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Adult Trichoptera as indicators of water quality in the Upper Ohio River Drainage Basin

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Abstract. The U.S. Army Corps of Engineers light trapped adult Trichoptera at monthly intervals between May and September or October at the inflows and outflows from sixteen reservoirs operated by them in the Upper Ohio River Drainage Basin. The samples contained seventeen families of caddisflies represented by 176 species. We identified four species of *Hydroptila* as new to science. The outflows from reservoirs showed slightly lower total species richness than the inflows (130 versus 136 taxa). This might be explained by more diverse ecosystems in the inflow areas. Mean Trichoptera species richness, however, was slightly higher at the outflow stations, possibly indicating generally improved water quality. In addition, we correlated the number of species with available chemical and biological water quality data. The results show that the adult Trichoptera species richness is a potentially useful indicator of environmental conditions and of general status of the ecosystem.

Until recently, most of the studies on emergence of adult aquatic insects in Pennsylvania were conducted on small, fast flowing, uncontrolled streams which were not impacted by the operations and tailwater discharges (outflows) of man-made reservoirs or lakes. Even less information is available on the emergence of adult insects from inflows of lakes and man-made reservoirs as compared with tailwaters.

The Pittsburgh District of the U.S. Army Corps of Engineers has been conducting biological inventories for many years. For example, District fish and wildlife, and water quality biologists have conducted periodic and regular surveys dealing with algae, aquatic invertebrates, fish and amphibians at sixteen reservoirs located in the District since the early 1970's.

In 1987 the Pittsburgh District initiated what is called the "Adult Aquatic Insect Light Trap Program." As far as we know, Pittsburgh is the only District in the Corps of Engineers collecting data on adult aquatic insect populations at their flood control reservoirs.

Our primary objectives were to determine species composition and seasonal distribution of adult Trichoptera at sixteen flood control reservoirs. This information is pertinent because Trichoptera are the dominant component of benthic aquatic macroinvertebrate communities in the tailwaters of most District dams. The opportunity to identify unusual, rare and new species, and contribute to the development of our biological database was an additional benefit. This information may improve identification of benthic invertebrates collected under different programs. Also, these data are useful for characterization and monitoring of changes in environmental quality of the reservoirs. Our principal goal was to sample all sixteen outflows (Phase I) and inflows (Phase II) of the reservoirs and as many small tributaries as possible (Phase III). To date we have completed Phases I and II. Currently we are engaged in Phase III of the sampling program.

Methods

We collected adult insects at the inflows and outflows of sixteen reservoirs located in western Pennsylvania, southwestern New York, northern West Virginia, northeastern Ohio, and northwestern Maryland (Table 1). In Pennsylvania the reservoirs included Allegheny Reservoir, Conemaugh River Lake, Crooked Creek Lake, East Branch Clarion River Lake, Loyalhanna Lake, Mahoning Creek Lake, Shenango River Lake (outflow and one inflow), Tionesta Lake, Union City Reservoir, Woodcock Creek Lake, and Youghiogheny River Lake. In Ohio we sampled inflows and outflows of Berlin Lake, Mosquito Creek Lake, M.J. Kirwan Reservoir, and one inflow of Shenango River Lake. In West Virginia the investigated

TABLE 1. Basic characteristics of Pittsburgh District reservoirs. G = glaciated plateau, U = unglaciated plateau, M = Allegheny Mountains.

Drainage and reservoir	Drainage area (km^2)	Trophic state	Outflow thermal regime
BEAVER RIVER			
M.J. Kirwan, G	208	mesotrophic	warm
Berlin, G	645	eutrophic	warm
Mosquito Cr., G	251	eutrophic	warm
Shenango, G	1526	eutrophic	warm
ALLEGHENY RIVER			
Woodcock, G	118	eutrophic	warm
Union City, G	575	eutrophic	cool
Allegheny, G,U	5646	mesotrophic	cold
Tionesta, U	1238	oligotrophic	cool
East Branch, U	189	oligotrophic	cold
Mahoning, U	881	mesotrophic	cool
Crooked Creek, U	717	mesotrophic	warm
Conemaugh, M, U	3499	oligotrophic	warm
Loyalhanna, M, U	751	mesotrophic	warm
MONONGAHELA RIVER			
Youghiogheny, M	1124	mesotrophic	cold
Tygart River, M, U	3067	mesotrophic	cool
Stonewall, U	264	eutrophic	cool

localities included inflows and outflows of the Stonewall Jackson Lake and Tygart River Lake. We also sampled the Allegheny Reservoir inflow in southwestern New York and the inflow to Youghiogheny River Lake in northwestern Maryland.

Battery operated U-V light traps with fluorescent tubes were used in collecting insects. The collection container was charged with ethyl or isopropyl alcohol. We operated the traps at the outflows from shortly before dusk until the next morning for one night a month from May until September or October. We collected the adults at the inflows for two hours after dusk. We preserved all collections in ethyl alcohol.

Collections could not be considered quantitative as we collected great numbers of Trichoptera, especially in June and July. Therefore, the identification of the entire collection was not always practical and we subsampled some samples counting only aliquots. Also we could only identify the females of the genera *Hydropsyche*, *Cheumatopsyche* and the family Hydroptilidae to the family or genus level.

Results

We collected a total of 176 taxa at both outflow and inflow stations, 130 taxa of caddisflies from the outflows (Phase I), including two species of *Hydroptila* new to science collected in the Youghiogheny River Lake tailrace in 1991 (Sykora and Harris 1994). We conducted Phase II sampling in 1992 and identified 136 taxa of caddisflies from the inflows. Two of the taxa which we collected at Stonewall Jackson Lake, West Virginia were *Hydroptila* species new to science (Harris and Sykora, 1996). Preliminary data from the Phase III sampling program includes two new records for Pennsylvania, *Oxyethira coercens* Morton collected at Crooked Creek Lake at Cherry Run and *Hydroptila eramosa* Harper found in a sample from French Creek at Union City Reservoir.

Tygart River Lake's inflow had the highest diversity with 54 taxa recorded. Mahoning Creek Lake's inflow had the second highest diversity with 40 taxa. Woodcock Creek Lake and Youghiogheny River Lake inflows had the third highest diversity with 36 taxa each (Table 2). A similar pattern emerges when the outflow data are examined. Youghiogheny had the highest diversity with 49 taxa. Mahoning had the second highest diversity with 39 taxa, and Tygart had the third highest diversity with 34 taxa (Table 2).

Table 2. Comparison of caddisfly diversity at the reservoirs based on total number of taxa collected from inflows and outflows (1987-92).

Reservoir	Number of taxa and rank (in parentheses) Inflow	Outflow
Allegheny	33 (4)	27 (6)
Berlin	23 (6)	21 (9)
Conemaugh	2 (12)	32 (4)
Crooked Creek	2 (12)	30 (5)
East Branch	10 (9)	23 (8)
Loyalhanna	9 (10)	18 (11)
Mahoning	40 (2)	39 (2)
M.J. Kirwan	6 (11)	19 (10)
Mosquito	19 (7)	10 (12)
Shenango	15 (8)	24 (7)
Stonewall Jackson	30 (5)	6 (13)
Tionesta	9 (10)	32 (4)
Tygart	54 (1)	34 (3)
Union City	33 (4)	30 (5)
Woodcock	36 (3)	27 (6)
Youghiogheny	36 (3)	49 (1)

Discussion

The reservoir outflows show lower total species richness than the reservoir inflows (130 versus 136 taxa). This might be explained by more diverse ecosystems in the inflow areas where a variety of pools, riffles, seepages, and semi-aquatic environments support diversified benthic communities. However, we were surprised to note that the average Trichptera species richness at the outflow stations exceeded that of the inflow stations (outflow mean of 26.3 versus an inflow mean of 22.3). Four of the project inflows with depressed diversity are degraded by acid mine drainage pollution (Conemaugh, Crooked Creek, East Branch, and Loyalhanna). The water quality of these inflows is moderated by detention in the reservoirs, and their outflows have both substantially improved water quality and increased Trichptera diversity. Therefore, improved water quality conditions might contribute to a tendency for these outflows to have an increased mean Trichoptera species richness. In many instances the reservoir impoundments have only a slight effect on the composition of biota in tailwaters as compared with the inflows. For instance, two new species of *Hydroptila* (*H. antennopedia* Sykora and Harris and *H. parachelops* Sykora and Harris) were present in both the Youghiogheny River Lake inflow and outflow. It is of interest that both of these species are known from the Youghiogheny River and other cold streams in Pennsylvania, New England and Minnesota, and thus could be considered indicators of oligotrophic, cold water ecosystems.

The most common family in both outflows and inflows was Hydroptilidae followed by Hydropsychidae and Polycentropodidae (include plankton or algae feeding species). Several genera living in small, cold streams and rivers such as *Brachycentrus*, *Agapetus*, and *Homoplectra* were not captured at the tailwaters (outflows) but were sometimes abundant in the inflows (e.g., *Agapetus*). The data show that the highest species richness of Trichoptera should be expected in cold or cool outflows from mesotrophic reservoirs (Youghiogheny, Mahoning, and Tygart). Thus, this study indicates that the adult caddisfly species richness is a potentially useful indicator of water quality and of the general status of the aquatic ecosystem.

Literature Cited

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