Quantitative and Qualitative Assessment of Aquatic Macroinvertebrate in Streams and Springs of Forested Fen Forest Preserve, Kane County, Illinois

Final Report

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Abstract. Fox River Forested Fen Forest Preserve, Kane County, near Elgin, Illinois, is a new acquisition of the Forest Preserve District of Kane County and a new Illinois nature preserve. Because of its geographical proximity and plant community similarity to Trout Park Nature Preserve, Forested Fen probably has a similar aquatic macroinvertebrate fauna to that of Trout Park. Quantitative and qualitative sampling was conducted in April and May 2015 to answer this question. Several coldwater aquatic macroinvertebrates were found to inhabit the Forest Fen stream. The south and north branches of the stream differed markedly in from each other in terms of abundance, total taxa richness, and EPT (sensitive insect) richness, the north branch being the better of the two. Less than half of the historical EPT richness (most sensitive of aquatic insects) reported from Trout Park was present in Forested Fen. Forest Fen compare better to two other regional springbrook systems. Suggested management includes replanting of the area in white cedar to increase resistance to water temperature changes, and removal of the artificial pond that increases water temperature and disrupts dispersal routes.

INTRODUCTION

The Illinois Tollway Authority in 2013 donated a parcel of land northwest of the I-90 interchange at Elgin to the Forest Preserve District of Kane County (FPDKC). The parcel was later named Fox River Forested Fen Forest Preserve (Fig. 1). This preserve, once the site of the former Fox River Country Day School and the Chicago Junior High School, is comprised of 10.93 hectares (27 acres). The forested fen consists of a short bluff that grade to a wet area that is drained by a north and south branch. Both branches enter a small pond and a single drainage leaves the property. This stream then flows south along Duncan Ave. until it crosses the road and enters the Fox River just upstream of I-90. A unique plant community consisting of *Thuja occidentalis* L. (white cedar, or arborvitae) occurs in the lower terraces of the preserve and presently covers approximately 20% of site. This type of tree often grows along seeps and springbrooks further northward. This preserve is one of the most southern remnants of white

cedar fen found in Illinois. The Illinois Nature Preserve Commission granted nature preserve status to the fen in 2014.

A similar white cedar fen, Trout Park Nature Preserve, occurs just south of I-90. The two fen communities were continuous at one time prior to the construction of I-90. Trout Park historically supported a unique aquatic insect assemblage (Ross 1944). The springs and springbrooks supported a coldwater fauna relict of much colder times. Disjunction of the larger habitat, encroachment of exotic vegetation, and the addition of nutrients from overland flow and aerial sources have diminished the quality of both fen systems through time.

Mr. William Graser of the FPDKC contacted us in winter, 2015 to conduct an inventory of aquatic invertebrates in Fox River Forested Fen Forest Preserve. Sampling of the two branches of the stream that drained the fen occurred in April and May of that year. The objectives of the study were to do the following:

1. Quantitatively sample the macroinvertebrate fauna in streams in the preserve, comparing the assemblages from the north and south branches, examining differences in rank abundance curves, total abundance, total taxa richness, and Ephemeroptera+Plecoptera+Trichoptera species richness (EPT richness)..
2. Conduct qualitative sampling of adults to confirm identifications of larval taxa.
3. Compare EPT species richness findings with nearby Trout Park and three other fen or fen-like systems in northern Illinois.

METHODS

The south branch of the fen stream may be nutrient enriched over that of the north branch, as evidenced by the luxuriant filamentous algal growth it presented. Sampling proceeded to determine if there were differences between the two branches. We conducted quantitative sampling on two occasions (Table 1). April 17 sampling employed a Surber sampler on the south branch and mainstem (Fig. 1). Three grouped Surber samples were collected from three locations: the mainstem below a small pond just prior to the stream leaving the preserve, an area just above the pond within a small clump of white cedar, and an open area near a small footbridge. We collected May 21 samples using a dipnet at eight locations on the north branch above the pond. The dipnet and Surber samplers collected a nearly identical surface area, so their results are comparable. Additionally, we conducted sweepnetting during May to obtain adults of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) (EPT taxa), three sensitive orders of aquatic insects. We sorted samples in their entirety and identified specimens to the most specific level possible.

Rank Abundance Plots. Rank abundance plots demonstrate on a number of levels just how different samples or assemblages are based on the relative abundance of taxa, species richness, and evenness of species abundance (Magurran 1988). To construct the curves, we compiled a single composite assemblage for each branch using their sample data. We converted each species/taxon abundance to $\log_{10}$ scale so that it was comparable between stream branches, sorted the log abundance in descending order and gave a numerical rank (rank abundance) to each species by branch. Ties were give the next available number. A graph was produced that

summarizes the differences between each branch based on relative abundance $\log_{10}$ versus rank abundance, both branches being represented on the same graph.

Differences in abundance and taxa richness between branches. Since we collected quantitative samples we could compare abundance, total taxa richness, and total EPT richness values across the stream branches. These values were compared using a two-sample T-test with the hypothesis that branches supported different values for each variable. Test statistics were presented for two-tailed results; therefore, they are conservative statements about differences between branches. Results were presented graphically as mean and standard error for each branch for each of the three variables.

Qualitative comparisons of EPT assemblages to other fen/spring habitats in northern Illinois. Our interest in this case is to determine if Forest Fen supports an EPT fauna that is similar to historical records for Trout Park (once known as Elgin Botanical Gardens). Trout Park was historically rich in EPT species, especially caddisflies (Ross 1944), although several species appear to have been lost since the mid-1950s. Since Forested Fen is just north of the I-90 corridor, and was probably continuous with the Trout Park fen south of the interstate, it makes sense to examine how the EPT assemblage has diverged from Trout Park since I-90 was built in the 1950s.

We also compiled EPT presence data from the Illinois Natural History Survey Insect Collection database for two additional springbrook complexes from northern Illinois:

1. Split Rock Brook, La Salle Co., 3 km W Utica
2. Wade Creek and springboil, Nachusa Grasslands (TNC) in Lee Co.

All are coldwater streams and should be informative in determining the relative importance of Forest Fen in protecting coldwater EPT fauna in Illinois.

RESULTS

Samples yielded 11,688 specimens from Fox River Forested Fen Preserve, representing 56 macroinvertebrate taxa (Table 2). Phyla recovered included Annelida, Arthropoda (Chelicerata, Crustacea, and Hexapoda), Mollusca, Nematoda, and Platyhelminthes. Taxa that were numerically dominant included two species of Amphipoda and one of Isopoda (crustaceans), a riffle beetle (Coleoptera: Elmidae), a small-minnow mayfly (Ephemeroptera: Baetidae), a forest stonefly (Plecoptera: Nemouridae), three caddisflies (Trichoptera: Glossosomatidae, Hydropsychidae, Thremmatidae), and planarians (Platyhelminthes: Turbellaria).

Rank abundance curves demonstrated that the two branches supported somewhat different assemblages. The curves for these two branches demonstrated deficits in the South Branch including: overall lower abundance, lower species richness, and a deficit of evenness of abundance of species.

The t-Tests demonstrated that there was a highly statistically significant difference in abundance between the two branches with the South Branch having only 30.3% of the abundance found in the North Branch (Fig. 3). Several taxa were much more abundant in the north branch than in the south: Oligochaeta (aquatic worms), *Crangonyx* sp. and *Gammarus*

pseudolimnaeus (amphipod crustaceans), *Tvetenia bavarica* group (Diptera: chironomid midge), *Baetis tricaudatus* (Ephemeroptera: Baetidae), and *Amphinemura* sp. (Plecoptera: Nemouridae).

Total species richness was also found to be highly significantly different between the two branches (Fig. 4), on average the South Branch was only 55.6% of the total species richness of the North Branch. Differences in EPT species richness between the two branches were not of the same scale, but the smaller absolute differences were consistent and thus significant (Fig. 4). The South Branch supported 66.2% of that found in the north branch. Total EPT richness, combining all samples for each branch, also demonstrated a similar relationship between the two branches (Fig. 6).

DISCUSSION

The branches of Forested Fen stream differ dramatically in all abundance and taxa richness measures. Past and current degradation related to nutrient enrichment may be the culprit. Possibly, domestic sewage infrastructure is leaking small amounts of effluent into the south branch. Whatever the cause, it must still be occurring since a nearby, connected branch maintains higher abundance and richness values.

Other evidence that supports degradation of Forested Fen is the large difference in EPT taxa richness between Trout Park Nature Preserve and Forested Fen (Fig. 6). These two preserves were most certainly one contiguous system before the construction of I-90. Ross (1944) suggested as much. A likely assumption is that the white cedar community was much more continuous and certainly of great scope than remains today. Ross (1944) and data in the INHS Insect Collection database points historically to at least 24 EPT species being present in Trout Park. Only 45.8% of which is present in Forested Fen. Comparison to other springbrooks is better; Forested Fen supported 84.6% EPT richness of Wade Creek, a coldwater stream and springboil complex in Nachusa Grasslands (TNC) of Lee County. Split Rock Brook, a spring/springbrook complex 2 mi W of Utica along the Illinois and Michigan Canal historically had a rich EPT fauna. Forest Fen supported 78.5% of the EPT richness found at Split Rock Brook (Ross 1944, unpubl. data).

CONCLUSIONS

Overall, Forested Fen still supports about half of the historical fauna present in Trout Park. It seems that the North Branch is the richest and holds the highest proportion of the historical assemblage. Management strategies in Forest Fen will determine if diversity is maintained, declines, or increases. Figuring out if there are indeed more nutrients in the South Branch, and the source of those nutrients, would be useful in determining if sanitary sewers are leaking. Lawn fertilizers might be an alternative source of nutrients, but if this were the case, the north branch would also have large algal blooms.

Management of existing vegetation might facilitate the resilience of the fen community. Removal of invasive shrubs and replanting of white cedar will help to reset the energy and nutrient economy of the fen branches by removing unpalatable leaf matter in favor of cedar leaves and branches with which the aquatic macroinvertebrates have evolved. This type of vegetation would also help to shade the land, slowing the warming of waters.

Another suggestion for improving the stream habitat is the removal of the pond in the lower drainage. This would reclaim up to 50 m of streambed if the channel were meandered through the old pond. Replanting of white cedar along this re-meandered bed would help to stabilize the bank and cool the water. The pond is effective at increasing the stream water temperature, as evidenced by the loss the saddlecase caddisfly, *Glossosoma intermedia*, in the outlet below the pond. Removing the pond may also help to improve migration corridors for Trout Park adult EPT that may fly along the channel that parallels Duncan Avenue.

LITERATURE CITED

Magurran, A. 1988. Ecological Diversity and Its Measurement. Princeton University Press, Princeton, New Jersey. 179 pp.

Ross, H. H. 1944. The caddis flies, or Trichoptera, of Illinois. Illinois Natural History Survey Bulletin 23:1-326.

Fig. 1. Map of features and sampling locations in Fox River Forested Fen Preserve, Elgin, Illinois. Mainstem and south branch locations represent three samples each.

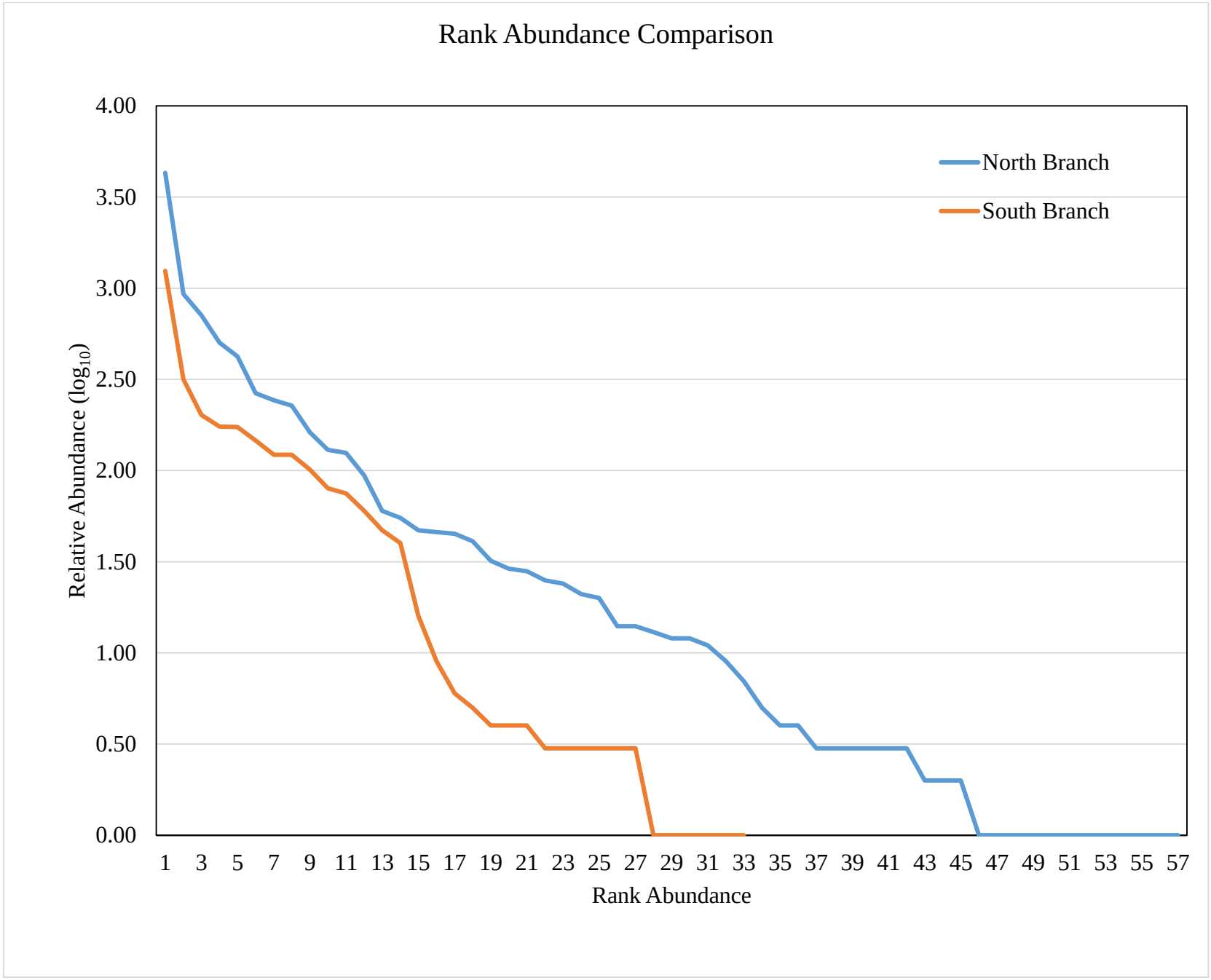

Fig. 2. Rank abundance curves for stream branches draining Forested Fen Preserve, Kane Co., Illinois.

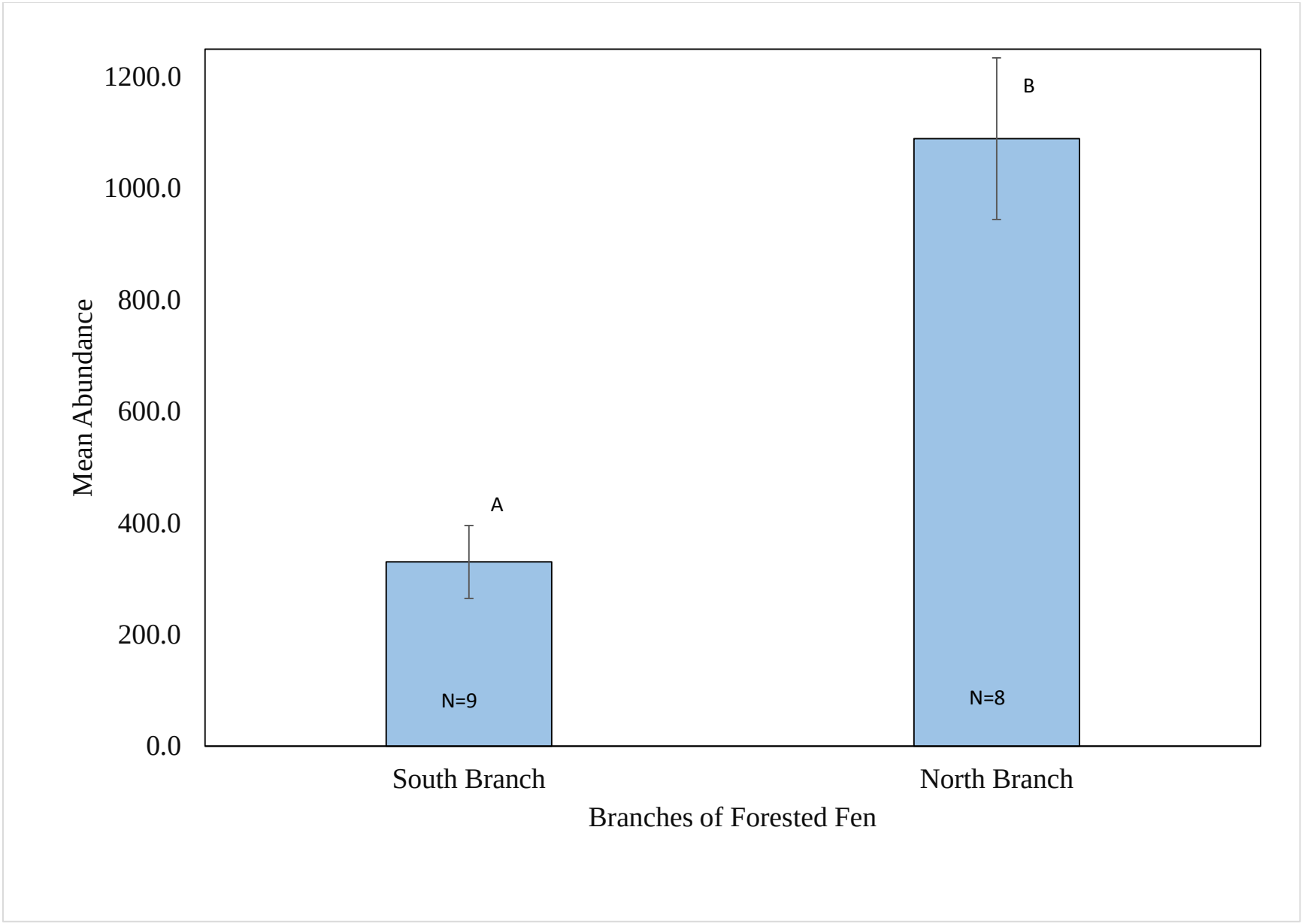

Fig. 3. Mean and standard error abundance from each branch of springbrook in Forested Fen Preserve, Elgin, Illinois. Two tailed T-test, t=-4.77, p=0.0008).

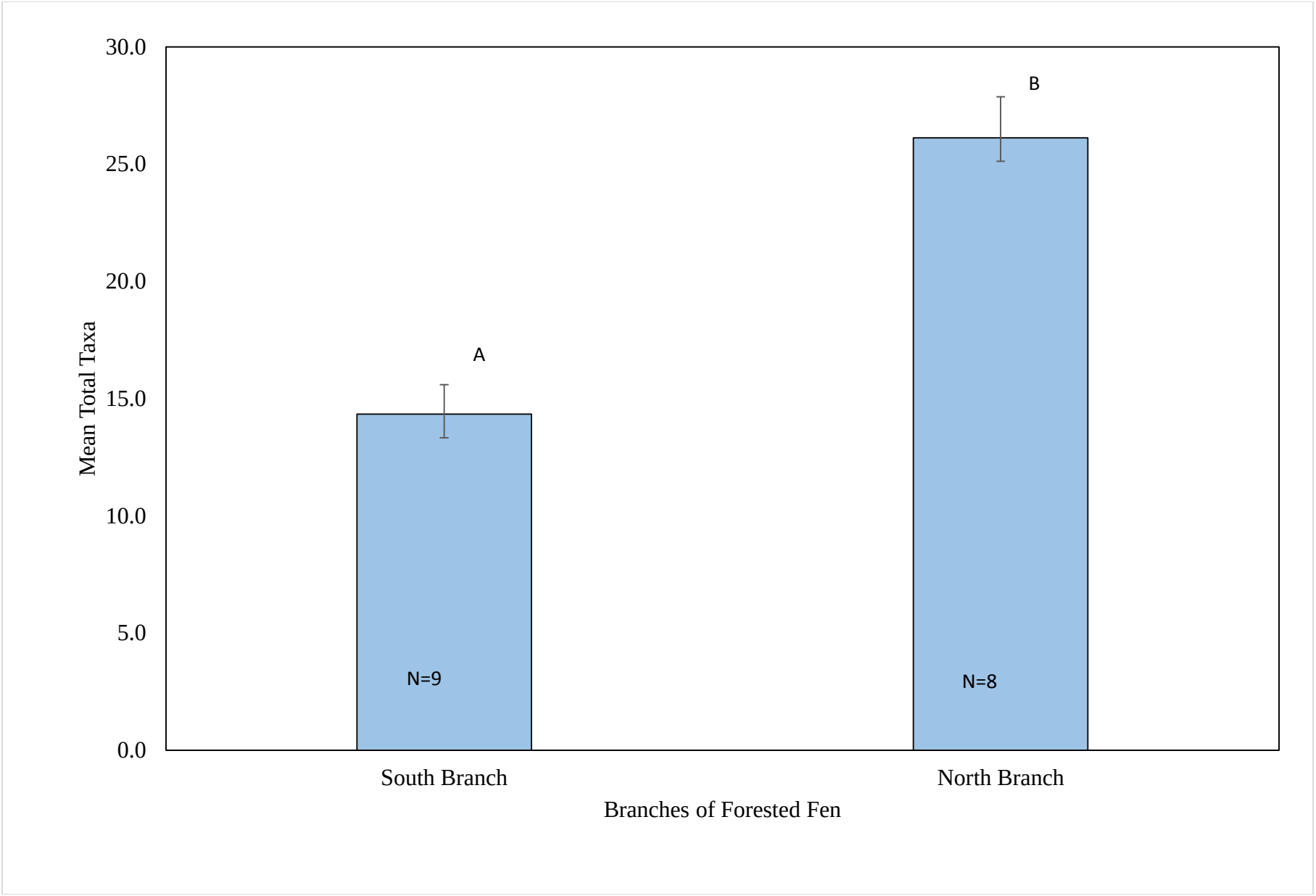

Fig. 4. Mean and standard error of total taxa richness from each branch of springbrook in Forested Fen Preserve, Elgin, Illinois. Two tailed T-test, t=-5.57, p=0.00005).

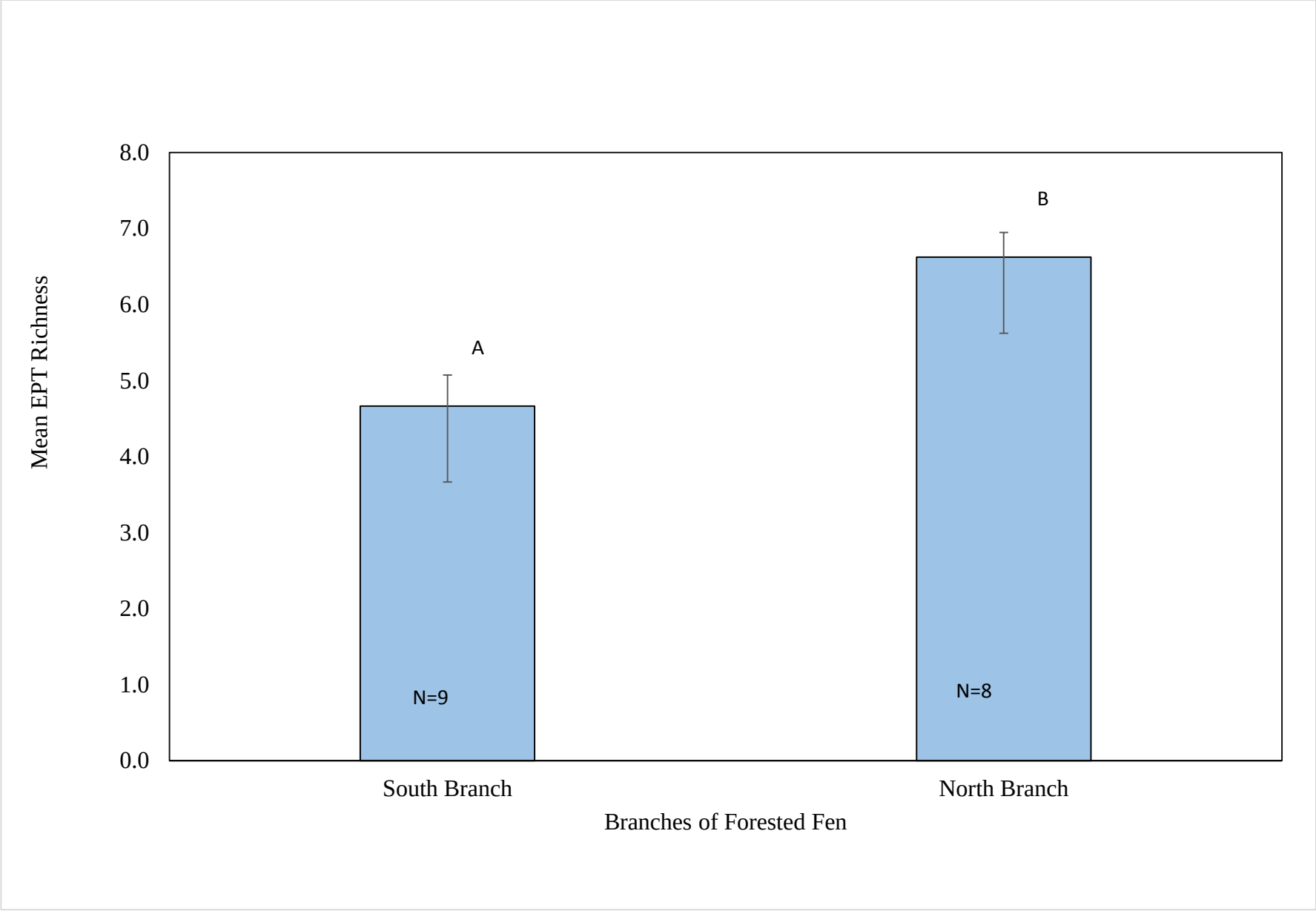

Fig. 5. Mean EPT richness from each branch of springbrook in Forested Fen Preserve, Elgin, Illinois. Two tailed T-test, t=-3.44, p=0.004).

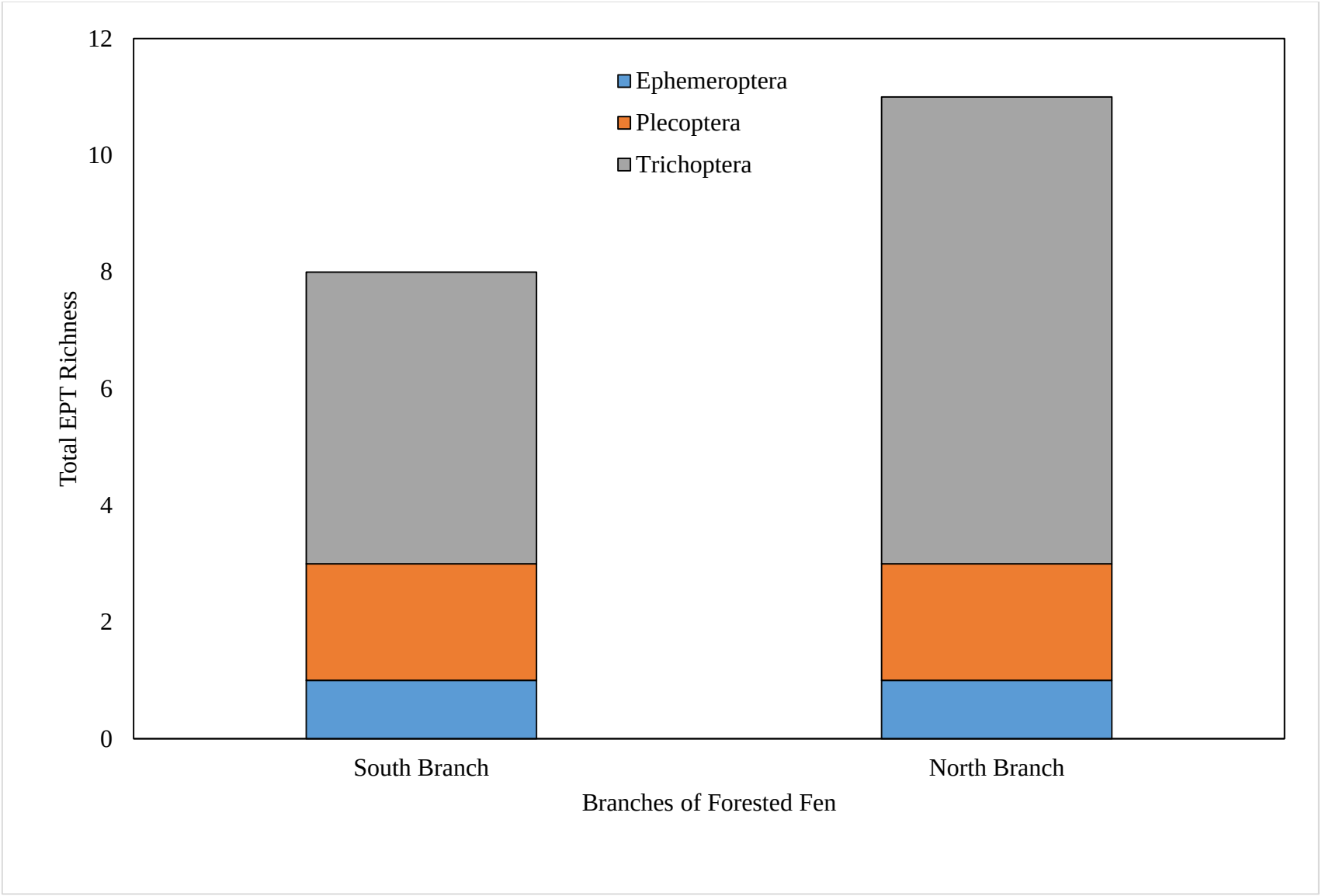

Fig. 6. Total EPT richness for South and North branches of Forested Fen Preserve, Elgin, Illinois.

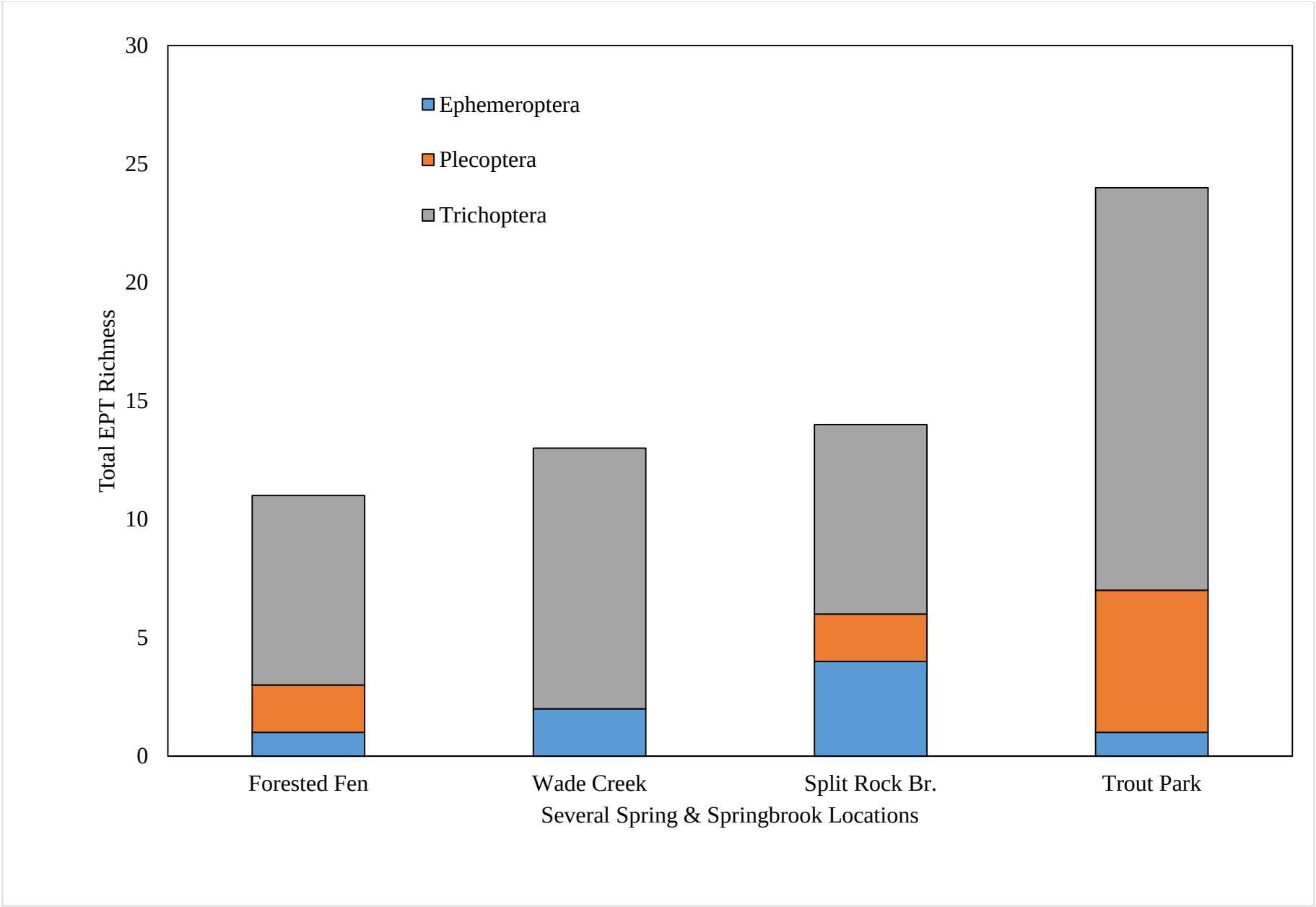

Fig. 7. Total EPT richness compared from several small springbrook systems in northern Illinois. Wade Creek, Lee County, Nachusa Grasslands; Split Rock Brook, La Salle County, ~3 km W Utica; and Trout Park, Kane County, across I-90 from Forested Fen Preserve.

Table 1. Sample dates, location

Date & d	Sample	Latitude	Longitude
4/17/2015	Surber 1	42.06915	-88.26929
	Surber 2		
	Surber 3		
above pon	Surber 4	42.06924	-88.26859
	Surber 5		
	Surber 6		
nr. footbri	Surber 7	42.06891	-88.26704
	Surber 8		
	Surber 9		
5/21/2015	dipnet 1	42.06950	-88.26832
	dipnet 2	42.06969	-88.26812
	dipnet 3	42.06971	-88.26794
	dipnet 4	42.06975	-88.26788
	dipnet 5	42.06987	-88.26756
	dipnet 6	42.06979	-88.26739
	dipnet 7	42.06981	-88.26697
	dipnet 8	42.06967	-88.26793

Table 2. Taxa and quantitative data for sampling conducted on two occasions at Fox River Forest Fen Preserve, Elgin, Illinois. EPT data provided for Trout Park, Split Rock Brook, Wade Creek are qualitative and are for comparative purposes only. S1-9 are Surber samples; D1-8 are dipnet samples.

	4/17/2015 South Branch										5/21/2015												
Taxa	**below pond**			**above pond**			**at footbridge**				**North Branch Above Pond**									**Total Forested Fen**	**Trout Park**	**Split Rock Br.**	**Wade Cr.**
Phylum	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**Sum 4/17**	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**Sum 5/21**				
Annelida																							
Oligochaeta	3	0	2	5	2	0	0	1	3	16	1	13	15	24	5	11	23	151	243	259			
Arthropoda																							
Chelicerata																							
Arachnida																							
Acari																							
Hydrachnidae	2	0	1	0	0	0	0	0	0	3	2	0	1	0	3	0	1	0	7	10			
Crustacea																							
Malacostraca																							
Amphipoda																							
Crangonyctidae																							
Crangonyx sp.	5	1	31	18	3	0	5	0	17	80	154	1330	348	218	884	715	344	297	4290	4370			
Gammaridae																							
Gammarus pseudolimnaeus	5	3	3	17	12	5	7	31	39	122	69	195	51	47	154	72	27	96	711	833			
Isopoda																							
Asellidae																							
Caecidotea intermedius	18	1	84	1	0	0	2	6	10	122	43	33	27	11	42	26	36	9	227	349			
Hexapoda																							
Entognatha																							
Collembola undertermined	0	0	0	1	0	0	0	2	0	3	1	1	0	3	1	2	2	2	12	15			
Insecta																							
Coleoptera																							
Agabus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	3	3			
Elmidae																							
Optioservus fastiditus	159	4	69	158	136	11	114	285	307	1243	41	4	43	280	272	53	212	23	928	2171			
Haliplidae																							
Haliplus sp.	2	0	2	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0		4			
Diptera																							
Ceratopogonidae	0	1	0	0	0	0	0	0	0	1	0	21	3	46	2	39	10	4	125	126			
Probezzia sp.	1	0	2	0	0	0	0	0	0	3	0	6	0	12	3	2	2	0	25	28			
Chironomidae																							
Chironominae																							
Dicrotendipes sp.	2	0	2	0	0	1	0	0	0	5	0	0	0	0	0	0	0	0	0	5			

Paratendipes sp.	0	0	0	0	0	0	0	0	0	0	0	4	0	17	0	0	0	0	21	21			
Polypedilum sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1			
Rheotanytarsus sp.	0	0	5	1	0	0	0	0	0	6	7	0	7	0	6	4	0	0	24	30			
Orthocladiinae																							
Acricotopus sp.	0	0	0	42	17	1	0	0	0	60	2	0	0	0	0	0	0	2	4	64			
Corynoneura sp.	0	0	0	0	0	0	0	0	0	0	1	10	2	0	0	0	0	0	13	13			
Eukiefferiella sp.	0	0	0	0	0	0	0	0	0	0	89	1	0	4	0	0	0	0	94	94			
E. claripennis gr.	0	0	4	0	0	0	0	0	0	4	14	0	0	0	4	0	0	11	29	33			
Limnophyes sp.	0	0	9	66	0	0	0	0	0	75	2	1	1	0	0	0	0	0	4	79			
Orthocladius sp.	0	0	0	27	8	4	0	0	1	40	2	0	0	0	0	0	0	0	2	42			
Parametriocnemus sp.	0	0	1	0	1	1	0	0	0	3	29	0	1	0	2	0	0	23	55	58			
Paraphaenocladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	3	3			
Thienemaniella sp.	0	0	0	0	0	0	0	0	0	0	0	11	3	9	0	2	1	2	28	28			
Tvetenia bavarica gr.	0	0	0	0	0	1	0	0	0	1	387	0	0	35	0	0	0	0	422	423			
Tvetenia sp.	0	0	0	0	1	0	0	0	0	1	2	3	3	22	12	3	1	0	46	47			
Tanypodinae																							
Thienemannimyia sp.	0	0	0	0	0	0	0	0	0	0	1	2	0	5	5	1	0	0	14	14			
Dixidae																							
Dixa sp.	0	0	0	0	0	0	0	0	0	0	1	0	1	5	0	0	2	2	11	11			
Dolichopodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1			
Empididae	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1			
Ephydridae																							
Setacera sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	10	12	12			
Pediciidae																							
Dicranota sp.	0	0	0	0	0	0	0	0	0	0	4	0	0	3	1	0	1	0	9	9			
Pedicia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3			
Simuliidae																							
Simulium sp.	0	0	4	0	0	0	0	0	0	4	39	0	1	1	0	0	0	0	41	45			
Stratiomyidae																							
Caloparyphus sp.	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	3	3			
Oxycera sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1			
Syrphidae	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1			
Tipulidae																							
Leptotarsus sp.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1			
Tipula sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1			
Ephemeroptera																							
Baetidae																							
Baetis brunneicolor																					0	1	1
Baetis flavistriga																					0	0	1
Baetis tricaudatus	21	1	97	30	9	0	7	5	3	173	237	18	11	90	15	1	17	114	503	676	1	1	0
Centroptilum sp.																					0	0	0
Heptageniidae																							
Maccaffertium vicarium																					0	1	0
Stenacron interpunctatum																					0	0	0
Isonychiidae																							

Isonychia sp.																					0	1	0
Hemiptera																							
Corixidae																							
Trichocorixa sp.	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1			
Gerridae																							
Trepobates sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1			
Saldidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1			
Megaloptera																							
Sialidae																							
Sialis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1			
Plecoptera																							
Capniidae																							
Allocapnia granulata																					0	1	0
Allocapnia vivipara																					0	0	0
Paracapnia angulata																					1	0	0
Nemouridae																							
Amphinemura delosa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	3	1	0	0
Amphinemura varshava																					1	0	0
Amphinemura sp.	33	0	26	27	14	1	0	0	0	101	87	9	14	52	56	12	25	10	265	366	0	0	0
Nemoura trisponosa																					1	0	0
Leuctridae																							
Leuctra tenuis																					1	0	0
Perlodidae																							
Clioperla clio	1	0	1	4	0	1	0	1	1	9	0	0	0	0	0	0	0	1	1	10	1	1	0
Trichoptera																						1	
Glossosomatidae																							
Glossosoma intermedium	0	0	0	24	45	24	9	15	29	146	3	0	14	1	7	6	10	4	45	191	1	0	1
Hydropsychidae																							
Cheumatopsyche oxa																					0	0	1
Cheumatopsyche sp.																					0	0	0
Diplectrona modesta	0	0	0	15	9	1	66	61	50	202	62	1	1	8	63	2	23	2	162	364	1	1	0
Hydropsyche betteni	0	0	0	0	2	0	1	0	0	3	3	0	0	0	0	0	2	0	5	8	1	0	1
Hydropsyche slossonae																					1	0	0
Hydroptilidae																							
Hydroptila consimils																					0	1	0
Hydroptila sp.	0	0	0	0	1	0	0	0	2	3	16	0	0	0	4	0	0	0	20	23	0	0	0
Orchrotrichia riesi																					0	1	0
Orchrotrichia spinosa																					0	1	0
Lepidostomatidae																							
Lepidostoma libum	0	0	0	0	0	0	0	0	0	0	0	1	6	1	14	9	0	1	32	32	1	0	1
Limnephilidae																							
Anabolia consocia																					0	0	1
Frenesia missa	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	3	3	1	0	1
Hesperophylax designatus																					1	0	0
Hydatophylax argus																					0	0	1

Limnephilus rhombicus																					1	0	0
Platycentropus radiatus																					1	0	0
Pseudostenophylax uniformis																					1	0	0
Pycnopsyche sp.																					1	0	1
Molannidae																							
Molanna tryphena																					1	0	0
Philopotamidae																							
Chimarra aterrima	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	2	1	1	0
Chimarra obscura																					0	0	1
Wormaldia moesta																					1	0	0
Polycentropodidae																							
Polycentropus pentus																					0	1	0
Phryganeidae																							
Ptilostomis sp.																					0	0	1
Psychomyiidae																							
Lype diversa																					1	0	0
Rhyacophilidae																							
Rhyacophila vibox																					1	0	0
Thremmatidae																							
Neophylax concinnus	9	7	16	0	0	1	22	56	63	174	16	2	8	21	2	11	45	25	130	304	1	1	1
Mollusca																							
Bivalvia																							
Sphaeriidae																							
Pisidium sp.	1	0	0	0	0	0	0	0	0	1	2	28	0	17	0	0	0	0	47	48			
Gastropoda																							
Physidae																							
Physella sp.	4	0	23	1	1	1	3	5	9	47	4	3	2	0	0	5	0	0	14	61			
Planorbidae	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	2			
Nematoda	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	2			
Platyhelminthes																							
Turbellaria	133	2	145	3	3	0	9	11	11	317	32	19	2	1	2	0	2	2	60	377			
Total abundance	**400**	**20**	**527**	**441**	**264**	**53**	**245**	**479**	**545**	**2974**	**1357**	**1718**	**572**	**939**	**1569**	**977**	**787**	**795**	**8714**	**11688**			
Total taxa	17	8	20	18	16	13	11	12	14	**33**	35	25	27	29	29	20	21	23	**54**	**56**			
Ephemeroptera taxa	1	1	1	1	1	0	1	1	1	**1**	1	1	1	1	1	1	1	1	**1**	**1**	1	4	2
Plecoptera taxa	2	0	2	2	1	2	0	1	1	**2**	1	1	1	1	1	1	1	2	**2**	**2**	6	2	0
Trichoptera taxa	1	1	1	2	4	3	4	3	4	**5**	5	3	5	4	6	4	4	4	**8**	**8**	17	8	11
Total EPT	**4**	**2**	**4**	**5**	**6**	**5**	**5**	**5**	**6**	**8**	**7**	**5**	**7**	**6**	**8**	**6**	**6**	**7**	**11**	**11**	**24**	**14**	**13**