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AN ANNOTATED LIST OF THE AQUATIC INSECTS COLLECTED IN 2004 IN THE WABASH RIVER WATERSHED, INDIANA

Paul D. McMurray, Jr. and **Steven A. Newhouse:** Indiana Department of Environmental Management, Biological Studies Section, 100 North Senate Avenue, Indianapolis, Indiana 46204 USA

ABSTRACT. In 2004 the Indiana Department of Environmental Management (IDEM) biologists sampled 47 streams and rivers within the Wabash River watershed. More than 5500 aquatic insect specimens, representing 229 taxa from nine orders, 61 families, and 167 genera were collected. Diptera (73 taxa) was the most diverse insect order followed by Coleoptera (43 taxa), Odonata (31 taxa), Ephemeroptera (25 taxa), Trichoptera (23 taxa), Hemiptera (20 taxa), Plecoptera (7 taxa), Megaloptera (5 taxa), and Lepidoptera (2 taxa). We collected 50–70% of the families, 21–45% of the genera, and 9–17% of the species of Ephemeroptera, Odonata, Plecoptera, and Trichoptera currently reported from Indiana. The upper Wabash sub-watershed had the greatest number of insect taxa (148) while the lower Wabash sub-watershed had the fewest taxa (119). Based on rank abundance, *Cheumatopsyche* spp., *Calopteryx maculata*, *Polypedium* spp., *Caenis* spp., *Stenelmis* spp., *Cricotopus/Orthocladius* group, *Tanytarsus* spp., *Ceratopsyche cheilonis*, and *Thienemannimyia* group were found at more than 50% of the sites.

Keywords: Wabash River, environmental quality, macroinvertebrate, IDEM, probabilistic, multi-habitat

For nearly 100 years aquatic macroinvertebrates have been used as indicators of water quality (Forbes 1928; Pantle & Buck 1955). In the 1970s American scientists shifted the focus of biomonitoring from using qualitatively collected indicator species to the use of quantitative sampling and analysis by means of various diversity indices (Bode 1988; Hilsenhoff 1982, 1987, 1988). In order to calibrate and validate indicator organism indices, basic information about distribution and taxonomy is needed. For many areas this information exists at the order or family level; but, other than large checklists, little information exists at the species or lowest taxonomic level (Helenthal et al. 2003).

In 1990, the Indiana Department of Environmental Management (IDEM) initiated a benthic macroinvertebrate community assessment program (IDEM 2001) based on the EPA RBP II protocols (Plafkin et al. 1989). This method utilized a single habitat for assessing rivers and streams using family-level taxonomic resolution. Recent comparisons of family-level versus genus- and species-level identifications of macroinvertebrates has determined that, in most situations, genus- and species-level identifications provide much greater diagonostic resolution (Lenat & Resh 2001). Later, in 2004, IDEM began the development of a multi-habitat (MHAB) sampling method for collecting benthic macroinvertebrates that would incorporate genus- and species-level identifications (IDEM 2006).

The purpose of the present study is to provide a list of aquatic insect taxa collected within the Wabash River watershed, and present a comparison of taxonomic occurrence in four sub-watersheds based on samples collected in 2004. This effort is based on a stratified random sampling approach that reflects representative occurrence in the area.

METHODS

Study area.—The Wabash River, the second largest tributary to the Ohio River, originates near St. Henry, Ohio and flows in a southwesterly direction for 765 km before entering the Ohio River 18 km southwest of Mt. Vernon, Indiana. The Wabash River watershed encompasses 85,236 km^2, with nearly 74% (62,693 km^2) located in Indiana (Illinois and Ohio contribute 21,805 km^2 and 738 km^2, respectively) (Hoggatt 1975). Major streams within the Wabash watershed include the Tip-

pecanoe River, Wildcat Creek, Mississinewa River, Salamonie River, Patoka River, Driftwood River, Flatrock River, Muscatatuck River, and the White River.

The Wabash River watershed is located primarily within the Eastern Corn Belt Plain Ecoregion with the extreme northern area being in the Southern Michigan/Northern Indiana Till Plain Ecoregion, the southcentral area being in the Interior Plateau and Eastern Corn Belt Plain Ecoregion, and the southwestern area being found in the Interior River Lowland Ecoregion. The Eastern Corn Belt Plain and Southern Michigan/Northern Indiana Till Plain Ecoregions are formerly glaciated with bedrock composed of Paleozoic shale, sandstone, limestone and dolomite overlain with clay and loam till and outwash. The Interior River Lowland is composed of both formerly glaciated and un-glaciated areas with bedrock composed of Pennsylvanian shale, sandstone, limestone and coal overlain by Quaternary alluvium and glacial outwash. The Interior Plateau Ecoregion, which was never glaciated, is an area with Quaternary loess, colluvium and alluvium underlain with Mississippian and Pennsylvanian shale, sandstone, and limestone (Woods et al. 1998). About 65% of the Wabash River watershed, primarily within the Eastern Corn Belt Plain and the Northern Indiana Till Plain Ecoregions, is utilized as agricultural cropland for corn and soybean production. Agriculture is also a primary land use within the Interior River Lowland Ecoregion, although oil wells and coal mines are also common. Forests account for 13.5% of the Wabash River watershed and are mostly found within the Interior Plateau Ecoregion (Gammon 1994; Woods et al. 1998).

Study design.—As part of the IDEM Surface Water Monitoring Strategy (2001, 2006), IDEM biologists sampled 47 sites within the Wabash River Watershed during 2004 (Table 1, Fig. 1). Site selection for this study was part of a watershed-based, statewide stratified, random subset of 736 previously sampled macroinvertebrate sampling sites. This study presents a comprehensive phylogenetic taxonomic list of species collected across the Indiana portion of the Wabash River watershed. For the purpose of this study, the Wabash River watershed was divided into four sub-watersheds based on the Monitoring Strategy Areas used by the IDEM Surface Water Monitoring Strategy (2001, 2006). The sub-watersheds are as follows: the upper Wabash River (UWR), lower Wabash River (LWR), West Fork of the White River (WFWR) and East Fork of the White River (EFWR) (Fig. 1).

Numerical classification analysis was conducted using STATISTICA for Windows (StatSoft 2002). We analyzed the 30 most commonly ranked taxa occurring in the entire Wabash River watershed and each of its four sub-watersheds. This information is presented in a cumulative frequency-distribution table of the most common taxa (Table 2).

Field collection.—Aquatic macroinvertebrate samples were collected at each site upstream of bridges (if present) to decrease any effects that the bridges might have on the downstream fauna. Following a modified D-frame dipnet method (IDEM 2001, 2006) described from Plafkin et al. (1989) and Barbour et al. (1999), a one-minute kick sample was taken within a riffle (if available), run, or a typical glide area at each site. In addition, a 50 m length of stream habitat was sampled with a D-frame dipnet to obtain a MHAB sample. Instream habitats included emergent vegetation, submerged macrophytes, depositional zones, logs, sticks, rootwads, rootmats, cobble, and sand. All habitats were sampled as encountered. The MHAB sample and the kick sample were combined and elutriated a minimum of five times through a 50 μm sieve. The contents of the sieve were emptied into a tray and picked through for 15 min, collecting at least 100 organisms per site, obtaining the greatest diversity of organisms possible. Aquatic macroinvertebrates were preserved in 80% isopropyl alcohol and returned to the lab to be processed and identified, usually to genus or species, using regionally-recognized taxonomic references (such as Merritt & Cummins 1996; Hilsenhoff 1995; and Brigham et al. 1982). All specimens were retained and are maintained at the IDEM Shadeland office/laboratory, Indianapolis, Indiana.

RESULTS AND DISCUSSION

This single year sampling effort of 47 sites in the Wabash River watershed collected more than 5500 aquatic insects. Using a MHAB sampling approach a total of 229 aquatic insect taxa, distributed over nine orders, 61 families, and 167 genera was collected (Table 3). The most diverse insect orders were Diptera

Table 1.—Site localities of all sites sampled in the Wabash River watershed, Indiana, in 2004. Site numbers correspond to Table 3 and are shown in Fig. 1.

Site	County	Locality	Latitude N	Longitude W
Upper Wabash River sub-watershed				
A1	Tippecanoe	Wildcat Creek @ Wolfe Rd	40° 27.17′	86° 43.59′
A2	Carroll	Wildcat Creek @ US 421	40° 27.52′	86° 38.13′
A3	Carroll	Wildcat Creek @ CR 50 E	40° 28.58′	86° 30.43′
A4	Carroll	Little Deer Creek @ CR 300 N	40° 35.24′	86° 28.04′
A5	Carroll	Deer Creek @ CR 300 N	40° 35.23′	86° 37.18′
A6	Carroll	Deer Creek U/S of Delphi, Indiana	40° 35.10′	86° 40.08′
A7	Carroll	Deer Creek D/S of Delphi Water Treatment Plant	40° 34.28′	86° 40.59′
A8	White	Honey Creek @ CR 225 N	40° 47.05′	86° 47.39′
A9	Pulaski	Tippecanoe River @ Pulaski	40° 58.22′	86° 39.35′
A10	Pulaski	Mud Creek @ SR 119	40° 59.01′	86° 38.51′
A11	Starke	House Ditch @ CR 850 S	41° 10.44′	86° 32.26′
A12	Fulton	Mill Creek @ CR 250 N (Olson Rd)	41° 05.30′	86° 13.53′
A13	Wabash	Eel River U/S Wabash Rd	40° 59.38′	85° 46.55′
A14	Huntington	Wabash River D/S Huntington Reservoir	40° 50.46′	85° 28.16′
A15	Wells	Eightmile Creek @ Aboite Rd	40° 54.53′	85° 19.09′
A16	Jay	Wabash River @ CR 215 E	40° 34.05′	84° 50.55′
A17	Delaware	Mississinewa River 200m D/S of CR 700 N	40° 17.33′	85° 18.47′
Lower Wabash River sub-watershed				
B1	Knox	Snapp Creek 30m D/S of Iron Bridge	38° 42.04′	87° 29.57′
B2	Knox	Smalls Creek @ ford W of RR, Sec 26	38° 45.06′	87° 29.16′
B3	Knox	Maria Creek @ CR 1050 S	38° 52.53′	87° 20.48′
B4	Sullivan	Sulphur Creek @ SR 48	39° 11.13′	87° 16.15′
B5	Montgomery	Sugar Creek @ CR 600 E	40° 06.28′	86° 47.38′
B6	Warren	Big Pine Creek @ SR 55	40° 18.14′	87° 15.47′
B7	Warren	Mud Pine Creek @ CR 850 N	40° 26.24′	87° 21.30′
West Fork White River sub-watershed				
C1	Greene	Buck Creek @ SR 54, E of Linton	39° 02.17′	87° 06.31′
C2	Clay	Wabash and Erie Canal @ CR 113 W	39° 11.54′	87° 08.09′
C3	Owen	Little Mill Creek @ CR 25 E	39° 21.32′	86° 45.50′
C4	Morgan	Lambs Creek @ Middle Patton Lake Rd	39° 28.10′	86° 30.23′
C5	Hendricks	East Fork White Lick Creek @ CR 800 S	39° 38.46′	86° 20.48′
C6	Putnam	Big Walnut Creek D/S Wildwood Bridge	39° 42.11′	86° 47.24′
C7	Putnam	Plum Creek @ CR 500 N	39° 43.53′	86° 46.04′
C8	Hamilton	Stony Creek @ Cumberland Rd Gaging Station	40° 01.44′	85° 59.42′
C9	Madison	Pipe Creek U/S Alexandria, in WWTP	40° 15.47′	85° 42.00′
C10	Randolph	West Fork White River 120 m U/S CR 1100 W	40° 09.59′	85° 11.11′
East Fork White River sub-watershed				
D1	Orange	Lost River @ Potato Rd	38° 38.11′	86° 21.57′
D2	Lawrence	Guthrie Creek @ Leesville/ Fort Ritner Rd	38° 48.08′	86° 17.43′
D3	Lawrence	Pleasant Run Creek @ CR 50 E	38° 54.01′	86° 28.10′
D4	Lawrence	Wolf Creek @ CR 825 N	38° 58.35′	86° 28.40′
D5	Lawrence	Henderson Creek @ CR off of SR 446	38° 57.43′	86° 22.08′
D6	Jennings	Otter Creek @ CR 190 E, Cherry Park Rd	38° 59.20′	85° 34.31′
D7	Jennings	Leatherwood Creek @ CR 925 N at Zenas	39° 07.03′	85° 28.21′
D8	Jennings	Vernon Fork Muscatatuck River @ CR 1225 N	39° 09.53′	85° 27.45′
D9	Shelby	Lewis Creek @ SR 252	39° 21.49′	85° 51.29′
D10	Johnson	Sugar Creek @ CR 650 S at old CCC Dam	39° 22.52′	86° 00.21′
D11	Shelby	Brandywine Creek @ SR 9	39° 41.13′	85° 46.26′
D12	Rush	Little Blue River @ CR 300 N	39° 39.18′	85° 34.15′
D13	Henry	Big Blue River @ CR 400 S	39° 52.26′	85° 26.20′

Table 2.—Percent occurrence of the 30 most common aquatic insects collected in the Wabash River watershed, Indiana, and its sub-watersheds in 2004. UWR = upper White River sub-watershed, LWR = lower White River sub-watershed, WFWR = West Fork White River sub-watershed, EFWR = East Fork White River sub-watershed.

Taxa	Entire Wabash watershed (N=47)	UWR (n=17)	LWR (n=7)	WFWR (n=10)	EFWR (n=13)
Cheumatopsyche spp.	72	71	57	80	77
Calopteryx maculata	66	53	86	60	77
Polypedilum spp.	60	82	86	60	15
Caeinis spp.	55	29	71	60	77
Stenelmis spp.	55	53	43	70	54
Cricotopus/Orthocladius grp.	53	59	57	60	38
Tanytarsus spp.	53	59	57	60	38
Ceratopsyche cheilonis	53	65	43	60	38
Thienemannimyia grp.	51	47	57	40	62
Enallagma divagans	49	47	57	70	31
Tipula spp.	43	18	14	50	85
Isonychia spp.	43	41	29	40	54
Microtendipes spp.	43	53	43	30	38
Tricorythodes spp.	43	65	43	40	15
Peltodytes duodecimpunctatus	38	41	29	40	38
Dubiraphia spp.	36	29	43	40	38
Boyeria vinosa	34	35	14	50	31
Dicrotendipes spp.	34	29	57	40	23
Argia tibialis	34	41	43	30	23
Baetis intercalaris	34	47	43	30	15
Hydroporus spp.	32	35	29	0	54
Chironomus spp.	32	24	43	30	38
Helichus lithophilus	32	18	57	50	23
Stenonema femoratum	30	6	29	20	69
Microvelia americana	30	6	43	30	54
Peltodytes lengi	30	18	14	40	46
Ceratopsyche spp.	30	35	14	40	23
Dubiraphia minima	30	35	14	40	23
Cladotanytarsus spp.	30	29	43	40	15
Cricotopus trifascia	30	35	43	30	15

(73 taxa), Coleoptera (43 taxa), and Odonata (31 taxa). The remaining 82 taxa were distributed among the orders Ephemeroptera (25 taxa), Trichoptera (23 taxa), Hemiptera (20 taxa), Plecoptera (7 taxa), Megaloptera (5 taxa), and Lepidoptera (2 taxa).

Hellenthal et al. (2003) published a list of 2307 aquatic insect species either recorded from Indiana or likely to occur within the state. The data collected from the Wabash River watershed are presented and compared with this list in Table 4. This study collected 50–70% of the families, 21–45% of the genera, and 9–17% of the species of Ephemeroptera, Odonata, Plecoptera, and Trichoptera currently reported from Indiana (Table 4) (Hellenthal et al. 2003). These are surprisingly high numbers considering the temporal and spatial limits of this study, which sampled only 47 sites in Indiana's largest watershed from September to November.

Diversity by subwatershed.—The UWR sub-watershed had the greatest number of insect taxa (148) while the LWR sub-watershed had the fewest taxa (119). The WFWR and the EFWR had 122 taxa and 132 taxa, respectively. The greatest number of taxa (48) was found in both the LWR sub-watershed in Sugar Creek, Montgomery County (site B5), and within the EFWR sub-watershed, in Brandywine Creek, Shelby County (site D11). The fewest taxa (9) were found in Wolf Creek, Lawrence County (site D4). The average number of taxa collected in the Wabash River wa-

Table 3.—Aquatic insects collected in the Wabash River watershed, Indiana, in 2004. Orders are arranged phylogenetically, followed by the alphabetical listing of families, genera, and species. Numbers associated with each taxon correspond to the site localities listed in Table 1 and shown in Fig. 1.

Order Ephemeroptera (10 families)

Family Baetidae

Acentrella turbida (McDunnough): A6, A7, A13, B5, B7, C6
Baetis spp.: B6, D1
Baetis flavistriga McDunnough: A1, A2, A4, A6, A7, A13, A15, B7, C7, C10
Baetis intercalaris McDunnough: A1, A3, A6, A7, A9, A13, A15, A16, B1, B2, B7, C1, C4, C5, D11, D13
Callibaetis spp.: B2, C8
Procloeon spp.: A2, C3, C5, C6

Family Baetiscidae

Baetisca lacustris McDunnough: D9

Family Caenidae

Caenis spp.: A8, A9, A12, A15, A17, B1, B2, B5, B6, B7, C1, C2, C3, C4, C6, C10, D1, D2, D3, D6, D7, D8, D9, D10, D11, D12

Family Ephemerellidae

Eurylophella spp.: D1, D5

Family Ephemeridae

Ephemera simulans Walker: A17, B5, B6, D2
Hexagenia limbata (Serville): A9, D9

Family Heptageniidae

Leucrocuta hebe (McDunnough): A1, A5, A6, A7, A12, A15, A17, B6, B7, C5, D11
Mccaffertium spp.: A1, A5, A6, A7, B6, C6
Mccaffertium mediopunctatum (McDunnough): A4, A5, A6, A7, B6, B7, C6, D10, D11, D12
Mccaffertium pulchellum (Walsh): A5, A7, A13, A16, A17, B5, B6, C10, D1, D6, D9, D10
Mccaffertium terminatum (Walsh): A3, A5, A6, A7, A9, A17, B6, C6, D10
Stenacron spp.: A17, B1
Stenacron interpunctatum (Say): A4, A5, A6, A7, A8, A9, A15, B2, C1, C2, C4, C6, D2
Stenonema femoratum (Say): A15, B6, B7, C3, C4, D1, D2, D3, D4, D5, D6, D7, D8, D9

Family Isonychiidae

Isonychia spp.: A1, A2, A3, A5, A6, A7, A17, B6, B7, C4, C6, C7, C10, D2, D6, D7, D9, D10, D11, D12

Family Leptohyphidae

Tricorythodes spp.: A1, A2, A3, A4, A5, A6, A7, A9, A13, A14, A16, B5, B6, B7, C5, C6, C8, C10, D10, D11

Table 3.—Continued.

Family Leptophlebiidae

Leptophlebia cupida (Say): D1, D2, D3, D7, D10
Paraleptophlebia ontario (McDunnough): A9

Family Potamanthidae

Anthopotamus spp.: C6
Anthopotamus myops (Walsh): A3, A17, B5, D10

Order Odonata (7 families)

Family Calopterygidae

Calopteryx maculata (Beauvois): A4, A6, A8, A9, A10, A11, A12, A13, A17, B2, B3, B4, B5, B6, B7, C2, C3, C4, C5, C7, C8, D1, D2, D3, D4, D7, D8, D9, D11, D12, D13
Hetaerina americana (Fabricius): A4, A6, C2, C5, C8, D11

Family Coenagrionidae

Argia spp.: A12, A16, B6, B7, C1, C2, C4, D1, D4
Argia apicalis (Say): A4
Argia fumipennis (Burmeister): A4, A8, B5, C2, C8, D7
Argia moesta (Hagen): A3, A5, A6, A7, A17, B5, B6, B7, C8, D1, D2, D6, D8
Argia sedula (Hagen): C1, C2
Argia tibialis (Rambur): A2, A3, A4, A8, A12, A13, A16, B3, B5, B6, C1, C6, C10, D9, D10, D11
Enallagma spp.: C1, C4
Enallagma divagans Selys: A2, A4, A6, A7, A8, A9, A12, A16, B1, B2, B4, B5, C1, C2, C4, C5, C6, C8, C10, D1, D9, D10, D11
Ischnura spp.: C1
Ischnura posita (Hagen): A8, A9, A11, A16, B4
Ischnura verticalis (Say): A8, A11, A16

Family Aeshnidae

Anax junius (Drury): A8, C2
Basiaeschna janata Say: B3, C4, D1, D2, D8
Boyeria vinosa (Say): A2, A6, A9, A10, A12, A13, B5, C2, C3, C5, C7, C10, D7, D9, D10, D13
Nasiaeschna pentacantha (Rambur): C2

Family Corduliidae

Somatochlora spp.: D7

Family Libellulidae

Libellula spp.: C2
Plathemis lydia (Drury): A8, B2, C4
Sympetrum obtrusum (Hagen): D2

Family Macromiidae

Macromia spp.: A5, A9, B5, D6, D9, D10, D11
Macromia illinoensis Walsh: B5, D9

Table 3.—Continued.

Family Gomphidae
Dromogomphus spinosus Selys: A4, B2, D1, D9, D10
Dromogomphus spoliatus (Hagen in Selys): A2, A3, A6, A9, B5, B6, B7, C5, D2, D8, D9, D10
Erpetogomphus designatus Hagen in Selys: A1, A9
Hagenius brevistylus Selys: C3
Ophiogomphus rupinsulensis (Walsh): A6
Progomphus obscurus Rambur: C4
Stylogomphus sigmastylus Cook and Laudermilk: C3
Stylurus spiniceps (Walsh): A9, D10

Order Plecoptera (4 families)

Family Nemouridae
Shipsa rotunda (Claassen): D10

Family Perlidae
Acroneuria abnormis (Newman): A9
Agnetina flavescens Walsh: D1
Perlinella drymo (Newman): A7, B6, D5, D10, D11

Family Perlodidae
Isoperla spp.: D2, D5

Family Taeniopterygidae
Taeniopteryx spp.: A1, A2, A9, D6, D10, D12
Taeniopteryx metequi Ricker and Ross: D10

Order Hemiptera (8 families)

Family Belostomatidae
Belostoma fluminea Say: A2, A4, A5, A8, A11, A13, A16, C2, C4, D4, D7, D11

Family Corixidae
Hesperocorixa spp.: D11
Sigara spp.: A8, A10, A11, B7, C7, C9, C10, D1, D11
Trichocorixa calva (Say): A2, A8, A11, A16, B2, C8, C10, D1, D3, D6, D11

Family Gerridae
Aquarius spp.: A11, A12, B2, B4, D5
Gerris spp.: A16, B2, B3, B4, C7, D5
Metrobates hesperius Uhler: A6, B5, C5
Rheumatobates spp.: A2, A4, C2, C5
Trepobates inermis-knighti grp.: C4, C6
Trepobates pictus (Herrich-Schaeffer): B1, B3, C1
Trepobates subnitidus Esaki: B2, C2, C3

Family Mesoveliidae
Mesovelia mulsanti White: A12, C4

Family Nepidae
Ranatra fusca Palisot: A2, A8, A13

Family Notonectidae
Notonecta irrorata Uhler: A11, B3, B4, C10

Table 3.—Continued.

Family Pleidae
Neoplea striola (Fieber): A2, B2, C5

Family Veliidae
Microvelia spp.: C7
Microvelia americana (Uhler): A12, B2, B3, B4, C3, C4, C7, D3, D4, D5, D7, D8, D9, D12
Rhagovelia spp.: A16, C6
Rhagovelia obesa Uhler: A13, A16, A17, B6
Rhagovelia oriander Parshley: A4, A9, A10, A17, B5, B6, B7, C3, C4, C5, C6

Order Megaloptera (2 families)

Family Corydalidae
Corydalus cornutus (Linnaeus): A17, B7, D2, D6, D7, D10
Chauliodes pectinicornis (Linnaeus): B2
Nigronia fasciatus (Walker): D3
Nigronia serricornis (Say): C3, D1, D3, D5, D6, D7, D8

Family Sialidae
Sialis spp.: B4, C1, C8, C10, D1, D2, D9, D12

Order Trichoptera (9 families)

Family Brachycentridae
Brachycentrus numerosus (Say): A9

Family Hydropsychidae
Ceratopsyche spp.: A1, A3, A4, A5, A6, A15, B5, C4, C6, C7, C10, D10, D11, D13
Ceratopsyche bronta (Ross): A5, A6, A7, B6, B7, C5, C10, D6, D9, D10, D12
Ceratopsyche cheilonis (Ross): A1, A2, A3, A4, A5, A6, A7, A9, A13, A14, A17, B5, B6, B7, C5, C6, C7, C8, C9, C10, D6, D9, D10, D12, D13
Ceratopsyche sparna (Ross): A10
Cheumatopsyche spp.: A1, A2, A3, A4, A5, A6, A7, A9, A14, A15, A16, A17, B1, B2, B6, B7, C1, C3, C4, C5, C6, C7, C9, C10, D1, D2, D3, D6, D7, D8, D9, D10, D12, D13
Hydropsyche spp.: A1, A8, A9, B2, C8, D11
Hydropsyche aerata Ross: A1, B5
Hydropsyche betteni-depravata group: A4, A8, A10, B2, B3, B7, C4, C8, C9, C10, D3, D11, D13
Hydropsyche dicantha Ross: A1, A3, A5, A6, A16, B7, C10, D13
Hydropsyche frisoni Ross: D11
Hydropsyche simulans Ross: A9, A13, A15, B2, B7

Family Hydroptilidae
Agraylea spp.: A9
Hydroptila spp.: C7

Family Leptoceridae
Nectopsyche exquisita (Walker): A6, A13
Oecetis spp.: A3, A4, B5, D6

Table 3.—Continued.

Family Limnephilidae
Pycnopsyche spp.: A10, D10
Family Philopotamidae
Chimarra aterrima (Hagen): C3, C7, D2, D3
Chimarra obscura (Walker): A1, A2, A3, A6, A7, C1, C4, D2, D6, D7, D8, D12
Family Phyrganeidae
Ptilostomis spp.: A11, A17, B4, D2
Family Polycentropodidae
Cernotina spicata Ross: A17, D9
Neureclipsis crepuscularis (Walker): A4, A9
Family Rhyacophilidae
Rhyacophila lobifera Betten: D2
Order Lepidoptera (1 family)
Family Pyralidae
Crambus spp.: A17, D4
Petrophila spp.: A1, A2, A4, A6, B5
Order Coleoptera (9 families)
Family Carabidae
Stenus spp.: D13
Family Dryopidae
Helichus basalis LeConte: C3, D5, D6, D8
Helichus fastigiatus (Say): D5
Helichus lithophilus (Germar): A4, A5, A7, B1, B2, B5, B6, C1, C3, C4, C6, C7, D4, D8, D9
Helichus striatus LeConte: A10
Family Dytiscidae
Agabus spp.: D5
Copelatus chevrolati Aube: B1
Coptotomus interrogatus (Fabricius): A3
Coptotomus loticus Hilsenhoff: A1, A11, B2
Hydroporus spp.: A1, A2, A3, A8, A11, A16, B2, B4, D1, D2, D3, D4, D5, D7, D8
Ilybius spp.: B4
Laccophilus spp.: B4
Laccophilus fasciatus Aube: B4
Laccophilus maculosus Say: A1, A11, B2, C7, C10, D7
Liodessus affinis (Say): A9, D11
Family Elmidae
Dubiraphia spp.: A1, A2, A7, A8, A10, B1, B2, B5, C1, C8, C9, C10, D1, D7, D9, D10, D11
Dubiraphia minima Hilsenhoff: A2, A3, A4, A6, A13, A16, B5, C1, C2, C4, C5, D9, D10, D11
Macronychus glabratus (Say): A2, A9, A13, B5, C1, C2, C5, C7
Optioservus spp.: A4, A6, A10, D12
Optioservus fastiditus (LeConte): A10
Optioservus trivittatus (Brown): D12

Table 3.—Continued.

Stenelmis spp.: A1, A2, A3, A4, A6, A7, A15, A16, A17, B3, B5, B6, C1, C4, C5, C6, C7, C9, C10, D2, D3, D6, D8, D11, D12, D13
Stenelmis crenata (Say): A4, A15, A17, B5, C1, C2, C5, C7, C10, D2, D3, D8, D11
Stenelmis quadrimaculata Horn: B2
Stenelmis sexlineata Sanderson: A2, A3, A4, A5, A17, B5, C4, C10, D6, D8, D9, D11
Stenelmis vittipennis Zimmerman: A2, A3, A16, B1, B5, D10
Family Gyrinidae
Gyrinus spp.: A10, A11, B4, C2, D9
Gyrinus maculiventris LeConte: D10
Family Haliplidae
Peltodytes duodecimpunctatus (Say): A2, A3, A8, A9, A10, A11, A16, B2, B3, C2, C7, C9, C10, D7, D8, D9, D11, D12
Peltodytes edentulus (LeConte): A3, A8, A16, D9
Peltodytes lengi Roberts: A2, A9, A11, B5, C5, C8, C9, C10, D1, D2, D7, D8, D11, D12
Peltodytes sexmaculatus Roberts: A8, B5, D3, D11
Family Hydrophilidae
Berosus spp.: A1, A2, A4, A8, A14, B6
Berosus fraternus LeConte: B2
Berosus pantherinus LeConte: B2
Enochrus spp.: D9
Helophorus spp.: A3, A16, D11
Hydrobius spp.: C7
Laccobius spp.: C7
Tropisternus glaber (Herbst): B2, B3, C2, D2
Family Psephenidae
Ectropia spp.: D1
Psephenus herricki (De Kay): A17, C3, D1, D2, D3, D4, D6, D7, D8, D9, D11, D12
Family Scirtidae
Cyphon spp.: A2, A9, A10, B3, B5, B6, C1, C4, D2, D5, D7, D11
Order Diptera (11 families)
Family Chironomidae
Subfamily Orthocladiinae
Tribe Corynoneurini
Corynoneura spp.: A4, A6, A17, C7, D2, D7, D9, D11, D12
Thienemanniella spp.: A7
Thienemanniella taurocapita Hestenes and Saether: C7
Theinemanniella xena (Roback): A12, B5
Tribe Orthocladiini/Metriocnemini:
Brillia spp.: A4
Cardiocladius spp.: A3
Cricotopus/Orthocladius spp.: A1, A2, A3, A4, A5, A6, A7, A9, A13, A14, B2, B5,

Table 3.—Continued.

B6, B7, C2, C5, C6, C7, C8, C10, D2, D9, D10, D11, D13
Cricotopus trifascia Edwards: A1, A2, A3, A6, A7, A13, B5, B6, B7, C7, C8, C10, D9, D11
Diplocladius cultiger Kieffer: D2
Eukiefferiella spp.: A3, D10
Hydrobaenus spp.: A17, D7, D11
Nanocladius spp.: A4
Parakiefferiella spp.: A3, A4, A5, A6, A7, A8, B6, B7, C8, D9, D10
Psectrocladius spp.: D11, D13
Rheocricotopus spp.: A13, C3
Tvetnia spp.: A1, A14, C8

Subfamily Chironominae
Tribe Chironomini
Chironomus spp.: A2, A3, A4, A7, B2, B4, B6, C6, C7, C9, D7, D9, D10, D11, D13
Cryptochironomus spp.: A2, A17, B2, B5, B6, B7, C5, C9
Cryptotendipes spp.: B2, C2
Dicrotendipes spp.: A1, A2, A3, A4, A5, B2, B5, B6, B7, C6, C7, C8, C10, D9, D11, D12
Glyptotendipes sp.: B2, C7
Microtendipes spp.: A1, A2, A3, A4, A6, A8, A14, A15, A17, B5, B6, B7, C3, C6, C10, D7, D9, D10, D11, D12
Paracladopelma spp.: B1
Paurolaterborniella nigrohalteralis (Malloch): A3
Paratendipes spp.: B1
Phaenopsectra spp.: A1, A2, A4, A5, A7, A14, B7, C1, C6, D13
Polypedilum spp.: A1, A2, A3, A4, A5, A6, A7, A9, A12, A13, A14, A15, A16, A17, B1, B2, B3, B4, B6, B7, C1, C2, C3, C6, C7, C10, D6, D12
Saetheria spp.: A15, C5, C6
Stictochironomus spp.: A3, A4, A7, A17, B3, C5, D7, D10, D11

Tribe Pseudochironomini
Pseudochironomus spp.: A3

Tribe Tanytarsini
Cladotanytarsus spp.: A3, A5, A6, A7, A15, B1, B6, B7, C4, C5, C6, C7, D9, D11
Neozavrelia spp.: A6
Paratanytarsus spp.: C2, C6, C8, D9, D10
Rheotanytarsus spp.: A1, A6, A8, A14, B5, B6, B7, C6, C7
Stempellinella spp.: A4, A7, B5, B7, C6, D11, D12
Subletta spp.: C6
Subletta coffmani (Roback): A8
Tanytarsus spp.: A1, A2, A3, A4, A5, A6, A7, A13, A14, A17, B1, B2, B5, B7, C1, C4, C6, C7, C8, C10, D9, D10, D11, D12, D13

Table 3.—Continued.

Subfamily Tanypodinae
Tribe Procladiini
Procladius spp.: A12, B2, B5, C7, C9, D10
Tribe Pentanuerini
Ablabesmyia spp.: A12
Ablabesmyia janta (Roback): A3
Ablabesmyia mallochi (Walley): B2, B5, B6, C6, D1
Labrundinia pilosella (Loew): A3, A6, A9, A12, C3, C4, C7
Paramerina spp.: A2, A4, D12
Pentaneura spp.: C7
Telopelopia spp.: A15
Theinenmannimyia group: A2, A5, A6, A12, A13, A14, A15, A17, B2, B5, B6, B7, C5, C6, C7, C9, D2, D6, D7, D8, D9, D11, D12, D13
Zavrelimyia spp.: D8

Tribe Tanypodini
Tanypus neopunctipennis Sublette: B2

Family Athericidae
Atherix spp.: A9

Family Ceratopogonidae
Bezzia-Palpomyia group: D9
Ceratopogon spp.: B5
Dasyhela spp.: D9

Family Culicidae
Anopheles punctipennis (Say): B2, C4, C7
Culex spp.: C1

Family Dixidae
Dixella spp.: C3, C4, D7, D11

Family Empididae
Hemerodromia spp.: A1, A4, A5, A6, A7, A8, A16, B5, B7, C7

Family Simuliidae
Simulium spp.: A3, A6, A15, D10
Simulium jenningsi Malloch: A1, A3, A13, B7, C6
Simulium tuberosum complex: A4, A15, B1, C4
Simulium venustum complex: D6
Simulium vittatum Zetterstedt: A3, A4, A5, A6, A7, A8, A14, A15, B7, C8, C10, D11

Family Stratiomyidae
Nemotelus spp.: D13

Family Syrphidae
Helophilus spp.: D12

Family Tabanidae
Chrysops spp.: A2, A5, A7, A8, A15, B5, C1, C3, C4, C5, C10, D7, D12
Tabanus spp.: B7, C6, D5, D12

Table 3.—Continued.

Family Tipulidae
Antocha spp.: C7, D10
Dicranota spp.: D5
Erioptera spp.: A7, A17
Hexatoma spp.: A12, C4, C5, C7, C10, D2, D5, D12
Pilaria spp.: C10
Pseudolimnophila spp.: B2, D7
Tipula spp.: A4, A10, A17, B7, C1, C7, C8, C9, C10, D1, D2, D3, D6, D7, D8, D9, D10, D11, D12, D13

tershed was 29. Among the individual sub-watersheds, the greatest average number of taxa (31) was in the LWR sub-watershed while the smallest average number of taxa (27) was in the EFWR sub-watershed. The average number of taxa at sites in the UWR and WFWR sub-watersheds was 29.

Rank abundance by site occurrence.—Table 2 presents the 30 most abundant taxa by site occurrence. The most commonly encountered taxon, the Trichoptera genus *Cheumatopsyche* spp., occurred at 72% of all sites (Table 2). Although Hellenthal et al. (2003) reported 11 *Cheumatopsyche* species for Indiana, the larvae of this genus currently cannot be identified to species level. Sampling and identification of adult material using larval-rearing, emergence traps, black-lights or

Table 4.—Comparison of number of families, genera and species of Ephemeroptera, Odonata, Plecoptera and Trichoptera collected from the Wabash River watershed during the present study to those currently known from Indiana (Hellenthal et al. 2003).

	Families	Genera	Species
Ephemeroptera			
Hellenthal et al. (2003)	16	50	143
Wabash (present study)	10	18	18
% representation	63%	36%	13%
Odonata			
Hellenthal et al. (2003)	10	47	154
Wabash (present study)	7	21	26
% representation	70%	45%	17%
Plecoptera			
Hellenthal et al. (2003)	8	29	71
Wabash (present study)	4	6	6
% representation	50%	21%	9%
Trichoptera			
Hellenthal et al. (2003)	16	58	194
Wabash (present study)	9	14	21
% representation	56%	24%	11%

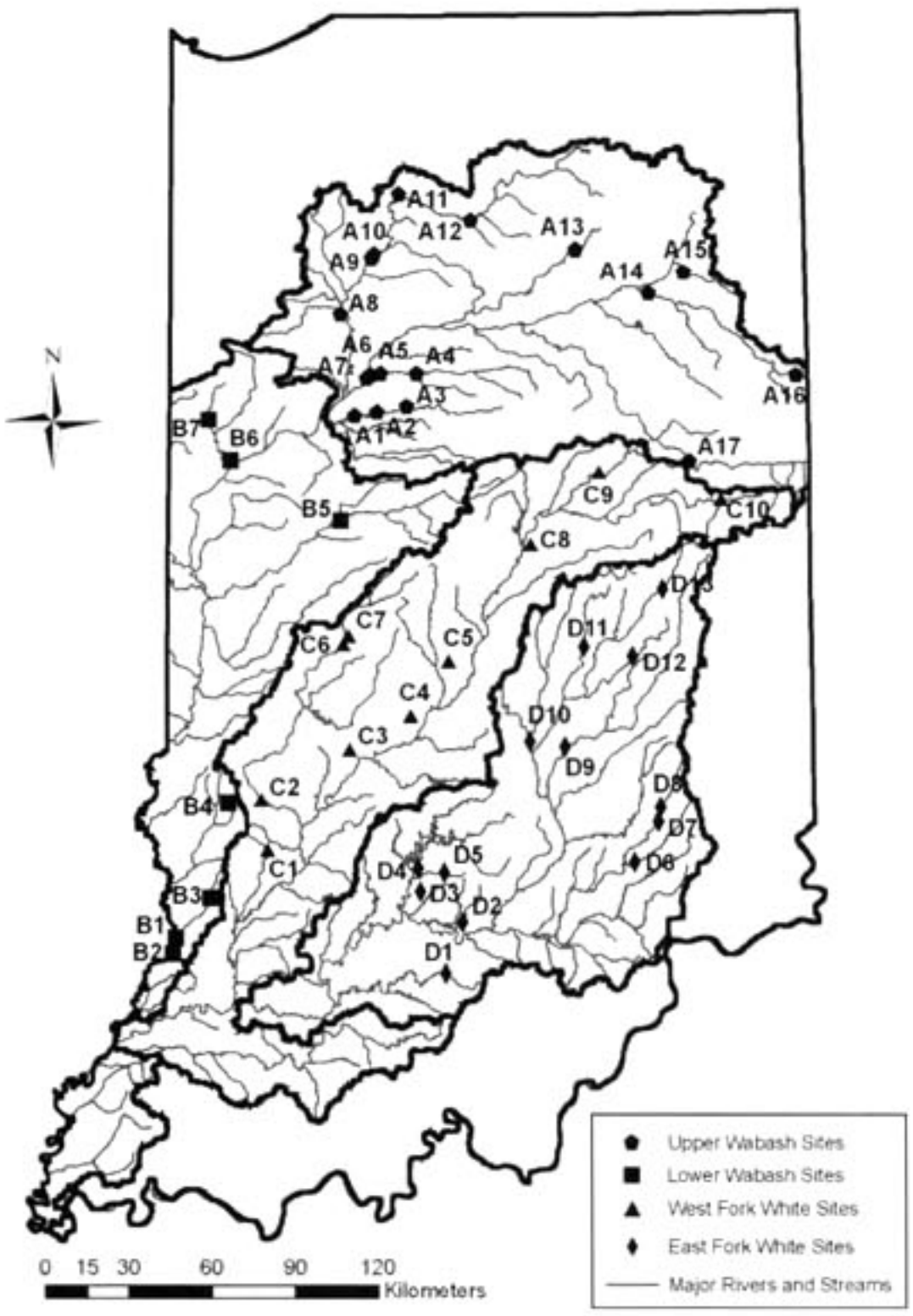

Figure 1.—Map of the Wabash River Watershed in Indiana, showing collection sites sampled in 2004.

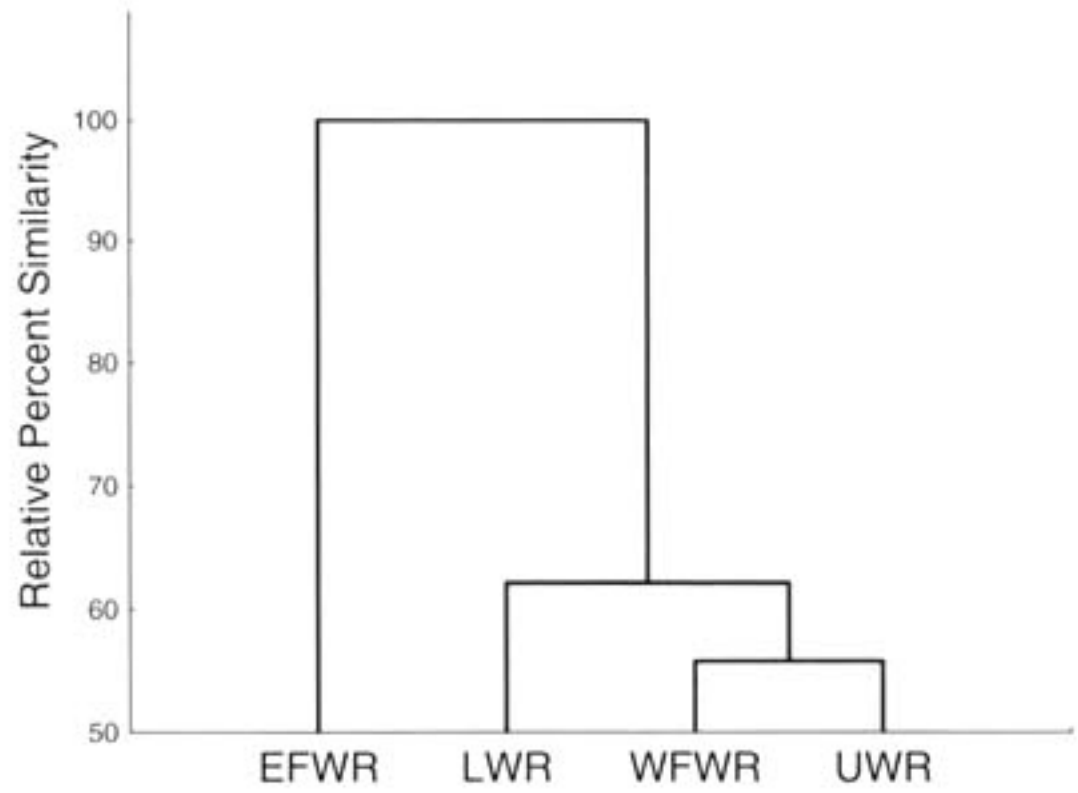

Figure 2.—Numerical classification analysis comparison of top 30 rank occurring aquatic insects by sub-watershed using Euclidean distance similarities. UWR = upper White River sub-watershed, LWR = lower White River sub-watershed, WFWR = West Fork White River sub-watershed, EFWR = East Fork White River sub-watershed.

other such collection methods may be useful for providing species occurrence data for problem insect genera.

Numerical classification analysis.—Numerical classification analysis of the percentage of occurrence of the 30 most common taxa (Table 2) from the four sub-watersheds is presented in Fig. 2. This dendogram shows that sites in the UWR sub-watershed are most compositionally similar to sites within the WFWR. These two sub-watersheds are then most similar to sites in the LWR sub-watershed. The internodal distance between the EFWR and the other sub-watersheds is reflected by a relative difference of 40% (Fig. 2) indicating that this sub-watershed is significantly different in composition and structure. Sobat et al. (2006) reported that the Wabash River (including both UWR and LWR sub-watersheds), the WFWR, and the EFWR fish communities, based on analysis of Index of Biotic Integrity (IBI) scores, have been assessed in the good-to-excellent condition at 14%, 17% and 33%, respectively. This numerical pattern of aquatic insect and fish community data suggested that the EFWR sub-watershed was of a higher environmental quality than the other sub-watersheds within the Wabash River watershed.

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