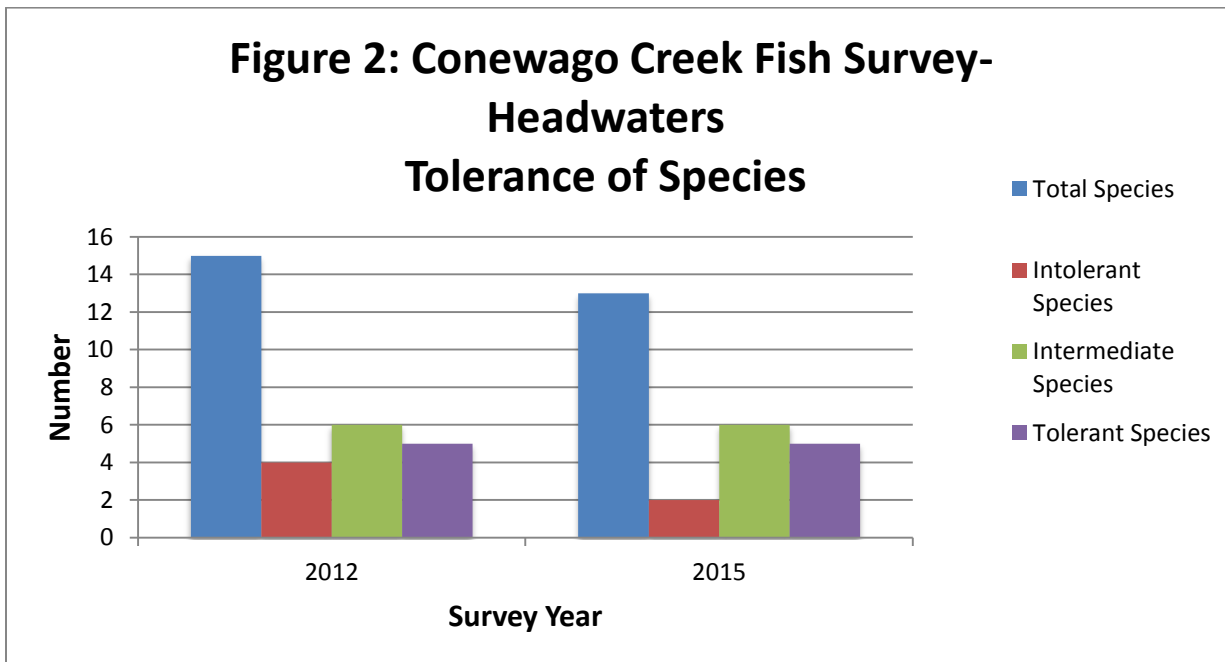


Figure 2: This graph compares the number species per tolerance levels at the headwaters site from the 2012 and 2015 surveys.

Fish can also act as indicators of stream health based on the diets of the species present. Omnivores and generalist feeders can survive on many different food sources while insectivores need to have specific types and amounts of aquatic insects to eat. Macroinvertebrates are very good indicators of stream health and their presence is determined by the water quality and habitat provided by the stream. It suggests then that if a greater abundance and variety of insect eating fish are present in the stream that there is a healthier macroinvertebrate population and a higher quality stream environment. Figure 3 compares the number of fish in each trophic level at the Headwaters in 2012 and 2015. During the 2015 survey, no piscivores or herbivores

were identified. Since fewer fish and fish species were identified this year, and numbers of fish in these trophic levels were small in 2012, it is hard to say whether habitat has changed or whether sampling missed certain trophic levels during 2015. In 2012 the two fish species that accounted for these trophic levels were Central Stonerollers and stocked Brown Trout.

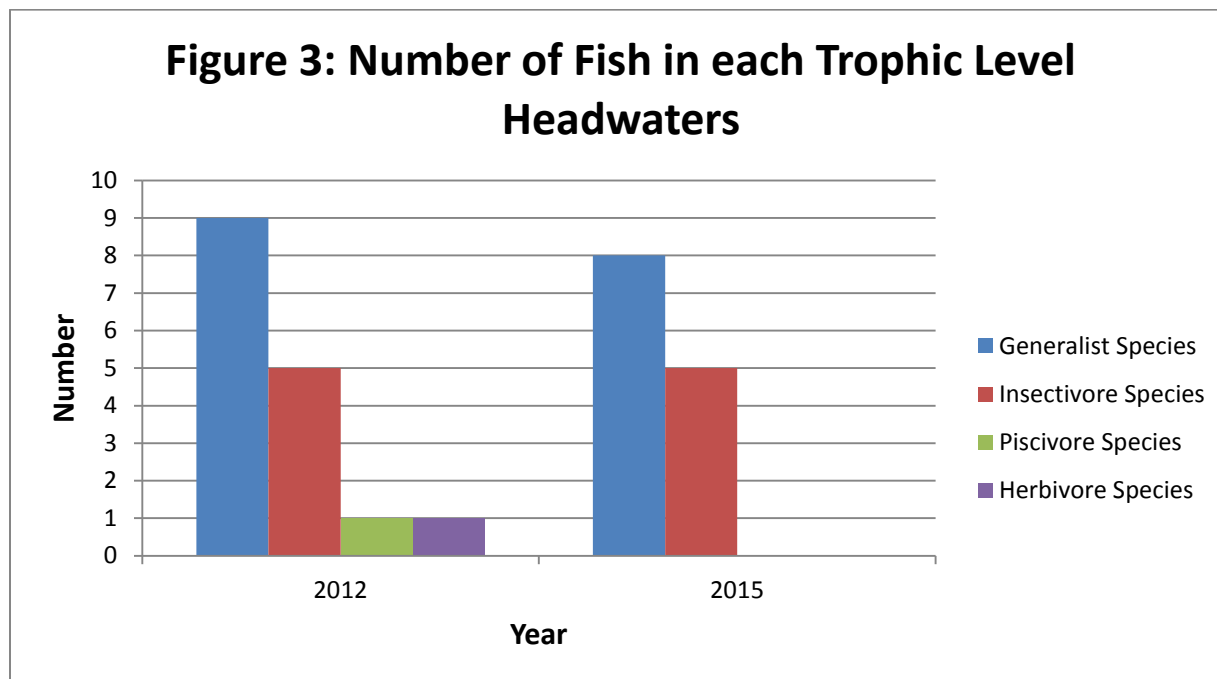


Figure 3: This graph compares the number of fish in each trophic level at the headwaters site from the 2012 and 2015 surveys.

Hershey Meadows

The section of the Conewago Creek referred to as Hershey Meadows underwent a stream restoration project that began in 2009 on Hershey Trust Property. This project was designed to repair nearly a mile of eroded stream banks and 15 acres of wetlands. The restoration was led by the U.S. Fish and Wildlife Service and the Tri-County Conewago Creek Association. On this site, steep banks were leveled out and log and rock structures were installed to increase fish habitat and stabilize the banks. Wetlands were restored in the floodplain to increase the site's infiltration capacity and reduce pollutants entering the stream. Twenty acres of native trees and shrubs were planted alongside the stream to create a forest buffer. The 2012 fish survey was the first survey to be conducted at this site following the completed restoration.

It appears from these results that the restoration project has been effective at increasing the diversity, abundance, and intolerance of fish in this section of stream. The total number of species caught at this site doubled from 2007 to 2012 suggesting an increase in diversity of fish species. Figure 4 demonstrates that diversity has remained high since the restoration project was completed with 24 species recorded in 2012 and 17 species recorded in 2015. A decrease in minnow species was observed during the 2015 survey, likely attributable to the muddy water.

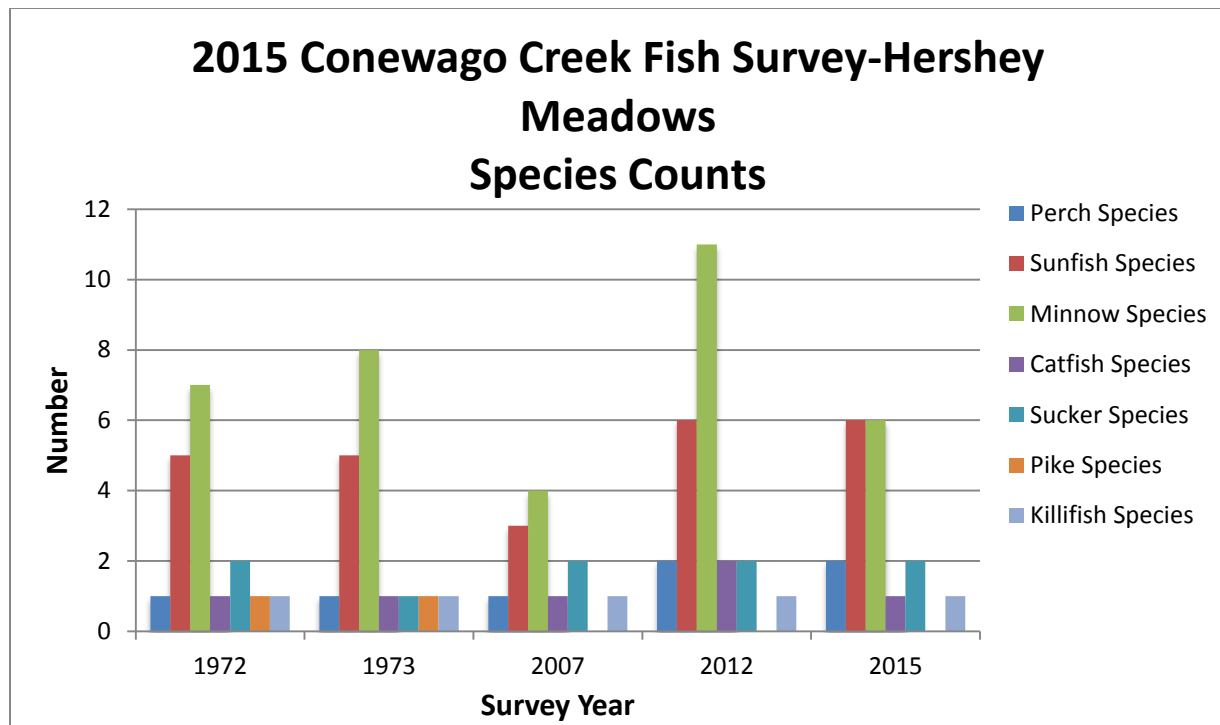


Figure 4: This graph compares the number of species within each family for the 5 years that sampling occurred at Hershey Meadows.

The number of intolerant species has remained at 2012 levels as can be seen in Figure 5. This could be tied to an improvement in stream health due to the restoration project. Length of stream and time spent sampling is unknown for the years prior to 2012 which makes it difficult to compare results, but the extreme increase in number of fish collected (less than 300 in previous years to almost 900 in 2012) suggests that the abundance of fish at this site has also increased since the fish habitat structures were installed.

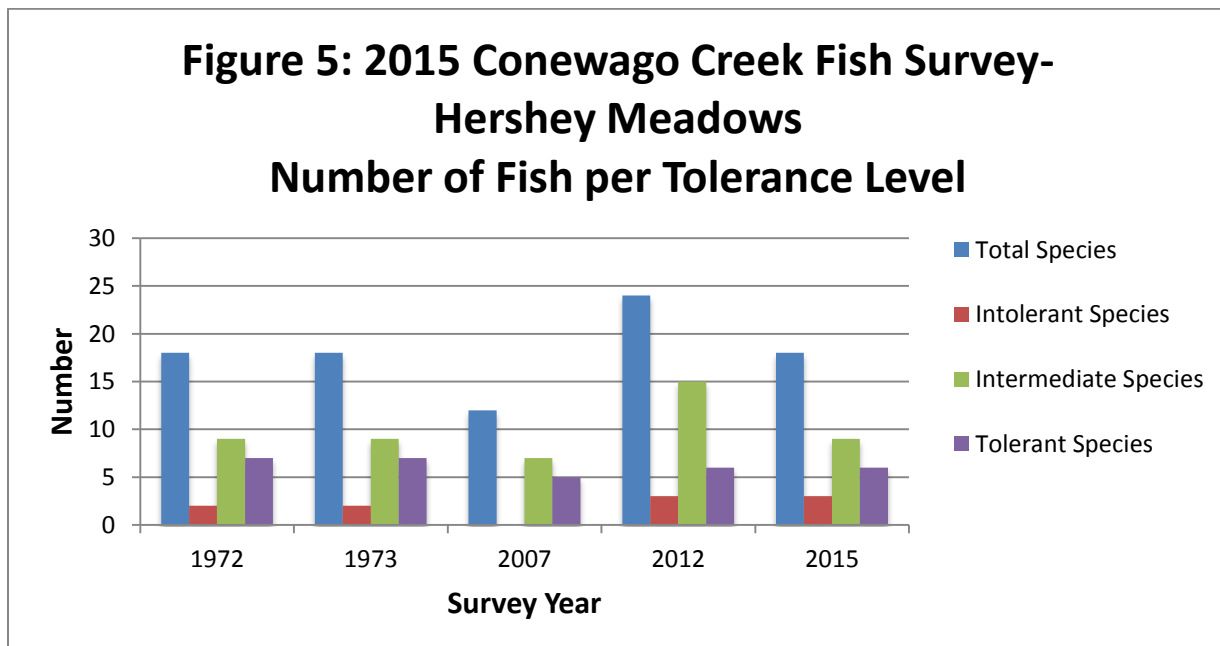


Figure 5: This graph shows the number of fish from Hershey Meadows identified as either tolerant, intermediate, or intolerant during the 5 sample years.

Figure 6 shows that there was a shift from a population dominated by generalists in 2007 to a population dominated by insectivores in 2012. This switch in dominate trophic level could be demonstrating an improvement in macroinvertebrate habitat and water quality. In 2015 insectivore population dropped but remained above 2007 levels. Generalists are back to being the dominate trophic level, but the increase in fish

species diversity suggests that macroinvertebrate habitat has remained healthier since the restoration project was installed.

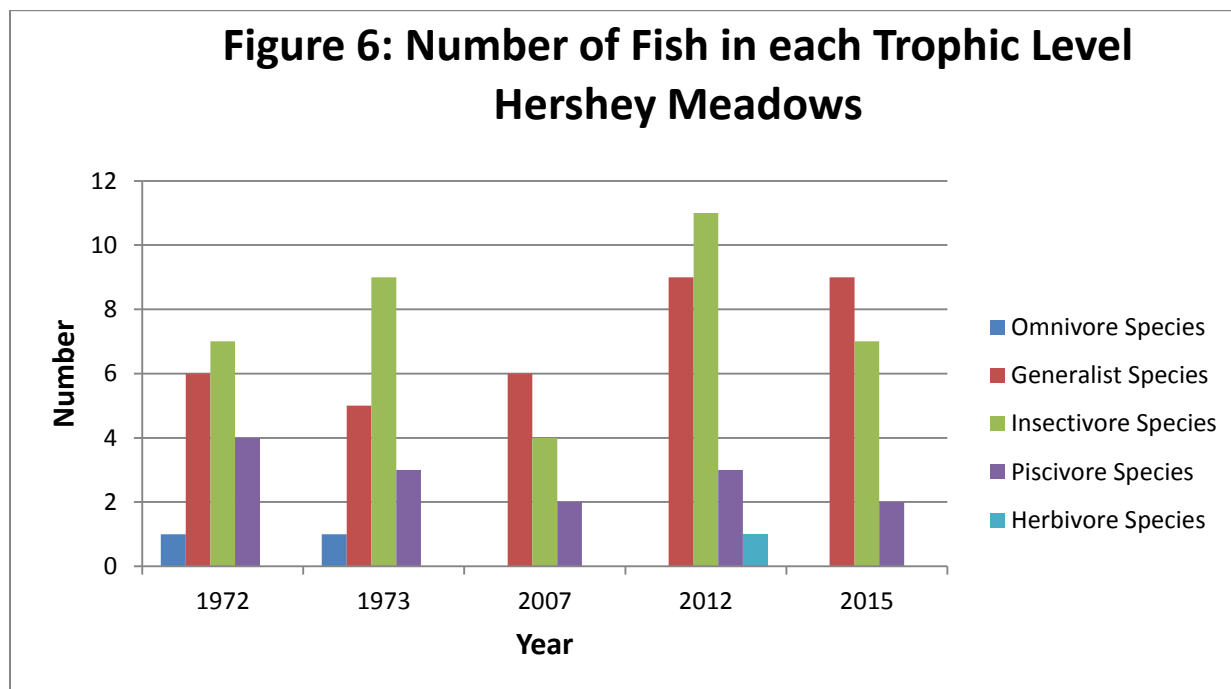


Figure 6: This graph shows the number of fish species identified at Hershey Meadows during the 5 sample years within each trophic level

Near the Mouth

Diversity of species at the mouth is definitely higher today than it was in 1972 (18 versus 12 species). A slight jump in Catfish species is observed between the 2012 and 2015 surveys. This put the Catfish species back to 1973 levels. Although the number of species in the Minnow family has decreased since the 1973 survey, across the board there are more species per family today than there were in 1972 (Figure 7). 2012 had the highest level of diversity at 22 species.

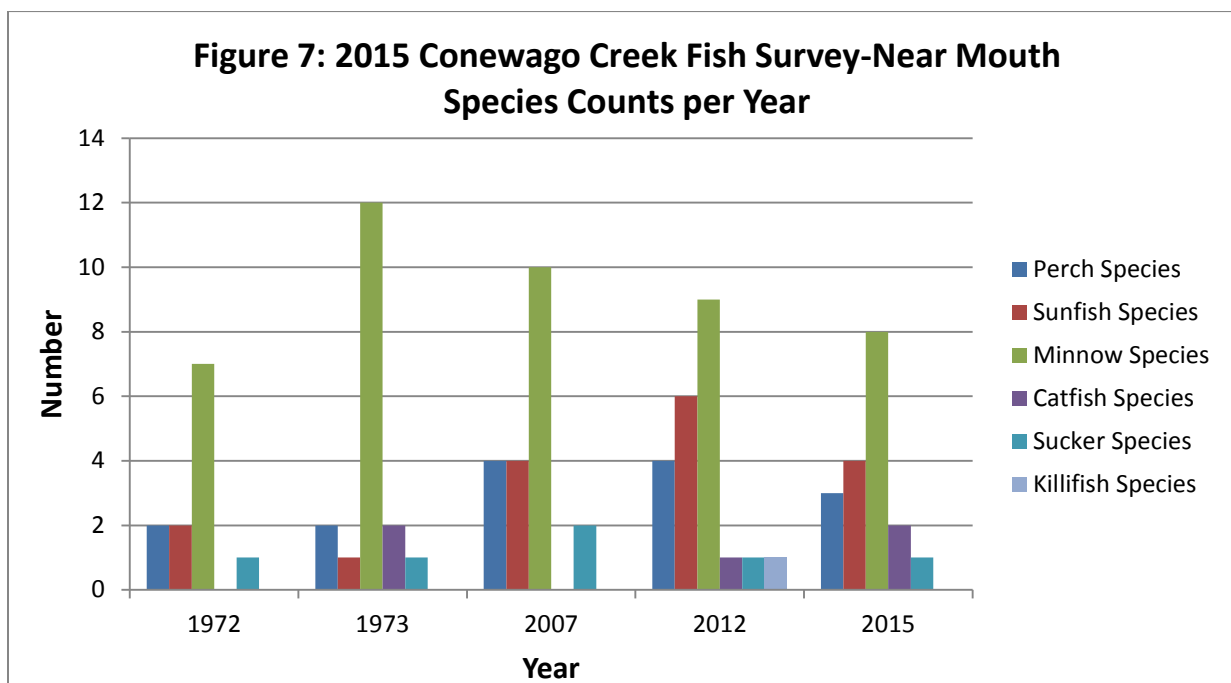


Figure 7: This graph compares the number of species within each family for the 5 years that sampling occurred near the mouth of the Conewago Creek.

Figure 8 shows the number of fish per tolerance level near the mouth. Tolerant species continue to be higher than 2007 levels while intolerant species have managed to stay at similar levels.

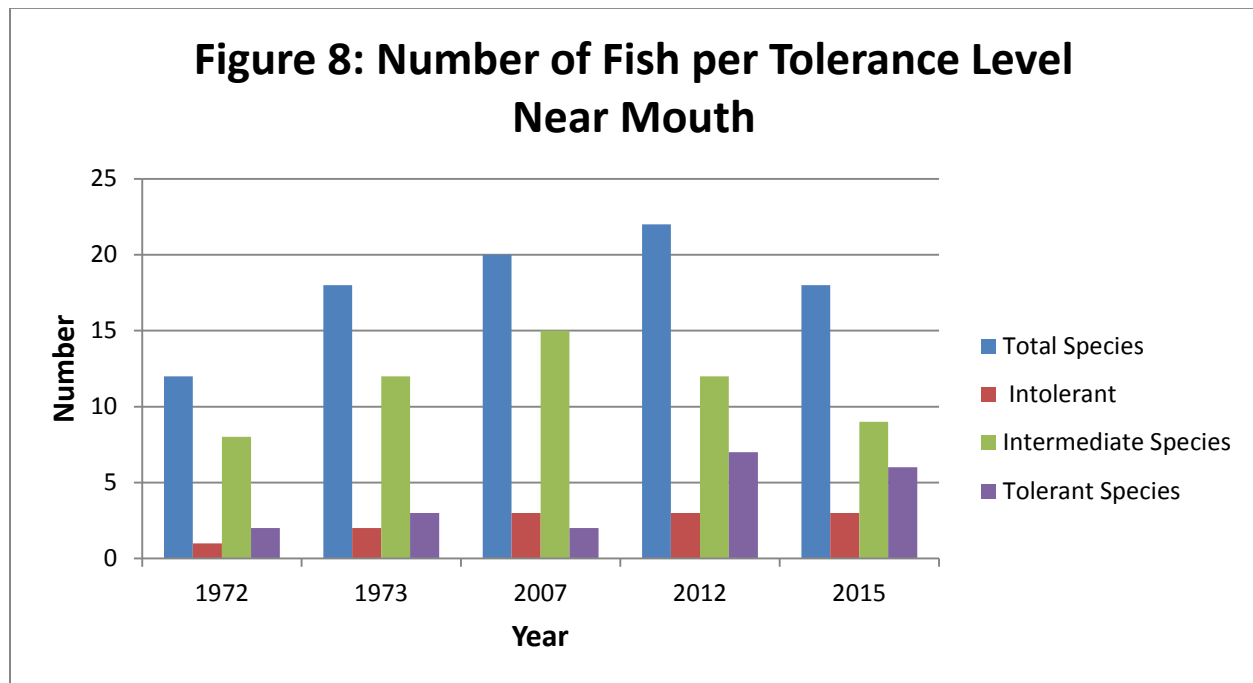


Figure 8: This graph shows the number of fish from the sites near the mouth of the Conewago Creek identified as tolerant, intermediate, or intolerant during the 5 sample years.

Figure 9 shows that there has been a decrease in the percentage of insect eating fish since the 1970's. Generalist feeders continue to be more abundant than insectivores suggesting that water quality and habitat might be worse today than in 2007 and the years prior.

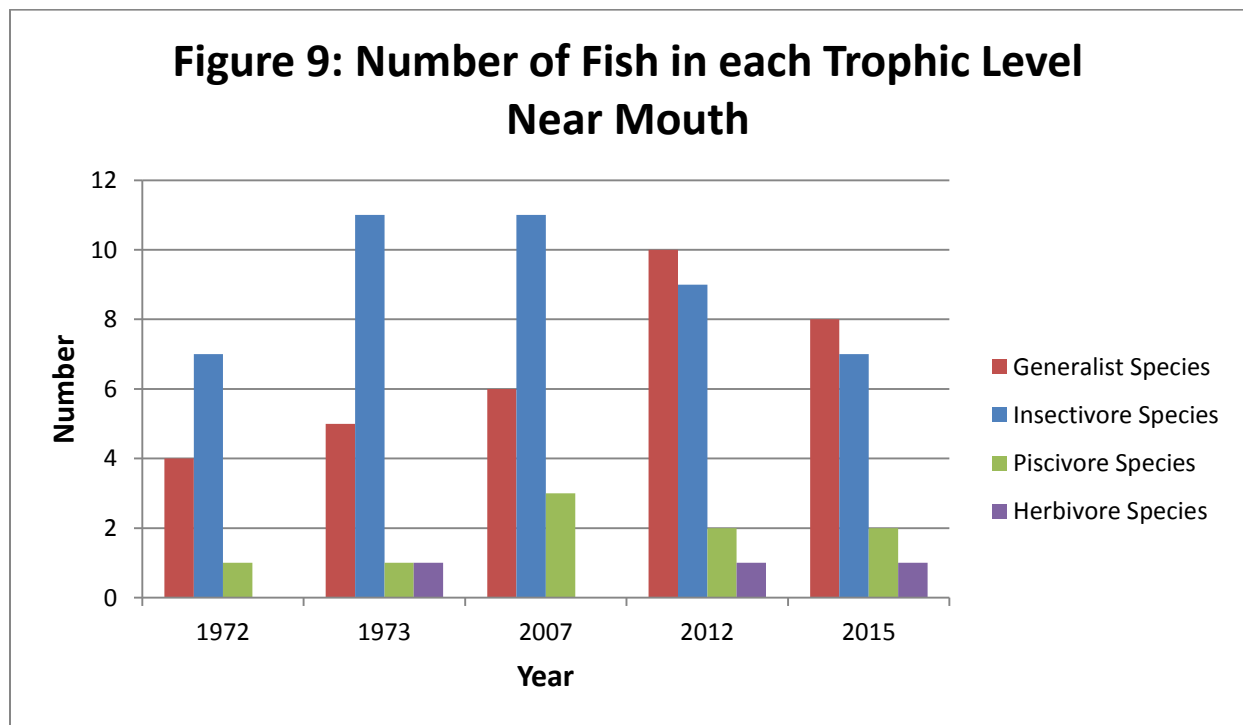


Figure 9: This graph shows the number of fish species identified at sites near the mouth of the Conewago Creek during the 5 sample years within each trophic level.

The population was healthier in 2007 and the years prior when compared to the 2015 survey with higher levels of insectivores and fewer tolerant fish observed. The good news is that the fish population appears to have

remained fairly stable since 2012. While diversity has decreased, the loss in specific fish species is likely attributable to sampling conditions. Trophic levels and tolerance levels have remained equivalent.

Over the 5 sample years, the number of fish sampled has varied from 50 fish identified in 1972 to 640 fish in 1973. Additionally, high water in 2012 prevented the team from sampling both sides of the stream, and the muddy waters in 2015 prevented thorough sampling. Length of stream sampled in previous years is unknown. These variations in sampling methods make it difficult to draw any definite conclusions from this data. The shift in sample locations from Hillsdale Rd to Covered Bridge Rd could also affect any noticeable trends. Future sampling will help solidify any conclusions that were made.

Comparison of 3 Surveys Completed in 2015

All three sites are demonstrating similar fish population diversity and tolerance. Intermediate species are hovering around 50% at all three locations, while intolerant and tolerant are at 15% 35% respectively. Diversity is fairly consistent at all three sites, with the Minnow family representing the majority of species found at each site. Generalists are the dominant feeders at each site with insectivores following closely behind. The following graphs compare the three locations for the 2015 survey.

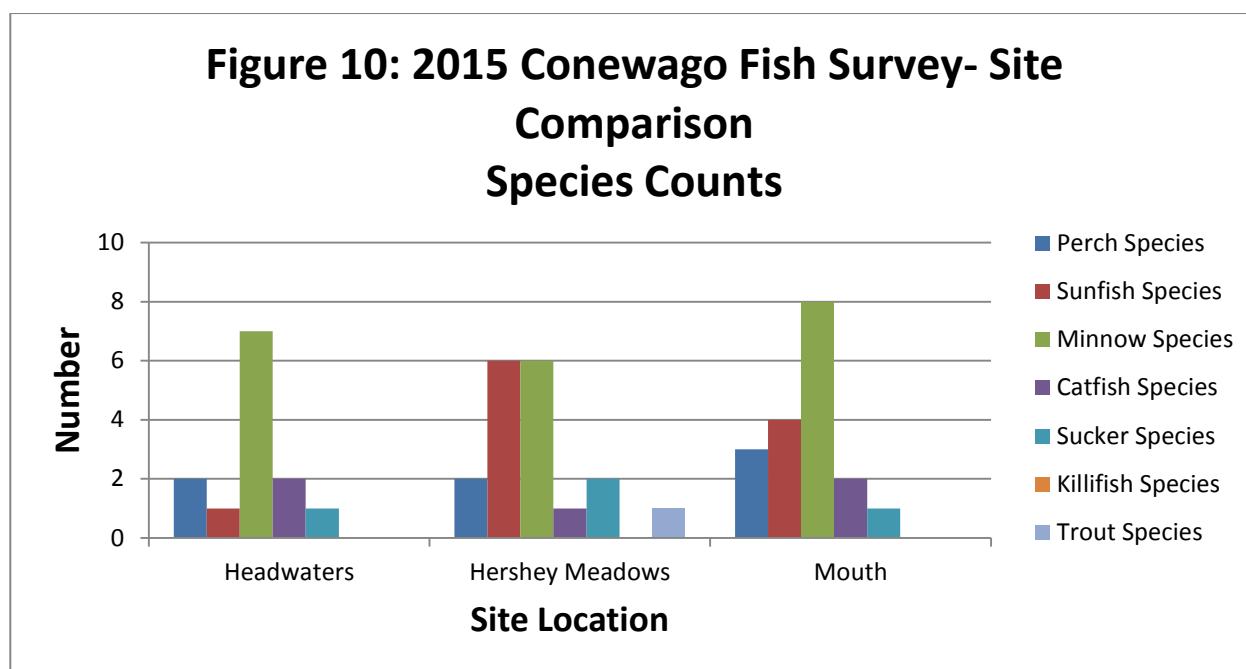


Figure 10: This graph compares the number of species within each family for the 3 sites that were surveyed in 2015.

**Figure 11: Number of Fish per Tolerance Level
2015 Site Comparison**



Figure 11: This graph shows the number of fish species broken down into tolerant, intermediate, and intolerant levels for the 3 sites surveyed in 2015.

**Figure 12: Number of Fish in each Trophic Level
2015 Site Comparison**



Figure 12: This graph compares the number of fish in each trophic level by site for the 2015 survey.

Chart 4: Comparison of 2015 Fish Survey Results

	Mouth	Hershey Meadows	Headwaters	Tolerance	Trophic Level	Total Number
Cyprinidae (Carps and Minnows)						
Campostoma anomalum (Central stoneroller)	1 - 1%			Intermediate	Herbivore	1
Exoglossum maxillingua (Cutlips minnow)	5 - 3%	3 - 2%	9 - 9%	Intolerant	Insectivore	17
Luxilus cornutus (Common Shiner)	2 - 1%		1 - 1%	Intermediate	Insectivore	3
Notropis hudsonius (Spottail shiner)		2 - 1%		Intermediate	Insectivore	2
Notropis rubellus (Rosyface shiner)	5 - 3%	2 - 1%		Intermediate	Insectivore	7
Notropis procne (Swallowtail shiner)		4 - 2%		Intolerant	Insectivore	4

Notropis volucellus (Mimic shiner)	38 - 26%			Intermediate	Generalist	38
Pimephales notatus (Bluntnose minnow)	1 - 1%		1 - 1%	Tolerant	Generalist	2
Rhinichthys atratulus (Blacknose dace)			19 - 19%	Tolerant	Generalist	19
Rhinichthys cataractae (Longnose dace)	25 - 17%		40 - 40%	Intermediate	Insectivore	65
Semotilus atromaculus (Creek chub)	6 - 4%	3 - 2%	2 - 2%	Tolerant	Generalist	11
Semotilus corporalis (Fallfish)		4 - 2%	3 - 3%	Intermediate	Generalist	7
Catostomidae (Suckers)						
Catostomus commersoni (White sucker)	4 - 3%	37 - 20%		Tolerant	Generalist	41
Hypentelium nigricans (Northern hog sucker)		1 - 1%	17 - 17%	Intermediate	Generalist	18
Ictaluridae (Bullhead catfishes)						
Ameiurus natalis (Yellow bullhead)	7 - 5%	1 - 1%	1 - 1%	Tolerant	Generalist	9
Ameiurus nebulosus (Brown bullhead)	1 - 1%		1 - 1%	Tolerant	Generalist	2
Cyprinodontidae (Killifishes)						
Fundulus diaphanus (Banded killifish)		19 - 10%		Tolerant	Insectivore	19
Centarchidae (Sunfishes)						
Ambloplites rupestris (Rock bass)	8 - 5%	32 - 18%		Intermediate	Piscivore	40
Lepomis auritus (Redbreast sunfish)	2 - 1%	38 - 21%		Intermediate	Generalist	40
Lepomis cyanellus (Green sunfish)		4 - 2%		Tolerant	Generalist	4
Lepomis gibbosus (Pumpkinseed)		15 - 8%	3 - 3%	Intermediate	Generalist	18
Lepomis macrochirus (Bluegill)	1 - 1%	2 - 1%		Tolerant	Generalist	3
Micropterus dolomieu (Smallmouth bass)	7 - 5%	4 - 2%		Intermediate	Piscivore	11
Percidae (Perches)						
Etheostoma blennioides (Greenside darter)	17 - 11%	5 - 3%		Intolerant	Insectivore	22
Etheostoma olmstedii (Tessellated darter)	17 - 11%	5 - 3%	3 - 3%	Intermediate	Insectivore	25
Etheostoma zonale (Banded darter)	2 - 1%		1 - 1%	Intolerant	Insectivore	3

Chart 4: This chart compresses Charts 1-3 to include only the 2015 data. Like charts 1-3, number of fish per species identified and the percentage of that count compared to the total number of fish identified is shown. The tolerance and trophic designations of each fish species is also shown.

IV. Conclusion

Overall, all three sites are demonstrating similar fish population diversity and tolerance. The presence of insectivores at all three sites (around 40% each) is a positive sign for stream health. Due to the significant amount of rain received before the 2015 sampling, species counts were likely lower than if there had been ideal sampling conditions. However, the results are continuing to build a trend that is needed to judge improvement.

Monitoring these sites is an important activity to judge stream health and success of watershed restoration projects. After improvements are made in a watershed, it can take several years before results are noticeable in stream monitoring. While Hershey Meadows showed noticeable improvements following the restoration, which was directly next to the stream, the rest of the watershed is not yet showing noticeable improvements from projects upland. Fish sampling will continue to occur every 3 years in hopes that eventually the stream will show signs of improvement from all of the work watershed wide. No significant decreases in fish population have been observed, suggesting the watershed conditions are remaining stable.

Appendix- Site Location Maps

Headwaters- State Game Lands 145



Creeks and Roads

- Streams
- Roads



0 70 140 Feet

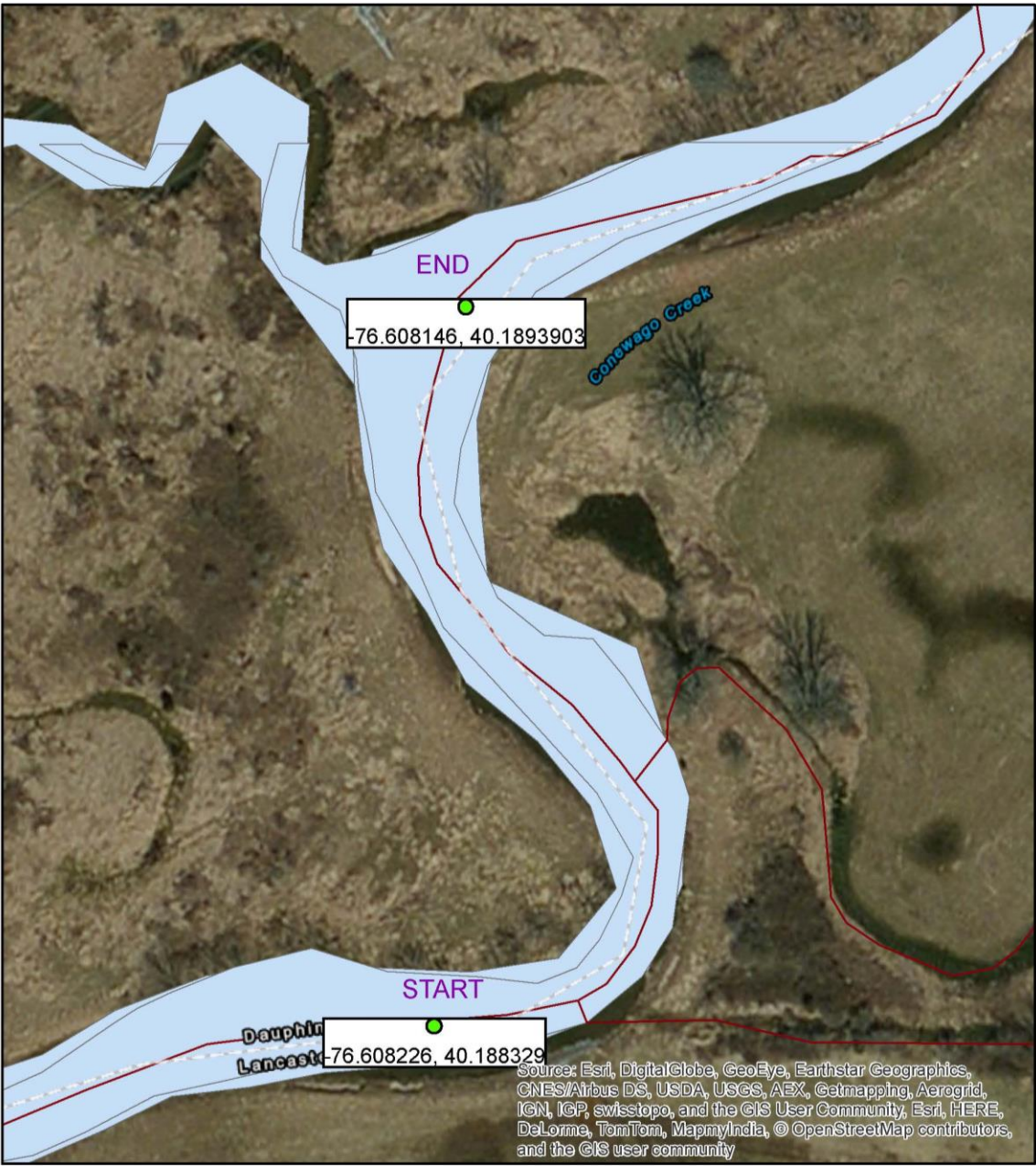
Hershey Meadows- Upstream of Gallagher Run



0 300 600 1,200 Feet

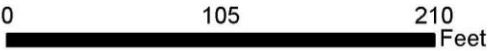


Hershey Meadows: Downstream of Gallagher Run



Creeks and Roads

- Streams
- Roads



Near the Mouth- Covered Bridge Road



0 140 280 560 Feet

