Conewago Creek Initiative

The Conewago Creek Revisited
Fish Survey Report

A compilation of historic fish survey data from 1972, 1973, 2007, 2012, 2015, 2018, 2021 & 2024 for three locations along the Conewago Creek

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*This is an update to earlier reports prepared by Kristen Koch, Hillary Yarger, Isaac Nulton, and Ryan Hill, Penn State Agriculture and Environment Center in 2012, 2015, 2018 and 2021.

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, June 2015, June 2018, June 2021, and June 2024. 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, 2015, 2018, 2021 and 2024 surveys were coordinated by the Conewago Creek Initiative with expertise from partners including the Lancaster County Conservation District, the Susquehanna River Basin Commission, and Larry Coble.

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 six years. Beginning in 2012, a sampling location was selected close to the headwaters. This site is located within State Game Lands 145 across from Fieldcrest Drive. In the 1970's surveys, a sample site was located near the mouth of the Conewago 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.

Routine fish sampling is an essential component of ongoing monitoring to gauge the effectiveness of restoration projects and overall water quality in the Conewago Creek Watershed. The results compare the number of species present in each of the eight survey years at the surveyed locations, the number of species per fish family, the tolerability of the species identified, and the trophic level of each fish species. Electrofishing was used during all sample years and seine netting was additionally used during the 1972 and 1973 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 sample sites will not be included in this report. Additional sampling has also occurred at Old Hershey Road and near Route 230 to track improvements related to specific restoration efforts and those results are also not included in this report.

The tolerability 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 Wadable Streams (EPA 841-B-99-002) Appendix C: Tolerance and Trophic Guilds of Selected Fish Species. Tolerability 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.

As part of the Muddy Run Pumped Storage Project, Exelon Generation Company, LLC stocked Conewago Creek with 16,502 juvenile eels under the direction of the SRBC on June 16, 2017. The effort is a condition by the Federal Energy Regulatory Commission which states that Exelon will trap and transport eels from the Conowingo Dam to selected sites in the Susquehanna River watershed. The American eel, *Anguilla rostrate*, population has decreased due to the lack of migration possibilities. The species spawns in salt water and spends its mature life in freshwater. Freshwater mussels, primarily the Eastern elliptio, *Elliptio complanate*, rely on the American eel to reproduce. Eel reintroduction, due to its connection with freshwater mussels, could help improve local water quality. During the 2018 and 2021 surveys, eel information was collected to track the progress of reintroduction. No eels were captured during the 2024 survey.

The Fish and Boat Commission has also been working on reintroducing the Chesapeake Log Perch to the Conewago Creek.

II. Data

Headwaters

The survey, conducted on October 21, 2012, found 16 species of fish out of the 187 fish collected. There were 7 Minnow species, 2 Sucker species, 2 Catfish species, 1 Trout species, 2 Sunfish species, and 1 Perch species. There were 3 intolerant species, 8 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 were 7 Minnow species, 1 Sucker species, 2 Catfish species, 1 Sunfish species, and 2 Perch species. There were 2 intolerant species, 6 intermediate species and 5 tolerant species recorded.

The survey, conducted on June 25, 2018, found 19 species of fish, out of the 48 fish collected. There was 1 Eel species, 9 Carp/Minnow species, 2 Sucker species,1 Catfish species, 1 Trout species, 4 Sunfish species, and 1 Perch species. There were 2 intolerant species, 11 intermediate species and 6 tolerant species recorded.

The survey conducted on June 23, 2021, found 18 species of fish, out of the 243 fish collected. There was 1 Eel species, 8 Carp/Minnow species, 2 Sucker species, 1 Catfish species, 4 Sunfish Species, and 2 Perch species. There were 2 intolerant species, 13 intermediate species, and 4 tolerant species recorded.

The survey conducted on June 11, 2024, found 10 species of fish, out of the 88 fish collected. There were 5 carp/minnow species, two sucker species, one trout species, one sunfish species, and one perch species. There was 1 intolerant species, 4 intermediate species, and 5 tolerant species recorded.

Species	2012		2015		2018		2021		2024		Tolerance	Trophic
Anguillida (Freshwater eels)												
Anguilla rostrata (American eel)					2	4%	1	0%			Intermediate	Piscivore
Cyprinidae (Carps and Minnows)												
Campostoma anomalum (Central stoneroller)	3	2%									Intermediate	Herbivore
Cyprinella spiloptera (Spotfin shiner)							23	9%			Intermediate	Insectivore
Cyprinus carpio (Common carp)					1	2%			4	4%	Tolerant	Omnivore
Exoglossum maxillingua (Cutlips minnow)	6	3%	9	9%	3	6%	18	7%			Intolerant	Insectivore
Luxilus cornutus (Common Shiner)			1	1%			1	0%			Intermediate	Insectivore
Nocomis micropogen (River chub)					2	4%					Intermediate	Insectivore
Notemigonus crysoleucas (Golden shiner)					1	2%					Tolerant	Omnivore
Notropis hudsonius (Spottail shiner)							1	0%			Intermediate	Insectivore
Notropis procne (Swallowtail shiner)	3	2%			1	2%	26	11%	1	1%	Intermediate	Insectivore
Pimephales promelas (Fathead minnow)							13	5%			Tolerant	Generalist
Pimephales notatus (Bluntnose minnow)			1	1%							Tolerant	Generalist
Rhinichthys atratulus (Blacknose dace)	20	11%	19	19%	9	19%	50	21%	30	34%	Tolerant	Generalist
Rhinichthys cataractae (Longnose dace)	1	1%	40	40%	8	17%	24	10%	15	17%	Intermediate	Insectivore
Semotilus atromaculus (Creek chub)	3	2%	2	2%	1	2%			2	2%	Tolerant	Generalist
Semotilus corporalis (Fallfish)	14	7%	3	3%	2	4%					Intermediate	Generalist
Catostomidae (Suckers)												
Catostomus commersoni (White sucker)	12	6%			3	6%	13	5%	2	2%	Tolerant	Generalist
Hypentelium nigricans (Northern hog sucker)	4	2%	17	17%	3	6%	11	5%	3	3%	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%			2	4%	1	0%			Intermediate	Insectivore
Salmonidae (Trouts)												
Oncorhynchus mykiss (Rainbow trout)					1	2%			1	1%	Intolerant	Piscivore
Salmo Trutta (Brown trout)	1	1%									Intolerant	Piscivore
Centachidae (Sunfishes)												
Lepomis auritus (Redbreast sunfish)					3	6%	33	14%			Intermediate	Generalist
Lepomis gibbosus (Pumpkinseed)	104	56%	3	3%	1	2%	2	1%			Intermediate	Generalist
Lepomis macrochirus (Bluegill)	3	2%			2	4%	2	1%	30	34%	Tolerant	Generalist
Micropterus salmoides (Largemouth bass)							1	0%			Intermediate	Piscivore
Micropterus dolomieu (Smallmouth bass)					1	2%					Intermediate	Piscivore
Percidae (Perches)												
Etheostoma olmstedi (Tessellated darter)			3	3%	2	4%	17	7%	1	1%	Intermediate	Insectivore
Etheostoma blennioides (Greenside darter)							6	2%			Intolerant	Insectivore
Etheostoma zonale (Banded darter)	3	2%	1	1%							Intolerant	Insectivore
Other												
Hybrid Sunfish Lepomis gibbosus X L. Macroch	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, 2015, 2018, 2021 & 2024 surveys at State Game Lands 145. The tolerance and trophic designations of each fish species are also shown.
**The Hybrid Sunfish species was given a tolerability level of intermediate to not skew the tolerability average.*
**Percentages are presented as rounded numbers and will not equal 100%.*

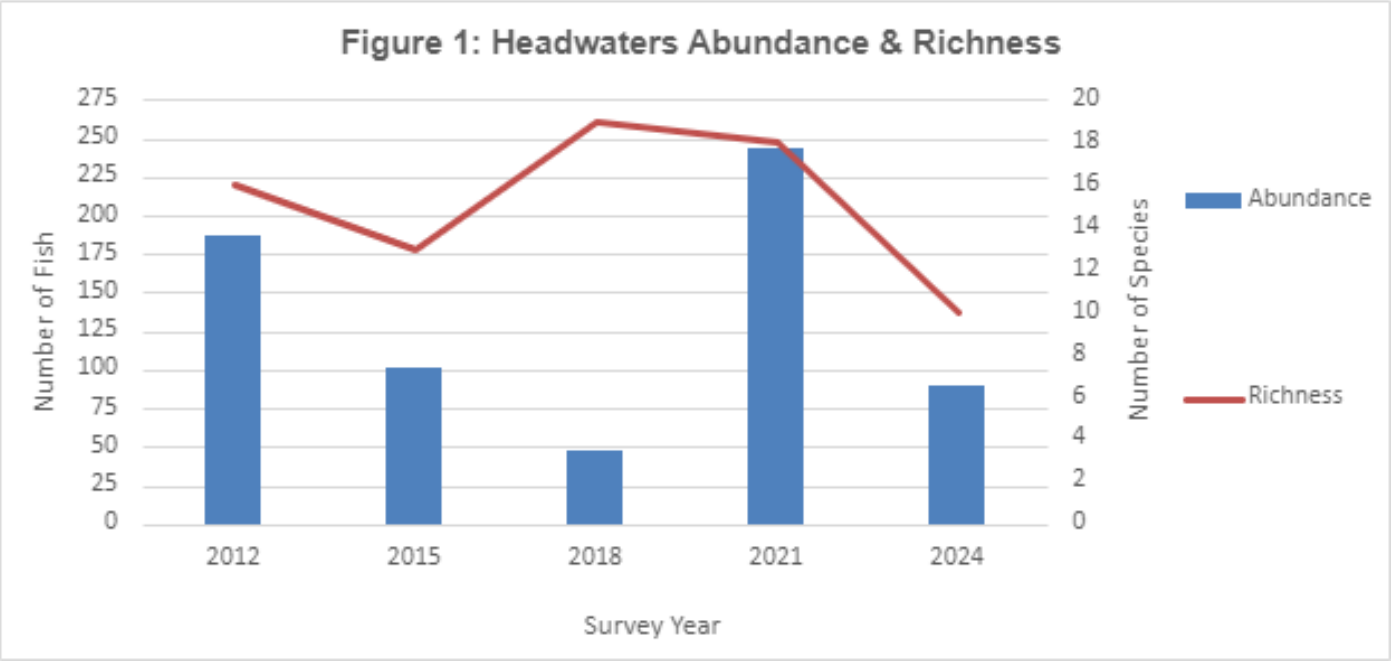

Figure 1: This graph shows the change of species richness and abundance for the headwaters for the 2012, 2015, 2018, 2021 and 2024 surveys.

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 1 intolerant species, 10 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 1 intolerant species, 11 intermediate species, and 6 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 June 28, 2012 survey 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 5 Tolerant species recorded.

The June 25, 2018 survey found 28 species out of the 315 fish collected. There were 1 Eel species, 13 Minnow species, 3 Sucker species, 1 Catfish species, 1 Killifish species, 6 Sunfish species, and 3 Perch species. There were 4 intolerant species, 18 Intermediate species, and 6 tolerant species recorded.

The June 23, 2021 survey found 23 species out of the 671 fish collected. There was 1 Eel species, 11 Carp/Minnow species, 2 Sucker species, 1 Catfish species, 1 Killifish species, 5 Sunfish species, and 2 Perch species. There were 2 intolerant species, 15 intermediate species, and 6 tolerant species recorded.

The June 11, 2024 survey found 25 species out of the 645 fish collected. There were 12 Carp/Minnow species, 2 Sucker species, 2 Catfish species, 1 Killifish species, 5 Sunfish species, 2 Perch species, and 1 Other species. There were 3 intolerant species, 14 intermediate species, and 8 tolerant species recorded.

Chart 2: Results of Fish Surveys in Hershey Meadows

Species	1972		1973		2007		2012		2015		2018		2021		2024		Tolerance	Trophic
Anguillida (Freshwater eels)																		
Anguilla rostrata (American eel)											4	1%	3	0.4%			Intermediate	Piscivore
Cyprinidae (Carps and Minnows)																		
Campostoma anomalum (Central stoneroller)							9	1%			2	1%	5	0.7%			Intermediate	Herbivore
Cyprinella analostana (Satinfin shiner)	4	2%	1	0%											16	2.5%	Intolerant	Insectivore
Cyprinella spiloptera (Spotfin shiner)	44	27%	16	5%			39	4%			35	11%	54	8.0%	11	1.7%	Intermediate	Insectivore
Exoglossum maxillingua (Cutlips minnow)							9	1%	3	2%	3	1%					Intolerant	Insectivore
Luxilus cornutus (Common Shiner)					C		18	2%			8	3%	18	2.7%	67	10.4%	Intermediate	Insectivore
Nocomis micropogen (River chub)							8	1%			1	0%			8	1.2%	Intermediate	Insectivore
Notemigonus crysoleucas (Golden shiner)	1	1%	1	0%									3	0.4%	1	0.2%	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%	8	3%	54	8.0%	50	7.8%	Intermediate	Insectivore
Notropis rubellus (Rosyface shiner)							135	15%	2	1%	4	1%	7	1.0%	10	1.6%	Intolerant	Insectivore
Notropis procne (Swallowtail shiner)	25	15%	157	53%			104	12%	4	2%	17	5%	183	27.3%	1	0.2%	Intermediate	Insectivore
Notropis volucellus (Mimic shiner)											6	2%	14	2.1%			Intermediate	Generalist
Pimephales notatus (Bluntnose minnow)							3	0%			18	6%	2	0.3%	2	0.3%	Tolerant	Generalist
Pimephales promelas (Fathead minnow)					P												Tolerant	Generalist
Rhinichthys atratulus (Blacknose dace)			8	3%	A										5	0.8%	Tolerant	Generalist
Rhinichthys cataractae (Longnose dace)			5	2%							1	0%					Intermediate	Insectivore
Semotilus atromaculus (Creek chub)	2	1%					16	2%	3	2%	1	0%			17	2.6%	Tolerant	Generalist
Semotilus corporalis (Fallfish)							6	1%	4	2%	29	9%	28	4.2%	19	2.9%	Intermediate	Generalist
Cyprinus carpio (Common carp)													3	0.4			Intermediate	Generalist
Catostomidae (Suckers)																		
Catostomus commersoni (White sucker)	11	7%	8	3%	A		188	21%	37	20%	46	15%	78	11.6%	88	13.6%	Tolerant	Generalist
Hypentelium nigricans (Northern hog sucker)	1	1%			P		8	1%	1	1%	7	2%	6	0.9%	2	0.3%	Intermediate	Generalist
Erimyzon oblongus (Creek chubsucker)											2	1%					Intermediate	Generalist
Ictaluridae (Bullhead catfishes)																		
Ameiurus natalis (Yellow bullhead)	2	1%			P		1	0%	1	1%			2	0.3%			Tolerant	Generalist
Ameiurus nebulosus (Brown bullhead)															2	0.3%	Tolerant	Generalist
Noturus insignis (Margined madtom)			1	0%			1	0%			1	0%			1	0.2%	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%	13	4%	4	0.6%	24	3.7%	Tolerant	Insectivore
Centachidae (Sunfishes)																		
Ambloplites rupestris (Rock bass)	4	2%	3	1%	P		70	8%	32	18%	32	10%	18	2.7%	97	15.0%	Intermediate	Piscivore
Lepomis auritus (Redbreast sunfish)	29	18%	40	13%	C		35	4%	38	21%	55	17%	148	22.1%	85	13.2%	Intermediate	Generalist
Lepomis gibbosus (Pumpkinseed)			12	4%			142	16%	15	8%	1	0%	1	0.1%	30	4.7%	Intermediate	Generalist
Lepomis macrochirus (Bluegill)	3	2%	8	3%			23	3%	2	1%	2	1%			36	5.6%	Tolerant	Generalist
Lepomis cyanellus (Green sunfish)											1	0%	1	0.1%			Tolerant	Generalist
Micropterus dolomieu (Smallmouth bass)	5	3%	1	0%	P		17	2%	4	2%	5	2%	31	4.6%	47	7.3%	Intermediate	Piscivore
Micropterus salmoides (Largemouth bass)							2	0%									Intermediate	Piscivore
Percidae (Perches)																		
Etheostoma blennioides (Greenside darter)									5	3%	3	1%	1	0.1%	1	0.2%	Intolerant	Insectivore
Etheostoma olmstedi (Tessellated darter)	15	9%	5	2%	P		8	1%	5	3%	8	3%	7	1.0%	2	0.3%	Intermediate	Insectivore
Etheostoma zonale (Banded darter)							2	0%			2	1%					Intolerant	Insectivore
Other																		
Shiner Sp															23		Intermediate	Insectivore
crappie sp	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 8 survey years at Hershey Meadows. The tolerance and trophic designations of each fish species are 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 and unknown shiner species were given a tolerability level of intermediate to not skew the averages. The crappie species was given a trophic level of generalist to not skew the averages while the shiner species was given a trophic level of insectivore since that is the most common trophic level for shiner species in the watershed.*

**Percentages are presented as rounded numbers and will not equal 100%.*

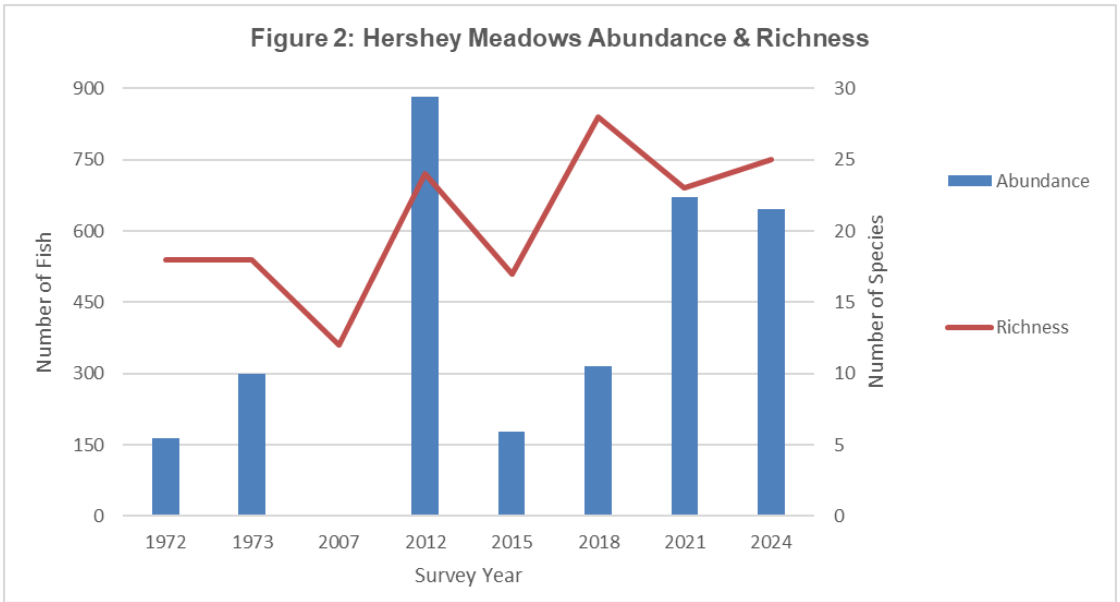

Figure 2: This graph shows the change of species richness and abundance for the 8 years that sampling occurred at Hershey Meadows.

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 were 3 intolerant species, 7 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, 14 intermediate species and 2 tolerant species recorded.

The October 21, 2012 survey 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 4 intolerant species, 11 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 4 intolerant species, 8 intermediate species, and 6 tolerant species recorded.

The June 25, 2018 survey found 20 species of fish, out of the 120 fish collected. There were 1 Eel species, 8 Minnow species, 1 Sucker species, 1 Catfish species, 1 Killifish species, 5 Sunfish species, and 3 Perch species. There were 3 intolerant species, 11 intermediate species, and 6 tolerant species recorded.

The June 23, 2021 survey found 18 species of fish, out of the 92 fish collected. There were 7 Carp/Minnow species, 3 Sucker species, 2 Catfish species, 3 Sunfish species, and 3 Perch species. There were 3 intolerant species, 10 intermediate species, and 5 tolerant species.

The June 11, 2024 survey found 18 species of fish, out of the 141 fish collected. There were 9 Carp/Minnow species, 1 Sucker species, 6 Sunfish species, and 2 Perch species. There were 4 intolerant species, 9 intermediate species, and 5 tolerant species.

Chart 3: Results of Fish Surveys Near the Mouth

Species	1972		1973		2007		2012		2015		2018		2021		2024		Tolerance	Trophic
Anguillida (Freshwater eels)																		
Anguilla rostrata (American eel)											1	1%					Intermediate	Piscivore
Cyprinidae (Carps and Minnows)																		
Campostoma anomalum (Central stoneroller)			1	0%			2	1%	1	1%	1	1%	2	2%	5	4%	Intermediate	Herbivore
Cyprinella analostana (Satinfin shiner)	1	2%															Intolerant	Insectivore
Cyprinella spiloptera (Spotfin shiner)	29	58%	562	88%	18	4%	98	34%			6	5%	3	3%	3	2%	Intermediate	Insectivore
Exoglossum maxillingua (Cutlips minnow)			1	0%					5	3%	1	1%			1	1%	Intolerant	Insectivore
Luxilus cornutus (Common Shiner)					5	1%			2	1%	1	1%			1	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
Notemigonus crysoleucas (Golden shiner)													2	2%			Tolerant	Omnivore
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%			6	7%	23	16%	Intolerant	Insectivore
Notropis procne (Swallowtail shiner)			2	0%	25	6%											Intermediate	Insectivore
Notropis volucellus (Mimic shiner)							83	29%	38	26%	22	18%	29	32%	59	42%	Intermediate	Generalist
Pimephales notatus (Bluntnose minnow)			10	2%			19	7%	1	1%	8	7%	2	2%	7	5%	Tolerant	Generalist
Rhinichthys atratulus (Blacknose dace)	1	2%	1	0%	1	0%									1	1%	Tolerant	Generalist
Rhinichthys cataractae (Longnose dace)			9	1%	15	4%	7	2%	25	17%	15	13%	5	5%	1	1%	Intermediate	Insectivore
Semotilus atromaculus (Creek chub)							4	1%	6	4%							Tolerant	Generalist
Semotilus corporalis (Fallfish)	1	2%	2	0%	18	4%	6	2%			1	1%					Intermediate	Generalist
Catostomidae (Suckers)																		
Catostomus commersoni (White sucker)	2	4%			6	1%	5	2%	4	3%	5	4%	5	5%	1	1%	Tolerant	Generalist
Hypentelium nigricans (Northern hog sucker)			2	0%	10	2%							3	3%			Intermediate	Generalist
Moxostoma macrolepidotum (Shorthead redhorse)													1	1%			Intermediate	Insectivore
Ictaluridae (Bullhead catfishes)																		
Ameiurus natalis (Yellow bullhead)							7	2%	7	5%	2	2%	1	1%			Tolerant	Generalist
Ameiurus nebulosus (Brown bullhead)									1	1%							Tolerant	Generalist
Ictalurus punctatus (Channel catfish)			1	0%									1	1%			Intermediate	Piscivore
Noturus insignis (Margined madtom)			4	1%													Intermediate	Insectivore
Cyprinodontidae (Killifishes)																		
Fundulus diaphanus (Banded killifish)							1	0%			2	2%					Tolerant	Insectivore
Centachidae (Sunfishes)																		
Ambloplites rupestris (Rock bass)					12	3%	9	3%	8	5%	6	5%	9	10%	18	13%	Intermediate	Piscivore
Lepomis auritus (Redbreast sunfish)	1	2%	7	1%	3	1%	7	2%	2	1%	7	6%			2	1%	Intermediate	Generalist
Lepomis cyanellus (Green sunfish)							14	5%			13	11%	9	10%	2	1%	Tolerant	Generalist
Lepomis gibbosus (Pumpkinseed)					14	3%	5	2%							6	4%	Intermediate	Generalist
Lepomis macrochirus (Bluegill)							1	0%	1	1%	1	1%			2	1%	Tolerant	Generalist
Micropterus dolomieu (Smallmouth bass)	1	2%			7	2%	3	1%	7	5%	5	4%	2	2%	5	4%	Intermediate	Piscivore
Percidae (Perches)																		
Etheostoma blennioides (Greenside darter)							1	0%	17	11%	7	6%	7	8%	1	1%	Intolerant	Insectivore
Etheostoma olmstedi (Tessellated darter)	2	4%	11	2%	25	6%	2	1%	17	11%	10	8%	1	1%			Intermediate	Insectivore
Etheostoma zonale (Banded darter)					6	1%	2	1%	2	1%	6	5%	4	4%	3	2%	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 8 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 tolerability level of intermediate to not skew the tolerability average.*
**Percentages are presented as rounded numbers and will not equal 100%.*

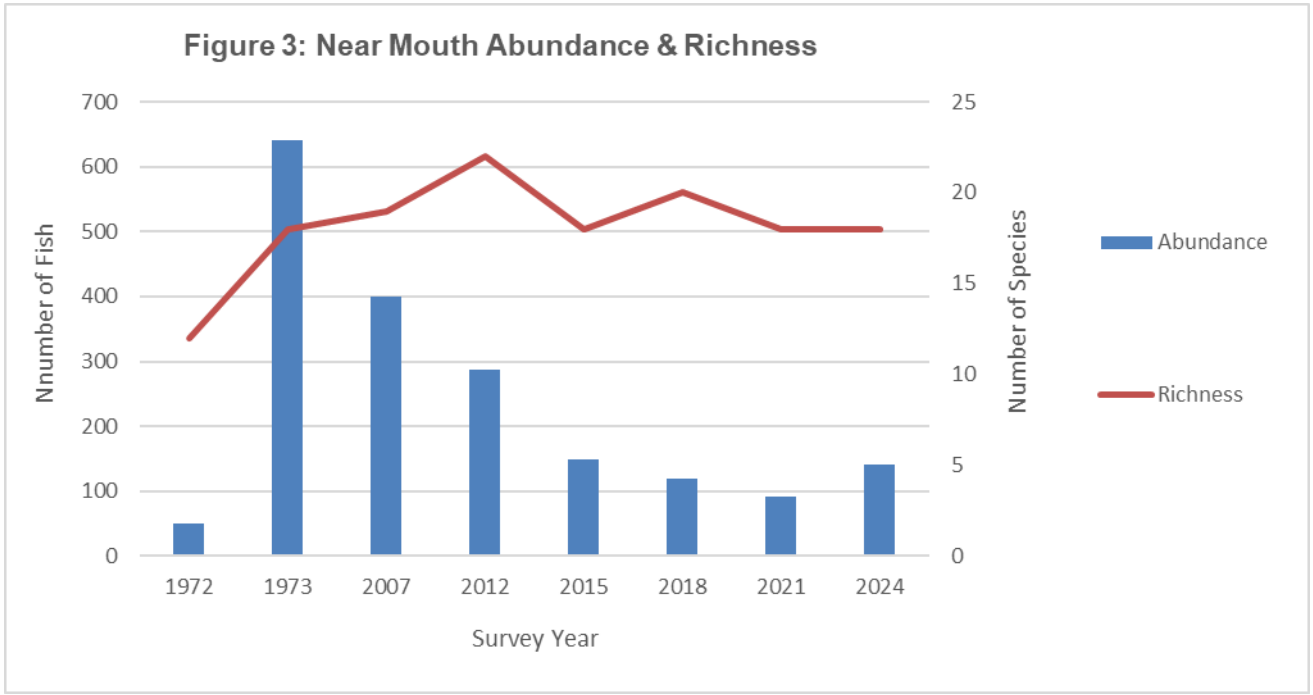

Figure 3: This graph shows the change of species richness and abundance for the 8 years that sampling occurred near the mouth.

III. Discussion

Fish survey results are compared to all available historical fish sample data 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. The survey was completed June 30, 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 it was 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.

The 2018 survey was also conducted during turbid conditions. The survey was held on Monday, June 25, 2018, following about an inch of rain falling over the weekend. The survey had already been postponed once due to rain and it was decided that the survey should be held to stay consistent with a spring survey. The Hershey Meadows site and the Mouth locations had particularly muddy waters making it challenging to capture bottom sinking fish.

The 2021 survey followed bridge construction at Cover Bridge Road which increased water depth at the Near Mouth sample site. As a result, sampling at this location was more difficult due to the increased water depth and a small section immediately beneath the bridge had to be skipped as the water was too deep to wade.

Headwaters

The following charts display various data from 2012, 2015, 2018, 2021, and 2024. Figure 4 compares the number of fish species per family identified at the Headwaters site for the 2012-2024 surveys. The population composition has stayed consistent with more minnows compared to the other families. There was an increase in sunfish species from 2015 to 2018 that dropped off again for the 2024 survey. Species diversity was lower for the 2024 survey.

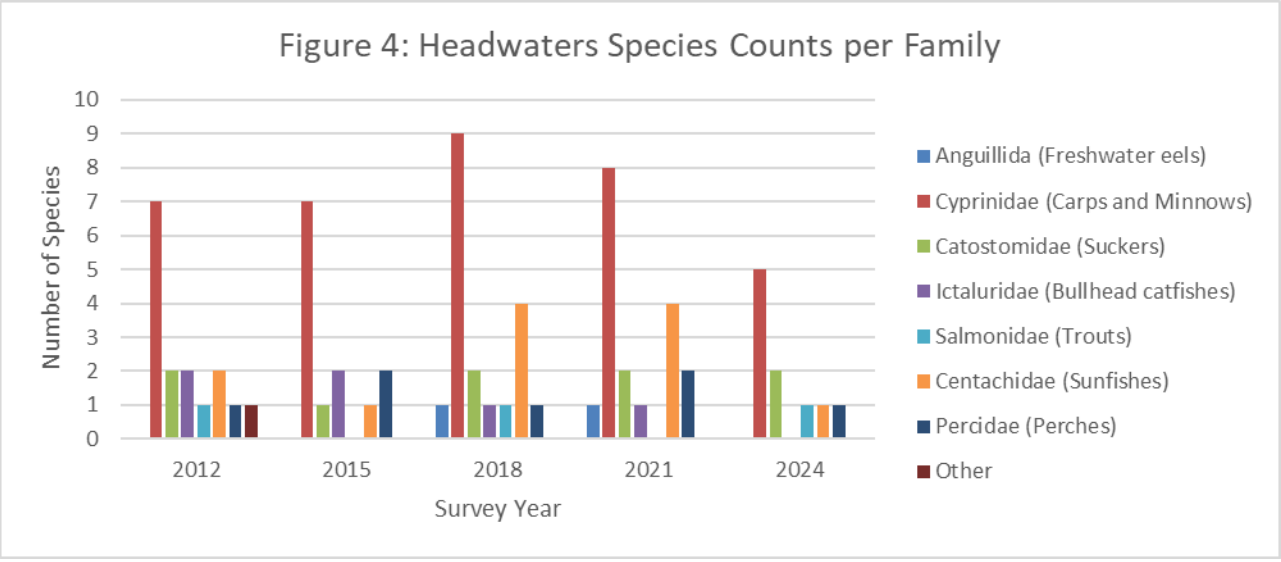

Figure 4: This graph compares the number of species within each family found at the headwaters site from the 2012 to 2024 surveys.

Figure 5 shows the number of fish per tolerance level found in the Headwaters from 2012, 2015, 2018, 2021 and 2024. The number of tolerant and intolerant species has remained constant over the years. The number of intermediate species increased over time before dropping in 2024. Overall, 2024 saw fewer species than previous years. Intolerant species are indicators of good stream health and while they are not plentiful in the headwaters, there has remained several species present.

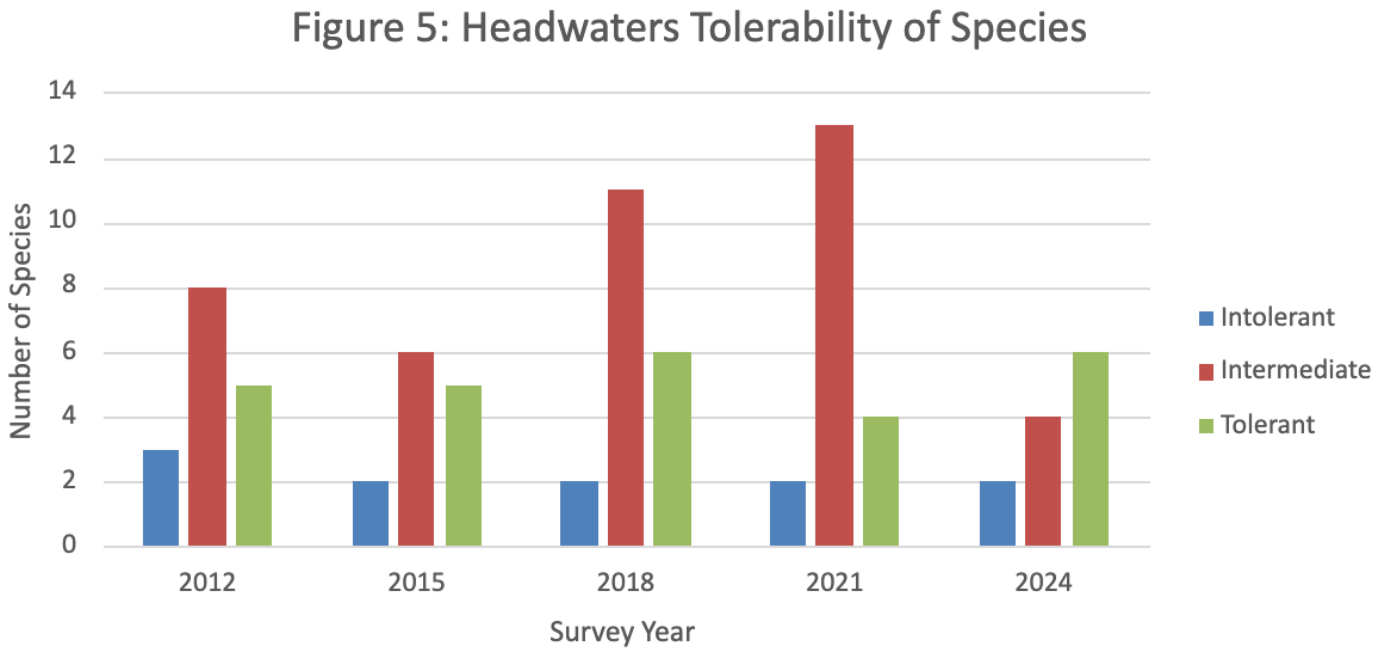

Figure 5: This graph compares the number of species per tolerance levels at the headwaters site from the 2012, 2015, 2018, 2021, and 2024 surveys.

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 specific types and amounts of aquatic bugs to eat. Macroinvertebrates are good indicators of stream health, and their presence is determined by the water quality and habitat provided by the stream. It suggests that if a greater abundance and variety of insect-eating fish are present in the stream, there is a healthier macroinvertebrate population and a higher-quality stream environment. Figure 6 compares the number of fish species in each trophic level at the Headwaters in 2012, 2015, 2018, 2021, and 2024.

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 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. In 2018, there was an overall increase in the diversity of trophic levels. In 2021 there was an increase in the number of insectivore species. This may indicate an increase in stream health. In 2024, fewer species were observed but the composition of trophic levels remained similar with near equal levels of generalist and insectivore species and a single piscivore species.

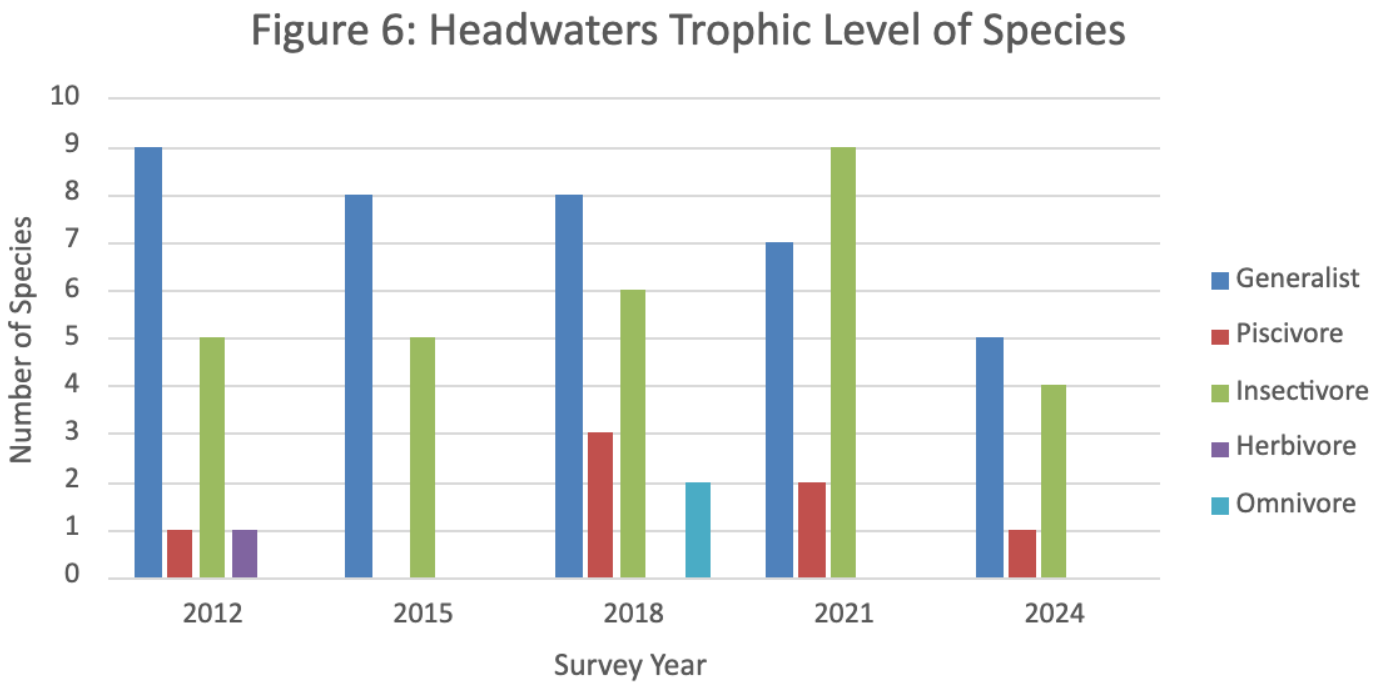

Figure 6: This graph compares the number of fish in each trophic level at the headwaters site from 2012, 2015, 2018, 2021, and 2024 surveys.

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 and intolerance of fish in this section of the stream. The total number of species caught at this site more than doubled from 2007 (12 species) to 2018 (28 species) and has remained higher than pre-restoration. Figure 7 demonstrates how diversity is distributed between the different families. A decrease in minnow species was observed during the 2015 survey, likely attributable to the muddy water.

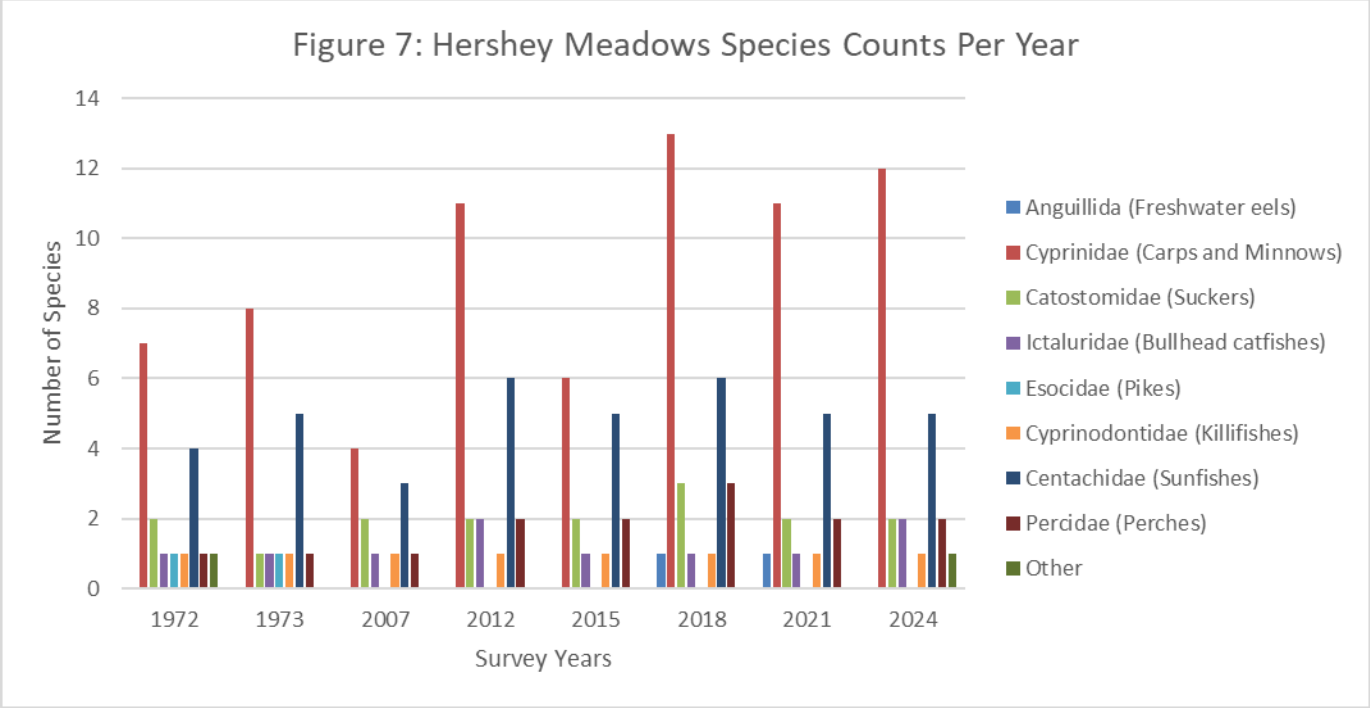

Figure 7: This graph compares the number of species within each family for the 8 years that sampling occurred at Hershey Meadows.

The number of tolerant species has remained constant over all sample years as can be seen in Figure 8. The intermediate species increase or decrease depending on total number of species observed. Since restoration, at least 1 intolerant species has been observed each survey.

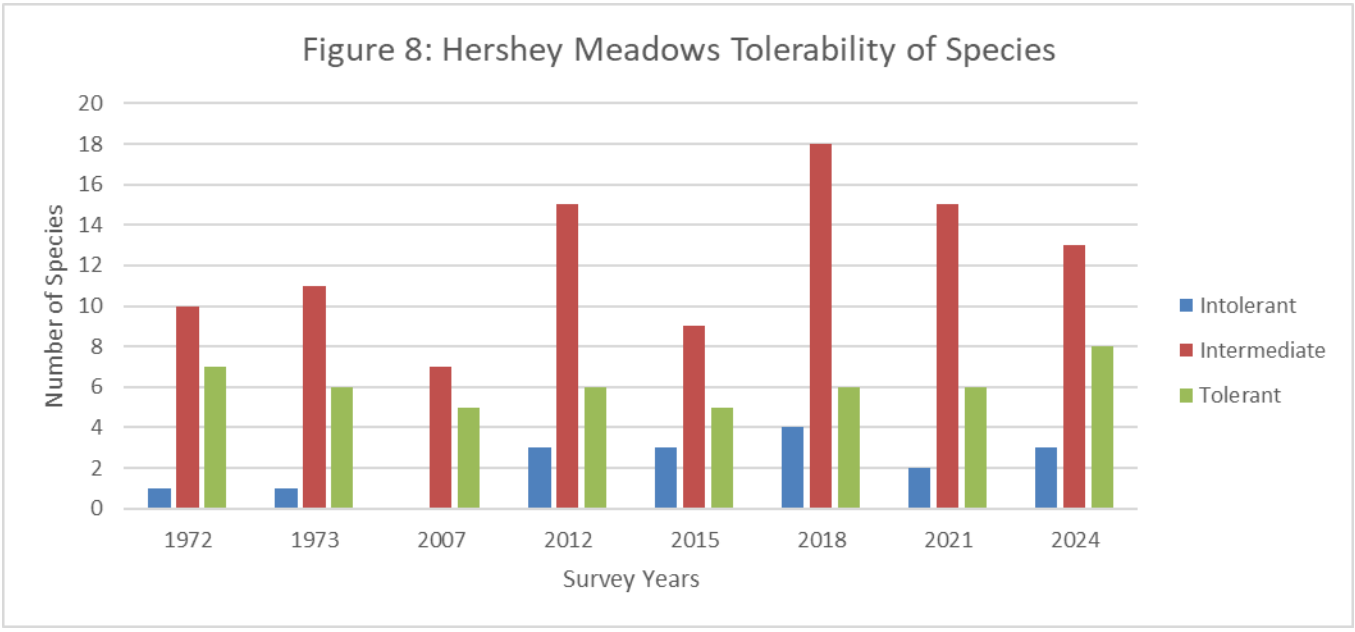

Figure 8: This graph shows the number of fish from Hershey Meadows identified as either tolerant, intermediate, or intolerant during the 8 sample years.

Figure 9 shows that trophic level ratios have remained constant over time. The population is co-dominated by both generalist and insectivore species. Both have more than doubled since the restoration project. Each survey has also observed several piscavores and occasionally other trophic levels.

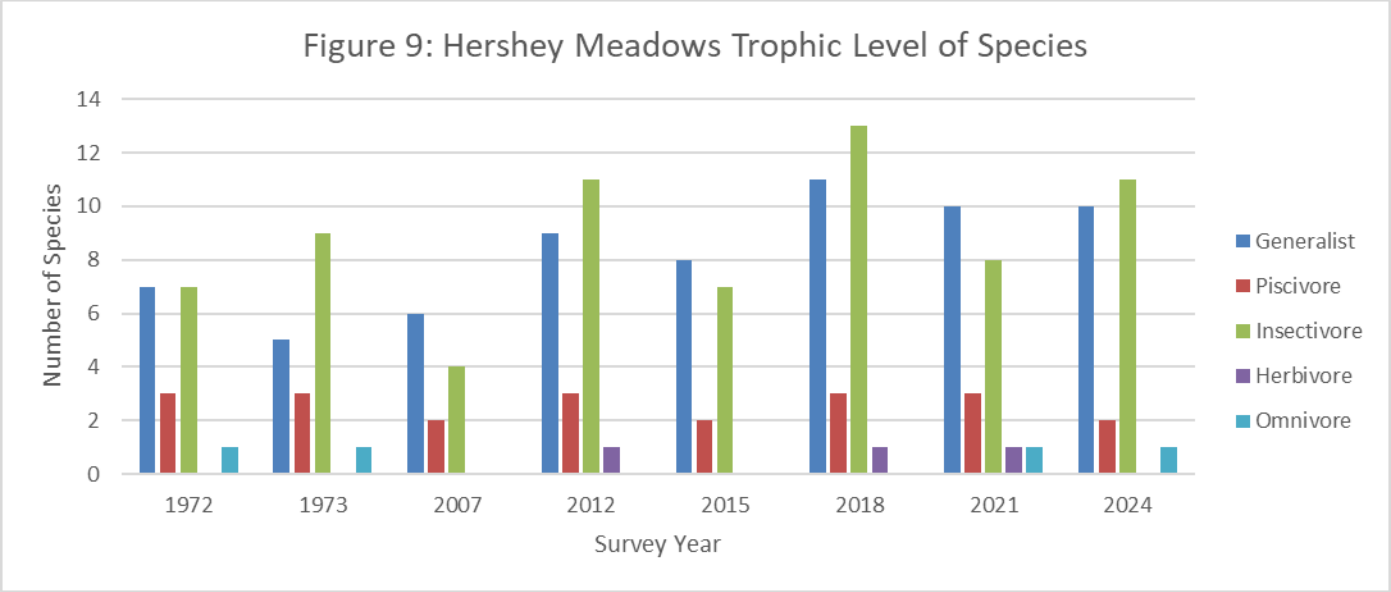

Figure 9: This graph shows the number of fish species identified at Hershey Meadows during the 8 sample years within each trophic level

Near the Mouth

Sampling conditions have made sampling this site challenging to draw conclusions on diversity and species composition. Over the 8 sample years, the number of fish sampled has varied from 50 fish identified in 1972 to 640 in 1973. The length of the stream sampled in the oldest surveys is unknown. Additionally, high water in 2012 prevented the team from sampling both sides of the stream, and the muddy waters in 2015 and 2018 prevented thorough sampling.

Before the 2021 survey, the bridge underwent construction, which deepened the stream channel, making it impossible to sample directly under the bridge in 2021. In 2024, sampling was able to be done under the bridge but only by a small team of people and not as thoroughly as before construction.

The shift in sample locations in 2007 from Hillsdale Road to Covered Bridge Road could also affect noticeable trends. Future sampling will help solidify any conclusions that are made.

Figure 10, below, shows that the site is dominated by Carp and Minnow species followed by Sunfish species. The other fish families have increased and decreased throughout the years. 2012 had the highest level of diversity at 22 species while both the 2012 and 2018 surveys observed the largest number of fish families at 7. The 2024 survey observed the fewest number of fish families at only 4.

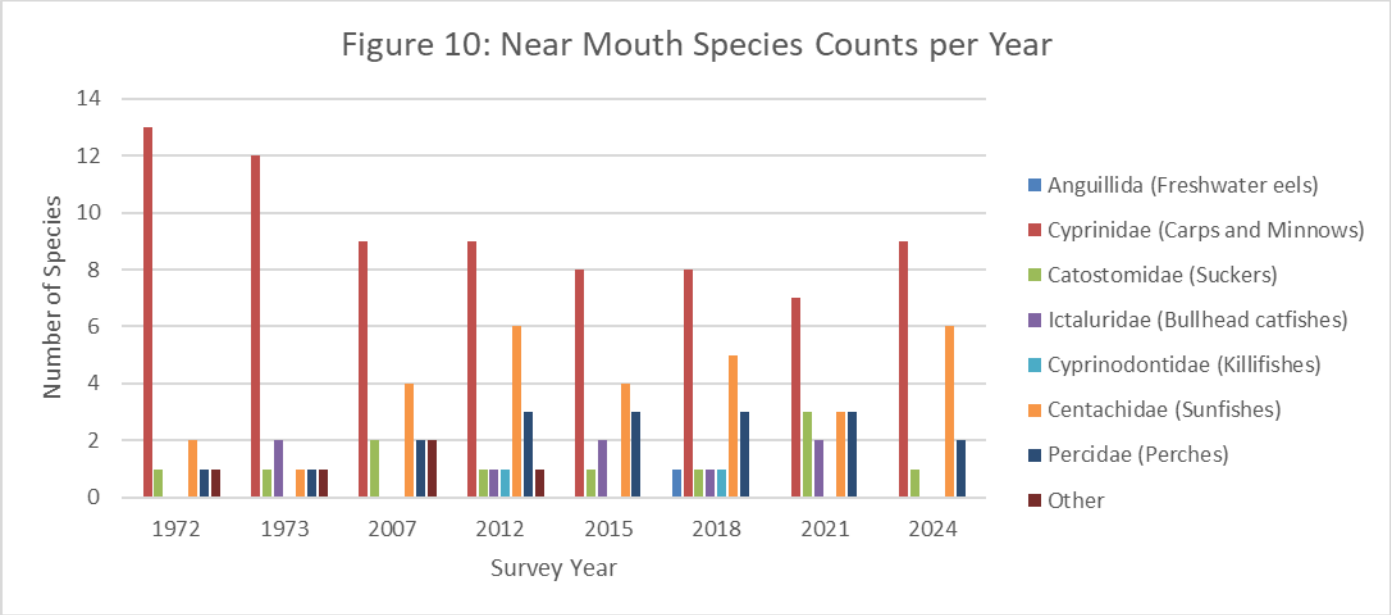

Figure 10: This graph compares the number of species within each family for the 8 years that sampling occurred near the mouth of the Conewago Creek.

Figure 11 shows the number of fish species per tolerance level near the mouth. The number of tolerant species increased between the 2007 and 2012 surveys and there continues to be more than double the number from the earlier sampling years. Intolerant species have managed to stay at similar levels.

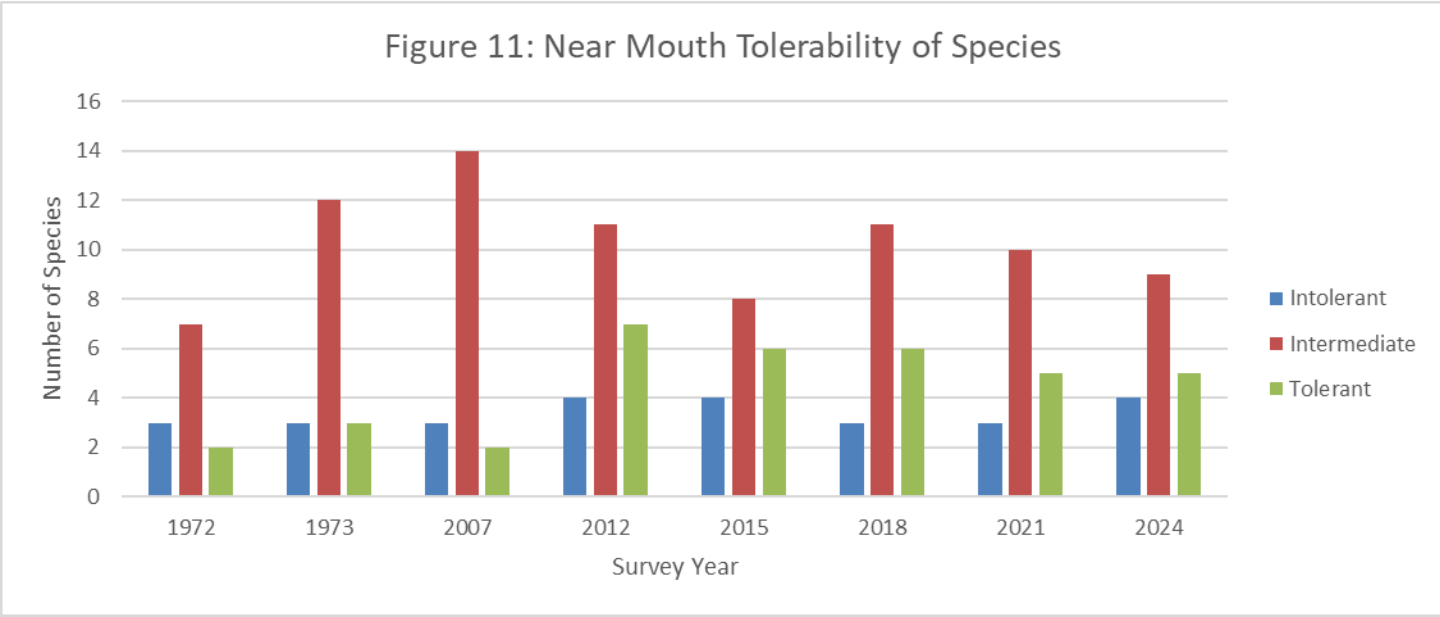

Figure 11: This graph shows the number of fish species from the sites near the mouth of the Conewago Creek identified as tolerant, intermediate, or intolerant during the 8 sample years.

During and prior to 2007, the fish population was dominated by insectivores. In more recent years the population has been dually dominated by insectivores and generalists. Piscivores generally increased since 1972 and 1973.

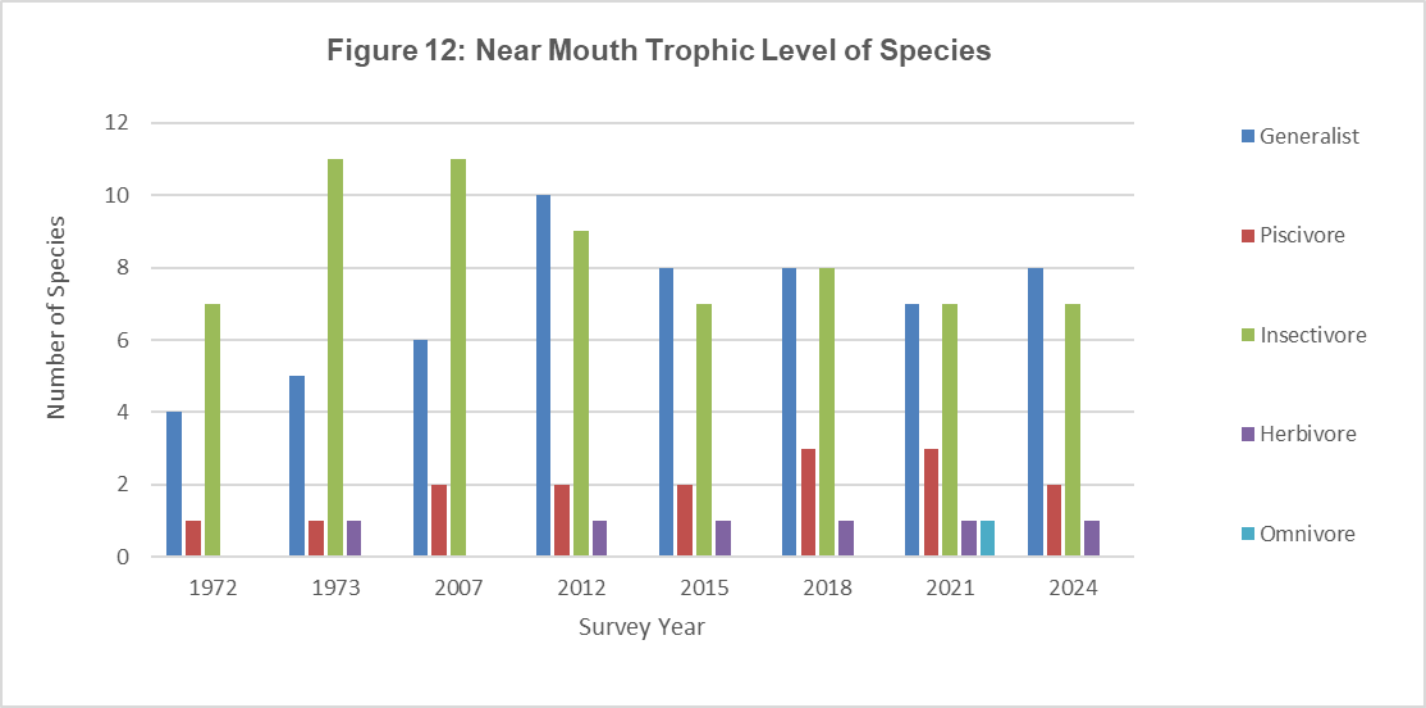

Figure 12: This graph shows the number of fish species identified at sites near the mouth of the Conewago Creek during the 8 sample years within each trophic level.

It is also worth noting that there were a considerable number of nonnative, rusty crayfish observed during the 2021 sampling that had not been observed before.

Comparison of 3 Surveys Completed in 2021

All three sites are dominated by the Minnow family (Figure 13). Diversity across species and family is highest at Hershey Meadows where the restoration project was completed.

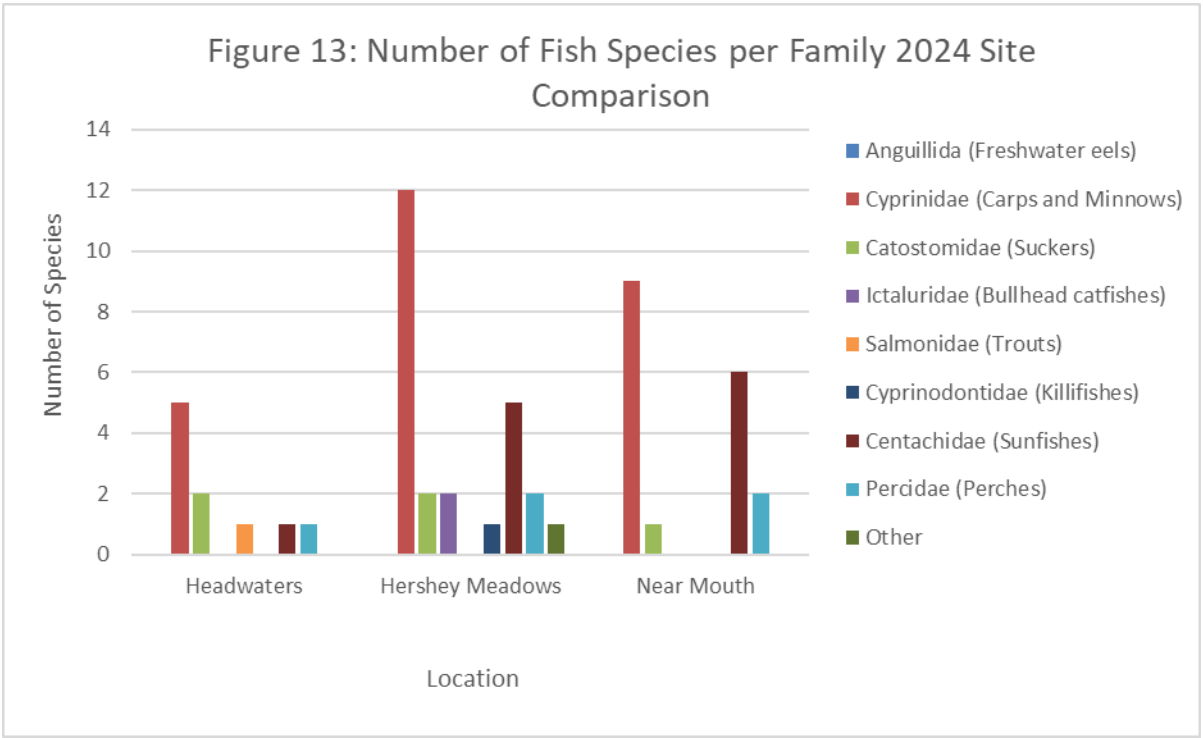

Figure 13: This graph compares the number of species within each family for the 3 sites that were surveyed in 2021.

Intermediate species are the most common tolerance level at the Hershey Meadows and Near Mouth locations (Figure 14). Intolerant species increase from the headwaters to more downstream sampling locations.

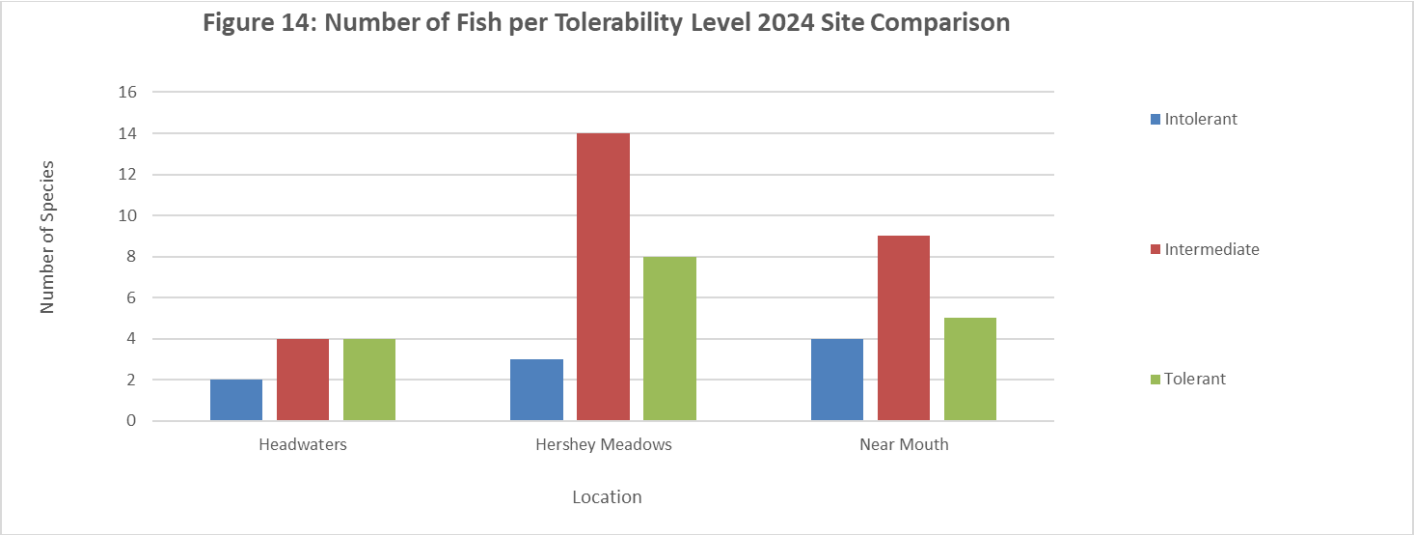

Figure 14: This graph shows the number of fish species broken down into tolerant, intermediate, and intolerant levels for the 3 sites surveyed in 2021.

Generalists and insectivores co-dominate at all three sites (Figure 15). The only other trophic level represented at all three sites is piscivore.

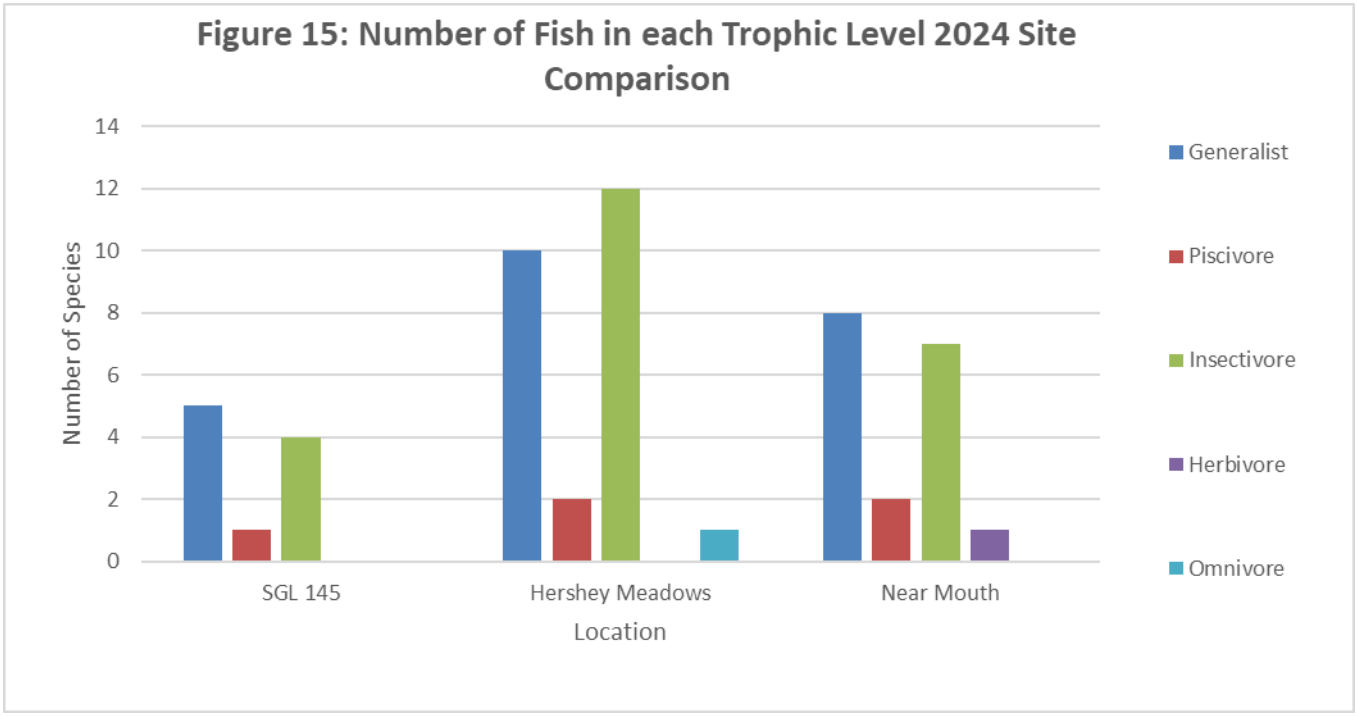

Figure 15: This graph compares the number of fish in each trophic level by each of the 3 sites for the 2021 survey.

Figure 16 shows the total number of fish species identified each year a survey has been conducted. As seen on the graph, there has been an average increase in total number of species since 1972 which could indicate an improvement in stream health. In 2024, 32 species of fish were identified.

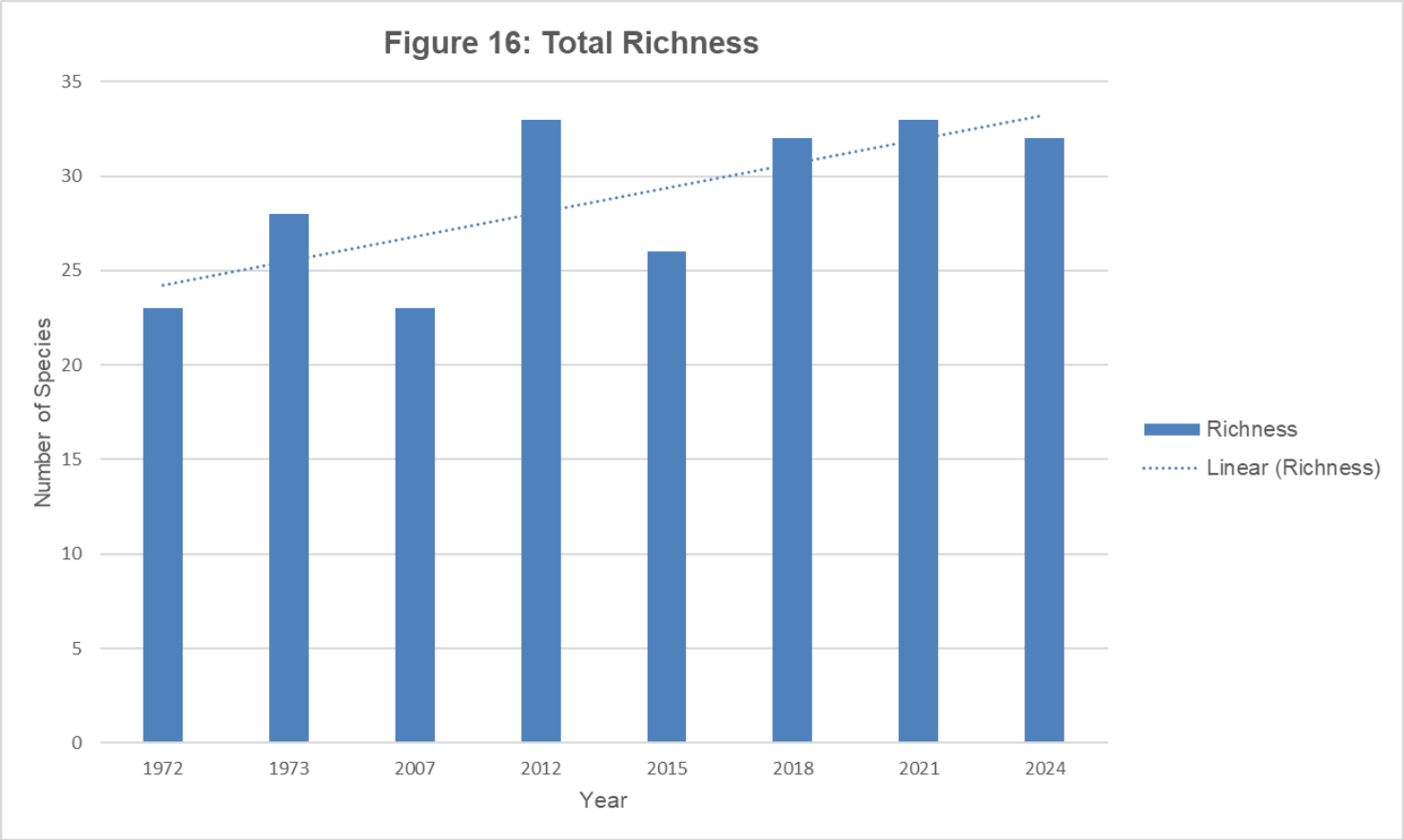

Figure 16: This graph shows the total number of species collected during the years that the survey took place.

During the 2018 and 2021 surveys, captured eels were weighed and measured to track progress following their release in 2016. The eel information collected is provided in Chart 4. When the eels were stocked in 2017, the average length was 122.3 mm and the average weight was 2.1 grams. All eels captured have shown growth since their release. Photo 1 is of the largest eel, captured in the headwaters during the 2018 survey. Additionally, eels captured during the 2021 survey were given ID tags. No eels were observed or captured during the 2024 survey at any location.

Chart 4: Eels Captured Since Release						
2018 Eels				**2021 Eels**		
Site	Length (mm)	Weight (grams)		Site	Length (mm)	Weight (grams)
Headwaters	254	14		Headwaters	*	*
Headwaters	660	454		Hershey Meadows	*	*
Hershey Meadows	254	28		Hershey Meadows	440	382
Hershey Meadows	317	113		Hershey Meadows	360	95
Hershey Meadows	285	38				
Hershey Meadows	290	40				
Covered Bridge	229	21				

Chart 4: This chart provides the recorded eel information gathered in the 2018 and 2021 surveys. (indicate eel observed, but not captured)*

Photo 1: largest eel captured during the 2018 survey.

During the 2024 survey, Rock bass and Redbreast Sunfish were surveyed at the highest percentages at 13% and 10% respectively. Redbreast Sunfish consistently makes up one of the highest percentages of the survey each year.

Chart 5: Comparison of 2024 Fish Survey Results Between Sites							
	Mouth	Hershey Meadows	Headwaters	Tolerability	Trophic Level	Total Number	Total Percent
Anguillida (Freshwater eels)							
Anguilla rostrata (American eel)				Intermediate	Piscivore	0	0%
Cyprinidae (Carps and Minnows)							
Campostoma anomalum (Central stoneroller)	5			Intermediate	Herbivore	5	1%
Cyprinella analostana (Satinfin shiner)		16		Intolerant	Insectivore	16	2%
Cyprinella spiloptera (Spotfin shiner)	3	11		Intermediate	Insectivore	14	2%
Exoglossum maxillingua (Cutlips minnow)	1		4	Intolerant	Insectivore	5	1%
Luxilus cornutus (Common Shiner)	1	67		Intermediate	Insectivore	68	8%
Nocomis micropogen (River chub)		8		Intermediate	Insectivore	8	1%
Notemigonus crysoleucas (Golden shiner)		1		Tolerant	Omnivore	1	0%
Notropis amoenus (Comely shiner)				Tolerant	Insectivore	0	0%
Notropis hudsonius (Spottail shiner)		50		Intermediate	Insectivore	50	6%
Notropis rubellus (Rosyface shiner)	23	10		Intolerant	Insectivore	33	4%
Notropis procne (Swallowtail shiner)		1	1	Intermediate	Insectivore	2	0%
Notropis volucellus (Mimic shiner)	59			Intermediate	Generalist	59	7%
Pimephales notatus (Bluntnose minnow)	7	2		Tolerant	Generalist	9	1%
Pimephales promelas (Fathead minnow)				Tolerant	Generalist	0	0%
Rhinichthys atratulus (Blacknose dace)	1	5	30	Tolerant	Generalist	36	4%
Rhinichthys cataractae (Longnose dace)	1		15	Intermediate	Insectivore	16	2%
Semotilus atromaculus (Creek chub)		17	2	Tolerant	Generalist	19	2%
Semotilus corporalis (Fallfish)		19		Intermediate	Generalist	19	2%
Cyprinus carpio (Common carp)				Intermediate	Generalist	0	0%
Catostomidae (Suckers)							
Catostomus commersoni (White sucker)	1	88	2	Tolerant	Generalist	91	10%
Hypentelium nigricans (Northern hog sucker)		2	3	Intermediate	Generalist	5	1%
Erimyzon oblongus (Creek chubsucker)				Intermediate	Generalist	0	0%
Ictaluridae (Bullhead catfishes)							
Ameiurus natalis (Yellow bullhead)				Tolerant	Generalist	0	0%
Ameiurus nebulosus (Brown bullhead)		2		Tolerant	Generalist	2	0%
Noturus insignis (Margined madtom)		1		Intermediate	Insectivore	1	0%
Salmonidae (Trouts)							
Oncorhynchus mykiss (Rainbow trout)			1	Intolerant	Piscivore	1	0%
Salmo Trutta (Brown trout)				Intolerant	Piscivore	0	0%
Esocidae (Pikes)							
Esox niger (Chain pickerel)				Intermediate	Piscivore	0	0%
Cyprinodontidae (Killifishes)							
Fundulus diaphanus (Banded killifish)		24		Tolerant	Insectivore	24	3%
Centachidae (Sunfishes)							
Ambloplites rupestris (Rock bass)	18	97		Intermediate	Piscivore	115	13%
Lepomis auritus (Redbreast sunfish)	2	85		Intermediate	Generalist	87	10%
Lepomis gibbosus (Pumpkinseed)	6	30		Intermediate	Generalist	36	4%
Lepomis macrochirus (Bluegill)	2	36	30	Tolerant	Generalist	68	8%
Lepomis cyanellus (Green sunfish)	2			Tolerant	Generalist	2	0%
Micropterus dolomieu (Smallmouth bass)	5	47		Intermediate	Piscivore	52	6%
Micropterus salmoides (Largemouth bass)				Intermediate	Piscivore	0	0%
Percidae (Perches)							
Etheostoma blennioides (Greenside darter)	1	1		Intolerant	Insectivore	2	0%
Etheostoma olmstedi (Tessellated darter)		2	1	Intermediate	Insectivore	3	0%
Etheostoma zonale (Banded darter)	3			Intolerant	Insectivore	3	0%
Stizostedion vitreum (Walleye)				Intermediate	Piscivore	0	0%
Other							
Shiner Sp		23		Intermediate	Insectivore	23	3%
crappie sp				Intermediate	Generalist	0	0%
shield darter				Intermediate	Insectivore	0	0%
Cyprinella species				Intermediate	Insectivore	0	0%
Hybrid Sunfish Lepomis gibbosus X L. Macrochirus						0	0%
Total	**141**	**645**	**89**			**875**	

Chart 5: This chart compresses Charts 1-3 to include only the 2024 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 are also shown. The total count and percentage are shown in the right-hand columns.
**Percentages are presented as rounded numbers and will not equal 100% as presented in this chart.*

There have been 47 combined species identified in the years since the study has begun, including those in the "other" category. During the 2024 survey, 32 species were identified, with 24 being native and 7 being non-native as seen in chart 6.

Chart 6: Native Designations		
	Native v. Non-native	**2024**
Anguillida (Freshwater eels)		
Anguilla rostrata (American eel)	Native	
Cyprinidae (Carps and Minnows)		
Campostoma anomalum (Central stoneroller)	Native	*
Cyprinus carpio (Common carp)	Non	
Cyprinella analostana (Satinfin shiner)	Native	*
Cyprinella spiloptera (Spotfin shiner)	Native	*
Exoglossum maxillingua (Cutlips minnow)	Native	*
Luxilus cornutus (Common Shiner)	Native	*
Nocomis micropogen (River chub)	Native	*
Notemigonus crysoleucas (Golden shiner)	Native	*
Notropis amoenus (Comely shiner)	Native	
Notropis hudsonius (Spottail shiner)	Native	*
Notropis rubellus (Rosyface shiner)	Native	*
Notropis procne (Swallowtail shiner)	Native	*
Notropis volucellus (Mimic shiner)	Non	*
Pimephales notatus (Bluntnose minnow)	Native	*
Pimephales promelas (Fathead minnow)	Non	
Rhinichthys atratulus (Blacknose dace)	Native	*
Rhinichthys cataractae (Longnose dace)	Native	*
Semotilus atromaculus (Creek chub)	Native	*
Semotilus corporalis (Fallfish)	Native	*
Catostomidae (Suckers)		
Catostomus commersoni (White sucker)	Native	*
Hypentelium nigricans (Northern hog sucker)	Native	*
Moxostoma macrolepidotum (Shorthead redhor	Native	
Ictaluridae (Bullhead catfishes)		
Ameiurus natalis (Yellow bullhead)	Native	
Ameiurus nebulosus (Brown bullhead)	Native	*
Ictalurus punctatus (Channel catfish)	Native	
Noturus insignis (Margined madtom)	Native	*
Esocidae (Pikes)		
Esox niger (Chain pickerel)	Native	
Cyprinodontidae (Killifishes)		
Fundulus diaphanus (Banded killifish)	Native	*
Salmonidae (Trouts)		
Oncorhynchus mykiss (Rainbow trout)	Non	*
Salmo Trutta (Brown trout)	Non	
Centachidae (Sunfishes)		
Ambloplites rupestris (Rock bass)	Non	*
Lepomis auritus (Redbreast sunfish)	Native	*
Lepomis cyanellus (Green sunfish)	Non	*
Lepomis gibbosus (Pumpkinseed)	Native	*
Lepomis macrochirus (Bluegill)	Non	*
Micropterus dolomieu (Smallmouth bass)	Non	*
Micropterus salmoides (Largemouth bass)	Non	
Percidae (Perches)		
Etheostoma blennioides (Greenside darter)	Native	*
Etheostoma olmstedi (Tessellated darter)	Native	*
Etheostoma zonale (Banded darter)	Non	*
Stizostedion vitreum (Walleye)	Native	
Other		
shield darter		
shiner sp		*
Cyprinella species		
crappie sp		
Hybrid Sunfish Lepomis gibbosus X L. Macrochirus		
	Total Native	24
	Total Non Native	7
	Total	**32**

Chart 6: This chart includes all the species that have been identified in the sampling years and indicates their designation as native or non-native to the Susquehanna River basin. It also indicated which of these species were found in the 2024 survey.

Conclusion

Overall, all three sites are demonstrating similar fish population diversity and tolerability from year to year. Total richness continues to increase on average across the watershed. The 2024 survey shows continued high levels of diversity both by species and family. It is also interesting to note the increase in intolerant species downstream versus in the headwaters. These results are continuing to build a trend that is needed to judge improvement as restoration projects continue.