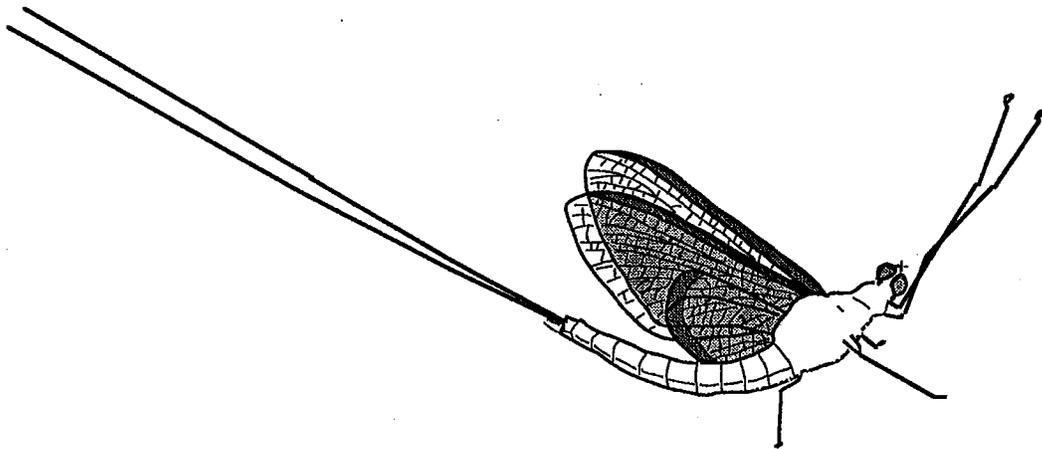


# Mayfly Watch 1998

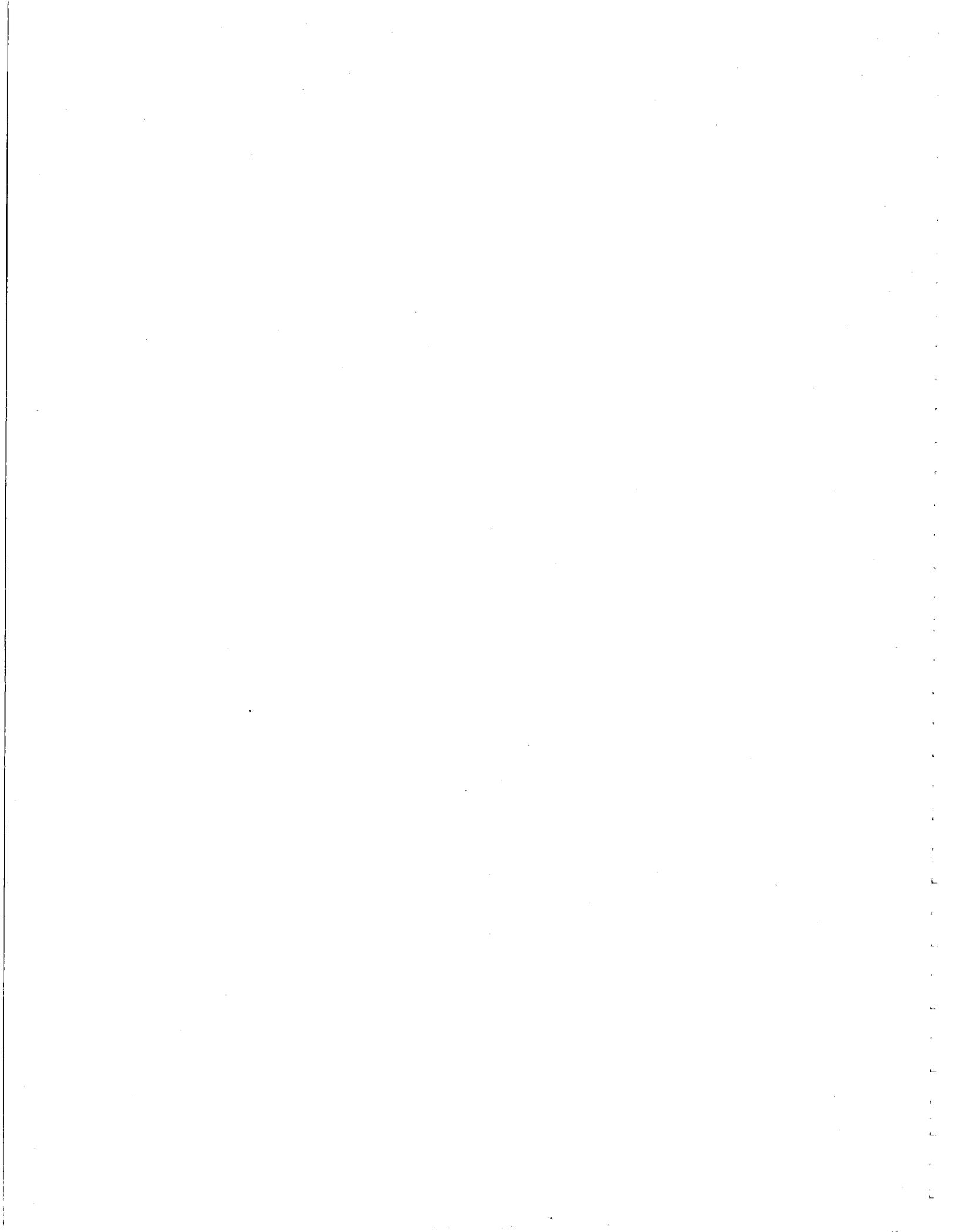
Report on Year Two  
of a Citizen Volunteer Project  
Along the Ohio Shore of Lake Erie



Submitted to the Ohio Lake Erie Office  
in Partial Fulfillment of  
Lake Erie Protection Fund Project LEPF-97-30

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## Executive Summary

This report presents the results of Year Two of "Mayfly Watch", and compares them with the findings of Year One. Mayfly Watch is a volunteer monitoring effort organized to determine whether burrowing mayflies (*Hexagenia*) are increasing in their range and abundance in the central basin of Lake Erie. Such an increase would be a strong sign that the quality of Lake Erie has improved in recent years.

Winged *Hexagenia* were found at all 21 locations in 1998 compared with 19 of 21 locations in 1997. The primary period of emergence began approximately 16 days earlier in 1998, and the pattern of emergence also varied between the two years. Mayfly Watch, as well as collections of nymphs from lake sediments, provided evidence that there were more mayflies in 1998 than in 1997, primarily from Cleveland westward.

The Mayfly Watch program successfully distinguishes slight variations in the timing, duration, and intensity of *Hexagenia* emergences from year to year. Furthermore, Mayfly Watch has been effective in detecting the presence of the sparsely distributed burrowing mayflies in the eastern part of the central basin while sediment sampling has largely failed to reveal them. Year Three of Mayfly Watch may show more conclusively than the first two years whether the abundance of the central basin population is increasing.

## Introduction

Burrowing mayflies of the genus *Hexagenia* are native to North America and the Great Lakes. They were abundant in the soft, muddy sediments of the western basin and other parts of Lake Erie until chronic pollution resulted in their sudden disappearance in the 1950s. Pollution abatement programs in the United States and Canada apparently have led to improved lake conditions that permitted *Hexagenia* to recolonize the western basin of Lake Erie rapidly during the 1990s.

The importance of *Hexagenia* mayflies to the ecology of Lake Erie, especially as a food source for sport and commercial fishes, its life history, and details of its recovery in the western basin, are described in the report on the first year of Mayfly Watch<sup>1</sup> and Fact Sheet FS-069<sup>2</sup>. Readers may request a copy of these reports from the Water Quality Laboratory of Heidelberg College (419 448-2198).

By 1995, summer emergences of winged *Hexagenia* had reached nuisance levels along the southern and western shores of the western basin.

However, there was at that time no direct evidence that these mayflies were beginning to repopulate areas of the central basin of Lake Erie.

Our expectation (hypothesis) for this study has been that *Hexagenia* will also repopulate areas of the central basin where they were formerly present, perhaps spreading in an eastward direction from the western basin. The citizen monitoring program called "Mayfly Watch" was established in 1997 through sponsorship of the Lake Erie Protection Fund of the Ohio Lake Erie Office as one means to determine whether *Hexagenia* was beginning to recolonize the soft sediments in parts of the central basin.

Because the flying adults and subadults of these mayflies congregate along and near the shore of the lake, it was thought that surveillance of the winged *Hexagenia* would be a more efficient way of detecting their presence in Lake Erie than would the sampling of the lake bottom to find the burrowing nymphs. Indeed, a parallel effort was made in early June of 1997, 1998, and 1999 to locate nymphs in the central basin nearshore sediments. The results of this "needle in a haystack" approach are presented in Table 1, and they show a distinct increase in the number of sampling sites where nymphs were found as well as the number of nymphs per square meter of sediment in the central basin west of Euclid, but essentially no nymphs east of Euclid in those three years. The absence of nymphs in our sediment samples, which were restricted to nearshore waters, does not mean that the nymphs are not present in that area. They *might* be absent, but more likely, they are present in such low numbers that we are unlikely to collect even one within the small area (0.05 square meter) of sediment within our sampler.

**Table 1.** Average number of *Hexagenia* nymphs found per square meter of soft bottom sediment in the central basin of Lake Erie in early June 1997 through 1999, proportion of the sites sampled that had nymphs, and nearest onshore locations.

Year	Average Number per Square Meter (and Percent of Sites)		Nearest Onshore Locations
	West of Euclid	East of Euclid	
1997	2.4 (10%)	0.6 (11%)	Outside Lorain Harbor Outside Fairport Harbor
1998	1.5 (21%)	0.0 (0%)	Cedar Point, Huron, Vermilion, Lorain
1999 (provisional)	5.4 (44%)	0.0 (0%)	Cedar Point, Huron, Rocky River, Cleveland

This brief report summarizes the results of Year 2 of Mayfly Watch and compares those results with the findings of Year 1. A more extensive report covering the first three years of Mayfly Watch will be produced in 2000. It is noteworthy that *Hexagenia* has also been increasing in abundance in areas of the eastern basin of Lake Erie. That region is beyond the geographical extent of Ohio's Mayfly Watch. However, a similar program was instituted this summer by Pennsylvania Sea Grant staff along the Pennsylvania shoreline and part of the New York shoreline, and therefore evidence of increasing numbers of *Hexagenia* in eastern Lake Erie should be available in the future.

Two presentations of the results and conclusions contained in this report were made in the spring of 1999:

- April 26-29, 1999: University of Windsor, Ontario. Symposium titled "Lake Erie at the Millennium -- Changes, Trends, and Trajectories".  
Poster Presentation: "Annual Changes in Patterns, Timing, and Intensity of Emergence of Burrowing Mayflies (*Hexagenia* spp.) along the Lake Erie Shore as Revealed by Citizen Monitoring Data"
- May 25, 1999: Case Western Reserve University, Cleveland, Ohio, 42<sup>nd</sup> Conference of the International Association for Great Lakes Research.  
Slide Presentation: "Citizen Volunteers as a Valuable Resource for Monitoring Changes in Lake Erie: Results from 'Mayfly Watch' "

## Acknowledgments

Many volunteers have participated in this project. As in Year 1, a primary contact was assisted by additional volunteers at some of the 21 locations. As far as is known, all participants are listed in Table 2 or Table 3. However, numerous other individuals were doubtless involved, including employees at some of the lake-side industries, family members, and lakeshore residents, especially several enlisted by Ms. Nancy Csider near Mentor Marsh and Headlands Beach State Park. Mr. Keith Linn of the Northeast Ohio Regional Sewer District (NEORSD) also involved many field technicians (Table 3) in the project. Heidelberg College undergraduate technicians Chris Monsour, Jamie Saxton, and Laura Shields delivered and retrieved materials from the volunteers, and Stacie Wildman identified the species and sex of the mayflies.

The enthusiasm, vigilance, and persistence of all of these people are deeply appreciated. I am especially grateful to those who agreed to participate for a second time!

Table 2. Volunteers who participated in the 1998 Mayfly Watch, listed from west to east.

Primary Contact	Additional Volunteers	Organization	Location
Mike & Kathy Grote	Dr. David M. Klarer	Old Woman Creek State Nature Preserve	2 miles east of Huron, Erie County
Donald Parsons	Christy Kuntz	Don Parsons, Inc.	Vermilion, Lorain County
Jim Cooper	Helen Cooper	J & H Charters	Beaver Park Marina, Lorain County
David O. Kelch		Ohio Sea Grant Program	Beaver Park Marina, Lorain County
Irene Baumler	Bill Baumler		Lorain, Lorain County
Ed Abel		charter captain	Lorain, Lorain County
Mike Krzywicki	Karl Ceceris	First Energy-CEI	Avon Lake, Lorain County
Keith Linn	See Table 3. Eva Roller	Northeast Ohio Regional Sewer District	Cleveland from Edgewater Park to Euclid Beach, Cuyahoga County
Thomas J. Denbow		Chagrin River Watershed Partners	Euclid, Cuyahoga County
Jonathan Cherry	Michael & Barbara Cherry		Euclid, Cuyahoga County
Rickie Crone	Erich Obersteiner		Willowick, Lake County
Frank Lichtkoppfer		Ohio Sea Grant Program	Mentor-on-the-Lake, Mentor Park, Lake County
Nancy Csider	"Headlands Network" of volunteers	Mentor Marsh Nature Center, Cleveland Museum of Natural History	w. of Headlands Beach State Park, Lake County
Bob Horvath		Lake Metro Parks, Painesville Twp. Park	4 miles east of Fairport Harbor, Lake County
John Pogacnik		Lake Metro Parks	North Perry, Lake County
Georgette Allison	Allison Family	Village of Geneva-on-the-Lake	Geneva-on-the-Lake, Ashtabula County
Louise Watson			Madison on the Lake, Lake County
John Mahan		Ashtabula River Partnership	Ashtabula, Ashtabula County
Ronald Golen		First Energy-CEI	Ashtabula, Ashtabula County.
Leonard Eames		Ashtabula Remedial Action Plan	North Kingsville, Ashtabula County
Karen & Jim Supplee	Jeff Supplee		Conneaut, Ashtabula County

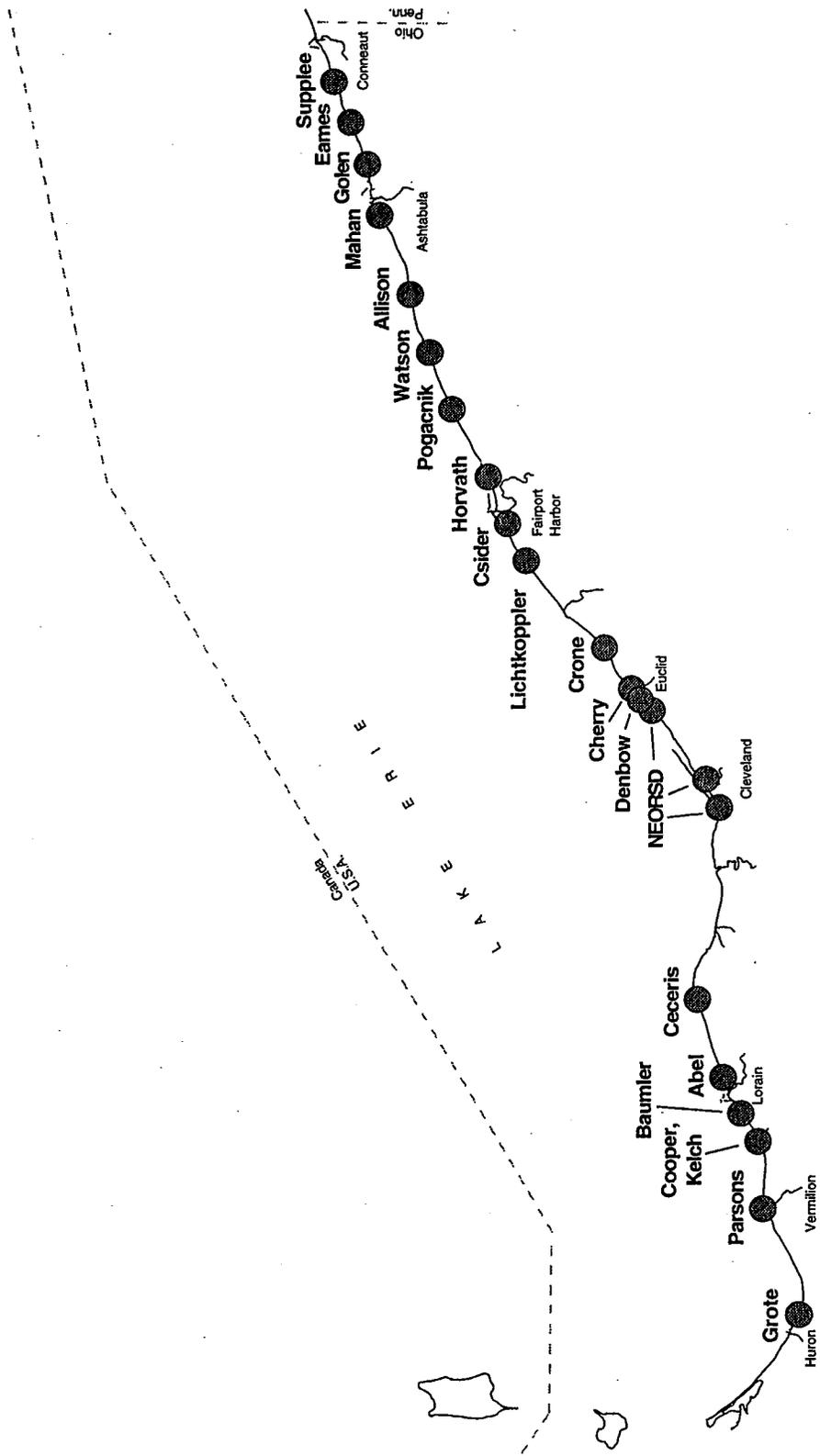
## Methodology

Observation sites were established at the residence, dockage, or work location of the individual volunteers from just east of Huron in Erie County to just east of Conneaut in Ashtabula County (Figure 1). Because 20 of the 21 participants in 1997 repeated in 1998, there was little change in geographical coverage. The easternmost location in 1997 was not repeated in 1998. A site was added at Geneva-on-the-Lake. Employees of the NEORS were able to look for *Hexagenia* at numerous locations both along the lakeshore and in downtown Cleveland (Table 3). Lakeshore locations were at private residences; state, county, township, and city parks; state nature preserves; electric generating plants; charter boat services; and wastewater treatment plants. Two individuals represented citizen river coalitions, two others represented the Ohio Sea Grant Program, and another served as mayor of a lakeshore village (Table 2).

Each volunteer received (1) the fact sheet<sup>2</sup> describing the life cycle and history of *Hexagenia* in Lake Erie; (2) a set of instructions (Appendix A) on the desired procedures; (3) a data sheet (Appendix B) on which to record daily observations; (4) three vials, one containing a male and a female winged *Hexagenia*, one a shed subadult (subimago) skin, and the third a shed nymphal skin; and (5) a jar containing ethyl (grain) alcohol, into which a few specimens of mayflies or skins would be placed each day that they appeared during the observation period. Volunteers were to compare the appearance, color patterns, and size of specimens that they observed against the specimens given them in the vials to ensure that they were indeed observing *Hexagenia* and not other kinds of mayflies. In 1998 they also looked for the slightly smaller *Ephemera simulans*, which differs from *Hexagenia* in having distinct spots on the wings and three "tails" rather than two.

**Table 3.** Locations where winged *Hexagenia* were observed in 1998 by personnel of the Northeast Ohio Regional Sewer District.

Location	Observers	Dates <i>Hexagenia</i> Were Found
Avon Lake	Mark Link	20 June 1998
Edgewater Beach State Park	A. Cook, T. Curtis, M. Kivett, M. Lynch, A. Zellner	20, 21 June 1998
Westerly Wastewater Treatment Facility	Paul Svoboda, Charles Johnson, Rich Allison	11, 17, 18 June 1998
East 55 <sup>th</sup> & St. Clair	Mary Maciejowski	19 June 1998
Euclid Beach State Park	A. Cook, T. Curtis, A. Dynes, M. Kivett, M. Lynch, A. Zellner	17, 20, 21 June 1998
Forest City Yacht Club	Bill Mack	24 July 1998



Mayfly Watch 1998

Figure 1. Locations of observations by Mayfly Watch volunteers in 1998.

The daily observations included the following: (1) At any time, but preferably in the first hours after sunset since birds begin eating mayflies at dawn, the volunteer looked for winged *Hexagenia* on surfaces near or under lights. The volunteer was asked to collect two or three individuals for later confirmation. (2) During daylight, the volunteer observed the same surfaces as above for the presence of shed subadult skins, and collected a few for confirmation. (3) Under calm weather conditions, if the sampling area was at the water's edge, the volunteer looked for shed nymphal skins floating on the water surface, and saved a few for confirmation.

Beginning on 10 June 1998 and ending on 31 July 1998, observations were recorded daily on the data sheet. Additional comments often included general weather conditions, a subjective estimate of the number of mayflies present, and other pertinent information. Volunteers were encouraged to enlist the help of someone else if they were unable to make observations for several days.

The proportion of volunteers who recorded *Hexagenia* on a given date provided a measure of the geographic extent of the emergence. The proportion of dates each volunteer recorded *Hexagenia* provided a measure of the duration of emergence in that particular area.

## Results and Discussion

The results for 1998 and their comparison with the results for 1997 are presented only briefly in this report, with more thorough analysis to follow after the Year 3 (1999) results are compiled.

Winged *Hexagenia* were found at all 21 locations in 1998 (Figure 2). By comparison they were found at 19 of 21 locations in 1997, being absent at two locations near the eastern end.

The primary period of emergence began approximately 16 days earlier in 1998 (June 10; Table 4 and Figure 3, top) than in 1997 (June 26), which seems to correspond with a warmer winter, and hence probably a more rapid growth of nymphs, in 1998. Both years, the frequency of observation was somewhat greater toward the western end of the basin (Figure 2 and Figure 3, bottom). In 1998, the greatest proportion of volunteers who observed *Hexagenia* on any given date was 64%, while in 1997 it was only 47% (Table 5); yet the median and average proportions were about the same both years (Table 5).

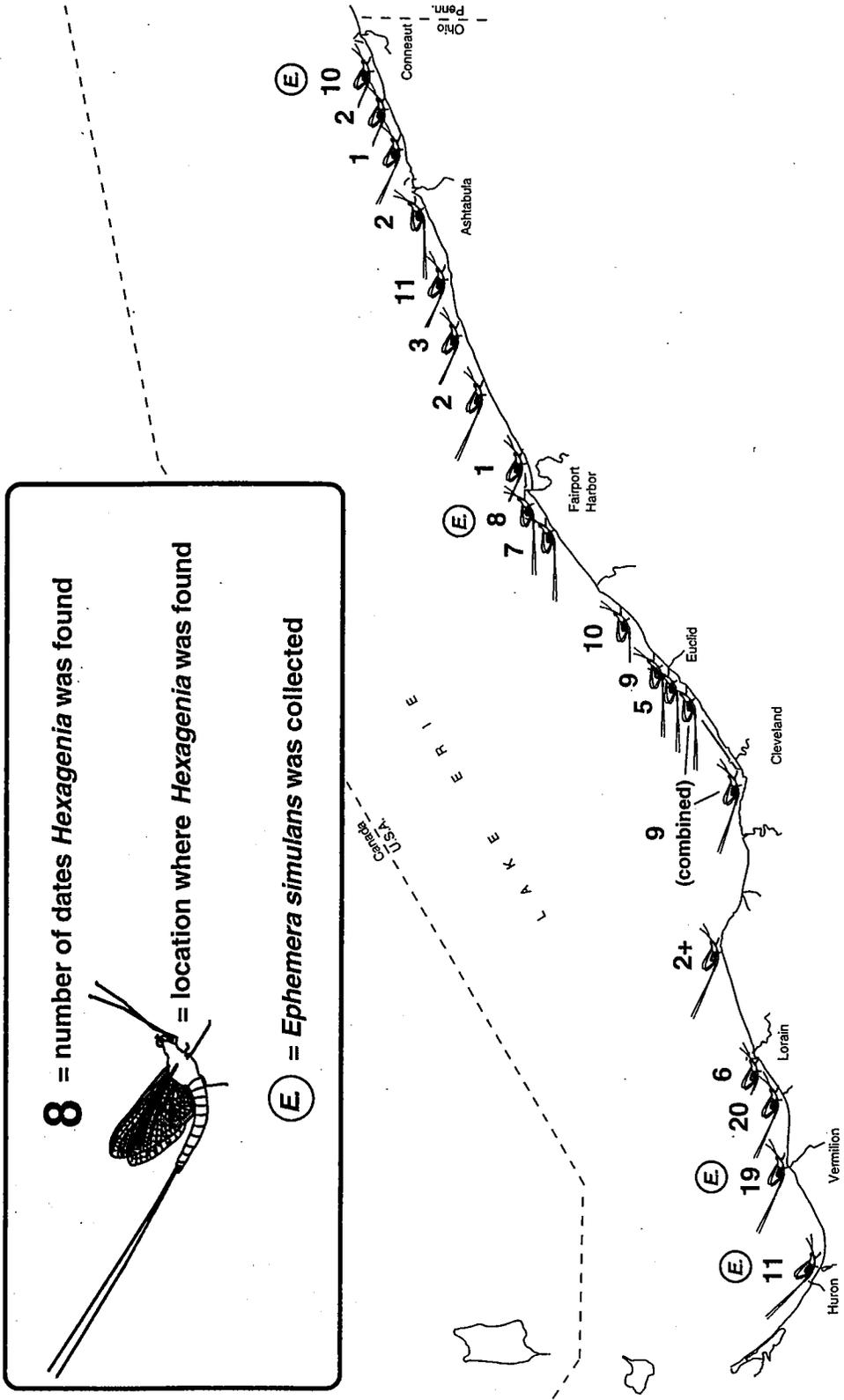
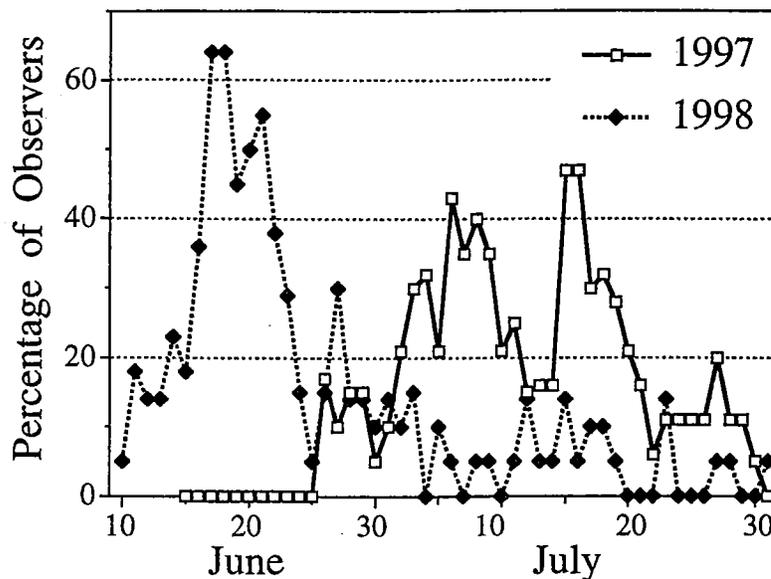


Figure 2. Number of dates *Hexagenia* was observed at each location in 1998, and locations where *Ephemera simulans* was collected.

**Percentage of Observers Finding *Hexagenia* each Day**



**Percentage of Days Each Observer Found *Hexagenia***

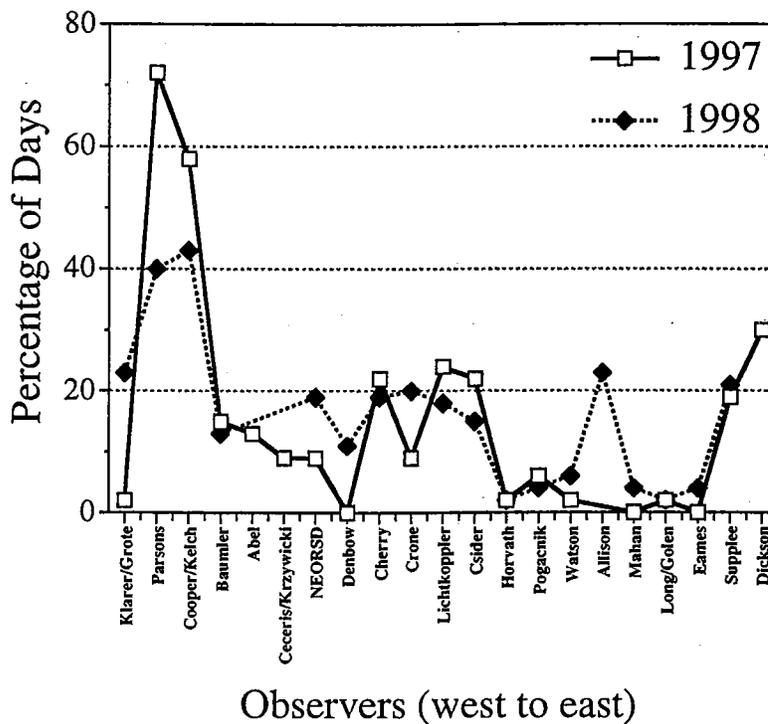


Figure 3. Patterns of *Hexagenia* sightings by Mayfly Watch participants in 1997 and 1998.



Table 5. Observations of *Hexagenia* during the first 36 days of the emergence period.

Day of First Sighting	1997	1998
	26 June*	10 June*
<b>Percentage of Observers Finding <i>Hexagenia</i></b>		
Days with None	0	3
Days with Fewer than 10%	3	10
Days with More than 25%	11	9
Days with More than 50%	0	3
Average Percentage	20.6	18.9
Median Percentage	16.5	14.3
Minimum Percentage	0	0
Maximum Percentage	47	64
<b>Consecutive Days More Than 25% of Observers Found <i>Hexagenia</i></b>		
Number of Days	2, 4, 5	8
Dates	3-4 July 6-9 July 15-19 July	16-23 June
<b>Percentage of Days Each Observer Found <i>Hexagenia</i></b>		
Average Percentage	15.8	15.9
Median Percentage	9.0	16.5
Minimum Percentage	0.0	2.0
Maximum Percentage	72	43

\* Date when largescale emergence began; a few *Hexagenia* were observed prior to these dates.

Winged *Hexagenia* were found somewhere along the shoreline every day after the beginning of emergence in 1997, whereas in 1998 there were three days when none were found. There were three periods of 2, 4, and 5 consecutive days from early through mid-July 1997 when more than 25% of the volunteers recorded *Hexagenia*, while in 1998 there was a single period of 8 consecutive days in mid-June (Table 5). The observations of *Hexagenia* were relatively evenly distributed over the emergence period in 1997 as opposed to 1998, when most of the observations occurred during the first 15 days (Table 4). Some volunteers commented that much larger emergences occurred on a few consecutive dates in June 1998 than were ever seen in 1997.

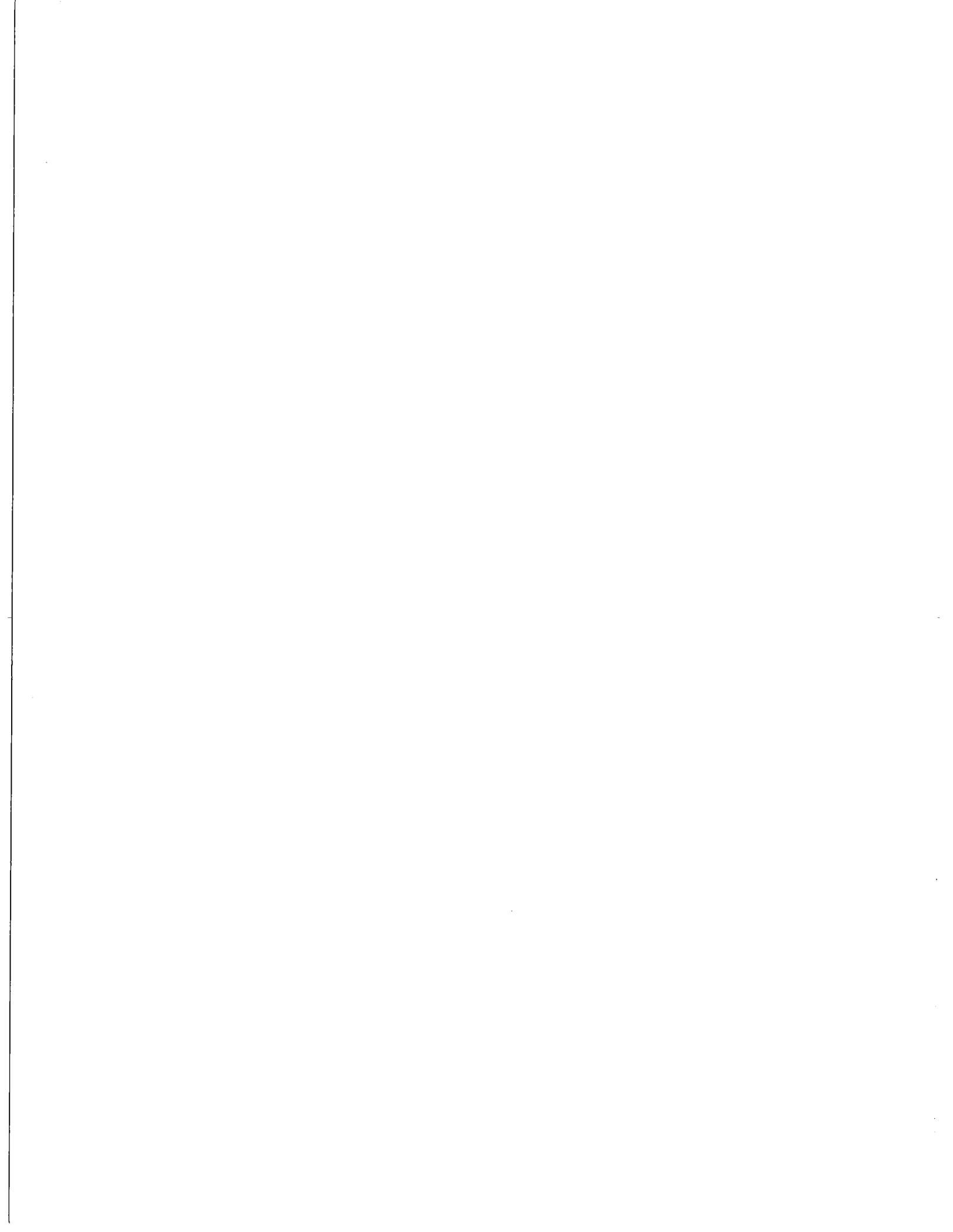
It is apparent from the results in 1997 and 1998 that the timing and pattern of emergence of winged *Hexagenia* varied between the two years. Mayfly Watch provided evidence, though not strong, that there were more of the mayflies in 1998 than there were in 1997. The evidence includes comments about the concentrations of mayflies written by some observers on a few days, the number of days when over half of the observers reported *Hexagenia*, the maximum percentage of observers reporting mayflies on a single day, the number of consecutive days when more than one-fourth of the observers found mayflies, and the median percentage of days that each observer found them (Table 5). Some other statistics indicated that there were about as many *Hexagenia* in 1998 as in 1997 (Table 5). The finding of nymphs at a greater proportion of sediment sampling stations in 1998 (and especially in 1999) than in 1997 provides additional support to the argument that the abundance of *Hexagenia* is increasing in the central basin; however, that increase, as judged by the collection of nymphs, appears to be restricted mostly to the western half of the study area at this time.

The results reported through the "Mayfly Watch" program show that this volunteer approach successfully distinguishes slight variations in the timing, duration, and intensity of emergences from year to year. Furthermore, the onshore methodology has been effective in detecting the presence of the sparsely distributed burrowing mayflies in the central basin although sediment grab sampling has largely failed to reveal nymphs except in the western half of the study area. Year Three of Mayfly Watch may show more conclusively than the first two years whether the abundance of the central basin population is increasing.

## References

(Additional references are cited in the two reports listed below.)

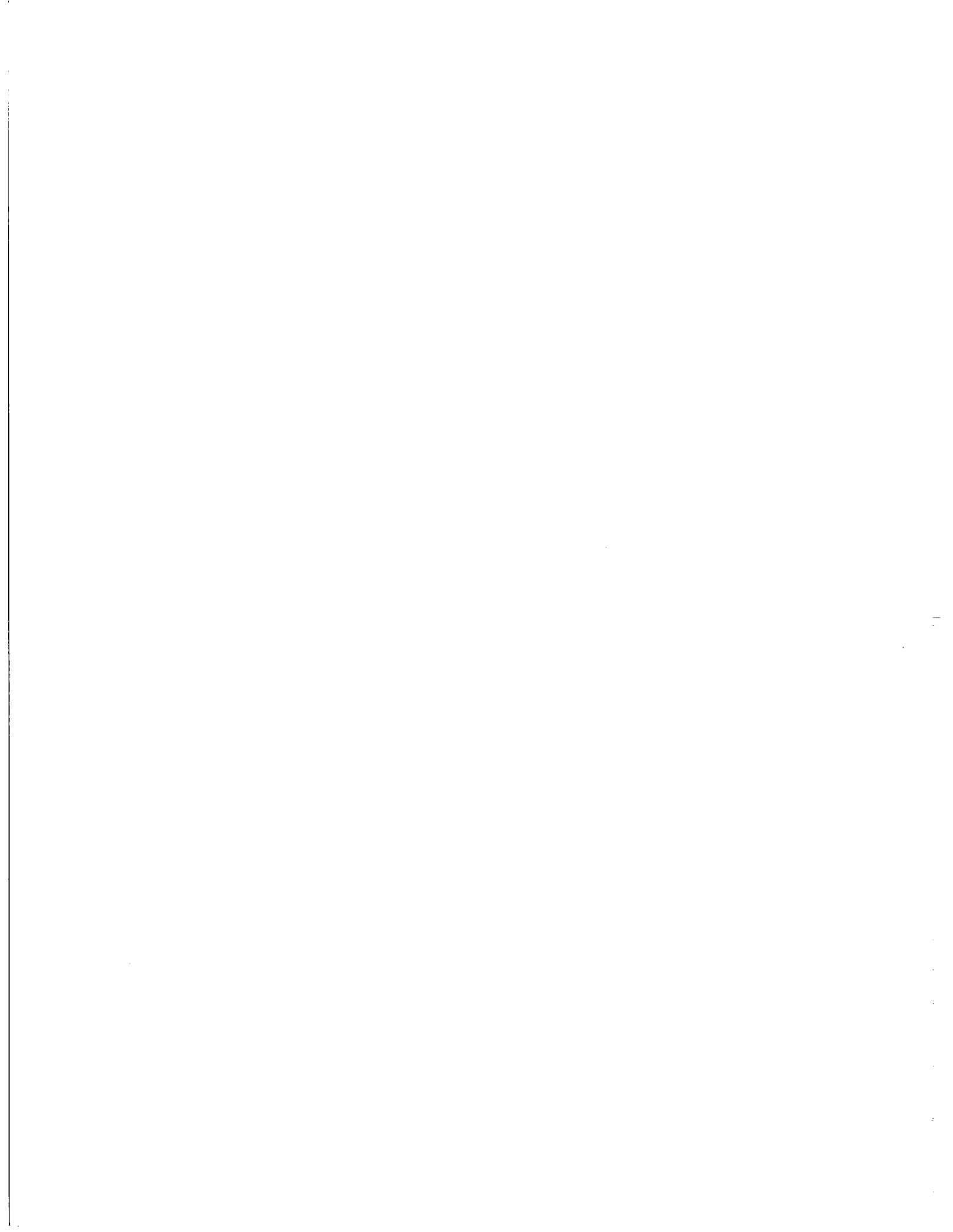
1. Krieger, K. A. 1998. *Mayfly Watch 1997*. Report to the Ohio Lake Erie Office. Toledo, Ohio. 21 pp. + app.
2. Krieger, K. A. 1998. *Mayflies and lake Erie, a sign of the times*. Ohio Sea Grant Fact Sheet OHSU-FS-069. The Ohio State University, Columbus, Ohio. 4 pp.



# **A P P E N D I C E S**

**APPENDIX A      Instructions to Volunteers**

**APPENDIX B      Volunteer Data Sheet  
(First Page of Two)**



## APPENDIX A INSTRUCTIONS TO VOLUNTEERS

Date: 2 June 1998  
To: NEW "MAYFLY WATCH" VOLUNTEERS  
From: Ken Krieger  
Subject: PROCEDURES FOR MONITORING MAYFLIES

Dear Volunteer:

Your willingness to help this summer in spotting the presence of the large burrowing mayflies, called *Hexagenia*, along the shoreline of Lake Erie is very much appreciated. Many Ohioans know this insect as the Junebug, fishfly, shadfly, or Canadian soldier. As a result of improved water quality, this native insect has already recolonized the western basin of the lake in large numbers. In the summer of 1996, winged adult *Hexagenia* were noticed in the westernmost end of the central basin, and it is believed that these large mayflies will soon be found in more-eastern areas of the central basin. (The central basin is the region approximately from Sandusky, Ohio, to Erie, PA.)

The return of this mayfly to the bottom sediments of the central basin will be a very positive sign that important progress has been made toward improving the environmental quality of the basin. The enclosed fact sheet from the Ohio Sea Grant Program ("Mayflies and Lake Erie, a Sign of the Times") provides information about the life history and role of *Hexagenia* in Lake Erie, and its importance to people living on or near the lake.

In order to document the presence or absence of adult *Hexagenia* along the shoreline this summer--and to compare their abundance this year with last year's abundance--we are enlisting the help of volunteers like you who can keep a watchful eye during the period of peak emergence of the adults from the lake. This week, two student assistants from my laboratory will drop off some materials to make your task easier:

(1) **Three vials containing preserved specimens** of (a) shed skins of *Hexagenia* nymphs that float on the water surface, (b) skins of flying *Hexagenia* (subadults) that are shed while the mayfly is on land, and (c) adult *Hexagenia*. You will need to look each day for the presence of one or more of these three "signs" that these mayflies are present. Because there are many kinds of mayflies, most of them considerably smaller than *Hexagenia*, you may want to compare the general

appearance, color patterns, and size of shed skins or adults that you see against the specimens provided to you. If you have doubts about whether the skins or adults you see belong to *Hexagenia*, go ahead and collect them; if they are not *Hexagenia*, they will still be useful to the study. The enclosed fact sheet has pictures and drawings that should help you identify the various life stages of this mayfly.

Last year, as noted in the enclosed report for 1997, several volunteers collected another kind of large mayfly in addition to *Hexagenia*. The other kind, called *Ephemera*, is similar in size (usually slightly smaller) to *Hexagenia* but can be distinguished from *Hexagenia* in two ways: The wings have a few very obvious dark spots on them, which are not present in *Hexagenia*; and three filaments, or "tails", trail from the tip of the abdomen of *Ephemera*, but only two from *Hexagenia*. **Please collect specimens of both *Hexagenia* and *Ephemera* if you see them.**

(2) A pint-size **jar containing ethanol** (grain alcohol) into which you should put representative specimens of the mayflies each date.

(3) A "**Volunteer Data Sheet**" (2 pages) on which to record daily the presence of *Hexagenia* in the area you have chosen to look for them. Each day of the observation period is listed on the Volunteer Data Sheet, and there are boxes to record the presence of one or more of the forms (skins or adults), the weather that day, brief comments, and your initials.

The daily procedures are as follows:

(1) If it is convenient, look nightly any time after sunset, preferably two to three hours after, for winged *Hexagenia* that may have landed on sidewalks, walls, or other structures in the immediate vicinity of outdoor lights at or near the water's edge. Several (four or five) animals that look like the specimens provided in the vials should be collected by grasping the erect wings of the animal, lifting it off the surface, and placing it in the plastic jar. Collect four to five animals each date of observation. If it is not convenient for you to look for winged *Hexagenia* at night, you may look for them the next morning, although birds may have eaten most of them.

(2) Observe walls, window screens, and other objects for the presence of shed skins of the first winged stage (subadult) that was left after the adult flew away. If these look like, and are about the same size as, the skins provided to you as examples, place a few of these (two or three) in the same jar as the winged animals. Winged *Hexagenia* may also be present.

(3) If your sampling area includes water at the edge of Lake Erie, such as at a pier or beach, observe the water surface either at night or during the day for the presence of shed nymphal skins floating on the

surface. The nymph swims from the muddy lake bottom up to the surface, then the subadult emerges from a split in the top of the nymphal skin. Collect two or three of the nymphal skins and place them in the same container of alcohol. For your safety, look for floating nymphal skins only when the lake is calm. Note: The container is supplied to you with ethanol (grain alcohol); should it be spilled, you can replace it with methanol (wood alcohol) or isopropyl alcohol (rubbing alcohol), available at any drugstore.

(4) Daily, record your observations on the "Volunteer Data Sheet", placing a check mark in the appropriate boxes for the forms of *Hexagenia* that were found. Even if the skins or animals that you saw were beyond your reach, place a check mark on the sheet and write a comment about that on the sheet. If you prefer, rather than using a check mark, you may record an estimate of the numbers of each form you saw; but a check mark is adequate.

(5) Only if you think *Hexagenia* have begun to appear, you should begin to record brief weather observations on the data sheet each day. General descriptions will do, such as "windy off lake" or "calm", "rained all day" or "shower around 6 p.m." Also, if available, indicate the approximate high and low temperatures on each date; they don't have to be exact or official readings. This general information will help us determine the kinds of weather conditions that may typically exist before the mayflies emerge from Lake Erie.

(6) Finally, the first time you think you have seen signs of the large burrowing mayflies, please notify me the next day by telephone (419 448-2226), fax (419 448-2124), or e-mail (kkrieger@mail.heidelberg.edu).

If you will be away or cannot look for mayflies for two or three days, feel free to enlist the help of someone else during that time, or simply begin your observations again as soon as you can. It is preferred, but not essential, that observations be made every day from June 10th through July 31st. If *Hexagenia* are present in your area, they will probably appear on more than one or two days.

If you are in a boat and see nymphal skins floating on the water, or if winged *Hexagenia* land on your boat, please write down your observations as soon as you can, including the date, general location, and weather conditions. If possible, bring back some specimens.

THANK YOU FOR YOUR HELP! During the winter, you will receive a report about the results of MAYFLY WATCH 1998.

**THIS PROJECT IS SPONSORED BY THE LAKE ERIE PROTECTION  
FUND OF THE OHIO LAKE ERIE OFFICE.**

# APPENDIX B FIRST PAGE OF VOLUNTEER DATA SHEET MAYFLY WATCH 1998

## VOLUNTEER DATA SHEET

Project Director: Dr. Ken Krieger, Heidelberg College, Tiffin, OH 44883  
 phone: 419 448-2226 fax: 419 448-2124 e-mail: kkrieger@mail.heidelberg.edu

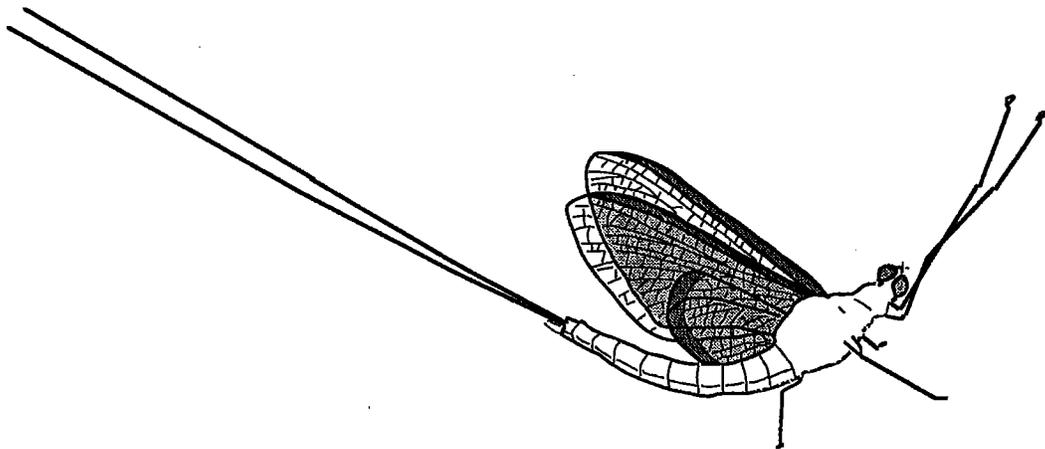
Names of Volunteers		Cooperating Organization		City/County				
Day	Date	Floating Nymphal Skin Found (✓)	Subimaginal Skin Found (✓)	Winged Hexagenia Found (✓)	Winged Ephemera Found (✓)	TODAY'S WEATHER (and other comments) Wind (dir. & speed) Rain (when)	°F Hi Lo	Recorder's Initials
Wed	10-Jun							
Thu	11-Jun							
Fri	12-Jun							
Sat	13-Jun							
Sun	14-Jun							
Mon	15-Jun							
Tue	16-Jun							
Wed	17-Jun							
Thu	18-Jun							
Fri	19-Jun							
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Sat	27-Jun							
Sun	28-Jun							
Mon	29-Jun							
Tue	30-Jun							
Wed	1-Jul							
Thu	2-Jul							
Fri	3-Jul							
Sat	4-Jul							
Sun	5-Jul							

Volunteer Data Sheet

Sponsored by the Lake Erie Protection Fund

# Mayfly Watch 1998

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Along the Ohio Shore of Lake Erie



Submitted to the Ohio Lake Erie Office  
in Partial Fulfillment of  
Lake Erie Protection Fund Project LEPF-97-30

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Tiffin, OH 44883

July 1999