Bioassessment of Deep Creek Lake Tributaries

Garret Co., Maryland

Report prepared for:

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Executive Summary

During the month of July 2022, a team from PennWest – California and the Maryland Department of Natural Resources conducted a synoptic bioassessment of 29 perennial Deep Creek Lake tributaries at sites selected by the Deep Creek Watershed Foundation. Most stations were established as close to the lake confluence as accessible. The team obtained water samples, assessed fish and macroinvertebrate communities, and performed habitat evaluations. Four stations exhibited flows too low to permit either fish or macroinvertebrate collection, here only water samples were taken. Three stations were accessed via boat. Overall, results describe coolwater streams which exhibit measurable total alkalinity and, in general, possess good chemical water quality. However, poor habitat including siltation and embedded stream bottoms resulted in low macroinvertebrate and fish abundance. This study serves as a preliminary baseline against which future monitoring and mitigation efforts of Deep Creek Lake tributaries may be evaluated.

Description of Study Area

The Deep Creek watershed, located in Garrett County MD is impounded over 9% of its drainage area by a hydroelectric dam creating a 3,900-acre lake which is raised and lowered seasonally according to energy production and recreational uses (Maryland Department of the Environment 2010). The lake is fed by a high proportion of first order streams because higher order tributaries are submerged by the impoundment (Maryland Department of the Environment 2010). Cultural impacts, including residential, commercial, and recreational development (Fig. 1) exacerbate the stream morphology of these low order streams. Bog and wetland conditions are also present in a number of sub-watersheds here (Fig. 2). Moreover, the flat topography

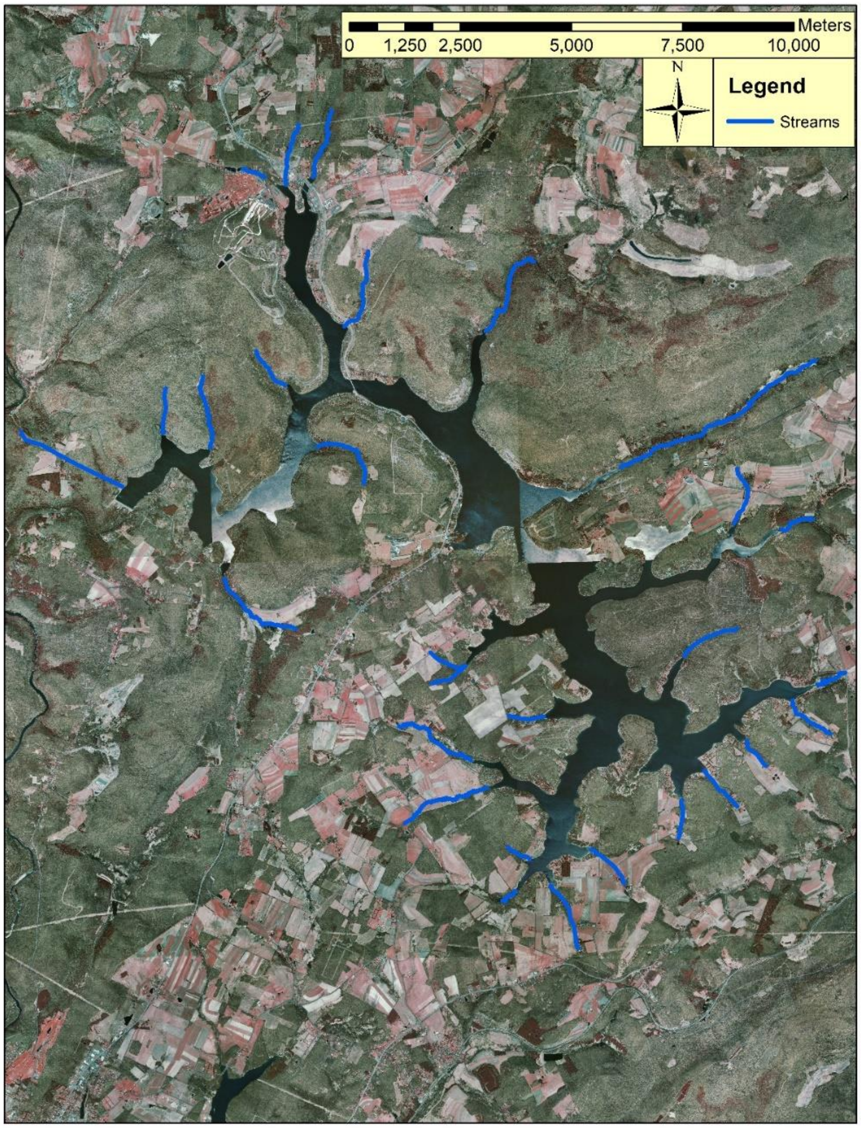


Image credit: Dakota Knott

Figure 1 – Map depicting land use/land cover around the watershed. Tributaries are highlighted in blue (refer to Table 1 for stream names). Red indicates developed and residential areas, Dark green indicates forest, and Light green and yellow indicates agriculture (either livestock grazing or crops).

Figure 2 – Image depicting bog-type habitat present on Red Run.

adjacent to Deep Creek Lake produces low gradients and few riffle areas which are the preferred habitats of stream macroinvertebrates.

The two largest tributaries are Cherry Creek and Mountain Meadow Run. The former has a history of coal mining and subsequent acid mine drainage (AMD; Maryland Department of the Environment 2010). Acid mine drainage in Cherry Creek is currently mitigated by several passive treatment systems located upstream of an active limestone doser (Fig. 3). All remediation structures were initially installed between 1998 and 2001 (USEPA 2012). Sedimentation is prevalent throughout the entire Deep Creek Lake basin (Maryland Department of the Environment 2010).

Figure 3 – Images of limestone doser located on Cherry Creek, upstream of its confluence with Deep Creek Lake.

Methods

On-site measurements of temperature (^oC), pH, and specific conductance µS/cm were taken at 26 of 29 stations (Table 1; Fig. 4). Similarly, additional samples were taken for analysis of total alkalinity (mg/l as $CaCO_3$) by standard titration in the laboratory at PennWest - California (Table 1). Habitat was evaluated at 26 of the established stations using the US Environmental Protection Agency's Rapid Bioassessment habitat form (Barbour et al. 1999). The large majority of sites were evaluated using the low gradient form, while three were assessed using the high gradient form (see Barbour et al. 1999).

Table 1 – Sampling stations established on Deep Creek Lake tributaries. Three streams that are bolded were accessed using a boat.

No.	Stream Name	Fish	Macro	Water	Habitat	Latitude	Longitude
1	North Glade Run	X	X	X	X	39.50692	-79.25082
2	Poland Run	X	X	X	X	39.48635	-79.27678
3	Green Glade	X	X	X	X	39.48291	-79.24597
4	UNT - 1 Green Glade		X	X	X	39.47621	-79.25317
5	UNT - 2 Green Glade		X	X	X	39.47100	-79.26404
6	UNT - 3 Green Glade		X	X	X	39.46639	-79.27179
7a	Pawn Run - 1	X	X	X	X	39.47490	-79.33199
7b	Pawn Run - 2			X		39.47014	-79.32214
8	Bull's Arm Run			X	X	39.47583	-79.30975
9	Red Run	X	X	X	X	39.49357	-79.36624
10	Smith Run	X	X	X	X	39.51824	-79.34944
11	Murray Swamp Run			Dry		39.52129	-79.38280
12	Brushy Hollow		X	X	X	39.51890	-79.37291
13	Shingle Camp			Dry		39.52804	-79.35825
14	Gravelly Run	X	X	X	X	39.53808	-79.34421
15	UNT - 3 McHenry			Inaccessible		39.56072	-79.35204
16	UNT - 2 McHenry			X	X	39.55973	-79.35776
17	UNT - 1 McHenry	X	X	X	X	39.56071	-79.36232
18	Hoop Pole Run	X	X	X	X	39.48469	-79.32574
19	UNT - 21 DC	X	X	X	X	39.45435	-79.29457
20	Meadow Mountain Run	X	X	X	X	39.52232	-79.26929
21	UNT - 22 DC			X	X	39.52786	-79.31738
22	UNT - 23 DC (Chatterton Run)	X	X	X	X	39.44815	-79.30307
23	UNT - 24 DC (Upper UNT Pawn Run Arm)			X	X	39.46166	-79.33103
24	Cherry Creek	X	X	X	X	39.53755	-79.31573
25	**Deep Creek**	X	X	X	X	39.44824	-79.31214
26	**UNT - 25 DC**	X	X	X	X	39.45359	-79.30949
27	**UNT - 24a Pawn Run**	X	X	X	X	39.46530	-79.31642
28	UNT - 27 DC			X	X	39.45723	-79.27853

UNT = unnamed tributary

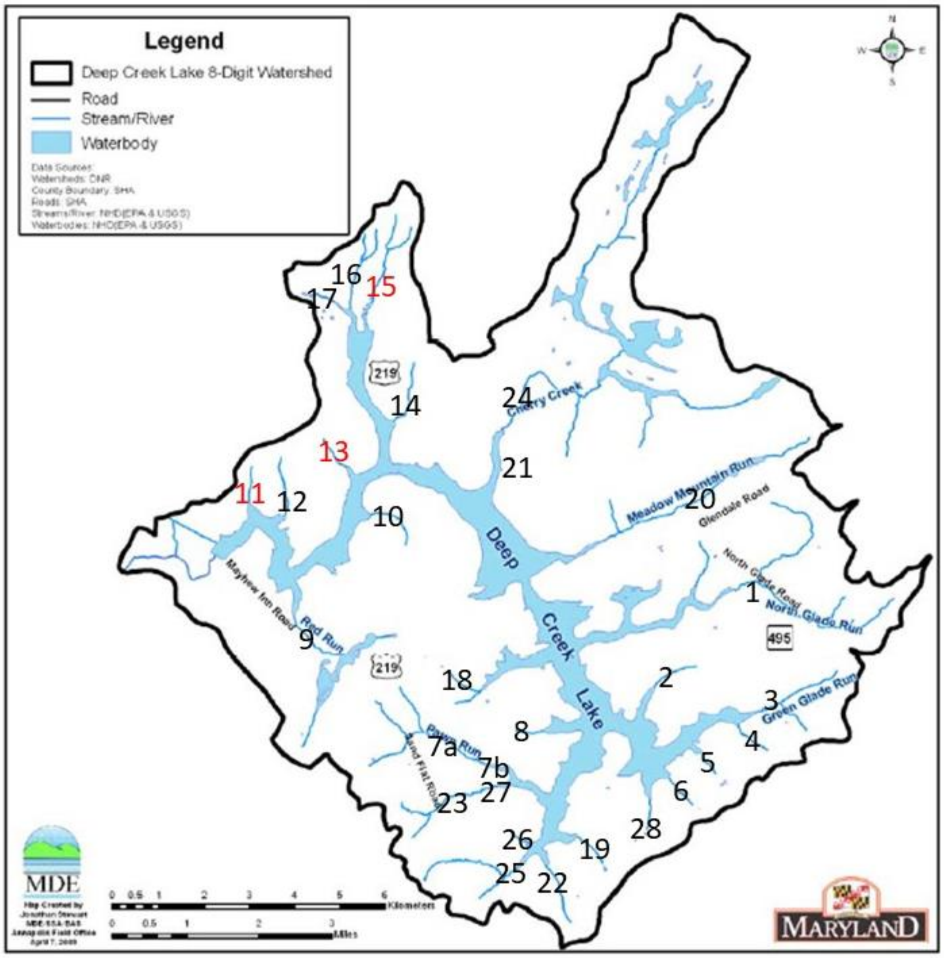


Figure 4 – Map depicting sampling stations around Deep Creek Lake, Maryland. Numbers correspond to those found in Table 1. Three streams indicated with red lettering did not have any data collected because of low flow conditions. Base map acquired from Maryland Department of the Environment (2010).

Macroinvertebrate sampling was conducted at 20 stations using either a D-frame kick net or a 500 µm kick-net (Barbour et al. 1999). All organisms were preserved in 70% isopropyl alcohol and transported to PennWest - California for processing. Collected organisms were identified to the lowest practicable taxonomic level (Merritt and Cummins 2008; Peckarsky et al. 1990; Voshell 2002) and enumerated. The only documentation of macroinvertebrate communities in the Deep Creek watershed of which we are aware of is found in reports issued by the Maryland Department of the Environment (2010) following surveys conducted in 1995-97 and 2000-2004 from eight sampling stations. No unimpacted sites were available to serve as references for this stream compliment for comparison. As a result, any historical data was not considered relevant to the scope of our evaluation of the current status of the watershed tributaries. The fish community at each station was sampled over an approximately 100-m reach by back-pack electrofishing using methods described by Barbour et al. (1999). All collected individuals were identified to species, enumerated, and released.

Results and Discussion

Water quality

Four water quality parameters were measured among 26 stream of the 29 streams listed in Table 1; two streams were dry at the time preventing sampling and one, UNT-3 McHenry, was inaccessible as it flows through a bog located on private property. Despite the lake being at full pool, many tributaries were very low – a likely reflection of the near drought like conditions around the region during July 2022. Overall, water temperatures suggest that streams feeding Deep Creek Lake can best be described as coolwater (streams whose temperature ranges from 15 to 26^{o}C) (PFBC 2000; Table 2). Values of pH were circumneutral ranging from 6.4 to 7.9;

Table 2 –Summary of water quality parameters from perennial coolwater tributaries to Deep Creek Lake, MD.

No.	Stream Name	Temperature (ºC)	pH	Conductivity (µS/cum)	Alkalinity (mg/L as $CaCO_3$)
1	North Glade Run	21.1	7.1	243	22
2	Poland Run	19.4	7.2	224	28
3	Green Glade	21.3	6.8	167	16
4	UNT - 1 Green Glade	18.7	7.3	257	24
5	UNT - 2 Green Glade	19.9	7.6	85	30
6	UNT - 3 Green Glade	18.9	7.1	47	10
7a	Pawn Run - 1	23.7	7.1	52	20
7b	Pawn Run - 2	20.5	7.3	313	62
8	Bull's Arm Run	23.3	7.3	172	42
9	Red Run	24.5	7.0	268	32
10	Smith Run	21.2	7.3	38	12
11	Murray Swamp Run			Dry	
12	Brushy Hollow	20.3	6.4	56	26
13	Shingle Camp			Dry	
14	Gravelly Run	17.4	7.4	204	70
15	UNT - 3 McHenry			Inaccessible	
16	UNT - 2 McHenry	17.8	7.3	226	28
17	UNT - 1 McHenry	19	7.9	409	100
18	Hoop Pole Run	21.9	7.5	175	28
19	UNT - 21 DC	24.1	7.4	158	40
20	Meadow Mountain Run	22.2	6.7	70	8
21	UNT - 22 DC	19.9	7.0	95	30
22	UNT - 23 DC (Chatterton Run)	20.4	7.5	275	34
23	UNT - 24 DC (Upper UNT Pawn Run Arm)	23.7	7.1	103	28
24	Cherry Creek	20.5	7.3	234	32
25	Deep Creek	20.8	7.2	248	30
26	UNT - 25 DC	21.6	7.4	263	32
27	UNT - 24a Pawn Run	21.9	7.4	232	28
28	UNT - 26 DC	24.3	6.8	52	14

UNT = unnamed tributary

while conductivity and total alkalinity values ranged from 38 to 409 µS/cm and from 8 to 100 mg/l as $CaCO_3$, respectively (Table 2). These values fall within ranges acceptable for aquatic life: alkalinity, 20 mg/l or more as $CaCO_3$ except where natural conditions are less, and pH, 6.5 to 9 (USEPA 1986); and specific conductance, $\leq$300 µS/cm (USEPA 2011).

Habitat

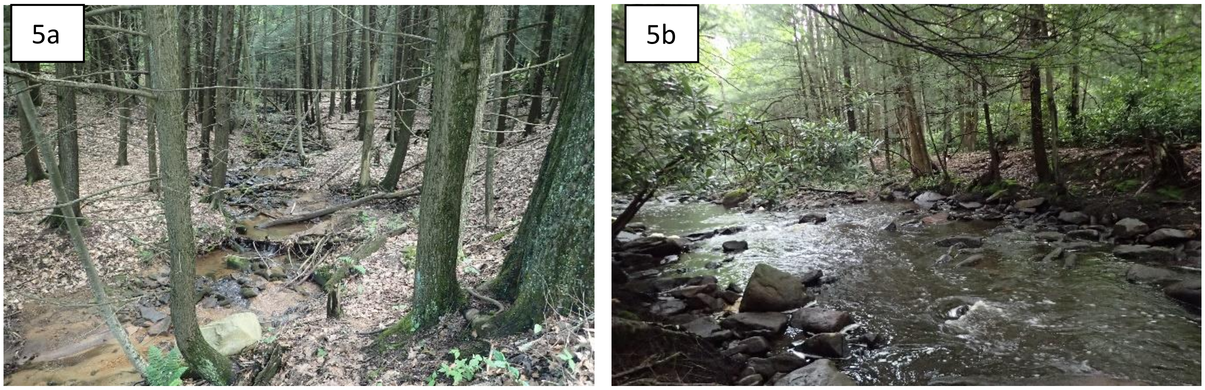
The US Environmental Protection Agency's Habitat evaluation form (Barbour et al. 1999) was used to assess each sampled tributary. Three streams (Smith Run, UNT-22DC, and Cherry Creek) were recognized as "high gradient", while the rest "low gradient". Many streams had relatively high sediment loads (silt and clay categories combined), while others e.g., Smith Run and Cherry Creek contained more cobble, gravel, and boulder substrates (Table 3; Figs. 5a and 5b). Among "low gradient" streams, habitat evaluation scores ranged from 82 to 123 (a perfect score is 200). These results suggest that many streams are lacking in habitat (i.e., they lack woody debris and suitable pool/riffle sequences), have increased sediment loads, and reduced or compromised riparian cover (Tables 3, 4 and 5). Among the three "high gradient" streams (Table 4), scores were a little better ranging from 116 to 143. However, Cherry Creek which scored highest among "high gradient" streams, has historically been impacted by AMD and bottom substrates at the sampling site were iron-stained (Figs. 6a and 6b). This effect is due to the neutralization of AMD by the doser resulting in iron hydroxide precipitates (Kimmel 1983). No remarkable odors or substances (i.e., oils or waste) were observed at each sampling site among the tributary collective.

Table 3 – Summary of substrate composition of Deep Creek tributaries. “High gradient” streams are expressed in bold type.

	Rock Type (size, mm)					
Stream Name	Boulder	Cobble	Gravel	Sand	Silt	Clay
North Glade Run	0	10	60	10	10	10
Poland Run	0	0	30	20	40	10
Green Glade	0	0	10	45	25	20
UNT - 1 Green Glade	0	10	30	40	15	5
UNT - 2 Green Glade	0	40	10	10	30	30
UNT - 3 Green Glade	0	0	40	30	20	10
Pawn Run - 1	0	5	20	30	40	5
Pawn Run - 2	No habitat form completed, water sample only					
Bull's Arm Run	0	10	40	20	20	10
Red Run	0	0	70	15	10	5
Smith Run	0	20	30	40	10	0
Murray Swamp Run	No habitat form completed, dry					
Brushy Hollow	0	10	30	30	20	10
Shingle Camp	No habitat form completed, dry					
Gravelly Run	5	30	40	10	15	0
UNT - 3 McHenry	No habitat form completed, inaccessible					
UNT - 2 McHenry	0	0	0	0	100	0
UNT - 1 McHenry	0	5	80	10	5	0
Hoop Pole Run	0	15	20	20	40	5
UNT - 21 DC	0	10	10	20	50	10
Meadow Mountain Run	0	20	20	20	30	10
UNT - 22 DC	5	15	20	40	15	5
UNT - 23 DC (Chatterton Run)	0	15	20	30	30	5
UNT - 24 DC (Upper UNT Pawn Run Arm)	0	10	10	20	55	5
Cherry Creek	35	25	20	10	5	5
Deep Creek	0	10	25	35	25	5
UNT - 25 DC	0	5	30	30	30	5
UNT - 24 a Pawn Run	0	10	20	35	30	5
UNT - 26 DC	0	5	15	10	50	20

Boulder > 256 mm; Cobble 64-256 mm; Gravel 2-64 mm; Sand 0.06-2.0 mm; Silt 0.004-0.06 mm; Clay <0.004 mm

UNT = unnamed tributary



Figures 5a and 5b – Images of Smith Run (5a) and Cherry Creek (5b) showing the presence of cobble, gravel, and boulder substrates.

Figures 6a and 6b – Images of Cherry Creek showing the presence of iron staining on the substrates.

Table 4 – Habitat evaluation rating scores for "low gradient" tributaries that feed Deep Creek Lake.

Habitat Parameter	Epifaunal Substrate	Pool Substrate	Pool Variability	Sediment Deposition	Channel Flow Status
North Glade Run	11	10	11	7	11
Poland Run	5	6	5	3	7
Green Glade	10	10	8	7	10
UNT - 1 Green Glade	8	6	10	6	7
UNT - 2 Green Glade	6	15	8	5	5
UNT - 3 Green Glade	9	8	4	10	5
Pawn Run - 1	10	16	8	8	10
Pawn Run - 2	Water Sample Only				
Bull's Arm Run	5	11	8	4	5
Red Run	5	13	7	5	11
Murray Swamp Run	No habitat form completed, dry				
Brushy Hollow	5	14	4	6	7
Shingle Camp	No habitat form completed, dry				
Gravelly Run	11	13	8	12	8
UNT - 3 McHenry	No habitat form completed, inaccessible				
UNT - 2 McHenry	3	8	11	2	15
UNT - 1 McHenry	10	17	6	16	6
Hoop Pole Run	7	12	5	6	7
UNT - 21 DC	10	7	5	5	6
Meadow Mountain Run	12	12	10	10	12
UNT - 23 DC (Chatterton Run)	11	11	9	11	11
UNT - 24 DC (Upper UNT Pawn Run Arm)	11	10	10	9	9
Deep Creek	10	10	9	10	11
UNT - 25 DC	11	9	11	9	11
UNT - 24 a Pawn Run	11	12	10	11	10
UNT - 26 DC	7	6	9	9	10

UNT = unnamed tributary

Table 4 – Continued.

Habitat Parameter	Channel Alteration	Channel Sinuosity	Bank Stability	Vegetative Protection	Riparian Vegetative Zone Width	Aggregate Score
North Glade Run	10	10	12	16	18	116
Poland Run	13	11	12	12	16	90
Green Glade	7	10	9	12	6	89
UNT - 1 Green Glade	15	11	12	14	16	105
UNT - 2 Green Glade	15	13	14	16	16	113
UNT - 3 Green Glade	16	15	12	16	14	109
Pawn Run - 1	16	14	14	9	6	111
Pawn Run - 2	Water Sample Only					0
Bull's Arm Run	15	6	14	14	10	92
Red Run	12	8	12	7	4	84
Murray Swamp Run	No habitat form completed, dry					0
Brushy Hollow	15	9	12	12	12	96
Shingle Camp	No habitat form completed, dry					0
Gravelly Run	16	8	11	12	7	106
UNT - 3 McHenry	No habitat form completed, inaccessible					0
UNT - 2 McHenry	14	10	12	12	8	95
UNT - 1 McHenry	16	6	12	14	7	110
Hoop Pole Run	14	13	14	14	10	102
UNT - 21 DC	12	10	12	13	11	91
Meadow Mountain Run	16	13	14	12	12	123
UNT - 23 DC	16	13	12	12	12	118
UNT - 24 DC	11	10	12	10	4	96
Deep Creek	16	11	13	12	12	114
UNT - 25 DC	16	12	13	13	13	118
UNT - 24 a Pawn Run	15	10	10	12	14	115
UNT - 26 DC	11	9	9	6	6	82

UNT = unnamed tributary

Table 5 – Habitat evaluation rating scores for "high gradient" tributaries that feed Deep Creek Lake.

Stream Name	Epifaunal Substrate	Embeddedness	Velocity	Sediment Deposition	Channel Flow Status
Smith Run	11	5	10	5	7
UNT - 22 DC	15	16	10	15	12
Cherry Creek	15	14	15	16	17

UNT = unnamed tributary

Table 5 – Continued.

Habitat Parameter	Channel Alteration	Frequency of Riffles	Bank Stability	Vegetative Protection	Riparian Vegetative Zone Width	Aggregate Score
Smith Run	15	16	14	18	15	116
UNT - 22 DC	17	14	15	15	10	139
Cherry Creek	14	16	16	12	8	143

UNT = unnamed tributary

There are several main threats to the integrity of stream habitats forming the Deep Creek tributary network. First, construction near tributaries creates disturbance and negatively impacts riparian areas. Poorly maintained sites can increase soil erosion. Second, agriculture which includes both livestock and crops, comes in several forms - the physical damage done to streams by livestock that have free access to stream corridors and the vast areas utilized to grow corn and soybeans. Such disturbance is pervasive throughout the watershed (Fig. 1). In combination, these two landscape disturbances account for the majority of anthropogenic sediment that washes into neighboring streams (Maryland Department of the Environment 2010).

Third, is infrastructure like roads and bridges that surround the lake. Roads facilitate runoff and many roads in and around the lake exhibit rather poor drainage (personal observation). As roads are built, localized areas must be channelized to accommodate bridges; bridges create artificial habitats that may scour or result in increased deposition. These in turn can create barriers for movement of fishes. Lastly, is the lake itself. The change in depth over the course of a season influences the availability and suitability of habitat. At the time this survey was completed, Deep Creek Lake was at full pool inundating stream channels at confluence areas characterized by emergent and submerged vegetation. During winter drawn down, the lake level can be reduced by several feet reducing stream/lake connectivity. While tributaries continued to drain towards the lake, the connections established at full pool are often significantly truncated. The aerial image in Figure 7 (taken from Google earth) demonstrates an example of this common phenomenon as it clearly shows a lack of connection between the lake and its tributary, Deep Creek. While a faint stream channel exists, the stream mouth clearly shows the abundance of sediments.

Image acquired from Google Earth.

Figure 7 – Confluence of Deep Creek with Deep Creek Lake during winter drawdown. Note that while a stream channel does exist, habitat connections between the tributary and the lake have been greatly diminished.

Macroinvertebrates

Macroinvertebrates were collected from 22 sampling stations around Deep Creek Lake. In total, 645 individuals representing 9 orders and 43 different taxa were obtained. Tributary taxa richness ranged from a low of one in Hoop Hollow Run to a high of 10 in Cherry Creek and Smith Run (Appendix A). However, the total number of individuals collected at each site averaged less than 30. The two dominant forms were chironomids (Diptera) and hydropsychids (Trichoptera) but, these results are skewed as one site, North Glade Run which provided 75% of the hydropsychids collected while the more evenly distributed chironomids were collected from 13 stations. As a result of the paucity of macroinvertebrates collected we elected to use Ephemeroptera/Plecoptera/Trichoptera (EPT) taxa as a measure of stream health. This metric is widely employed for this purpose in flowing waters (Barbour et al. 1999). Values of EPT taxa ranged from low of 0 in Pawn Run Cove streams to a high of 8 in Cherry Creek (Appendix A) and suggest that streams are impaired.

In addition, we used sensitivity to pollution to evaluate stream health. The majority of macroinvertebrates (23 of 43 taxa) collected were tolerant to pollution having rating scores > 3 (Fig. 8). The rating scale for pollution tolerance of a taxon ranged from 0 to 10, with 0 being the most sensitive to pollution and 10 being the least sensitive to pollution. Three is the cutoff point for sensitivity which decreases with increasing numerics. With respect to functional feeding groups (FF), tributaries appear relatively balanced, with even proportions of Collector-gatherers, Predators, and Shredders (Fig. 9). In summary, the macroinvertebrate communities of sampled Deep Creek Lake tributaries can be described as impaired as evidenced by low numbers, low taxa richness, and EPT scores.

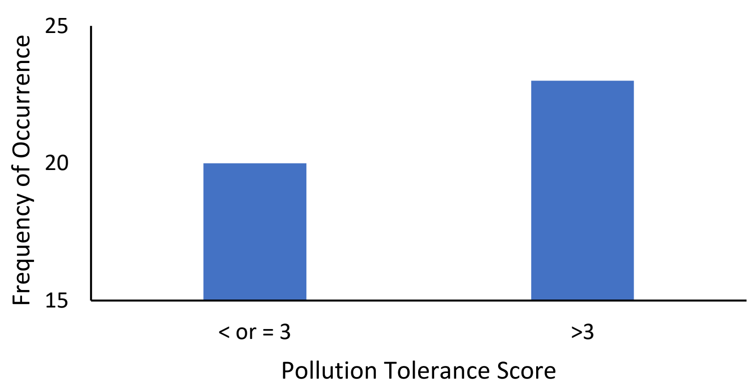


Figure 8 – Frequency of occurrence of pollution tolerance rankings among macroinvertebrate taxa collected from Deep Creek Lake tributaries. Intolerant (≤3) and Tolerant (>3).

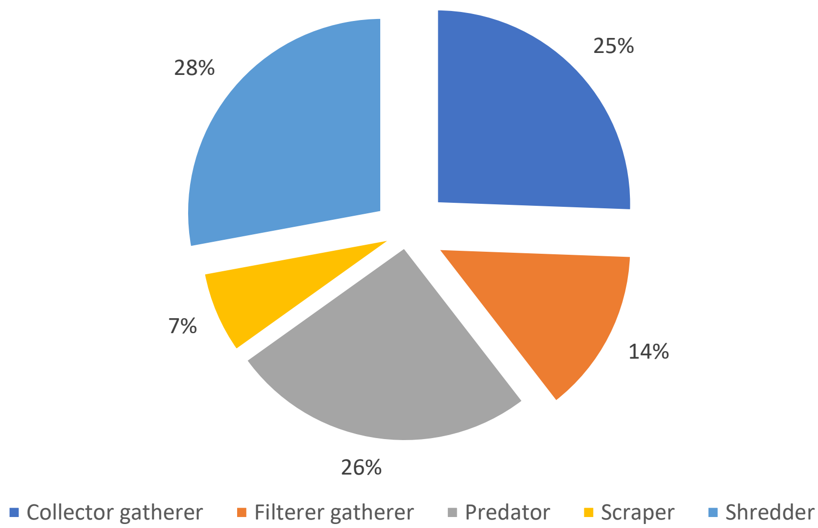


Figure 9 – Relative proportions of macroinvertebrate functional feeding groups.

Fish

Among the sampling locations surveyed, thirteen yielded fish. In total, we collected 8 different species representing 6 different families (Appendix B). The most frequently captured fish was brown bullhead (*Ameiurus nebulosus*), followed by Creek Chub (*Semotilus atromaculatus*), and Western Blacknose Dace (*Rhinichthys obtusus*) – the latter two minnows being typical stream residents (Fig. 10). Of note, was the collection of several wild Brook Trout (*Salvelinus fontinalis*) from Smith Run. Cherry Creek below the limestone doser harbored no resident fish community – only two Rock Bass (*Ambloplites rupestris*) were collected – likely immigrants from the lake. The only other lake species which occupied the sampled streams were Brown and Yellow Bullhead fry (*A. natalis*).

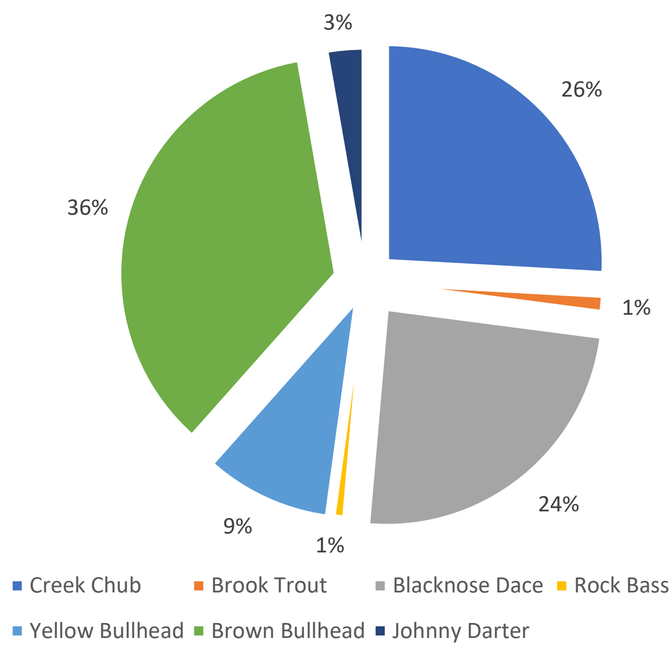


Figure 10 – Relative proportions of fishes captured from Deep Creek Lake tributaries.

Conclusions

All sampled Deep Creek Lake tributaries are impaired to varying degrees by a variety of anthropogenic activities (e.g., commercial, residential development and agricultural). While chemical analyses suggest circumneutral pH and total alkalinity values compatible with aquatic life, habitat analyses suggest that most streams here are impacted by increased sediment loads, embedded substrates, and narrow riparian buffers. Maryland Department of the Environment (2010) documented similar findings concluding that one hundred percent of stream miles here are estimated to be biologically impaired.

Cherry Creek, the largest tributary in the Deep Creek Lake watershed, has been historically impacted by coal extraction leading to episodes of AMD. Mitigation efforts have been completed in the headwaters and a limestone doser has been installed above the lake confluence. At the time of sampling, water quality was good – pH of 7.3, total alkalinity of 32 mg/l as $CaCO_3$; however, at this time due to a lack of rain, the stream was experiencing a period of low flows increased the efficiency of the doser. However, should this system fail, the stream and its lake cove would be negatively impacted. We suggest a comprehensive water quality monitoring effort to include seasonal periods of high and low flows in order to evaluate the overall efficacy of the treatment strategy.

The lake is managed as a multi-purpose (for both recreation and hydroelectric power) facility. As such, the resident tributary communities reveal little connectivity to Deep Creek Lake proper. The fish population of the lake (Eric Null, MD DNR personal communication) is considerably different than that of the sampled tributaries, with select lake species utilizing the tributaries as nursery waters. The seasonal fluctuation in water levels also impacts fish communities as many habitats that are present when at full pool are absent as the lake is drawn down. Our conclusions agree with those of Maryland Department of the Environment (2010) and suggest no changes to reported degrees of impairment identified in this watershed. This study serves as an ecological baseline to which future work can be compared.

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Appendix A – Summary of macroinvertebrate taxa collected from Deep Creek tributaries. Streams have been arranged by connection to the main lake or cove. Refer to Fig. 4 for map summarizing locations. Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa are bolded. FF = functional feeding group and Pollution = Pollution Tolerance.

General Lake Assemblage – tributaries not associated with a particular cove but which drain directly into Deep Creek Lake.

Family	Genus	FF	Pollution	North Glade Run	Poland Run	Hoop Pole Run	Meadow Mountain Run	Bull's Arm Run
Hirudinae	*Gammarus*	cg	4	0	1	0	0	0
Cambaridae	*Orconectes*	cg	6	0	0	2	2	0
Ephemeridae	*Ephemera*	cg	2	2	0	0	0	0
Aeshnidae	*Boyeria*	pr	2	3	0	0	0	0
Leuctridae	*Leuctra*	sh	0	0	2	0	0	0
Peltoperlidae	*Peltoperla*	sh	2	1	0	0	0	0
Hydropsychidae	*Diplectrona*	fc	0	84	0	0	0	0
Limnephilidae	*Pycnopsyche*	sh	4	0	3	0	0	0
Elmidae	*Macronychus*	sc	2	2	0	0	0	0
Corydalidae	*Nigronia*	pr	4	4	0	0	0	0
Sialidae	*Sialis*	pr	6	1	0	0	0	0
Tabanidae	Chrysops	pr	7	0	1	0	0	0
Chironomidae		cg	6	3	27	0	4	0
Tipulidae	*Dicranota*	pr	3	4	0	0	0	0
Tipulidae	*Pilaria*	sh	5	0	1	0	0	0

Green Glade Cove

Family	Genus	FF	Pollution	Green Glade	UNT - 1 Green Glade	UNT - 2 Green Glade	UNT - 3 Green Glade	UNT - 27 DC
Physidae		sc	8	3	0	0	0	0
Cambaridae	*Orconectes*	cg	6	3	4	0	0	0
Cambaridae	*Cambarus*	cg	6	0	1	0	2	0
Heptageniidae		sc	3	0	0	1	1	0
Ephemeridae	*Litobrancha*	cg	6	0	0	3	0	0
Leuctridae	*Leuctra*	sh	0	0	0	0	8	0
Peltoperlidae	*Peltoperla*	sh	2	0	0	0	16	0
Hydropsychidae	*Diplectrona*	fc	0	0	0	1	18	0
Lepidostomatidae	*Lepidostoma*	sh	1	0	2	1	2	0
Limnephilidae	*Pycnopsyche*	sh	4	0	1	0	0	0
Sialidae	*Sialis*	pr	6	0	2	0	1	0
Chironomidae		cg	6	0	6	0	1	0
Tipulidae	*Tipula*	sh	4	0	0	1	2	0

Pawn Run Cove

Family	Genus	FF	Pollution	Pawn Run - 1	Pawn Run - 2
Ephemeridae		cg	4	1	0
Hydropsychidae	*Cheumatopsyche*	fc	6	2	0
Lepidostomatidae	*Lepidostoma*	sh	1	1	0
Phryganeidae		sh	4	1	0
Stratiomyidae		cg	8	1	0
Tabanidae	Chrysops	pr	7	4	0
Chironomidae		cg	6	21	0
Tipulidae	*Hexatoma*	pr	2	1	0
Tipulidae	*Tipula*	sh	4	1	0

Dam Cove

Family	Genus	FF	Pollution	Red Run	Smith Run	Murray Swamp Run	Brushy Hollow	Shingle Camp
Hirudinae	*Gammarus*	cg	4	11	0	0	0	0
Cambaridae	*Cambarus*	cg	6	0	1	0	0	0
Heptageniidae		sc	3	3	0	0	0	0
Ephemeridae	*Ephemera*	cg	2	2	0	0	0	0
Gomphidae	*Stylogomphus*	pr	4	0	4	0	0	0
Leuctridae	*Leuctra*	sh	0	2	0	0	5	0
Nemouridae	*Amphinemura*	sh	3	0	0	0	1	0
Peltoperlidae		sh	2	0	1	0	0	0
Perlidae		pr	2	1	0	0	0	0
Perlidae	*Isoperla*	pr	2	0	3	0	0	0
Perlidae	*Cultus*	pr	2	0	1	0	0	0
Pteronarcyidae	*Allonarcys*	sh	0	0	8	0	0	0
Hydropsychidae	*Diplectrona*	fc	0	5	2	0	3	0
Philopotamidae	*Chimarra*	fc	4	0	0	0	1	0
Philopotamidae	*Dolophilodes*	fc	0	0	3	0	0	0
Lepidostomatidae	*Lepidostoma*	sh	1	0	0	0	2	0
Limnephilidae	*Pycnopsyche*	sh	4	0	0	0	3	0
Elmidae	*Macronychus*	sc	2	8	0	0	0	0
Chironomidae		cg	6	10	0	0	0	0
Tipulidae		sh	4	2	0	0	0	0
Tipulidae	*Antocha*	cg	3	0	1	0	0	0
Tipulidae	*Hexatoma*	pr	2	0	1	0	0	0

McHenry Cove

Family	Genus	FF	Pollution	Gravelly Run	UNT - 3 McHenry	UNT - 2 McHenry	UNT - 1 McHenry
Lepidostomatidae	*Lepidostoma*	sh	1	1	0	0	0
Limnephilidae	*Pycnopsyche*	sh	4	0	0	0	1
Chironomidae		cg	6	11	0	0	1

Pawn Run Cove

Family	Genus	FF	Pollution	UNT - 24 DC (Upper UNT Pawn Run Arm)	UNT - 24 a Pawn Run
Physidae		sc	8	0	3
Cambaridae	*Orconectes*	cg	6	0	4
Sialidae	*Sialis*	pr	6	0	3

Cherry Creek Cove

Family	Genus	FF	Pollution	Cherry Creek	UNT - 22 DC
Cambaridae	*Cambarus*	cg	6	0	4
Baetidae		cg	6	3	0
Heptageniidae		sc	3	5	0
Heptageniidae	*Epeorus*	sh	0	2	0
Gomphidae	*Stylogomphus*	pr	4	0	2
Leuctridae	*Leuctra*	sh	0	1	4
Nemouridae	*Amphinemura*	sh	3	1	3
Perlidae	*Paragnetina*	pr	1	2	0
Hydropsychidae		fc	5	18	1
Philopotamidae	*Chimarra*	fc	4	24	0
Philopotamidae	*Dolophilodes*	fc	0	0	1
Lepidostomatidae	*Lepidostoma*	sh	1	0	2
Elmidae	*Macronychus*	sc	2	2	0
Simulidae		fc	6	9	0

Deep Creek Cove

Family	Genus	FF	Pollution	UNT - 21 DC	Deep Creek	UNT - 25 DC	UNT - 23 DC (Chatterton Run)
Cambaridae	*Orconectes*	cg	6	1	4	1	2
Leptophlebiidae		cg	4	1	0	0	0
Ephemeridae	*Ephemera*	cg	2	0	6	0	1
Phryganeidae		sh	4	1	0	0	0
Corydalidae	*Nigronia*	pr	4	0	0	0	1
Sialidae	*Sialis*	pr	6	0	3	0	1
Chironomidae		cg	6	1	54	18	98

Appendix B. – Summary of fishes collected from Deep Creek Lake tributaries. Streams indicated with "No Fish" were sampled and did not produce any fish. Streams indicated with grey shading were not sampled due to low flow conditions.

Common Name	Scientific Name	North Glade Run	Poland Run	Green Glade	UNT - 1 Green Glade	UNT - 2 Green Glade	UNT - 3 Green Glade
Creek Chub	*Semotilus atromaculatus*	12	No Fish	12			
Blacknose Dace	*Rhinichthys obtusus*	0		0			
White Sucker	*Catostomus commersonii*	13		0			
Yellow Bullhead	*Ameiurus natalis*	0		0			
Brown Bullhead	*Ameiurus nebulosus*	0		0			
Brook Trout	*Salvelinus fontinalis*	0		0			
Rock Bass	*Ambloplites rupestris*	0		0			
Johnny Darter	*Etheostoma nigrum*	3		0			

Continued.

Common Name	Scientific Name	Pawn Run - 1	Pawn Run - 2	Bull's Arm Run	Red Run	Smith Run	Murray Swamp Run
Creek Chub	*Semotilus atromaculatus*	0			14	0	
Blacknose Dace	*Rhinichthys obtusus*	37			12	0	
White Sucker	*Catostomus commersonii*	1			1	0	
Yellow Bullhead	*Ameiurus natalis*	0			0	0	
Brown Bullhead	*Ameiurus nebulosus*	0			0	0	
Brook Trout	*Salvelinus fontinalis*	0			0	3	
Rock Bass	*Ambloplites rupestris*	0			0	0	
Johnny Darter	*Etheostoma nigrum*	0			0	0	

Common Name	Scientific Name	Brushy Hollow	Shingle Camp	Gravelly Run	UNT - 3 McHenry	UNT - 2 McHenry	UNT - 1 McHenry
Creek Chub	*Semotilus atromaculatus*			No Fish			10
Blacknose Dace	*Rhinichthys obtusus*						13
White Sucker	*Catostomus commersonii*						0
Yellow Bullhead	*Ameiurus natalis*						6
Brown Bullhead	*Ameiurus nebulosus*						10
Brook Trout	*Salvelinus fontinalis*						0
Rock Bass	*Ambloplites rupestris*						0
Johnny Darter	*Etheostoma nigrum*						0

Continued.

Common Name	Scientific Name	Hoop Pole Run	UNT - 21 DC	Meadow Mountain Run	UNT - 22 DC	UNT - 23 DC (Chatterton Run)
Creek Chub	*Semotilus atromaculatus*	No Fish	7	2	No Fish	1
Blacknose Dace	*Rhinichthys obtusus*		0	0		0
White Sucker	*Catostomus commersonii*		0	5		0
Yellow Bullhead	*Ameiurus natalis*		0	0		9
Brown Bullhead	*Ameiurus nebulosus*		0	0		40
Brook Trout	*Salvelinus fontinalis*		0	0		0
Rock Bass	*Ambloplites rupestris*		0	0		0
Johnny Darter	*Etheostoma nigrum*		0	0		4

Common Name	Scientific Name	UNT - 24 DC	Cherry Creek	Deep Creek	UNT - 25 DC	UNT - 24 a Pawn Run	UNT - 26 DC
Creek Chub	*Semotilus atromaculatus*	No Fish	0	0	4	4	
Blacknose Dace	*Rhinichthys obtusus*		0	0	0	0	
White Sucker	*Catostomus commersonii*		0	0	0	0	
Yellow Bullhead	*Ameiurus natalis*		0	2	7	0	
Brown Bullhead	*Ameiurus nebulosus*		0	17	12	12	
Brook Trout	*Salvelinus fontinalis*		0	0	0	0	
Rock Bass	*Ambloplites rupestris*		2	0	0	0	
Johnny Darter	*Etheostoma nigrum*		0	0	0	0	