A Comparison of Benthic Invertebrates in the Etowah River 1958 & 2018

Confluence '20

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Georgia Adopt-A-Stream

ABSTRACT

The Etowah River originates in Lumpkin County, northwest of Dahlonega. It flows south then west across North Georgia joining the Oostanala to form the Coosa River. It is famous for its biodiversity and is home to many threatened and endangered aquatic species.

Landscape use in North Georgia has changed in the past 100 years, shifting from agriculture to secondary regrowth of forests to increasingly large pockets of urbanization. This project examines benthic invertebrate composition change over sixty years in a small section of the Etowah.

Monthly benthic samples were taken at three locations in the section of the Etowah that borders Dawson Forest from October 1958 to September 1959. Organisms were identified to the lowest possible taxa level. These were the 'before' samples for a project to assess radiation impact on the river from an unshielded reactor. The project and the reactor were shut down and the data was stored.

We replicated equipment and collection sites from September 2017 to September 2018. Organisms were identified to lowest possible taxa and organic matter was identified and weighed. September though December 2017 and January 2018 samples have been analyzed.

There does not seem to be a huge difference in composition which may be due to the fact that the watershed was recovering from heavy agricultural use in the 1950s and has been relatively protected since then. This is changing rapidly with urbanization. Anecdotal evidence suggests large quantities of sand have reduced heterogeneity and depth in some areas.

The discussion of species loss and baseline shifting is in the news now. Our present day understanding of what is here is very different from what was here. We suggest that the boxes in closets containing field notebooks and old vials be checked to find interesting and important archived data.

INTRODUCTION

Macroinvertebrate biomonitoring is a standard method to assess aquatic health [1]. Organisms are collected, counted and identified to lowest taxon. Various metrics use species number, diversity and tolerance levels to put quantifiable number on health. These metrics are often developed using less impacted reference stream in the region.

We know that altered habitats affect species composition and numbers. Long-term monitoring, >6 years, is one of the best ways to assess changing environmental conditions and community structure. This is not always possible, due to personnel and monetary constraints, which can result in 'snapshot' comparison [2]. It is also possible that these one-off collections can be involuntary, such as when a grant is pulled and research stops. This does not make the data collected any less useful.

We were presented with a rare opportunity to compare a snapshot collection when one of the co-authors unearthed data collected sixty years ago on the Etowah River.

The North Georgia mountains have changed from old growth on the ridges and agriculture in the valleys in the early 1800s to subsistence farming with some forest cover to industrialized forestry and loss of farms in the late 1800s to early 1900s. [3] The City of Atlanta tract of Dawson Forest was initially small farms in the early 1900s. Farms were abandoned and sold in the 1930s and 1940s. The land consisted of cleared or abandoned fields and woodlots. By the early 1950s, Dawson Forest was a large, >10,000 acres, continuous tract of land with the Etowah River flowing through the central portion [4]

The US Federal Gov't, Army Corp of Engineers and the Air Force bought the land in 1956. Lockheed Aircraft Corporation operated the Georgia Nuclear Aircraft Laboratory there from the late 1950s until 1971. The site was decommissioned in 1971,sold to the City of Atlanta in 1972. The Georgia Forestry Commission started management in 1975. It is now a Wildlife Management Area managed by Georgia DNR Wildlife Resources Division. [4]

This history is important because it highlights the possibility of Shifting Baseline Syndrome [5]. The conditions in 1958 were not pristine, but the result of 150 years + of habitat alteration. It would be expected that the community differed from the pristine condition. The 2017-8 collections are therefore being compared to an already altered community.

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METHODS

The Etowah River originates in Lumpkin County northwest of Dahlonega. It flows south then west across North Georgia joining the Oostanala to form the Coosa River. It has high biodiversity in fishes and mollusks. The sites are located in a WMA with forested banks. Upstream land use is agricultural and more recently urban.

The purpose of the initial yearlong survey in 1958-59 was to get a broad spectrum of ecological information on the effects of radiation exposure on the environment. Three collection sites were established. One Surber sample was collected at each site monthly for a year. We reestablished the three collection locations, plus or minus a few hundred meters, with Dr. Teitjen's assistance, in September 2017 [Fig. 1]. Site One, the furthest upstream, is where a railroad bridge crossed the Etowah and is a mix of cobble and sand. Site Two is an equestrian crossing with gravel and small to large cobbles and is near the old reactor location [Fig. 2]. Site Three is at a small outcrop waterfall with cobble substrate and is the only exact location. All sites had *Podostemum* growing on cobbles.

We collected monthly samples from September 2017 through September 2018 following the 1958 protocol. We took three replicate samples at each site. All organic and inorganic matter collected was preserved in 75% ETOH. Especially large cobble or branches were brushed off into the net and returned to the river. We did not collect in March 2018 due to extremely high water.

Samples were picked using a dissecting scope. Organisms were identified to order and family. Organic matter, primarily *Podostemum*, was air dried and weighed. Inorganic matter, sand, gravel and cobble, was noted and discarded.

Diversity indices will be done when identification is completed to genus. Taxon and total numbers were compared here.

RESULTS

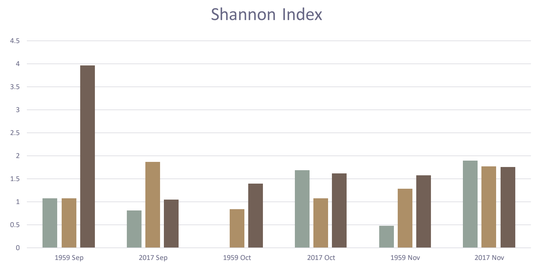

Chart 1: The Shannon Index comparison for of species diversity in the three months in 1958 compared with the 2017 data.

	Site 1		Site 2		Site 3	
Order	Count 1958	Count 2017	Count 1958	Count 2017	Count 1958	Count 2017
Diptera	84	199	818	20	339	49
Plecoptera	2	0	18	6	33	1
Ephemeroptera	1	10	17	2	69	13
Odonata	0	0	0	0	1	1
Trichoptera	0	23	230	15	189	27
Coleoptera	0	0	137	21	578	28
Annelida	50	2	17	1	7	41
Megaloptera	0	1	1	1	4	4
Hemiptera	0	1	0	0	0	0
Bivalvia	0	9	0	10	0	5
Gastropoda	24	5	19	13	40	32
Total	*161*	*250*	*1257*	*89*	*1260*	*571*

Table 1: Identification to order a nd abundance for September 1958 and 2017. All 3 samples for each site for 2017 are combined.

	Site 1		Site 2		Site 3	
Order	Count 1959	Count 2018	Count 1959	Count 2018	Count 1959	Count 2018
Diptera	N/A	32	456	150	257	179
Plecoptera	N/A	3	118	11	73	10
Ephemeroptera	N/A	0	78	10	22	20
Odonata	N/A	0	0	0	0	3
Trichoptera	N/A	31	300	66	77	17
Coleoptera	N/A	9	28	20	58	18
Annelida	N/A	0	0	3	6	3
Megaloptera	N/A	1	1	0	0	2
Hemiptera	N/A	0	0	0	0	0
Bivalvia	N/A	5	0	2	0	10
Gastropoda	N/A	7	1	9	14	76
Total	*N/A*	*88*	*982*	*271*	*507*	*338*

Table 2: Identificatio to order and abundance for January 1959 and 2018. Dr. Tietjen did not collect from site . Again, 3 combined samples for 2018.

Month	1958 Sep	2017 Sep	1958 Oct	2017 Oct	1958 Nov	2017 Nov	1958 Dec	2017 Dec	1959 Jan	2018 Jan
Total Organism Count	2767	451	929	721	2106	464	N/A	1085	1505	697

Table 3: The total organism count for September, October, November, December, and January in both 1958 to 1959, and 2017 to 2018. The 2017 and 2018 samples have three separate samples combined. Note that Dr. Teitjen did not collect in the month of December.

Fig. 1: The upper Etowah River with designated collection sites.

Fig. 2: Site Two on the Etowah River, September 2017, looking upstream.

RESULTS

The comparison across 58 years showed a decline in diversity and a large reduction in the numbers of specimens. September numbers in 1959 were 10X greater than the 2017 collections. The 2017 collections at each site are combined, so that numbers reflect 3X the area sampled in 1958 or 1959. Diversity is most obvious when taken to genera. Total numbers vary greatly. Hydropsychiidae, Brachycentridae, Elimidae and Simuliidae were most numerous and could dramatically increase total numbers in one collection. Based on discussions with Dr. Teitjen, we feel that the substrate is comparable among years.

DISCUSSION

Our data suggest change in abundance and diversity of species is due largely to habitat degradation. The landscape of Dawson Forest has changed from small farms and woody areas, to much larger farms and recreation areas, with more roads and trails available to the public. We currently do not have any abiotic measurements of water quality from 1958 and 1959, but the higher abundance of high tolerance organisms suggests degradation of water quality over the years is supported.

One of the goals of future research is to compare 1958 and 1959 land use to the current land use of Dawson Forest and upstream, giving insights into the reasons for such a dramatic drop in moderately tolerant organisms. Land upstream from our sites is converting from farms and woodlots to higher density suburban and commercial. This highlights the importance of data that can connect the effect of the land on the quality of the water. Records don't show that any of the collection years experienced drought, but an investigation into the average temperature and rainfall will be obtained in hopes of more evidence to support our data.

Studies on the Rhone River and the rivers in NY suggest a worldwide long term trend on the effect of habitat change on aquatic invertebrates [6,7]. Our data, although separated with larger time gaps between collections, follows these same long term trends. Not all samples have been separated and identified through September of 2018, but plans are in place to continue this through the next year. We plan to identify not only to family, but further to genre and species as we are best capable to do so. This will allow us to compare the over-all species diversity from 1958 to 2018.

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