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TRICHOPTERA (CADDISFLIES) OF WATERCRESS MARSH, COLUMBIANA COUNTY, OHIO[1]

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ABSTRACT. Caddisfly adults numbering 4,371 were collected by means of light traps at Watercress Marsh, Columbiana Co., Ohio, from June 1976 to October 1981. The marsh occupies a site of the Grand River lobe of the Wisconsin Glacier near its southernmost extent in Columbiana Co. The 69 species in the 10 families collected included 15 species of Limnephilidae and 4 new state records. Seasonal species diversity values were calculated.

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INTRODUCTION

Relatively little is known about the nature and origin of the Ohio Trichoptera fauna. Ross (1944) listed 60 species of caddisflies from Ohio. Additional state records reported by Marshall (1939) and Horwath (1964), from western Lake Erie, brought the total known Ohio caddisfly fauna to 74 species. More recently, many additional records have been added to the state list. McElravy et al. (1977) reported 70 new state records from northeastern Ohio. Masteller and Flint (1979) added 5 additional state records, also from northeast Ohio. MacLean and MacLean (1980) reported 16 new state records for Ohio caddisflies from collections made in Columbiana Co. Petersen and Foote (1980) added 2 new state records and Huryn and Foote (1981) added 25.

This paper presents the results of a caddisfly survey carried out from 1976 through 1981 at Watercress Marsh, a wet-

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lands of approximately 50 ha located 9 km south of Salem, Columbiana Co., Ohio. Collections made in 1976 and 1977 were supported by the Ohio Biological Survey and in 1980 by the Youngstown State University Research Council. Caddisflies were chosen because of the large number of species commonly reported in surveys of aquatic insects (MacKay and Wiggins 1979) and because of the diversity of aquatic habitats at Watercress Marsh. Water from underground springs and seeps eventually flows northwest into the Mahoning River and southeast into the Middle Fork of Little Beaver Creek. The location of the marsh near the southernmost extent of glaciation in Columbiana Co. (White 1951) and the presence of a number of northern and Atlantic Coastal plain plant species suggested the possibility of a diverse caddisfly fauna.

METHODS AND MATERIALS

Adult caddisflies were collected by light traps operated at a variety of sites throughout the marsh. East of St. Rt. 9 collections were made in wet sedge meadows, *Eleocharis* communities, *Juncus-Salix* communities, *Typha* associations, at the edge of a small kettlehole pond and along small wooded streams that originated from springs. Collections west of Rt. 9 were made at the edge of several large beaver ponds near *Equisetum* mats that were bordered by swamp forest. Although collections were not made on the same date in each year, representative collections were made for the entire flight period (late April to early October). Weeks were numbered according to Lewis and Taylor (1967). Few caddisfly larvae were collected due to the dense vegetation that often obscured the numerous springs and small streams. Specimens have been deposited in the Youngstown State University insect collection.

To determine species diversity and evenness, Brillouin's index

$$H = \frac{1}{N} \log \frac{N!}{N_1!N_2!\ldots N_s!}$$

and $J = H/H_{max}$ respectively were calculated (Pielou 1969). A species area curve was constructed for the cumulative number of species collected and the number of collections (McNaughton and Wolf 1979).

RESULTS

Thirty-five collections yielded a total of 4,371 adult caddisflies representing 69 species and 10 families. The total of new state records from Watercress Marsh was increased to 12 (MacLean and MacLean 1980). New state records are indicated by an asterisk (*) in the following list of species and collection data.

PHILOPOTAMIDAE

Chimarra aterrima Hagen 1-IX-77 (1 female); 31-VII-79 (1 male, 1 female); 14-VI-80 (1 female); 26-VI-80 (1 female); 20-VII-80 (1 female).

C. obscura Walker 14-VI-76 (1 male, 1 female).

POLYCENTROPODIDAE

Neureclipsis crepuscularis Walker 20-VII-80 (1 female).

Phylocentropus lucidus Hagen 14-VI-76 (1 male, 1 female); 26-VII-76 (1 male); 3-VIII-76 (4 males); 20-VII-80 (1 male); 2-VIII-80 (1 male).

Polycentropus aureolus (Banks) 11-VI-76 (6 males); 28-VI-80 (6 males); 5-VII-80 (1 male); 15-VII-80 (1 female); 20-VII-80 (6 males, 1 female); 2-VIII-80 (2 males).

P. cinereus Hagen 11-VI-76 (1 female); 11-VIII-77 (1 female); 5-VII-80 (1 female).

**P. flavus* Banks 14-VI-76 (3 females); 14-VI-80 (1 female); 28-VI-80 (11 females); 15-VII-80 (21 females); 20-VII-80 (9 females).

P. remotus (Banks) 14-VI-76 (1 male); 3-VIII-76 (1 female); 5-VII-80 (1 female).

HYDROPSYCHIDAE

Cheumatopsyche aphanta Ross 11-VII-80 (1 female); 20-VII-80 (3 females).

C. campyla Ross 11-VI-76 (2 males); 11-VIII-77 (6 females); 1-IX-77 (4 females); 14-VI-80 (1 female); 26-VI-80 (1 male); 11-VII-80 (19 females); 20-VII-80 (1 male, 11 females).

C. oxa Ross 11-VI-76 (1 male, 6 females); 14-VI-80 (3 males, 13 females); 26-VI-80 (3 females); 20-VII-80 (2 males, 6 females); 18-VIII-80 (1 female).

C. pettiti Banks 11-VI-76 (21 males, 38 females); 26-VII-76 (1 male); 3-VIII-76 (1 male, 8 females); 11-VI-77 (4 males); 16-VI-77 (3 males); 11-VIII-77 (11 females); 1-IX-77 (8 females); 5-V-80 (1 female); 14-VI-80 (3 males, 34 females); 21-VI-80 (1 male); 26-VI-80 (10 males, 27 females); 5-VII-80 (1 male, 7 females); 11-VII-80 (3 males, 16 females); 20-VII-80 (7 males, 9 females); 2-VIII-80 (1 male, 1 female); 18-VIII-80 (2 females).

Hydropsyche betteni Ross 11-VI-76 (10 males, 18 females); 18-VI-76 (4 females); 11-VIII-77 (1 female); 1-IX-77 (7 females); 8-IX-77 (1 male); 5-VI-80 (4 females); 14-VI-80 (2 females); 26-VI-80 (1 male, 1 female); 15-VII-80 (1 male, 6 females); 20-VII-80 (2 males, 6 females); 2-VIII-80 (1 female); 18-VIII-80 (3 females); 13-IX-80 (1 female); 3-VI-81 (1 female); 22-IX-80 (4 females).

H. dicantha Ross 14-VI-76 (15 males, 17 females); 18-VI-76 (2 females); 3-VIII-76 (1 female); 11-VIII-77 (1 female); 24-VII-79 (1 male); 14-VI-80 (1 male, 1 female); 25-VI-80 (5 females); 15-VII-80 (2 males, 1 female); 20-VII-80 (2 females).

H. orris Ross 11-VI-76 (5 males, 32 females); 18-VI-76 (1 female); 11-VIII-77 (5 females); 1-IX-77 (4 females); 15-VII-80 (5 females); 20-VII-80 (3 females).

H. scalaris Hagen 14-VI-76 (1 male); 20-VII-80 (1 male).

**H. valanis* Ross 11-VI-76 (8 females); 3-VIII-76 (1 female); 11-VIII-77 (4 females); 1-IX-77 (3 females); 14-VI-80 (1 female); 15-VII-80 (3 females); 20-VII-80 (6 females); 2-VIII-80 (33 females); 18-VIII-80 (14 females).

Potamyia flava Hagen 11-VI-76 (2 males, 67 females); 18-VI-76 (1 female); 5-VII-76 (12 females); 8-VIII-76 (66 females); 11-VI-77 (1 male); 4-VIII-77 (1 male); 1-IX-77 (1 female); 26-VI-80 (1 male); 15-VII-80 (3 males, 320 females); 20-VII-80 (209 females); 2-VIII-80 (436 females); 18-VIII-80 (64 females).

Symphitopsyche bronta (Ross) 11-VI-76 (5 males, 9 females); 3-VIII-76 (1 female); 27-IX-76 (4 females); 11-VIII-77 (2 females); 1-IX-77 (4 females); 24-VII-79 (1 male); 14-VI-80 (1 male, 17 females); 28-VI-80 (2 males, 4 females); 11-VII-80 (1 male, 2 females); 15-VII-80 (1 male, 6 females); 20-VII-80 (4 males, 11 females); 2-VIII-80 (1 male, 3 females); 18-VIII-80 (2 females); 3-VI-81 (1 male, 1 female); 22-IX-81 (2 females).

S. slossonae (Banks) 11-VI-76 (9 males, 17 females); 18-VI-76 (1 female); 7-IX-76 (7 females); 4-VIII-77 (1 male); 8-IX-77 (1 male); 24-VII-79 (1 male); 14-VI-80(1 female); 15-VII-80 (2 males, 1 female); 20-VII-80 (1 male, 2 females); 2-VIII-80 (2 females); 18-VIII-80 (2 females); 3-VI-81 (2 males); 22-IX-81 (2 females).

GLOSSOSOMATIDAE

Glossosoma sp. 22-IX-81 (1 female).

Protoptila sp. 24-VII-79 (1 female).

HYDROPTILIDAE

Agraylea multipunctata Curtis 26-VII-76 (1 female); 11-VIII-77 (5 females); 26-VI-80 (13 females); 5-VII-80 (6 females); 11-VII-80 (5 females).

Hydroptila sp. nr. *angusta* Ross 11-VIII-77 (1 female).

Orthotrichia aegerfasciella (Chambers) 5-VII-80 (1 female).

Oxyethira dualis Morton 5-VII-80 (3 females).

O. pallida (Banks) 11-VIII-77 (1 male); 1-IX-77 (1 female); 26-VI-80 (1 female).

PHRYGANEIDAE

Agrypnia sp. nr. *straminea* Hagen 21-VI-80 (1 female).

A. vestita (Walker) 27-IX-79 (7 males, 6 females); 29-IX-76 (8 males, 5 females); 1-IX-77 (6 males, 1 female); 27-V-80 (1 female); 14-VI-80 (16 males, 8 females); 18-VIII-80 (8 males); 13-IX-80 (2 males, 2 females); 22-IX-81 (7 males, 8 females); 4-X-81 (1 male).

Banksiola crotchi Banks 15-VI-76 (1 female); 31-VII-79 (1 male); 26-VI-80 (5 males, 2 females); 5-VII-80 (2 males, 2 females); 11-VII-80 (3 males, 7 females); 20-VII-80 (3 females).

Phryganea cinerea Walker 2-VIII-80 (1 male, 1 female).

P. sayi Milne 31-VII-79 (1 female); 28-VI-80 (1 female).

Ptilostomis ocellifera (Walker) 11-VI-76 (1 female), 14-VI-76 (4 females); 18-VI-76 (1 female); 24-VII-79 (1 male, 3 females); 31-VII-79 (3 males, 4 females); 2-VIII-79 (2 males, 4 females); 26-VI-80 (1 male); 5-VII-80 (5 females); 15-VII-80 (2 males, 4 females); 20-VII-80 (1 male, 3 females).

LIMNEPHILIDAE

Hydatophylax argus (Harris) 14-VI-80 (2 females).

Ironoquia parvula (Banks) 4-X-81 (20 males, 1 female).

I. punctatissima (Walker) 27-IX-76 (14 males); 1-IX-77 (6 females); 13-IX-80 (40 males); 22-IX-81 (30 males, 6 females); 4-X-81 (2 males, 1 female).

Limnephilus consocius Walker 11-VI-76 (2 males); 27-IX-76 (6 males); 8-IX-77 (1 male); 2-VIII-79 (1 female); 20-V-80 (41 males, 4 females); 14-IV-80 (2 males); 21-VI-80 (1 male); 28-VI-80 (7 males, 6 females); 20-VII-80 (1 male); 22-IX-81 (20 males); 4-X-81 (10 males).

L. indivisus Walker 11-VI-76 (2 males); 14-VI-80 (2 males); 26-VI-80 (3 males, 4 females); 22-IX-81 (5 males, 5 females); 4-X-81 (4 males, 1 female).

L. moestus Banks 11-VI-76 (2 males); 18-VI-76 (2 males); 14-VI-80 (2 males, 2 females); 21-VI-80 (1 male); 26-VI-80 (3 males, 1 female); 5-VII-80 (1 male, 1 female); 11-VII-80 (2 females).

L. ornatus Banks 11-VI-76 (1 male); 14-VI-80 (1 male); 26-VI-80 (1 male); 28-VI-80 (1 male).

**L. rhombicus* (L.) 20-V-80 (1 male).

L. submonilifer Walker 27-IX-76 (4 males, 4 females); 27-V-80 (2 males); 22-IX-81 (2 males, 3 females); 4-X-81 (8 males, 12 females).

Neophylax oligius Ross 27-IX-76 (1 male, 1 female).

Platycentropus radiatus (Say) 11-VI-76 (6 males, 1 female); 18-VI-76 (2 females); 27-IX-76 (1 female); 24-VII-79 (2 males); 31-VII-79 (9 females); 2-VIII-79 (2 males, 7 females); 14-VI-80 (1 male, 30 females); 21-VI-80 (9 females); 26-VI-80 (2 males, 10 females); 5-VII-80 (1 male, 3 females); 15-VII-80 (3 males, 9 females); 20-VII-80 (1 female); 2-VIII-80 (1 male, 2 females).

**Pycnopsyche antica* (Walker) 1-IX-77 (1 female); 27-IX-77 (1 female); 31-VII-79 (1 female).

P. divergens Walker 27-IX-76 (1 male); 8-IX-77 (1 male, 1 female); 18-VIII-80 (1 male); 4-X-81 (3 males).

P. lepida Hagen 8-IX-77 (3 males); 20-IX-77 (1 male, 1 female); 13-IX-80 (1 male).

P. scabripennis Rambur 1-IX-77 (1 female); 8-IX-77 (1 male); 10-IX-77 (1 male); 31-VII-79 (1 female); 2-VIII-79 (1 male); 15-VII-80 (1 male).

MOLANNIDAE

Molanna blenda Sibley 14-VI-76 (1 male); 2-VIII-79 (2 males).

LEPTOCERIDAE

Ceraclea alagma (Ross) 18-VI-76 (1 female); 16-VI-77 (1 female); 20-VI-80 (1 female); 11-VII-80 (1 female).

C. ancyla (Vorhies) 15-VII-80 (1 female).

C. maculata (Banks) 11-VI-76 (8 males, 31 females); 18-VI-76 (4 males, 1 female); 16-VI-77 (1 male); 1-IX-77 (1 male); 15-VII-80 (2 males, 2 females); 20-VIII-80 (1 male, 3 females); 2-VIII-80 (2 males); 18-VIII-80 (2 females).

C. tarsi-punctata (Vorhies) 11-VI-76 (3 males, 7 females); 18-VI-76 (1 male); 24-VII-79 (1 female).

C. sp. nr. *cancellatus* Betten 14-VI-76 (2 females); 1-IX-76 (1 female).

Leptocerus americanus (Banks) 14-VI-76 (1 male); 16-VI-77 (9 females); 5-VII-80 (6 males, 21 females); 11-VII-80 (2 males, 13 females); 20-VII-80 (2 females).

Mystacides sepulchralis (Walker) 15-VII-80 (1 male); 20-VII-80 (1 male).

Nectopsyche sp. nr. *exquisita* (Walker) 11-VI-76 (1 female); 14-VI-80 (2 females); 20-VII-80 (1 female); 2-VIII-80 (1 male, 3 females); 18-VIII-80 (1 female).

Oecetis cinerascens (Hagen) 11-VI-76 (1 male, 2 females); 18-VI-76 (1 female); 16-VI-77 (2 females); 11-VIII-77 (1 male); 1-IX-77 (2 males); 14-VI-80 (2 males, 2 females); 26-VI-80 (3 males, 13 females); 5-VII-80 (1 female); 15-VII-80 (1 female); 20-VII-80 (2 females); 2-VIII-80 (1 female); 18-VIII-80 (1 female).

O. ditissa Ross 11-VI-76 (3 males, 6 females); 2-VIII-76 (1 male, 3 females); 16-VI-77 (23 females); 11-VIII-77 (1 female); 1-IX-77 (2 females); 5-VII-80 (1 female).

O. immobilis (Hagen) 16-VI-77 (1 female).

O. inconspicua (Walker) 11-VI-76 (62 males, 84 females); 18-VI-76 (1 male); 26-VII-76 (11 males, 24 females); 3-VIII-76 (9 males, 50 females); 16-VI-77 (63 males, 16 females); 11-VIII-77 (24 males, 62 females); 1-IX-77 (22 males, 89 females); 8-IX-77 (27 males, 36 females); 24-VII-79 (1 male, 7 females); 14-VI-80 (27 males, 67 females); 21-VI-80 (1 male, 3 females); 26-VI-80 (2 males, 8 females); 5-VII-80 (1 male, 9 females); 11-VII-80 (1 male, 15 females); 20-VII-80 (8 males, 24 females); 2-VIII-80 (4 males, 7 females); 18-VIII-80 (1 male, 5 females).

O. nocturna Ross 14-VI-76 (2 females); 18-VI-76 (1 female); 26-VII-76 (1 male); 1-IX-77 (1 male, 6 females); 11-VIII-77 (9 females); 8-IX-77 (12 females); 2-VIII-80 (1 female); 18-VIII-80 (1 male, 4 females).

Trianodes aba Milne 11-VIII-77 (1 female).

T. dipsia Ross 16-VI-77 (1 male).

T. flavescens Banks 11-VI-76 (1 female); 28-VI-80 (1 female); 5-VII-80 (10 females).

T. marginata Sibley 11-VI-76 (1 male); 16-VI-77 (1 female); 11-VIII-77 (3 females); 1-IX-77 (16 females); 8-IX-77 (7 females); 24-VII-79 (1 female); 14-VI-80 (3 males, 5 females); 26-VI-80 (1 male, 3 females); 5-VII-80 (2 females); 20-VII-80 (2 females); 3-VI-81 (1 male).

T. tarda Milne 14-VI-76 (4 males, 18 females); 26-VI-76 (1 male); 26-VII-76 (8 females); 3-VIII-76 (11 females); 16-VI-77 (8 males, 47 females); 4-VIII-77 (1 male, 6 females); 11-VIII-77 (13 females); 1-IX-77 (25 females); 8-IX-77 (37 females); 24-VII-79 (1 male, 5 females); 11-VI-80 (6 males, 8 females); 21-VI-80 (2 females); 26-VI-80 (8 males, 35 females); 5-VII-80 (2 females); 11-VII-80 (2 males, 19 females); 20-VII-80 (5 females); 2-VIII-80 (15 females); 18-VIII-80 (1 male, 3 females); 3-VI-81 (1 female).

LEPIDOSTOMATIDAE

Lepidostoma griseum Banks 14-VI-80 (1 female); 15-VIII-80 (3 males).

L. sp. 11-VI-76 (1 female); 7-VI-81 (1 female); 22-IX-81 (2 males); 4-X-81 (1 male).

DISCUSSION

CADDISFLY SPECIES OCCURRENCE. Based on larval trophic relationships (Merritt and Cummins 1978), the shredder category was the best represented (28 species, 5 families). Collectors (20 species, 4 families) and engulfers (15 species, 3 families) were also well represented. The piercer and scraper categories were represented by 5 species each. No species of the free living caddisflies (e.g. Rhyacophilidae) were collected at Watercress Marsh.

Species characteristic of both cooler lotic habitats and warmer lentic habitats were present at Watercress Marsh. Caddisflies commonly found in small streams and springs (Wiggins 1977) were represented by several species of *Polycentropus* (Polycentropodidae), *Hydropsyche* and *Symphitopsyche* (Hydropsychidae). The most abundant caddisfly species at Watercress

Marsh, *Potamyia flava* (30%), is characteristic of larger and slower midwestern and southern streams (Ross 1944). Exposed water surface temperatures reached a maximum of 23C in July and declined to 18C by October. Shaded springs and streams were slightly cooler than unshaded. *Cheumatopsyche pettiti* which has a wide ecological tolerance (Ross 1944) was relatively abundant.

Few species or individuals of Hydroptilidae (microcaddisflies) were collected, although some individuals may have been overlooked in sorting.

The family Phryganeidae was well represented by a number of large case making species characteristic of marshes (Wiggins 1977), e.g. *Agrypnia vestita, Banksiola crotchi, Phryganea sayi,* and *Ptilostomis ocellifera.*

Six genera of the large family Limnephilidae were found at Watercress Marsh. The genus *Limnephilus* was especially well represented by 6 species, most of which are northern in distribution. How isolated these populations are is not known, but the genus *Limnephilus* is poorly represented farther south (Resh 1975). Many species of Phryganeidae and Limnephilidae are shredders of coarse particulate organic matter and are well adapted to the abundant decaying plant materials of marshes (Wiggins 1977).

The largest number of caddisfly species belonged to the family Leptoceridae all of which construct cases and many occur in both lotic and lentic habitats. Two species, *Oecetis inconspicua* and *Trianodes tardus,* were very abundant, making up respectively 771 and 292 of the 4,371 caddisflies captured.

Although additional collections would add to the list of caddisfly species occurring at Watercress Marsh, a species-area curve (fig. 1) suggests that the majority of species have been recorded.

An important characteristic of communities is species diversity. Two components of most diversity measures are species richness (S) or the number of species in a

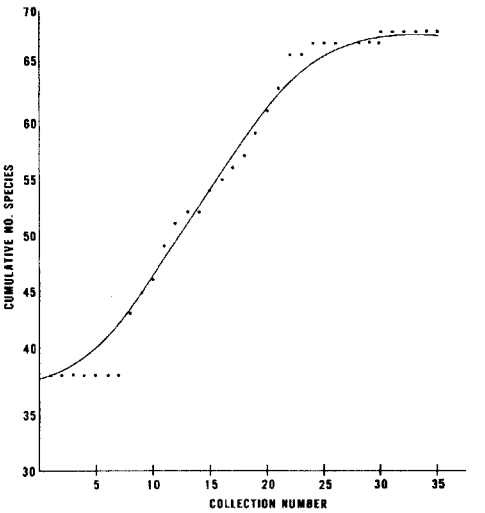

FIGURE 1. Cumulative number of trichopteran species collected at Watercress Marsh from 1976–81.

collection and evenness or the relative distribution of individuals among the S species (Poole 1974, May 1975). Brillouin's index (H) which expresses the uncertainty of correctly predicting the identity of an individual picked at random from a collection of size n_i was calculated for 27 collections (table 1). Evenness (J) expresses the ratio of species diversity to the maximum possible diversity for a collection of S species of size N (Pielou 1969).

Fig. 2 shows the seasonal distribution of values of H and J. Diversity values (H) were low during May (week 20) but steadily increased to a maximum by late June (week 26). Collections were small throughout May and early June but by mid-June included large numbers of species and individuals. Diversity declined to a low in early August (week 31), then increased to a second high level in late August (week 35), and then rapidly declined during mid-September (week 37). The increased flight activity of a number of limnephilids and phryganeids resulted in a third peak of species diversity throughout the latter half of September and early October. The number of caddisflies captured declined to zero by the second week of October 1981.

TABLE 1

Number of species (S), size (N), *and diversity measures* (H, J) *for 27 collections of caddisflies by week number.*

Week No.	Collection Date	S	N	H	J
20	20-V-80	2	46	0.036	0.129
21	27-V-80	2	3	0.159	0.761
22	3-VI-81	7	16	0.579	0.903
23	9-VI-81	8	11	0.593	0.974
24	14-VI-76	38	557		
	11-VI-77	13	182		
	14-VI-80	23	269	0.807*	0.645*
25	18-VI-76	14	24		
	21-VI-80	7	19	0.810*	0.801*
26	28-VI-80	25	208	1.036	0.796
27	5-VII-80	18	88	0.899	0.806
28	15-VII-80	27	514	0.720	0.520
29	20-VII-80	30	367	0.787	0.561
30	26-VII-76	7	48		
	24-VII-79	10	26	0.507*	0.649*
31	3-VIII-76	10	157		
	4-VIII-77	3	9		
	2-VIII-79	9	26		
	2-VIII-80	16	520	0.418*	0.568*
32	11-VIII-77	18	152	0.682	0.590
33	18-VIII-80	15	116	0.669	0.621
35	1-IX-77	20	215	0.870	0.712
36	8-IX-77	10	134	0.628	0.669
37	13-IX-80	4	46	0.184	0.336
38	22-IX-81	9	95	0.688	0.780
39	27-IX-76	8	62	0.626	0.769
40	4-X-81	7	63	0.619	0.806

*Average values for week no.

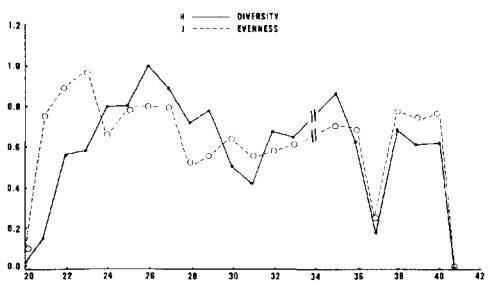

FIGURE 2. Seasonal distribution of Brillouin's diversity index (*H*) and evenness (*J*) based on Trichoptera collections at Watercress Marsh from 1976–81.

Evenness values generally paralleled diversity but were noticeably higher early in the flight season and again in early fall. This difference was largely due to the size

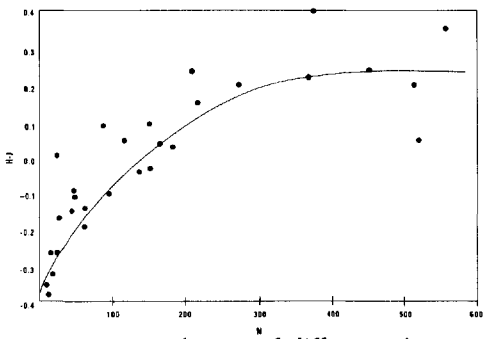

FIGURE 3. Distribution of differences between Brillouin's diversity index (*H*) and evenness (*J*) and collection size (*N*).

of the collection. As plotted in fig. 3, evenness values (*J*) usually exceeded diversity values (*H*) when collections were smaller than 100 individuals. For larger collections, values of *H* were generally greater than *J*.

The flight periods of selected caddisfly species were plotted in fig. 4. Most species of *Cheumatopsyche, Hydropsyche* and *Symphitopsyche* were active from late spring throughout the summer and in some cases (*H. betteni, S. bronta* and *S. slossonae*) into early fall. It could not be determined if this represented more than one generation. *Limnephilus submonilifer* and *L. indivisus* had 2 distinct flight periods; the first in late spring and the second in late summer and early fall. Novak and Shenal (1963, 1965) and Wiggins (1973) demonstrated that adults which emerge in late spring enter a reproductive diapause in early summer and remain inactive until fall at which time the ovaries of females mature. Diapause in these 2 species is controlled by photoperiod; i.e. long days of early summer inhibit ovarian development which is only completed during the shorter photoperiod of late summer and early fall. Thus adults captured in September and October actually are members of the spring emergence. Adults of *L. consocius* were collected from late spring to early fall. *L. moestus* was collected during early summer but was not collected again until fall. Adults of the phryganeid *Agrypnia vestita*

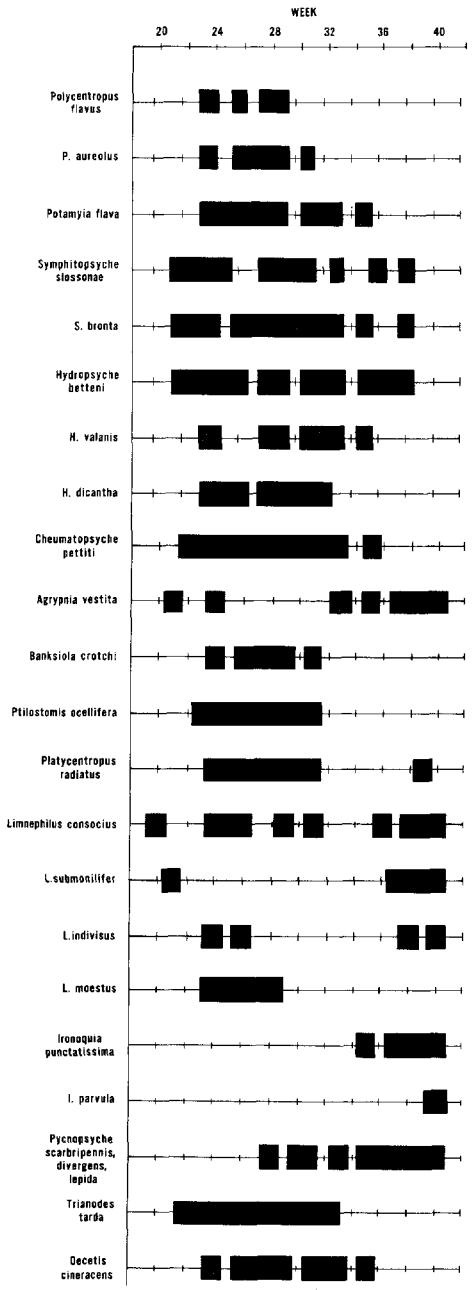

FIGURE 4. Seasonal distribution of selected species of Trichoptera collected at Watercress Marsh from 1976–81.

show a similar pattern of late spring and early fall flight behavior. It is not known if these species also undergo a reproductive diapause. Two species of *Ironoquia* were collected only in late summer and early fall.

Many species of Limnephilidae and Phryganeidae have adapted to temporary pools that fill with snowmelt or rain water in spring and fall (Wiggins 1973). Limnephilid females oviposit away from water, and the egg masses are covered with a gelatinous matrix in which the young larvae remain until the site is flooded (Wiggins 1973). Species adapted to temporary pools are common at Watercress Marsh, e.g. *Limnephilus* spp., even though permanent water is available throughout the year. No noticeable change in the depth of the beaver ponds occurred, although runoff from springs generally declined following dry periods in summer.

CADDISFLY SPECIES ORIGIN. A more thorough knowledge of the caddisfly fauna of both glaciated and nonglaciated eastern Ohio is necessary to evaluate further its biogeographic origins. However, collections from Watercress Marsh have revealed a strong northern element which likely dates back to recolonization of the area by aquatic insects following the retreat of the Grand River Lobe of the Wisconsin glacier. Species of caddisflies which became established in the area of the present day marsh must have survived in suitable refugia south of the glacial border. Ross et al. (1967) postulated a Cumberland Plateau refugium for 3 species of winter stoneflies (Plecoptera) in the genus *Allocapnia*. This region plus southeastern Ohio may have provided suitable habitats for a large and diverse caddisfly fauna as well. Ross et al. (1967) and Scudder (1979) suggested that the Ohio River and its tributaries served as a major dispersal route for insects in their recolonization of the Great Lakes region and beyond. This conclusion is supported by the composition of the Trichoptera fauna at Watercress Marsh in that it includes a number of glacial relict species (*Limnephilus* spp.) as well as species that are widespread throughout the Northeast and East.

The presence of the spike rush *Eleocharis rostellata* Torrey, which occurs throughout wetlands of the Southeast and scattered locations around the Great Lakes, is evidence of an Atlantic Coastal element in the flora of Watercress Marsh (Braun 1967). However, no comparable Atlantic Coastal element was discovered for the caddisfly fauna.

The Trichoptera fauna of Watercress Marsh demonstrates the significance of small isolated wetlands in supporting large assemblages of species over long periods of time. Habitats suitable for a large and diverse fauna are largely the result of glaciation which created a series of terminal moraines in eastcentral Columbiana Co. (White 1951). Springs that originate from these deposits provide a year-around water supply in the form of small streams and ponds. In addition to a large number of species that occupy lotic habitats, the area supports caddisflies typical of marshes and bogs including several transcontinental species found throughout the boreal and subarctic regions of Canada. Relatively undisturbed areas that are situated near major geological features or boundaries are extremely rare and may provide valuable data on the biogeography of Ohio's flora and fauna. Watercress Marsh, an important natural feature of northeastern Ohio, is such a site and worthy of additional study and preservation in its natural state.

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