FINAL REPORT

LAKE ERIE PROTECTION FUND PROJECT SG 145-01

Confirmation of Rapid Population Increase of Burrowing Mayflies in the Central Basin of Lake Erie

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Executive Summary

The Water Quality Laboratory of Heidelberg College has surveyed the distribution and abundance of burrowing mayflies (*Hexagenia limbata* and *H. rigida*) in the Ohio nearshore waters of the central basin of Lake Erie since 1997. The annual May surveys revealed an increase in the distribution of the burrowing nymphs between 1997 and 2000, particularly in the western half of the study area. In 2000, the nymphs were less abundant in the samples, but that was attributed to the emergence of many nymphs prior to sampling, which was delayed by storms. Despite the low numbers collected, the nymphs were more widely and more evenly distributed in 2000 than in previous years. By contrast, in May 2001, nymphs were only found at the westernmost site (Sandusky, 9.6 nymphs/m^2) and the easternmost site (Conneaut, 58 nymphs/m^2) within the central basin. Samples from three sites in the nearby island area of the western basin, however, revealed high densities (91 to 562 nymphs/m^2) at all three sites.

Our initial interpretation was that a catastrophic event such as the depletion of oxygen in the bottom water following the previous year's emergence of adults had killed most of the new generation of nymphs. However, within days after our sampling was completed, winged *Hexagenia* began to appear onshore in numbers comparable to the last two years, and perhaps in somewhat greater numbers. This suggests that *Hexagenia* has survived somewhere outside the narrow band near shore where our sampling has taken place. Therefore, the reason for our inability to find nymphs in most of our study area is not evident. Future sampling may incorporate sites that are further from shore and in deeper water in order to determine whether that vast area of the basin, though more subject to oxygen depletion, may be undergoing repopulation by the nymphs. If the *Hexagenia* metric of the Lake Erie Quality Index is to be applied in the central basin as well as in the western basin, it is important to know where the populations are and to be able to sample them dependably.

Introduction

Burrowing mayflies of the species *Hexagenia limbata* and *H. rigida* were historically an important component of the animal community in the bottom of the western basin of Lake Erie and parts of the central and eastern basins. They were a major part of the diets of several fishes. Massive pollution of the lake in the first three-fourths of the twentieth century apparently led first to a large increase in the abundance of the burrowing mayflies as their food supply increased, and later to their rapid disappearance as oxygen depletion in or near the sediment, and perhaps the build-up of toxic contaminants within the sediments, increased. These conditions and events are presented in greater detail elsewhere (Britt 1955a, 1955b, Burns 1985).

In the early 1990s, *Hexagenia* began to repopulate parts of the western basin, and studies ensued in 1993 and later years to determine the extent of its range expansion and the increase in its density in the western basin. The results of those studies have been published in several journals (Krieger *et al.* 1996, Madenjian *et al.* 1998, Schloesser *et al.* 2000) and in reports provided to the Ohio Lake Erie Office (Krieger 1999, 2000, 2001) that are available on its Web page (http://www.epa.state.oh.us/oleo/lepf/lepf_08-94_final.htm) or the Heidelberg College Web page (http://www.heidelberg.edu/wql/).

Because the density of the mayfly population was increasing rapidly in the western basin, we proposed in 1996 to begin to sample the central basin sediments to determine whether nymphs were present in the shallower nearshore zone and, if so, their densities. Through grants LEPF 97-30 and SG 129-00, we sampled nearshore sediments in May and June each year from 1997 through 2000. A citizen monitoring program called Mayfly Watch was also conducted in the summers of 1997 through 1999 to monitor the appearance and duration of winged *Hexagenia* on shore.

It appears that the *Hexagenia* population in the western basin has largely recovered. After peaking at an average abundance in the western basin of about 450 nymphs/m^2 in 1997, the population dipped to about 150 nymphs/m^2 in 1998 but rebounded to around 310 nymphs/m^2 in 1999, and 400 nymphs/m^2 in 2000 (1999 and 2000 data courtesy of Don Schloesser, USGS). The density appeared to be higher in 2001 than in 2000, although analysis of the 2001 samples remains to be completed (D. Schloesser, personal communication). By contrast, we found only about 1 nymph/m^2 in 1997 and 1998 in the nearshore areas of the central basin, and an increase to 4 nymphs/m^2 in 1999. The 1999 results showed a sudden upsurge in the abundance of nymphs in the nearshore area of the central basin west of Euclid, but not eastward to Conneaut, Ohio (Figure 1). In 2000, we found nymphs in very low numbers but widely distributed from Sandusky to Ashtabula and Conneaut. We attribute the low numbers to the fact that stormy weather delayed sample collection until emergence of the adults had begun. In summary, it appears that *Hexagenia* nymphs were recolonizing the nearshore central basin sediments during the years 1997 through 2000, but at a much slower pace than they had done earlier in the western basin.

The objective of the present grant, SG 145-01, was to provide continuity in the sampling of *Hexagenia* nymphs in the central basin from Sandusky to Conneaut in order to confirm the trend of increasing distribution and abundance. The results also are expected to be used as we work under grant LEQI 01-03 from the Ohio Lake Erie Office to refine the mayfly metric of the Lake Erie Quality Index.

Methods

As in our previous studies on *Hexagenia* nymphs, transportation to the sampling stations was provided aboard the *R/V Pike* by Mr. Chris Muzinic of the U.S. Geological Survey's Lake Erie Biological Station. The stations were sampled from west to east on 31 May (3 stations, all in the island area of the western basin), 5 June (1 station), 7 June (5 stations), 8 June (3 stations), 12 June (8 stations), 13 June (3 stations), and 14 June

2001 (7 stations), for a total of 30 stations (Table 1). In addition, sampling was attempted at numerous other stations where the sediments proved to be unsuitable (such as sand). Mr. Muzinic and two technicians from Heidelberg College collected four replicate sediment samples at each station using an Ekman grab (21 cm x 21 cm). Each sample was rinsed through a standard No. 30 screen (0.60 mm mesh openings), and nymphs found in the sample residues were placed in small vials on ice. The residues were put in 500-mL wide-mouth jars, were preserved in 5% formaldehyde, and were returned to the Water Quality Laboratory, where they were observed for additional mayflies. Nymphs found in the field were rinsed and frozen. Those nymphs as well as others found in the preserved samples were measured and weighed (as dry biomass), and those data will be used for comparison of length:biomass relations among stations as part of grant LEQI 01-03.

Results and Discussion

The stations where *Hexagenia* nymphs were found and their densities in 2001 are compared with the results from previous years in Figure 1. In addition, holes in the sediment surface interpreted to be *Hexagenia* burrows were seen at one station at each end of the Cleveland Harbor area (Figure 1). The nymph densities were higher at the two central basin stations where they were found in 2001 (9.6 nymphs/m^2 at 1CP and 58 nymphs/m^2 at CN1) than in 2000, when only 5 nymphs/m^2 (equivalent to one nymph collected in four grab samples) were found at both stations. The higher densities may simply be a reflection of our earlier sampling in 2001 – prior to the onset of the emergence of adults – as opposed to 2000, when sampling was delayed by stormy conditions. Table 2 compares the average density of nymphs and the percentage of sites where nymphs were found each year from 1997 through 2001.

The absence of nymphs in our samples between Sandusky and Conneaut was unexpected. The presence of what may have been old nymph burrows near Cleveland (Figure 1) may indicate that nymphs had been present but emerged prior to our sampling, which is unlikely in that winged *Hexagenia* had not been observed onshore by then. It is also possible that nymphs had been present but migrated elsewhere or died and decomposed prior to sampling. The high densities at the three western basin stations, two of which were at the juncture of the western and central basins, as well as the results from sampling elsewhere in the western basin (D. Schloesser, USGS, personal communication) and the large mayfly swarms in June and July 2001 in the island area indicate that conditions in that basin were excellent for nymph survival and maturation during the preceding year.

Several days after our sampling was concluded in mid-June 2001, word was received that swarms of winged *Hexagenia* comparable to or larger than those of the past two or three summers were appearing on buildings near the lakeshore around Cleveland (K. Linn, Northeast Ohio Regional Sewer District, personal communication, 20 June 2001). It appears that the nymphs were growing successfully in some parts of the central basin, but not where we have established our annual sampling stations. Therefore, as part of the Lake Erie Quality Index grant (LEQI 01-03), we are considering the establishment

of a new sampling strategy in the basin, perhaps extending straight-line transects of stations from near shore into deeper water at several key locations.

Benefits and Information Dissemination

The public continues to be interested in the increased presence of the large *Hexagenia* mayflies, and interest peaks a few weeks prior to and during the summer emergence. Reporters and writers who interviewed the project director during 2001 are listed in Table 3, and most of the resulting articles are included in the Appendix.

The project results were also disseminated in other ways. The project director made several oral slide presentations and wrote an article for Ohio Sea Grant's newsletter (*Twine Line*) during this project period. The presentations are listed in Table 4. Copies of a published abstract and the *Twine Line* article appear in the Appendix.

Acknowledgments

Mr. Chris Muzinic, USGS Sandusky, Ohio, provided transportation to all sampling stations and made the difficult decisions regarding suitable weather for sampling. Heidelberg College student technicians who assisted in the field collections and follow-up in the laboratory were Justin Harris and Ron Maichle. Nancy Miller of the Water Quality Laboratory provided administrative assistance.

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Table 1. Coordinates and depths of stations sampled for *Hexagenia* nymphs in the nearshore zone of the central basin of Lake Erie, 1995 through 2001. Stations successfully sampled are indicated with a check mark (√); stations where satisfactory samples could not be obtained are shown with a dash (--). Coordinates indicate initial sampling site each year; in some years it was necessary to move some distance off-site in order to obtain satisfactory sediments.

STATION	N LATITUDE	W LONGITUDE	DEPTH, latest yr	YEARS SAMPLED						
				1995	1996	1997	1998	1999	2000	2001
BRD15	41°24.37'	82°29.52'	31'			√	√	√	√	√
CP1	41°30.01'	82°38.07'	34'				√	√	√	√
CP2	41°26.60'	82°.35.00'	34'				√	√	√	√
CP3	41°25.71'	82°35.04	28'				√	√	√	√
LV52	41°27.30'	82°24.00'	41'			√		√	√	√
LV52s	41°26.14'	82°22.54'	40'				√			
LV56	41°27.30'	82°21.10'	40'			√		√	√	√
LV56b	41°27.00'	82°20.86'	43'				√			
LV66	41°28.75'	82°11.17'	33'			√	√	--	--	--
LV66b	41°28.79'	82°11.10'	34'							
LV67	41°29.77'	82°11.17				--				
LH1	41°28.50'	82°11.10'	30'						√	√
BRD16	41°30.11'	82°09.74'	40'			--				
BRD16b	41°29.57'	82°09.46'	40'				√	√	√	--
AV1	41°32.50'	82°01.00'	51'					√	√	√
RR1	41°29.49'	81°50.38'	15'		√	√				
RR1b	41°29.83'	81°51.72'	40'				√	√	√	√
RR2	41°30.59'	81°40.32'			√					
CW80	41°29.83'	81°45.33'	30'			√	√			
CW81	41°30.80'	81°45.33'	41'				√	√	√	√
CW82	41°32.88'	81°45.84'	50'					√	√	√
EW1	41°29.72'	81°43.94'	10'		√					
CE84	41°29.83'	81°43.50'	25'	√	√	√	√	√	√	√
CE85	41°30.30'	81°42.75'	28'	√			√	√	√	√
CE87	41°30.95'	81°41.67'								
CW88	41°31.50'	81°42.70'	40'				√	√	√	√
CW89	41°32.00'	81°43.92'								
CW89s	41°30.95'	81°43.60'	43'				√			
CE90	41°31.60'	81°40.50'		√						
CE91	41°32.25'	81°39.33'	23'			√	√	√	√	√

Table 1. Continued.

STATION	N LATITUDE	W LONGITUDE	DEPTH, latest yr	YEARS SAMPLED						
				1995	1996	1997	1998	1999	2000	2001
CE92b	41°32.25'	81°40.45'	42'				√			
CE97b	41°33.20'	81°38.03'	40'				√			
CE99	41°35.70'	81°34.58'				--				
CE99b	41°36.08'	81°34.25'	35'				√			
CE100	41°36.20'	81°35.83'	44'				--	√	√	√
BRD18	41°45.47'	81°19.22'	32'			√	√	√	√	--
FP106	41°41.50'	81°27.17'	43'			--				
FP107	41°42.15'	81°26.10'	30'			--				
FP111	41°46.10'	81°18.40'	35'			√	√	√		√
FH1	41°45.95'	81°16.91'	12'			√	√	√	√	√
FP115	41°46.67'	81°15.80'	35'			--				
FP116	41°47.17'	81°16.80'	46'			√				
FP116b	41°46.92'	81°16.87'	40'				√	√		--
FC57J	41°48.30'	81°15.15'	50'							√
AS124	41°52.25'	81°00.40'	48'			√				
AS124b	41°52.35'	80°59.25'	45'				√	√	--	√
BRD19	41°54.38'	80°49.42'	34'			--				
BRD19b	41°54.55'	80°49.49'	45'				√	√	√	√
AS135	41°56.39'	80°47.58'	56'			√				
AS135s	41°52.95'	80°55.60'	44'				√	√	√	√
AS139b	41°56.35'	80°47.60'	35'			--				
AS139c	41°54.89'	80°48.31'	45'			--	√	√	√	√
AH1	41°55.10'	80°47.65'	35'			√				
AH1b	41°55.15'	80°47.70'	21'				√	√	√	√
AH2	41°54.92'	80°47.30'	32'			√		√		
AH2b	41°54.92'	80°47.36'	28'				√		√	√
CN1	41°59.90'	80°34.00'	48'					√	√	√

Table 2. Average density of *Hexagenia* nymphs and the proportion of sampling sites where they were found in the central basin of Lake Erie between Sandusky and Conneaut, 1997 through 2001.

	Ave. Number nymphs per sq. meter		Percent of Sites with nymphs	
Year	West of Euclid	East of Euclid	West of Euclid	East of Euclid
1997	2.4	0.6	10%	11%
1998	1.5	0	21%	0%
1999	5.9	0	44%	0%
2000	1.3	2.4	26%	50%
2001	0.6	5.8	5.9%	10%

Table 3. Reporters and writers who interviewed the project director regarding *Hexagenia* during 2001.

Name & Phone	Affiliation	Date
Kim Bates	*The Blade* (Toledo)	6/11/01
Linda Culler	*Sandusky Register*	6/8/01
D'Arcy Egan	*The Plain Dealer* (Cleveland)	6/20/01
Tom Henry	*The Blade* (Toledo)	6/20/01
Art Weber	*Milbury Press, Maumee Bay Press*	6/14/01
Chip Gross	Ohio DNR, *Wild Ohio Magazine* (for Spring 2002 issue)	7/20/01

Table 4. List of presentations on the project results made during the project period.

Event/Place	Title of Presentation	Date
Twine Line Ohio Sea Grant	*Mayfly Storms – a Summer 2001 Event?* (*Twine Line* 23(3):5, May/June 2001)	April 2001
49th Annual Meeting North American Benthological Society LaCrosse, WI	*Recolonization of the central basin of Lake Erie by burrowing mayflies (Ephemeridae:* Hexagenia *spp.) and impact on fish diets* [*NABS Bulletin* 18(1):233 (Abstract)]	7 June 2001
Quarterly meeting of the Ohio Lake Erie Commission, Fremont, OH	Update on findings from central basin sampling	20 June 2001
Tuesday Talks F. T. Stone Laboratory Put-in-Bay, OH	*The History and Ecology of Burrowing Mayflies in Lake Erie*	3 July 2001
Lakeside Heritage Society Lakeside, OH	*Mayflies – Boon or Bane*	8 July 2001

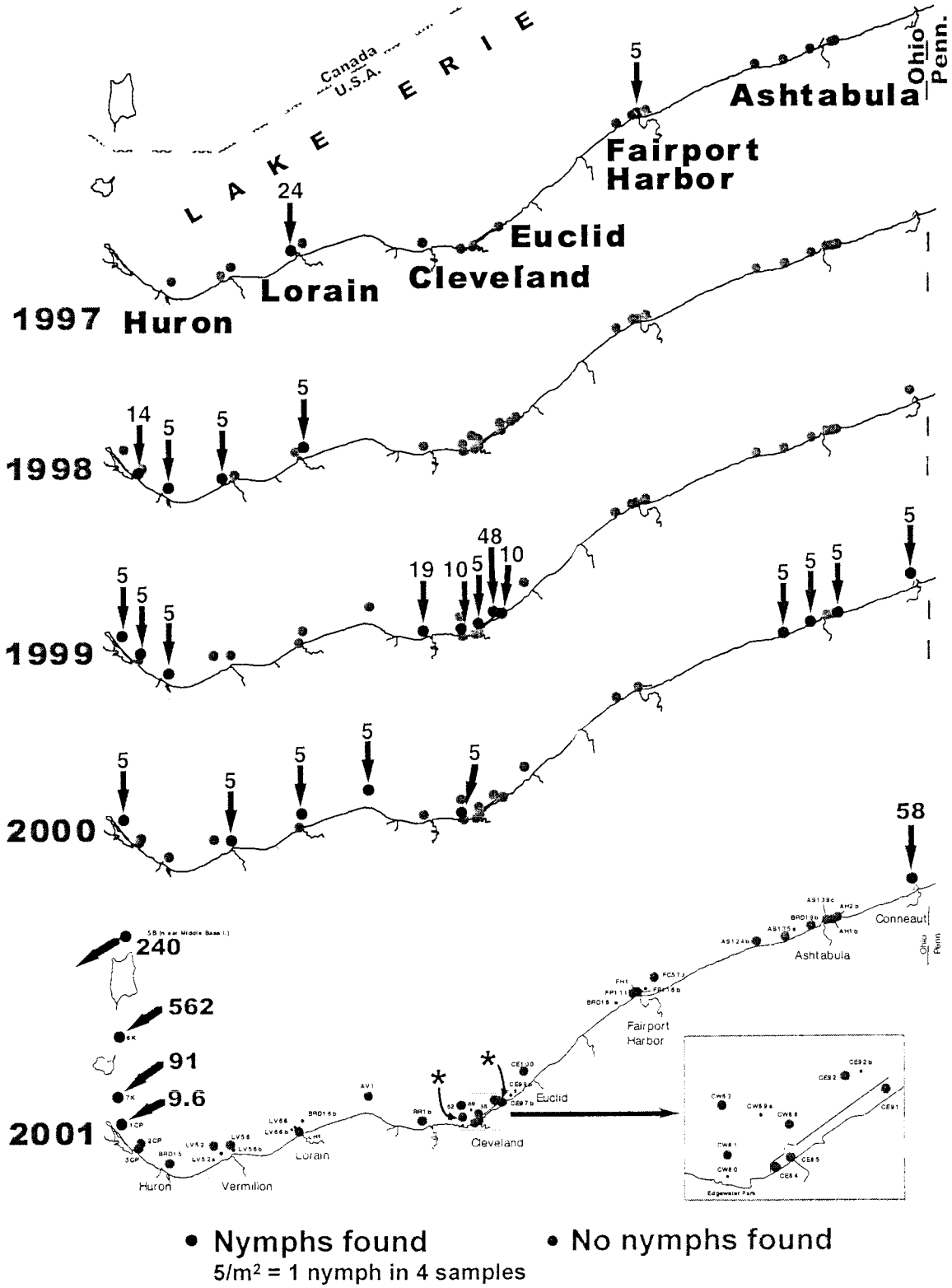


Figure 1. Stations successfully sampled for *Hexagenia* nymphs 1997 through 2001, and the densities (individuals per square meter) where nymphs were found. Asterisks show stations where apparent mayfly burrows were seen in 2001.

Appendix A. Abstract and Articles Related to this Project

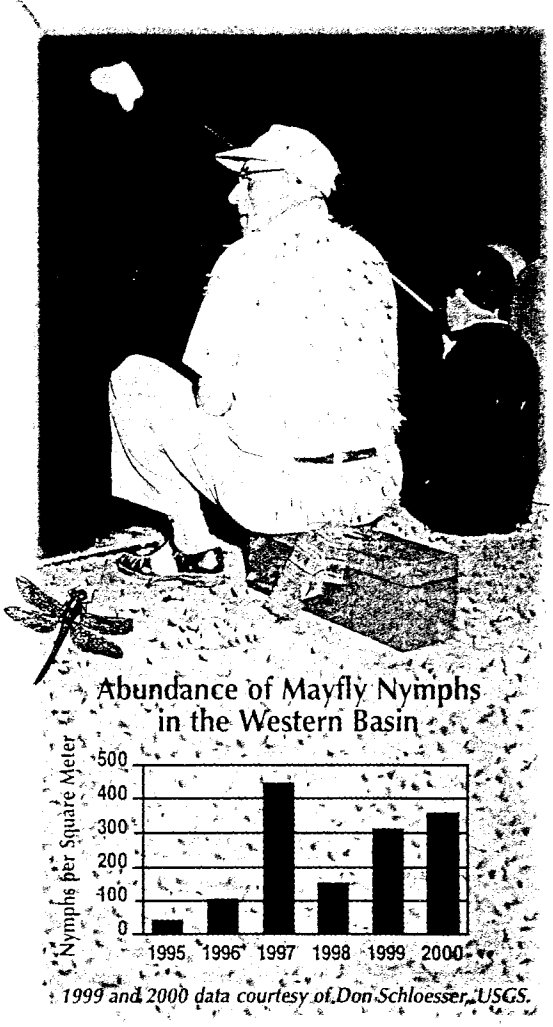
Mayfly Storms – A Summer 2001 Event?

by Dr. Ken Krieger, Heidelberg College

In his 1960 book, *Journey into Summer*, Edwin Way Teale describes a phenomenon that most Ohioans probably have never witnessed. Upon visiting the city of Sandusky and later Kelleys Island, he recounts a mayfly "storm" building on Lake Erie as "a dark wall of mayflies approaching across the water." The huge mating swarms of *Hexagenia* mayflies, the piles of decaying insects left in the aftermath, and the problems caused by their attraction to lights at night, had long been a part of summer life on the lakeshore.

Teale's observations were probably some of the last sightings of great swarms of the *Hexagenia* mayflies on Lake Erie, for they almost totally disappeared from the Lake by the 1960s due to pollution. While much smaller swarms of the pesky mosquito-like (but non-biting) midges continued to be commonplace along the lakeshore for the rest of the 20th century, few of the large mayflies could be found.

The summer of 1992 marked a turning point in the fate of *Hexagenia*, when the first burrowing nymph found in the island area in decades was collected by a Stone Laboratory class. Over the past several years the early summer swarms have become an annual expectation, though the sizes of the swarms at any particular place along the shoreline in a given summer has not been predictable.



The mayfly swarms during the summer of 2000 were particularly notable – both for their duration and the variability in their size from place to place. The abundance of nymphs in the bottom of the western basin appeared to be similar to that in recent years (see chart). To prepare for the onslaught, officials in Port Clinton turned off non-essential evening city lights, and were ready to shovel dead mayflies by the truckload from streets and sidewalks for composting.

However, only a relatively small amount of mayflies hit Port Clinton. News from Colchester, Ontario, across the basin on the Canadian shore, indicated that this community, rather than Port Clinton, experienced its heaviest inundation of mayflies in decades last summer. Mayflies are weak flyers and persistent, strong winds from the south and southwest during their peak emergence period apparently blew many of the southern mayflies onto the north shore!

Weather played a role in determining where, and on what nights, the great swarms would appear – the influence of weather conditions will continue to be researched by biologists.

Another remarkable feature of last summer's mayfly swarm were mayfly "clouds." As dusk fell, the mayflies, which emerged from the Lake the previous night, took flight and congregated in mating swarms at the shoreline. Night after night in late June and early July 2000, large swarms developed around the edges of the Lake Erie Islands. An observer standing at Perry's Lookout on Gibraltar Island could plainly watch "clouds" of mayflies form, though they were several miles away! The clouds thickened until darkness hid them.

The passing of dusk into night only partly obscured their presence. It is hard to imagine that a winged mayfly, with its undeveloped mouthparts and rather relaxed flight, could make noise of any kind. To most ears a single mayfly in flight is silent. Yet the soft, low-pitched hum of hundreds of thousands of swarming mayflies proved otherwise.

Although mayflies sometimes appear as nuisances, they are part of a healthy and recovering Lake Erie ecosystem. As they continue their recovery eastward of the western basin, swarms will probably become more noticeable from Huron, Ohio, into Pennsylvania and New York in coming years. The Mayfly Watch conducted on the Ohio shore in 1997-1999 showed a gradual increase in the number of sightings each summer. The annual searches for nymphs in the central basin sediments have revealed an eastward increase in their distribution and abundance (sampling in 2000 was largely post-emergence, yielding low numbers).

Will the summer of 2001 again bring these sights and sounds to the Ohio shore of western Lake Erie? An estimate of the density of nymphs in the lake sediments will be available only a few weeks prior to the beginning of the emergence. Without that, there are few clues to predict the size of the emergence swarms. Besides, wind conditions may be a more important factor than the actual number of winged mayflies. But just in case this is the year of the "Mayfly Storm," you'd better make your lakeside hotel reservations early before all the ring-side seats are taken!

For more information, contact Dr. Ken Krieger at 419.448.2226 or *kkrieger@heidelberg.edu*.

pp. 103, 233

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Habitat utilization by fluvial cyprinids (*Macrhybopsis aestivalis*, *Notropis jemezanus*, *Notropis simus*) was studied at two spatial scales within the middle Rio Pecos, NM at low to moderate discharge (0.2 to 7.0 m^3/s). Channel type discriminated macrohabitats (reaches, 44.0 to 122.0 river km). Year round distribution, abundance, and population structure surveys over eight years determined that fluvial cyprinids were most persistent, abundant, and demographically intact within active sandbed reaches. Mean depth/velocity of individual seine hauls (1.5 to 54.0 m^2) discriminated mesohabitats. Analysis of 1839 hauls from 20 sampling trips over five years concluded that fluvial cyprinids utilized swift mesohabitat compared to other fishes but exhibited broad mesohabitat preference. Availability of preferred mesohabitat was similar between reaches and did not correspond with fluvial cyprinid reach preference. Qualitative observations deduced that microhabitat distribution and abundance varied between reaches and did correspond with fluvial cyprinid reach preference. Sediment transport regimes (bedforms) in active sandbed reaches sustained high microhabitat heterogeneity that was lacking in inactive reaches. Increased understanding of fluvial cyprinid microhabitat utilization in relation to bedforms is critical for conservation since sediment transport regimes are constrained by water and sediment supply.

(364) DOMINANT TO ENDANGERED? HISTORICAL CHANGES IN YELLOWCHEEK DARTER AND ASSOCIATED FISHES IN THE LITTLE RED RIVER HEADWATERS.

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The yellowcheek darter (*Etheostoma moorei*) is an endemic species of north-central Arkansas, found only in four headwater streams of the Little Red River above Greers Ferry Lake. Headwater inundation as the result of the formation of Greer's Ferry Lake in 1962 has lead to habitat reduction and spatial isolation of yellowcheek populations. Despite these habitat changes, the yellowcheek was the most abundant riffle fish during a 1979-1980 status survey. A more recent study found genetic and meristic differences among populations of yellowcheek, and noted increasing difficulty in obtaining study specimens. During 1999-2000, we used kick seining and electroshocking to determine current yellowcheek abundances. In stark contrast to the earlier study, yellowcheek densities were extremely low and confined to small low and mid-stream reaches which largely sustained flow throughout the year. Where yellowcheek have been captured, they are now a distant fifth in abundance compared to other riffle fishes, suggesting that declines are more likely a species rather than community phenomena.

(365) POTENTIAL INTERACTIONS BETWEEN EURASIAN RUFFE AND ROUND GOBIES IN THE GREAT LAKES: PREY AND HABITAT PREFERENCES.

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The Laurentian Great Lakes have been subject to numerous human-mediated species invasions, including zebra mussels (*Dreissena polymorpha*), Eurasian ruffe (*Gymnocephalus cernuus*), and round gobies (*Neogobius melanostomus*). This "exotic triad" could significantly impact benthic communities as distributions converge. Ruffe and gobies may also compete with native fish such as yellow perch (*Perca flavescens*) for food, refuge, and spawning sites. Our hypothesis is that ruffe and gobies will consume similar invertebrate prey, but gobies will also prey on zebra mussels. We tested this hypothesis in laboratory aquaria supplied with 13 macroinvertebrate taxa. Both ruffe and gobies preferred soft-bodied taxa and avoided hard-bodied taxa. However, consumption of zebra mussels was highest in treatments containing gobies. Larger numbers of preferred taxa were eaten when gobies and ruffe coexisted. Ruffe collected from Lake Superior also preferred soft-bodied taxa, while gobies from Lake Michigan preferred zebra mussels. Habitat preferences of ruffe and gobies were examined in laboratory tanks during the light and dark. Both ruffe and gobies preferred cobble and plants at all times, and ventured into sand only in the dark when the fish were most active. Understanding the complex interactions among native and exotic fishes may yield insight into current benthic community structure.

(366) RECOLONIZATION OF THE CENTRAL BASIN OF LAKE ERIE BY BURROWING MAYFLIES (EPHEMERIDAE: *HEXAGENIA* SPP.) AND IMPACT ON FISH DIETS.

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Burrowing mayflies (*Hexagenia* spp.) repopulated soft sediments of the western basin of Lake Erie in the 1990s. We predicted (1) that as the ecosystem recovery of Lake Erie continued, they would recolonize their native habitat in the central basin by spreading eastward from the western basin, and (2) that forage fishes in both basins would feed on the mayfly nymphs increasingly as the density of nymphs increased. A volunteer Mayfly Watch program along the central basin lakeshore in the summers of 1997 through 1999 assisted in detecting the presence of winged *Hexagenia* at expected very low densities. The number of nymphs in nearshore sediments and of winged forms onshore increased between 1997 and 2000. Three of four forage fishes (trout perch, *Percopsis omiscomaycus*; silver chub, *Hybopsis storeriana*; spottail shiner, *Notropis hudsonius*) fed on the nymphs in the western basin, but only spottail shiners were found to have consumed nymphs in the central basin, perhaps because of the relatively low density of nymphs. The biomass of the nymphs consumed in the western basin comprised a far greater proportion of the diet (e.g., = 82% in trout perch) than the number of nymphs consumed (= 5% in trout perch).

Mayflies make June feast

PORT CLINTON, Ohio — The mayfly hatch is on and fishermen are forlorn around the Western Basin of Lake Erie.

Fly fishermen eagerly await a hatch of insects, a stream happening that causes trout to go on a feeding binge. When the same insects, *Hexagenia limbata* and *Hexagenia rigida* hatch on western Lake Erie, the walleye and yellow perch fishing stumbles and shoreline residents grumble about the proliferation of bugs.

The third week of June is the heart of the mayfly hatch on Lake Erie. The water is coated with mayfly "skins" this week, and the shoreline is littered with the carcasses of the inch-long insects.

Port Clinton officials turn off the city lights when conditions right to prevent the bright ghts from luring clouds of mayflies ashore on a north wind.

D'Arcy Egan

Five years ago, before individual switches were installed on city street lights, a massive mayfly hatch coated the Port Clinton streets. Snow plows were needed to clear the streets.

"When the mayfly hatch is on, the fish we check are obviously taking full advantage of the mayflies," said fisheries biologist Doug Johnson at the Lake Erie Research Station in Sandusky. "The stomachs of walleyes and yellow perch are full of mayflies.

"They certainly provide a food source for a variety of fish. It is a lot of work for a fish to catch a mayfly, but they do provide nutrition."

When fish have full stomachs, it is hard to entice them to chase a lure.

The latest lure for catching walleyes is called a Mayfly Rig. It consists of a small spinner and a hook tipped with a hunk of worm. Only a fish knows if the rig looks like an emerging mayfly, but fishermen claim they work.

Mayflies spend almost their entire lives as nymphs or "wigglers," living in the bottom sediment of Lake Erie. After spending a couple of winters in the mud, they head to the surface between late May and early July to hatch, leaving behind their exoskeleton, or skin, to emerge as a fully winged adult. The insects will

or famine for fishermen

molt once again, then mate and die.

Each female lays about 8,000 eggs on the water. The eggs sink to the lake bottom. When a tiny nymph hatches it will burrow into the mud and the cycle begins again.

Mayflies have increased in abundance in recent years around the Western Basin of Lake Erie. In the deeper waters of Lake Erie in the Cleveland area, mayflies are hatching and coming ashore, but not in the huge numbers seen along the Western Lake Erie shoreline.

Mayfly expert Dr. Kenneth A. Krieger of Heidelberg College says mayfly nymphs have been hard to find this year.

Technicians sampling the lake bottom have had difficulty finding nymphs in the Central Basin until they reached the Conneaut area. Two years ago, there were good numbers of nymphs in the samples.

"We are getting reports of mayflies hatching in the Huron area, and officials at the Northeast Regional Sewer District in Cleveland are seeing adults," said Krieger. "The picture is not as bleak as we thought, but we have to think there has been a decline or we would have found more nymphs.

"The yellow flag is out, but not the red one yet," said Krieger.

A lack of oxygen in the water is being blamed for the decline of the mayflies in the Central Basin. That was the reason, say the experts, that the mayfly population crashed in September, 1953, on Western Lake Erie and the blue pike began to disappear.

It is common for oxygen levels to falter in late August and September. This year, summertime oxygen levels of the Central Basin seem to be lower than normal.

While mayflies can be a nuisance and Cleveland residents complain about the "Canadian soldiers" arriving from Lake Erie, the winged insects should be welcome. *Hexagenia* thrive in clean water and their resurgence is proof Lake Erie is getting healthier. Mayflies also fatten yellow perch, walleyes and other game fish, providing a special source of nutrition.

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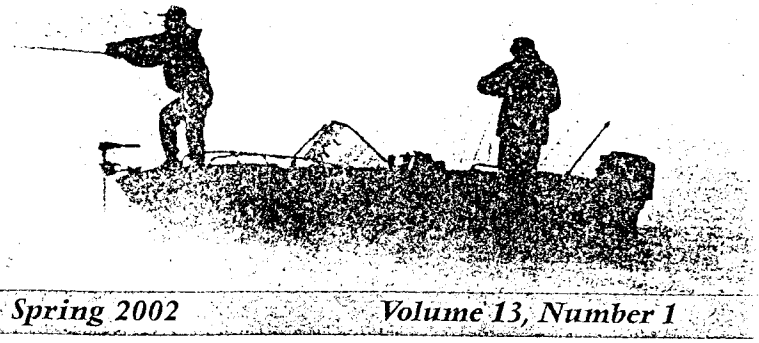
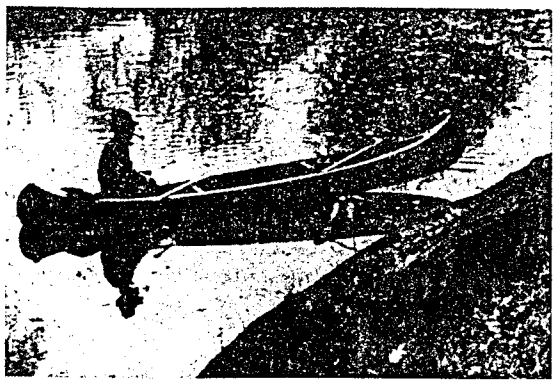
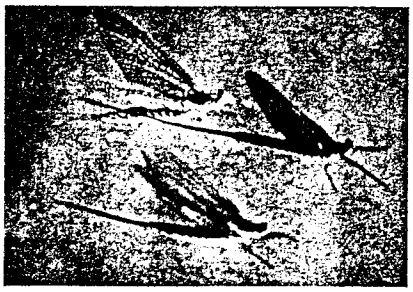


Features

Tim Daniel





Ohio Sea Grant

Tim Daniel

Cover Photo:

The largest of Ohio's four tree squirrel species, fox squirrels inhabit the more open woodlots of the state. For more about this common game animal, see our Watchable Wildlife story on pages 4 and 5. (Photo by Tim Daniel)

Departments

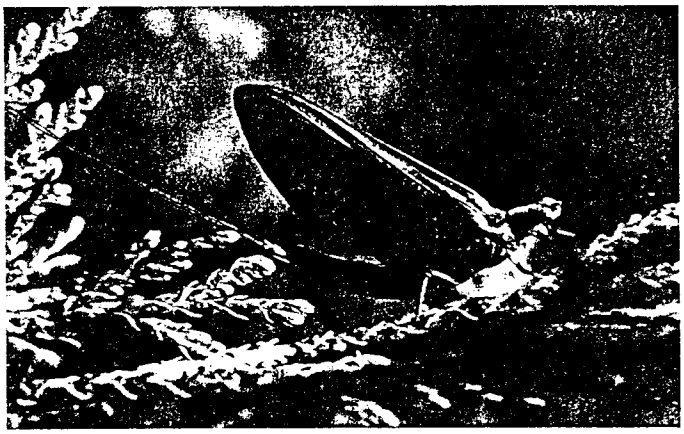
THE MAYFLY THAT ATE TOLEDO

HEXAGENIA RETURN TO LAKE ERIE

by W. H. (Chip) Gross

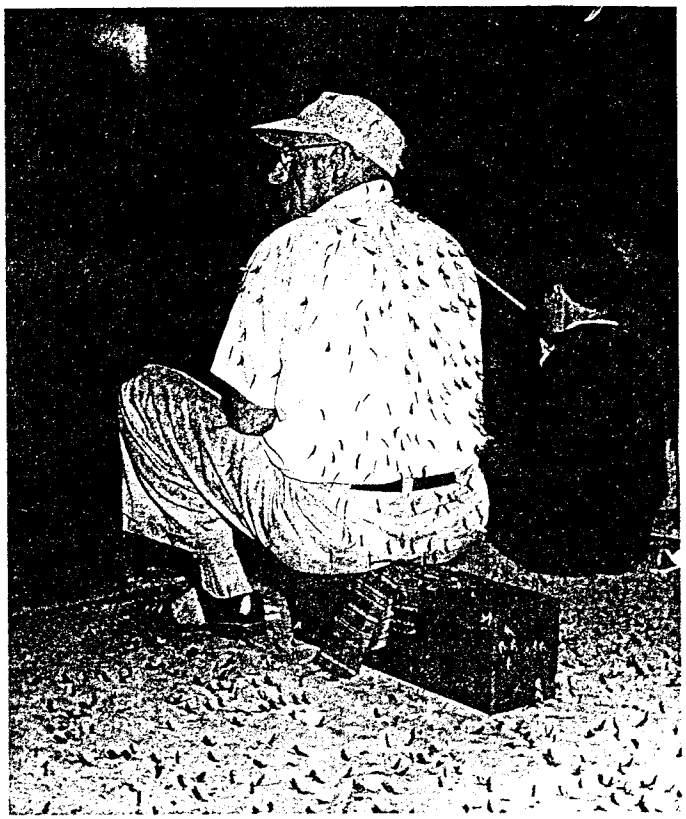
A science-fiction writer could not script a stranger scenario: hordes of insects emerge from the bottom of one of our nation's Great Lakes and descend on unsuspecting shoreline cities, causing power brownouts and even some cars to go spinning out of control.

But that is exactly what's been happening annually on Lake Erie during early summer for the past decade. Swarms of winged insects of the genus Hexagenia—commonly known as mayflies—have been hatching by the millions. Thankfully, they don't bite or sting, but can be a major nuisance to people.



Ohio Sea Grant

Known locally as "Canadian soldiers," mayflies have returned to Lake Erie by the millions, a sign that Ohio's Great Lake continues to grow healthier. They are also found throughout the state, especially in farm ponds.



Ohio Sea Grant Archives – Arthur Frock, Springfield, OH

Mayflies occurred in abundance in Lake Erie's Western Basin through the mid-twentieth century, when this photo was taken on Peach Point Dock at Stone Laboratory, Put-in-Bay, Ohio. The man in the photo is Milton Trautman, author of the classic book *The Fishes of Ohio*.

"No doubt they're an aggravation for a few weeks each year, but the return of mayflies to Lake Erie is a sign that the lake is becoming healthier," said Roger Knight, supervisor of the ODNR Division of Wildlife's Lake Erie fisheries office in Sandusky, Ohio. Knight went on to say that mayflies were once common in Lake Erie in the early part of the twentieth century, but that pollution of the lake caused most of them to disappear by the mid-1960s.

"They were an important part of the ecosystem in that they were eaten by many species of fish," Knight said. "Today, we see those same fish again making mayflies part of their diet."

Edwin Way Teale, in his book *Journey into Summer* published in 1960, describes one of the last mayfly "storms" that he saw building on Lake Erie as "a dark wall of mayflies approaching across the water." Today, those swarms have returned. Millions of mayflies descend on lakeshore towns such as Port Clinton and Toledo in June and July, attracted to the lights at night.

Invasion of the Body Snatchers

As adults, Hexagenia live only long enough to mate, a day or two, and then die. Their bodies can stack up in such heaps that they must be removed with heavy equipment. In 1996, for example, a year with an unusually high mayfly hatch, Port Clinton scraped 35 truckloads of fishy-smelling piles of mayfly carcasses off its city streets. As a result, it was the first city in the U. S. to receive a government grant to compost mayflies experimentally. The composted material is used for fertilizer on city parks. Port Clinton also regularly posts road signs during mayfly season warning motorists of dangerously slippery roadways. Traffic accidents have actually occurred when vehicles slid on thousands of squashed mayfly bodies.

Mayflies have also caused headaches in other areas of northwest Ohio. So many Hexagenia were attracted to the lights of a major electrical substation several years ago that as they settled on the equipment a brownout resulted. Toledo, too, has had its problems. Many businesses near lakeshore areas inform their customers that they will be intentionally dimming or completely turning off outdoor lighting during peak mayfly season.

One of Ohio's leading mayfly experts is Dr. Ken Krieger, a biology professor at Heidelberg College in Tiffin, Ohio. Krieger

Ohio Sea Grant

Walleye anglers know that fishing success can slump during a peak mayfly hatch on Lake Erie. Savvy fishermen adapt by down-sizing their baits to what's known as a "mayfly rig," a small lure tipped with a piece of nightcrawler that imitates the nymph form of a mayfly swimming its way to the surface.

Mayflies of the genus Hexagenia do not bite, but are attracted to lights after dark in great numbers. Port Clinton removed 35 truckloads of mayfly carcasses from beneath its streetlights in 1996 alone!

Tim Daniel

has studied mayflies for years, and says that once mayflies began recolonizing the Western Basin of Lake Erie their annual average densities in bottom sediments increased dramatically.

"In 1995, for example, the average density of nymphs was 34 per square meter," Krieger said. "In 1996, it was 104 per square meter; and in 1997, 451 per square meter. The density dropped dramatically in 1998, but has increased since then to near the number in 1997."

A Mayfly Life History

Female mayflies deposit their eggs (as many as 8,000 per female) directly into the waters of Lake Erie. The eggs sink to the bottom where a tiny nymph hatches from each egg. The nymphs then burrow into the lake sediment where they remain over one or two winters.

Once a nymph is ready to transform into a mayfly, it leaves its burrow at dusk and swims to the lake surface. Splitting its skin, or exoskeleton, lengthwise down its back, the mayfly takes flight within a few minutes. However, it is not yet an adult, as it is not fully developed sexually. Molting one more time the next day makes the transformation complete. The adults then gather into large swarms, breeding in flight. With mating complete, the female drops to the lake surface, deposits her eggs, and eventually dies.

Coming to a Shoreline Near You?

But whether mayflies will "bug" a certain community in a certain year is unpredictable. For instance, Port Clinton braced for a large invasion in the summer of 2000 that never materialized. Why? Strong south winds blew many of the emerging mayflies north to Colchester, Ontario.

Surveys have shown that mayflies are also moving east into Lake Erie's Central Basin. In the years to come, swarms will likely become more noticeable from Huron, Ohio, into Pennsylvania and New York.

If mayfly numbers continue to increase in Lake Erie, will they eventually eat Toledo? Probably not. How can we be sure? Because for the day or two that adult mayflies are alive, they don't eat at all—they have no mouthparts!