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Surveillance and Status of Fish Stocks in Western Lake Erie, 2007*

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Abstract

Each summer and autumn since 1961, the Lake Erie Biological Station has conducted assessments of fish populations in western Lake Erie near East Harbor State Park, Ohio, and more recently has included assessments of fish diets, zooplankton, and benthic macroinvertebrates. The catches of all major age-0 forage fishes in autumn 2007 were less than their 15-year (1993-2007) means. Catches of round goby *Neogobius melanostomus* (all ages combined) were similar to the previous four years, but substantially below the species' 12-year (1996-2007) mean. For five species examined, mean total lengths for age-0 individuals in 2007 were greater than their respective 20-year means; for four species the reverse was true. Yellow perch *Perca flavescens* and white perch *Morone americana* adults (age-2 and older) consumed predominately benthic macroinvertebrates in summer and fall. Although the autumn diet of white perch was dominated by benthic macroinvertebrates, fish accounted for a relatively large proportion (41.3% by wet weight). The proportion of benthic macroinvertebrates in the summer diet of yellow perch was the highest since 2004, and dominated the autumn diet. The proportion of benthic macroinvertebrates in the summer diet of white perch has increased since 2004. *Dreissena* spp. dominated the benthic macroinvertebrates collected in 2007, followed by Chironomidae. *Veligers of Dreissena spp. was the most abundant taxon in the summer zooplankton samples.*

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Introduction

Since 1961, the U.S. Geological Survey, Lake Erie Biological Station (LEBS), has conducted annual bottom trawl surveys during summer and autumn near East Harbor State Park, Ohio. The objectives for this survey are to determine the: 1) relative abundance and growth of key young-of-year (age-0) fish species, 2) diets of adult (age-2 and older) yellow perch *Perca flavescens* and white perch *Morone americana*, and 3) composition of benthic invertebrates and zooplankton in the study area. Relative abundance indices and growth data from these surveys provide information on potential recruitment of these important species. Abundances and composition of benthic invertebrates and changes in fish diets provide critical information on carrying capacity, expected growth, and condition of commercially important species.

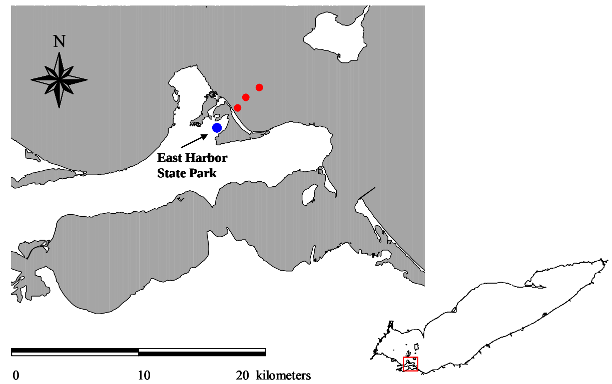

Figure 1. Location of sites sampled by the USGS Lake Erie Biological Station (red dots) offshore of East Harbor State Park (blue dot) in the western basin of Lake Erie.

This report includes results from the 2007 LEBS trawl surveys, diet analyses from adult yellow perch and white perch collected in the surveys, and assessments of benthic and zooplankton communities. For selected fish species, reproductive success was evaluated by comparing the 2007 autumn abundance values of age-0 individuals with long-term (15-year) LEBS average catches. We compare relative abundances and growth of age-0 fish species, composition of benthic invertebrates and zooplankton, and diets of yellow perch and white perch with results from previous years.

Methods

Collection of fish - Trawl surveys were conducted during the summer (30 July -1 August 2007) and autumn (15-17 October 2007) in western Lake Erie near East Harbor State Park, Ohio (Figure 1). On consecutive days (weather permitting) duplicate trawls were conducted at the 3, 4.5, and 6-m depth contours during the morning, afternoon, and night with a 7.9-m (headrope) bottom trawl. The trawl was towed for 10 minutes on-bottom at an average speed of 3.7 km/h (range 3.5-4.1 km/h). Area swept (in hectares) was calculated as width of the trawl opening (3.9 m, measured using acoustic net mensuration gear) multiplied by the distance towed. The distance towed was measured as the difference in starting and ending latitudes and longitudes determined using differential Global Positioning System (GPS). Total sampling effort was 6 h (36 tows) in each season. Fish caught in the trawls were identified to species.

Forage species (*e.g.*, alewife *Alosa pseudoharengus*, gizzard shad *Dorosoma cepedianum*, emerald shiner *Notropis atherinoides*, spottail shiner *N. hudsonius*, trout-perch *Percopsis omiscomaycus*, and rainbow smelt *Osmerus mordax*) were categorized as either age-0 or yearling-and-older. Spiny-rayed fish (*e.g.*, yellow perch, white perch, white bass *Morone chrysops*, walleye *Sander vitreus*, and freshwater drum *Aplodinotus grunniens*) were categorized as age-0, yearling, or age-2 and older. All ages were combined for round goby (*Neogobius melanostomus*).

Young-of-year abundance and growth - For each species, we calculated an index of abundance for 2007 based on catches of age-0 fish caught in the trawls during autumn. This index was calculated as the mean number of age-0 fish caught per hectare swept by the bottom trawl. Percent relative standard error (RSE) of the index was calculated by dividing the standard error by the mean number caught per hectare and then multiplying this ratio by 100. For each species, potential recruitment was then evaluated by comparing the age-0 abundance index for autumn 2007 with its respective long-term (12 years for round goby and 15 years for the remaining species) autumn mean. We used the 12-year mean for round goby because the species was first captured in this survey in 1996. Similarly, changes in growth rate were evaluated for each species by comparing mean total lengths of age-0 individuals captured in autumn 2007 with its respective long-term (12 years for round goby and 20 years for the remaining species) autumn mean with a t-test.

Yellow perch and white perch diets in 2007 - In both seasons, we removed stomachs and otoliths from a maximum of five yellow perch and five white perch, all age-2-and-older, at each of the three depths and in each of the three time periods. Stomachs were frozen in the field and transported to the laboratory. Ages of specimens were estimated by examining the otoliths under a microscope in the laboratory. Prey items in stomachs were identified in the laboratory to the lowest reasonable taxonomic level, enumerated, and measured (total length).Weights were calculated for individual invertebrates by appropriate length-weight regression equations (Dumont *et al.* 1975; Culver *et al.* 1985; G, Mittlebach, The Ohio State University, unpublished data). Results were reported as frequency of occurrence and mean percent weight (Wallace 1981) by taxon and by season. Only stomachs that contained food items were included in the analysis. In addition, we report mean percent weight of zooplankton, benthic invertebrates, and fish in summer and autumn diets of yellow perch and white perch collected on this survey during 2003-2007 (Bur *et al*. 2005, 2006, 2007).

Benthic macroinvertebrates - Samples of benthic macroinvertebrates were collected in both seasons during daylight (morning or afternoon) trawling sessions, using a standard Ponar dredge. Three replicate samples were taken from the 6-m station during each season (n = 12). Sediment and fine organic matter were removed (Pepper *et al.* 2001) and the remaining sample was preserved in 95% ethanol and Phloxin-B. Invertebrates collected were later sorted, identified to lowest reasonable taxonomic level, and enumerated in the laboratory. All samples were pooled to estimate relative abundance (mean number/m^2) and percent composition of benthic taxa collected.

Zooplankton - Zooplankton samples were collected by vertically towing a 0.5-m (153-µm mesh), conical plankton net at the 6-m station in both seasons. Three replicate samples were collected during two morning, afternoon, and night trawling sessions. The three replicate samples were pooled into a single jar while on station and a 10% Lugol's preservative was added. This yielded six composite summer samples and six composite autumn samples. In the laboratory, zooplankton taxa were identified to lowest reasonable taxonomic level and enumerated. Relative abundance (mean number/m^3) and percent composition were estimated.

Results and Discussion

Age-0 abundance and growth - Age-0 abundances for all ten target species in autumn 2007 were lower than their respective 15-year means (Table 1). Abundance of alewife has been below its 15-year mean since 2002. Similarly, abundance of gizzard shad has been below its 15-year mean since 2000 (Figure 2). Prior to 2000, catches of both species were quite variable. Rainbow smelt abundance has been quite low (< 2 individuals/ha) in five of the last seven years, and in 2007 abundance was the third lowest in the last 15 years (Table 1, Figure 3).

Although emerald shiner abundance in 2007 was below the 15-year mean, due mainly to unusually high densities in 1996 and 1997, it was the fourth highest density reported since 1993 (Figure 4). Conversely, abundance of trout-perch in 2007 has been lower than average for the past four of six years and that of spottail shiner has been lower than average for seven of the past eight years (Table 1, Figure 5).

Autumn abundances for age-0 spiny-rayed species in 2007 were lower than their respective 15-year means (Table 1). For freshwater drum, the mean catch/ha in 2007 was well below the 15-year mean, continuing a decreasing trend since 2005 (Table 1 and Figure 6). Although the abundance of age-0 white bass has increased since 2005, the 2007 abundance estimate was still 40% below the 15-year mean. The RSEs of the abundance indices for freshwater drum and white bass have been comparatively low since 2005 (Figure 6). In 2007, the abundance of white perch was below the long-term average, although the catch was the fourth largest since 1993 (Table 1, Figure 7). The abundance of age-0 yellow perch in 2007 was below the 15-year mean (Table 1), but was nearly double the median (24.9) and the highest since 2003 (Figure 8). Similarly, walleye abundance in 2007 was below the 15-year mean but was the highest catch since 2003.

Viral haemorrhagic septicemia (VHS) is an infectious disease caused by the VHS virus. VHS was associated with mass mortality of adult drum in spring 2006 and to a lesser extent in 2007. Similar to 2006, the mortalities linked to VHS may have inhibited recruitment of other species (*e.g.*, gizzard shad).

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Table 1. Autumn densities of age-0 fish from bottom trawling an area near East Harbor State Park, Ohio in western Lake Erie for 2007 and the mean autumn densites for 1992-2006 (15-year mean). Densities are expressed as the mean number per hectare swept by the trawl. Relative standard error (expressed as a percent) is calculated as standard error of the mean number per hectare for a species divided by mean number per hectare and multiplied by 100.

	Number/hectare		**Relative standard error (%)**	
Species	**2007**	**15-year mean**	**2007**	**15-year mean**
Alewife *Alosa pseudoharengus*	0	27	-	47
Gizzard shad *Dorosoma cepedianum*	9	127	31	31
Rainbow smelt *Osmerus mordax*	0.1	5	100	54
Emerald shiner *Notropis atherinoides*	293	979	32	39
Spottail shiner *N. hudsonius*	50	58	27	38
Trout-perch *Percopsis omiscomaycus*	5	70	23	27
White perch *M. Americana*	746	778	24	22
White bass *Morone chrysops*	3	5	30	47
Yellow perch *Perca flavescens*	47	99	25	27
Walleye *Sander vitreus*	9	11	27	36
Freshwater drum *Aplodinotus grunniens*	5	36	38	45

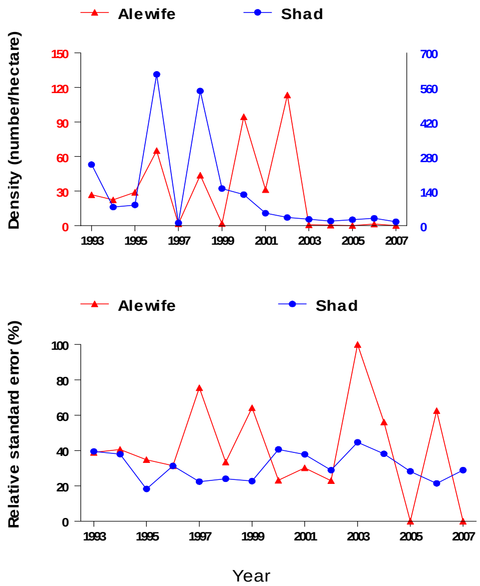


Figure 2. Density (top) and relative standard error (bottom) for age-0 alewife and gizzard shad as number of individuals per hectare in western Lake Erie near East Harbor State Park, Ohio, during autumn 1993-2007.

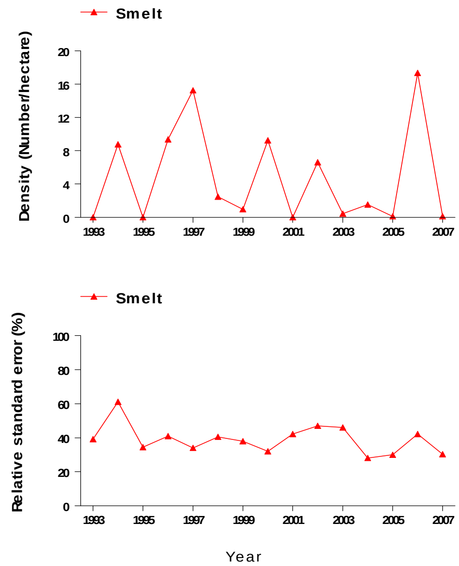


Figure 3. Density (top) and relative standard error (bottom) for age-0 rainbow smelt as number of individuals per hectare in western Lake Erie near East Harbor State Park, Ohio, during autumn 1993-2007.

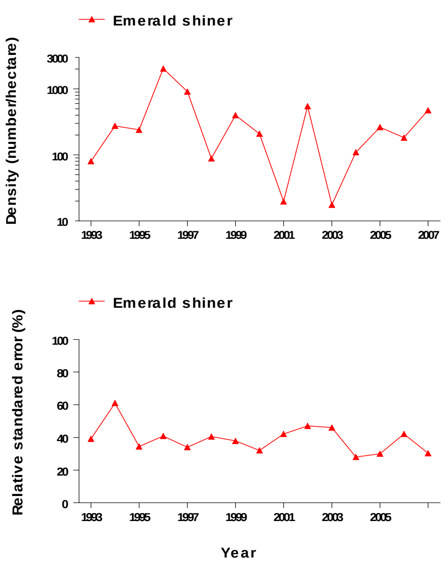


Figure 4. Density (top) and relative standard error (bottom) for age-0 emerald shiner as number of individuals per hectare in western Lake Erie near East Harbor State Park, Ohio, during autumn 1993-2007. Density (number/hectare) is presented in log scale.

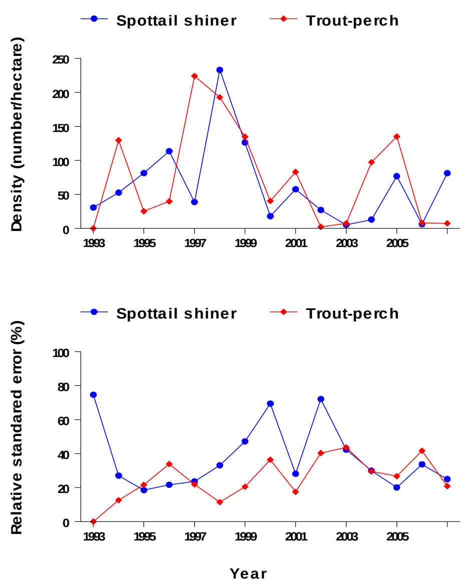


Figure 5. Density (top) and relative standard error (bottom) for age-0 spottail shiner and trout-perch as numbers of individuals per hectare in western Lake Erie near East Harbor State Park, Ohio, in autumn 1996-2007.

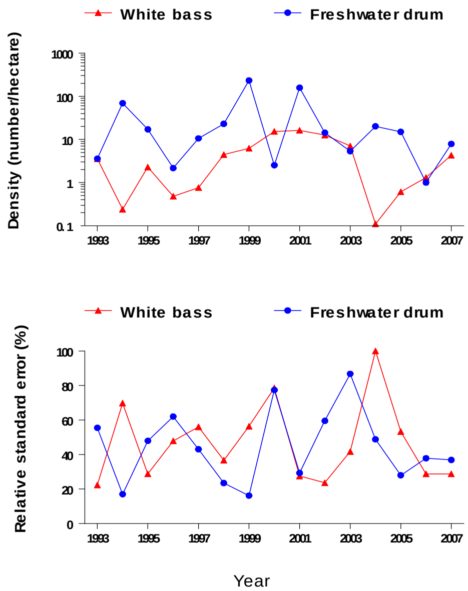


Figure 6. Density (top) and relative standard error (bottom) for age-0 white bass and freshwater drum as number of individuals per hectare in western Lake Erie near East Harbor State Park, Ohio, during autumn 1993-2007. Density (number/hectare) is presented in log scale.

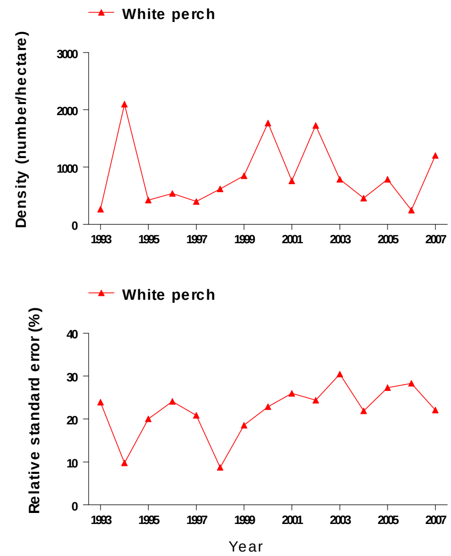


Figure 7. Density (top) and relative standard error (bottom) for age-0 white perch as number of individuals per hectare in western Lake Erie near East Harbor State Park, Ohio, during autumn 1993-2007.

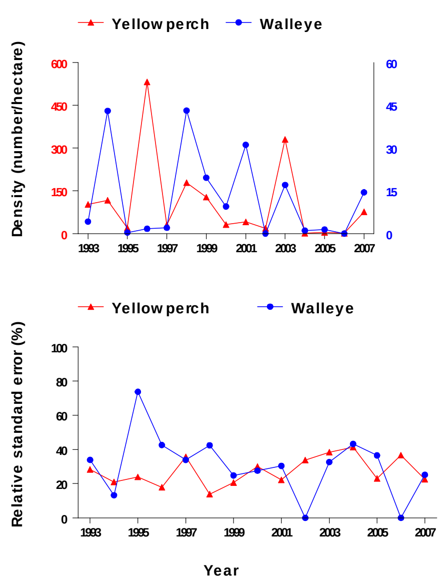


Figure 8. Density (top) and relative standard error (bottom) for age-0 yellow perch and walleye as number of individuals per hectare in western Lake Erie near East Harbor State Park, Ohio, during autumn 1993-2007.

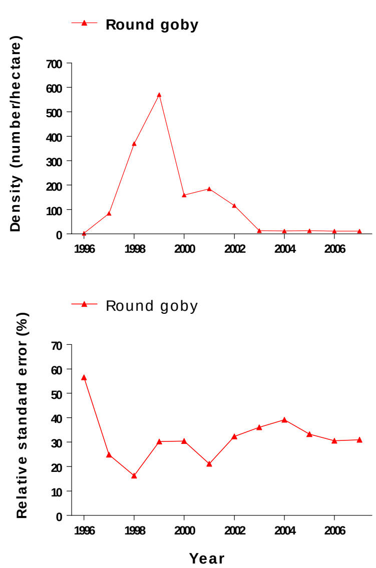


Figure 9. Density (top) and relative standard error (bottom) for age-0 and older round goby as number of individuals per hectare in western Lake Erie near East Harbor State Park, Ohio, during autumn 1996-2007.

Until recently, round goby had been the most abundant species in trawl samples. However, catches of round goby have been declining since 1999 (Figure 9). In 2007, mean abundance for round goby (Table 1, 11.7/ha for all ages combined) was about the same as abundances reported since 2003, but was much lower than the 11-year mean (128.9/ha).

For six species (gizzard shad, trout-perch, white bass, freshwater drum, yellow perch, and walleye), mean total lengths of age-0 fish in 2007 were greater than their respective 20-year means (Table 2; t-tests, $P < 0.01$). Conversely, mean total lengths in 2007 were less than the long-term mean for two species (emerald shiner and spottail shiner).

In 2007, greatest departures from respective 20-year mean total lengths occurred for freshwater drum (28% greater) and spottail shiner (26% less). The results for white bass (N = 32) and freshwater drum (N = 27) should be interpreted with caution due to comparatively small sample sizes. The mean total length of white perch in 2007 was similar to the long-term average.

Table 2. Mean total lengths (mm) of age-0 fishes collected from bottom trawl catches near East Harbor State Park, Ohio in western Lake Erie during autumn of 2007 and 1987-2006 (20-year mean). Sample sizes are in parentheses and SE=standard error. Scientific names of species are listed in Table 1. Positive t-values indicate that mean total length in 2007 was greater than the 20-year mean; negative values indicate the reverse.

	2007		20-year mean		2007 vs. 1987-2006	
Species	**Mean total length (N)**	**SE**	**Mean total length**	**SE**	**t-value**	**P**
Gizzard shad	113 (69)	3.2	101	3.9	5.2	<0.0001
Rainbow smelt	55 (1)	-	55	2.0		
Emerald shiner	51 (202)	1.0	59	1.8	-14.19	<0.0001
Spottail shiner	57 (142)	2.0	78	1.5	-24.73	<0.0001
Trout-perch	80 (42)	1.4	75	1.0	4.21	<0.0001
White perch	76 (160)	0.9	76	1.4	0.83	0.4087
White bass	134 (32)	3.7	120	5.5	4.08	<0.0001
Yellow perch	92 (167)	4.9	84	1.5	6.11	<0.0001
Walleye	208 (117)	1.5	184	4.1	12.61	<0.0001
Freshwater drum	128 (27)	5.7	100	4.7	8.37	<0.0001

For yellow perch and walleye mean total length has increased 20% and 37%, respectively, during the last 3-5 years (Figure 10). In each of the last three years yellow perch length exceeded the long-term mean, although during the previous six years (1999-2004) length was below the long term mean. Mean total length of walleye exceeded the 20-year mean in both of the last two years in which length was measured (2005 and 2007; no age-0 walleye were collected in 2006).

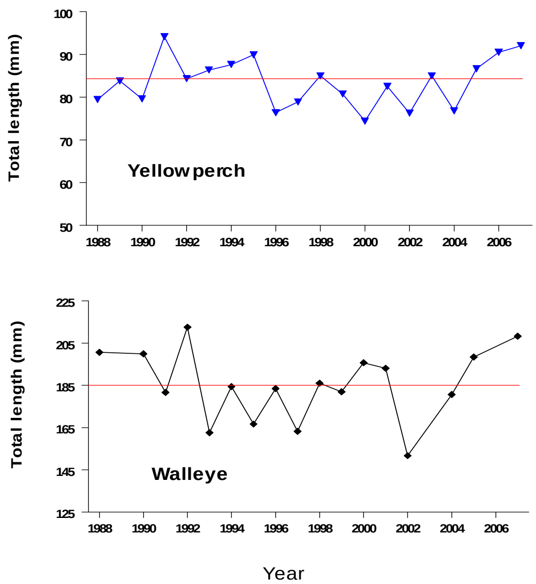


Figure 10. Mean total length of age-0 yellow perch and walleye in western Lake Erie near East Harbor State Park, Ohio, in autumn 1988-2007. The 20-year (1987-2006) mean is indicated by the horizontal red line.

Yellow Perch and White Perch Diets in 2007 - We collected 84 stomachs from yellow perch, 64 of which contained food (Table 3). There were no zooplankton in any of the yellow perch stomachs we collected. During summer yellow perch stomachs (n = 32), contained benthic macroinvertebrates and fish (77% and 23% respectively, by weight). *Hexagenia* spp. was found in more than half (56%) of yellow perch stomachs and dominated the benthic component of the summer diets by weight (32%), followed by *Trichoptera* spp. (18%). Fish accounted for the remaining 23% of the weight and were found in 16% of the yellow perch stomachs collected during summer.

Contents of yellow perch stomachs collected during autumn (n = 32) were dominated by benthic macroinvertebrates (81% by weight), followed by fish (19%) (Table 3). *Hexagenia sp.* was the most frequently found benthic macroinvertebrate in yellow perch stomachs, followed by *Dreissena sp.* (13%). Round goby and emerald shiner were the only fish identified in yellow perch stomachs in autumn, and 9% of the stomachs contained fish we were not able to identify.

We collected 76 white perch stomachs, 56 of which contained food. Benthic macroinvertebrates accounted for more than 91% (by weight) of the summer diet of white perch (Table 4, n = 29). Chironomidae dominated the benthic invertebrate portion of the diet (54% by weight) and were found in 86% of white perch stomachs in summer. *Hexagenia sp.* was found in 21% of white perch stomachs but contributed less than 1% of prey weight. Fish (5.4% by weight) and zooplankton (5%) were comparatively minor components of the summer diet. Emerald shiners and *Leptodora kindtii* dominated the fish and zooplankton components, respectively.

Benthic macroinvertebrates (51.7% by weight) and fish (41.3%) collectively accounted for 93% of the autumn diet of white perch (Table 4, n = 27). *Hexagenia sp.* was the dominant prey species observed in white perch stomachs collected in autumn (63% frequency). Amphipoda and *Hexagenia* spp. collectively contributed nearly 52% of the weight of the autumn diet of white perch. Emerald shiner was the dominant fish found by both mean percent weight and percent frequency (26% and 33% respectively). *Leptodora kindtii* accounted for nearly all of the weight of the zooplankton component of the diet.

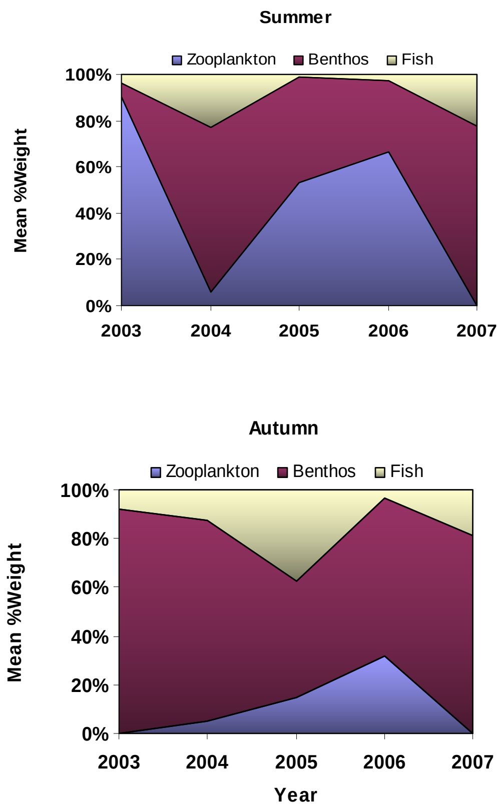
Yellow perch and white perch diet trends - After a steady increase in zooplankton consumption by yellow perch during 2004 – 2006 in both seasons, zooplankton were completely absent in yellow perch stomachs in 2007 (Figure 11). Zooplankton consumed by white perch in 2007 continued a decreasing trend from 66% by weight in 2005 to 5% in 2007during summer and from 40% by weight in 2004 to 7% in 2007 during autumn (Figure 12). In both seasons, the percent weight of benthic invertebrates in the diet of yellow perch was greater in 2007 than in 2006. Similarly, the percent weight

Table 3. Diet of age-2 and older yellow perch collected during summer and autumn 2007 near East Harbor State Park, expressed as mean percent (%) weight of all prey items and percent frequency of occurrence (% Frequency).

	Summer (n=32)		**Autumn (n=32)**	
Prey Item	**Mean % Weight**	**% Frequency**	**Mean % Weight**	**% Frequency**
Total Zooplankton	**0.0**		**0.0**	
Amphipoda	8.5	12.5	2.4	3.1
Ostracoda	3.6	12.5	0.0	0.0
Chironomidae	11.2	25.0	0.1	6.3
Nematoda	0.1	6.3	0.0	0.0
Trichoptera spp.	18.4	31.3	0.0	0.0
Dreissena spp.	3.9	34.4	7.2	12.5
Hexagenia spp.	31.7	56.3	71.4	81.3
Total Benthos	**77.4**		**81.1**	
Emerald shiner	9.3	9.4	0.0	3.1
White perch	0.6	3.1	0.0	0.0
Round goby	4.8	6.3	9.5	15.6
Unidentified fish	7.9	15.6	9.4	9.4
Total fish	**22.6**		**18.9**	

Table 4. Diet of age-2 and older white perch collected during summer and autumn 2007 near East Harbor State Park, expressed as mean percent (%) weight of all prey items and percent frequency of occurrence (% Frequency).

	Summer (n=29)		**Autumn (n=27)**	
Prey Item	**Mean % Weight**	**% Frequency**	**Mean % Weight**	**% Frequency**
Bythotrephes longimanus	0.1	3.4	0.0	0.0
Eubosmina spp.	0.0	0.0	< 0.1	3.7
Daphnia spp.	0.3	3.4	0.0	0.0
Daphnia retrocurva	0.0	0.0	0.3	3.7
Leptodora kindtii	4.5	17.2	6.7	11.1
Total Zooplankton	**4.9**		**7.0**	
Amphipoda	31.6	37.9	13.8	22.2
Ostracoda	0.3	6.9	0.0	0.0
Chironomidae	53.6	86.2	< 0.1	3.7
Nematoda	< 0.1	3.4	0.0	0.0
Trichoptera spp.	2.0	3.4	0.0	0.0
Dreissena spp.	3.4	6.9	< 0.1	3.7
Hexagenia spp.	0.3	20.7	37.9	63.0
Total benthos	**91.2**		**51.7**	
Gizzard shad	0.0	0.0	3.7	3.7
Emerald shiner	3.4	3.4	25.7	33.3
White perch	< 0.1	2.9	0.0	0.0
Round goby	0.0	0.0	0.3	3.7
Unidentified fish	0.4	17.2	11.6	29.6
Total fish	**3.8**		**41.3**	



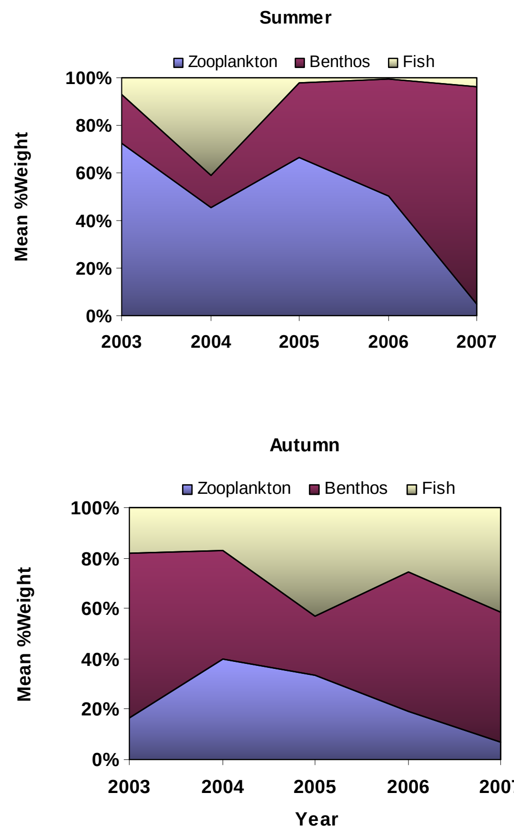


Figure 11. Mean percent weight of zooplankton, benthos, and fish recorded during the diet analysis of yellow perch collected in Lake Erie near East Harbor State Park, Ohio. Stomachs were collected in summer and autumn during 2003-2007.

Figure 12. Contributions of zooplankton, benthos, and fish recorded during the diet analysis of white perch collected in Lake Erie near East Harbor State Park, Ohio. Stomachs were collected in summer and autumn during 2003-2007.

of benthic macroinvertebrates in the diet of white perch has increased in both seasons since 2005 (Figure 12). The proportion of fish in yellow perch diets in both seasons and in white perch diets in autumn 2007 increased by at least 15%. Mean percent weight of fish in white perch diet in summer also increased, from nearly absent in 2006 to nearly 4% in 2007.

Benthic macroinvertebrates - We identified nine taxa in the pooled benthic sample (Table 5). *Dreissena* spp. accounted for 94% of the individuals recorded. This is the largest proportion of *Dreissena* spp. since the survey began in 1997. *Dreissena* spp. density increased by 23% and the proportion increased by 39% from levels recorded in 2006 (1,515/ m^2 and 55%, respectively) (Bur *et al*. 2007). Ephemeroptera was the second most abundant taxon found in the 2007 sample (2.5%, 177/m^2), and represented this taxon's highest density since 2004 (Bur *et al.* 2005). Chironimidae composed 1.5% of the total benthic sample, 23.5% lower than its historical high density recorded in 2006.

Oligochaeta, Trichoptera, Hirudinea, Amphipoda, and Nematoda collectively accounted for less than 2% of the individuals recorded in 2007. The density of Oligochaeta (56/m^2) in 2007 was the lowest since 2001 (Bur *et al.* 2002). Planaria accounted for less than 1% of the 2007 benthic sample but was not present in 2006 (Bur *et al*. 2007).

Zooplankton - We identified 9 zooplankton taxa in 2007, all of which occurred in both the summer and autumn samples (Table 6). *Dreissena* spp. veligers accounted for the largest proportion (39%) of zooplankton collected in the summer sample, followed by calanoid copepods (22%). Bosminidae composed the largest proportion (53%) of zooplankton collected in the autumn sample, followed by cyclopoid copepods and calanoid copepods (both 10%).

The densities of *Dreissena* spp. veligers and cyclopoid and calanoid copepods were much greater in summer than in autumn samples in 2007 (Table 6). For cyclopoid copepods, this seasonal difference has been observed since 2002 (Bur *et al*. 2003). *Dreissena* spp. veligers decreased from summer to autumn 2007, reversing a seasonal difference that had occurred since 2004 (Bur *et al*. 2005). In contrast, Bosminidae and *D. retrocurva* were much more abundant in autumn than in summer 2007, Bosminidae has exhibited a similar seasonal difference since 2001, except for 2004.

D. galeata mendotae, copepod nauplii, Sididae and *Leptodora* spp. had comparatively consistent seasonal proportions in both the summer and autumn samples.

Table 5. Composition of benthic macroinvertebrates offshore of East Harbor State Park, Ohio in 2007 (n = 12 benthic grabs), shown as mean number per square meter and percent (%) composition of a single pooled sample in which the results from each grab were combined.

Taxon	Mean number/m^2	% composition
Dreissena spp.	6,583	94
Ephemeroptera	177	2.5
Chironomidae	104	1.5
Oligochaeta	56	<1
Amphipoda	30	<1
Trichoptera	27	<1
Nematoda	10	<1
Planaria	5	<1
Hirudinea	3	<1
Total	6,995	100

Cyclopoid copepods, the most abundant zooplankton taxon recorded in summer 2006 (Bur *et al.* 2007), were 15% less abundant than in summer 2007. Conversely, Bosminidae was the most abundant (45%) zooplankton taxon collected in autumn 2006 and their density was 8% higher in autumn 2007. *Dreissena* spp. veligers were not detected in summer 2006 samples but were recorded at a high density (5284/m^3) in summer 2007.

Table 6. Mean individuals/m^3 and percent (%) composition of crustacean zooplankton taxa in western Lake Erie near East Harbor State Park, Ohio in 2007.

	Summer (n = 6)		Autumn (n = 6)	
Taxon	**Mean number/m^3**	**Mean % composition**	**Mean Number/m^3**	**Mean % composition**
Dreissena spp. veligers	5284	39	894	8
Calanoid copepods	3020	22	1161	10
Cyclopoid copepods	2203	16	1140	10
Bosminidae	1977	15	6242	53
Copepod nauplii	722	5	21	<1
Daphnia retrocurva	190	1	2267	19
Leptodora spp.	129	1	25	<1
Sididae	71	1	88	<1
Daphnia galeata mendotae	18	<1	6	<1

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