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Surveillance and Status of Fish Stocks in Western Lake Erie, 2008*

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Abstract. The Lake Erie Biological Station has conducted bottom trawl assessments of fish populations in western Lake Erie near East Harbor State Park, Ohio each summer and autumn since 1961. The catches of most age-0 forage fishes in 2008 were less than their 15-year means. Mean densities for five species exceeded the long term mean. Mean density of age-0 white perch *Morone americana* was more than double last year's mean and the long-term mean. Densities of both yellow perch *Perca flavescens* and walleye *Sander vitreus* were at or above their long term mean. Catches of round goby *Neogobius melanostomus* (all ages combined) exceeded the previous five years, but were substantially below the species' 13-year (1996-2008) mean. For five species, mean total lengths of age-0 individuals captured in 2008 were greater than their respective 20-year means. During 1988-2007, the frequency of occurrence for yellow perch diet items was highest for benthic invertebrates and zooplankton during the summer and benthic invertebrates in autumn. During summer zooplankton and benthic invertebrates were frequently consumed by white perch. Benthic prey for white perch occurred more frequently in the last 5-10 years.

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Introduction

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 since 1961. The objectives for these surveys are to determine relative abundance and growth of comparatively common young-of-year (age-0) fish species. Relative abundance indices and growth data from these surveys provide information on potential recruitment of these important species.

This report includes results from the autumn 2008 LEBS trawl survey and diet analyses from adult yellow perch and white perch collected in past surveys. For selected fish species, we evaluated recruitment by comparing the 2008 autumn abundance values of age-0 individuals with long-term (15-year) LEBS average catches. We then compare relative abundances and total lengths of age-0 fish species with results from previous years. We also analyze yellow perch *Perca flavescens* and white perch *Morone americana* diets over the past 20 years (1988-2007) from stomachs that were collected at the study site.

Methods

Collection of fish - Trawl surveys were conducted during the summer (4-6 August 2008) and autumn (13-16 October 2008) 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 morning and night with a 7.9-m (headrope) bottom trawl. Prior to 2008, data from afternoon sampling were also included. 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 (ha) was calculated as width of the trawl opening (3.9 m, measured using SCANMAR acoustic net mensuration gear) multiplied by the distance towed. The distance towed was measured as the difference in starting and ending coordinates, determined using differential Global Positioning System. Total sampling effort was 4 h (24 tows) in each season. Fish caught in the trawls were identified to species and counted.

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 2008 based on catches of age-0 fish caught in the trawls during autumn. This index was calculated as the arithmetic 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, relative potential recruitment was then evaluated by comparing the age-0 fish abundance index for autumn 2008 with its respective long-term autumn mean (13 years for round goby and 15 years for the remaining species). We used the 13-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 2008 with its respective long-term (13 years for round goby and 20 years for the remaining species) autumn mean with a t-test.

Yellow perch and white perch diets, 1988-2007 - During summer and autumn 1988-2007 we removed stomachs from a maximum of ten yellow perch and ten white perch, all age-2-and-older, at each of the three depths and in each of the three time periods. Stomachs were preserved in 10% formalin (1988-2002) or frozen in water (2003-2007) and transported to the laboratory and processed. Prey items in stomachs were identified in the laboratory to the lowest reasonable taxonomic level and enumerated. To examine potential trends in diet over the time series, the prey taxa were separated into three broad categories (benthic invertebrates, fish, and zooplankton), and diet was evaluated by season. We report annual percent occurrence of the three categories.

Results and Discussion

Young-of-year abundance and growth - Age-0 abundance for six of the eleven target species in autumn 2008 were lower than their respective 15-year means (Table 1). Abundance of alewife has been below its 15-year mean since 2002 (Figure 2). Similarly, abundance of gizzard shad has been below its 15-year mean since 2000. 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 2008 abundance was the third lowest in the last 15 years (Figure 3). Although emerald shiner abundance in 2008 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). Abundance of trout-perch has been lower than average for the past five of seven years, while that of spottail shiner has been above average for three of the past four years (Figure 5).

Autumn abundances for most age-0 spiny-rayed species (white perch, white bass, yellow perch, and walleye) in 2008 were higher than their respective 15-year means (Table 1). In contrast, the mean catch/ha in 2008 for freshwater drum was well below the 15-year mean, continuing a decreasing trend since 2005 (Figure 6). The abundance of age-0 white bass has increased each year since 2004, and 2008 was the first year since 2003 in which the abundance estimate exceeded the 15-year mean. The RSEs of the abundance indices for freshwater drum and white bass have been comparatively low since 2005 (Figure 6). White perch abundance in 2008 was the second highest since 1993, and was only exceeded by the 1994 catch (2,099 individuals/ha) (Figure 7). The abundance of age-0 yellow perch in 2008 was greater than the 15-year mean (Table 1), and was only exceeded in the last ten years by the comparatively successful 2003 year class (331 individuals/ha) (Figure 8). Walleye abundance in 2008 was similar to the 15-year mean and represented the second highest catch since 2003.

In 2008, mean abundance for round goby (150 individuals/ha) increased dramatically from the previous five years and was similar to mean catches (116-185 individuals/ha) in 2000-2002 (Figure 9). Catch of gobies peaked in 1999 and by 2003 the number of gobies in trawl catches dropped considerably. The mean catch in 2008 was slightly greater than the 13-year mean (131/ha).

Differences in mean total length between 2008 and the previous 20 years were recorded for some species. For five (gizzard shad, emerald shiner, spottail shiner, yellow perch, and walleye) of ten species examined, mean total lengths of age-0 fish in 2008 were greater than their respective 20-year means (Table 2: t-tests, $P < 0.05$). Conversely, mean total lengths in 2008 for two species, white bass and freshwater drum, were less than the long-term mean. In 2008, greatest departures from respective 20-year mean total lengths occurred for freshwater drum (35% less) and walleye (10% greater). However, the results for white bass (N = 17) and freshwater drum (N = 7) should be interpreted with caution due to small sample sizes. During each of the past four years the mean total length of yellow perch exceeded the long-term mean. Similarly, the 2008 mean total length of walleye exceeded the long-term mean length during three of the last four years (no age-0 walleye were collected in 2006) (Figure 10).

Yellow perch and white perch diets, 1988-2007- We examined 1,243 yellow perch stomachs that contained food during 1988-2007. The frequencies of both benthic invertebrates and zooplankton in stomachs were usually greater than frequencies for fish in summer yellow perch diets (Figure 11) although no obvious increase or decrease over the time series was apparent. Zebra mussel (*Dreissena polymorpha*) was the most frequently occurring benthic taxon and *Bythotrephes longimanus* and gizzard shad were the most frequently occurring taxa for zooplankton and fish. Benthic invertebrates occurred far more frequently in the autumn diets of yellow perch than either fish or zooplankton. Zooplankton were notably absent from the autumn diet during 1994-2002. *Hexagenia* spp. was the most frequently occurring benthic taxon in autumn yellow perch stomachs.

Similarly, we examined 1,082 white perch stomachs that contained food. Zooplankton occurred more frequently than either benthic invertebrates or fish in summer white perch diets in most years (58%) (Figure 12). Zooplankton prey was dominated by *B. longimanus* and *Daphnia* spp. The results suggest a decreasing trend in consumption of zooplankton during the summers of 2003-2007. In contrast, the occurrence of benthic invertebrates in the summer diet increased overall during 1988-2007. Major benthic

taxa were chironomids, amphipods, and *Hexagenia* spp., the last of which was first noticed in the diet in 1996. For autumn white perch diets, benthic invertebrates occurred more frequently than either fish or zooplankton in 65% of the study years. The frequency of benthic food items (generally amphipods and *Hexagenia* spp.) increased from 1996-2007. In contrast, the frequency of zooplankton (mainly *B. longimanus* and *Leptodora kindtii*) in the autumn diet slightly decreased during a similar time span.

Peer-reviewed research using historical East Harbor data –Analyses of our historical East Harbor data series revealed a transition to lower catchability of age-0 yellow perch during daylight compared to during night (Stapanian *et al.* 2009). The timing of this transition coincided with increased water clarity at nearshore sites in western Lake Erie, which was associated with the establishment of dreissenid mussels. Kocovsky *et al*. (in review) examined potential implications of the shift in catchability to management of harvest of yellow perch.

Acknowledgments

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References

Kocovsky, P.M., M.A. Stapanian, and C.T. Knight. (*in review*). Night sampling improves indices used for management of yellow perch in Lake Erie. *Fisheries Ecology and Management.*

Stapanian, M.A., P.M. Kocovsky, and J.V. Adams. 2009. Change in diel catchability of young-of-year yellow perch associated with establishment of dreissenid mussels. *Freshwater Biology* (in press).

Table 1. Autumn densities of age-0 fish from bottom trawling an area near East Harbor State Park, Ohio in western Lake Erie for 2008 and the mean autumn densities for 1993-2007 (15-year mean). Densities are expressed as the mean number per hectare swept by the trawl. Relative standard error (expressed as a percent) was calculated as standard error of the mean number per hectare for a species divided by mean number per hectare and multiplied by 100.

	Mean Number/ha		**Relative standard error (%)**	
Species	**2008**	**1993-2007**	**2008**	**1993-2007**
Alewife *Alosa pseudoharengus*	0.3	62	100	46
Gizzard shad *Dorosoma cepedianum*	8	140	35	31
Rainbow smelt *Osmerus mordax*	0.2	5	100	54
Emerald shiner *Notropis atherinoides*	475	982	35	39
Spottail shiner *N. hudsonius*	80	60	27	38
Trout-perch *Percopsis omiscomaycus*	10	70	27	30
White perch *Morone americana*	1968	825	23	22
White bass *M. chrysops*	8	5	34	47
Yellow perch *Perca flavescens*	117	102	26	27
Walleye *Sander vitreus*	12	12	44	35
Freshwater drum *Aplodinotus grunniens*	4	37	35	47

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 2008 and 1988-2007 (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 2008 was greater than the 20-year mean; negative values indicate the reverse. Significant differences occurred when $P \leq 0.05$.

	2008		1988-2007		2008 vs. 1988-2007	
Species	**Mean (N)**	**SE**	**Mean**	**SE**	**t-value**	**P**
Gizzard shad	108 (36)	4.9	101	2.8	2.27	0.023
Rainbow smelt	45 (1)	-	55	2.0	-1.40	0.161
Emerald shiner	63 (124)	0.6	58	1.8	6.95	<0.0001
Spottail shiner	80 (65)	0.5	77	1.6	2.41	0.016
Trout-perch	75 (18)	1.4	76	1.0	-0.58	0.563
White perch	74 (105)	0.9	75	1.3	-1.01	0.312
White bass	108 (17)	8.1	122	5.7	-3.04	0.003
Yellow perch	86 (146)	0.6	83	1.3	2.10	0.036
Walleye	204 (50)	2.1	185	4.1	6.80	<0.0001
Freshwater drum	66 (7)	15.5	101	5.0	-5.37	<0.0001

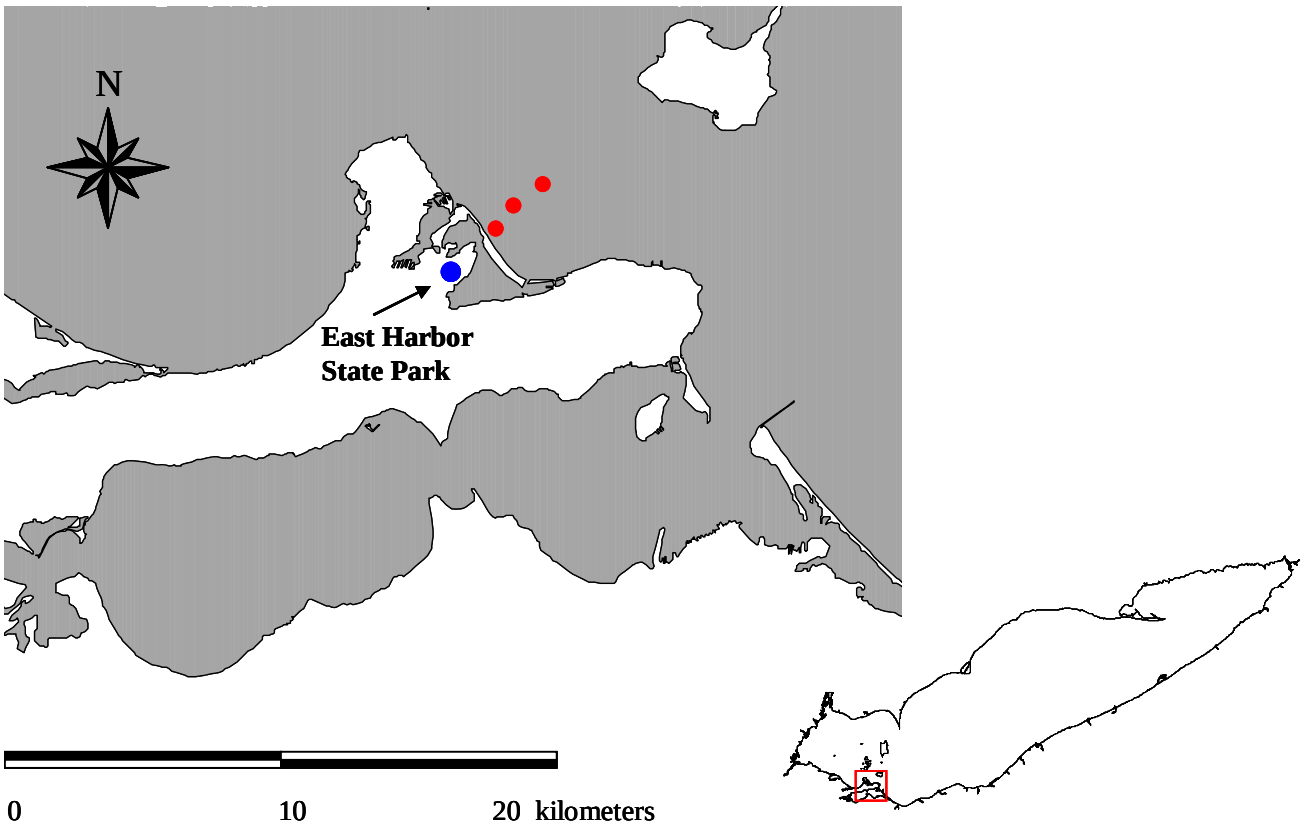

Figure 1. Location of sites sampled by the USGS Lake Erie Biological Station (red dots) offshore of East Harbor State Park (blue dot) in the western basin of Lake Erie.

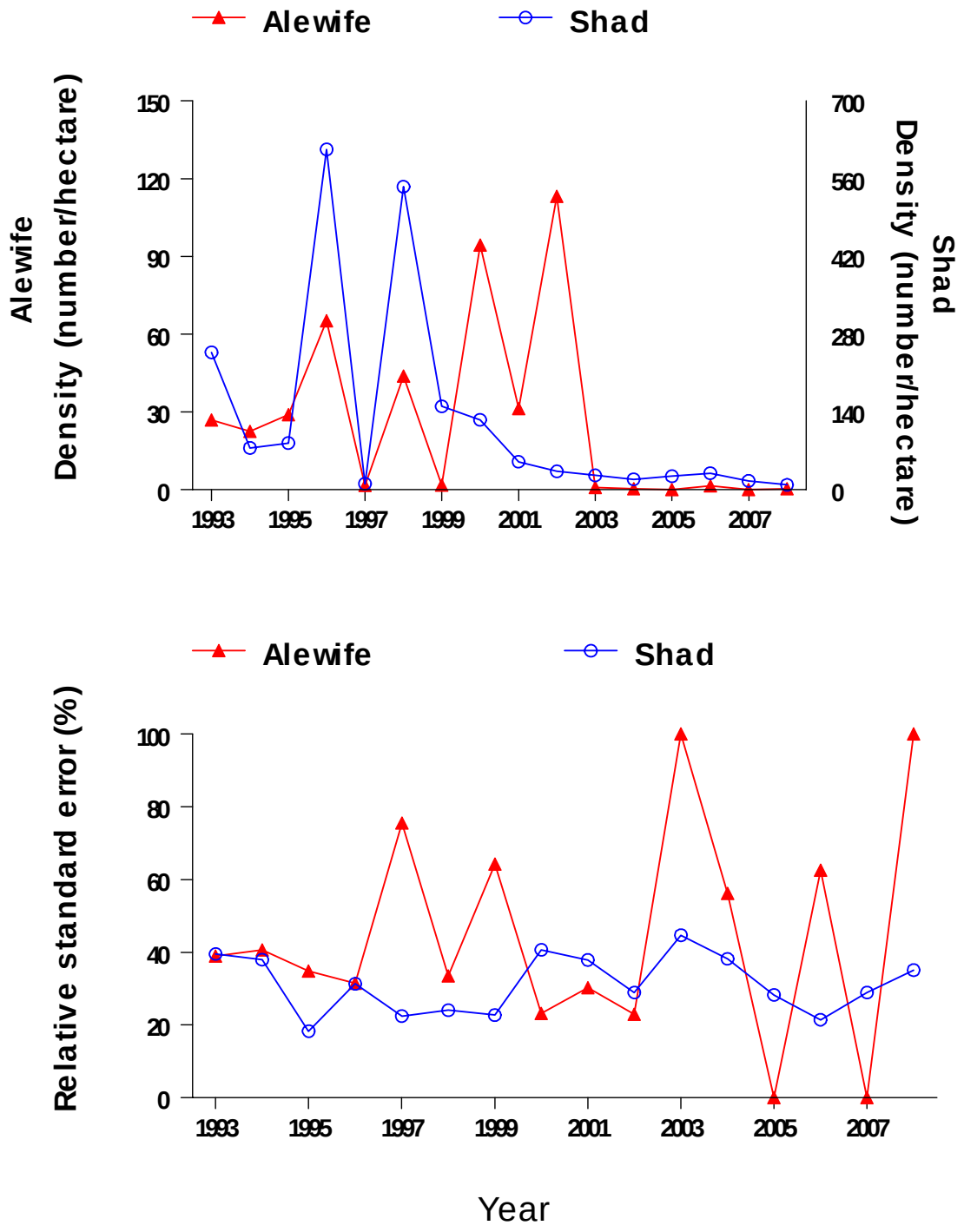

Figure 2. Density (top) and relative standard error (bottom) for age-0 alewife and gizzard shad as number of individuals per hectare in western Lake Erie near East Harbor State Park, Ohio, during autumn 1993-2008.

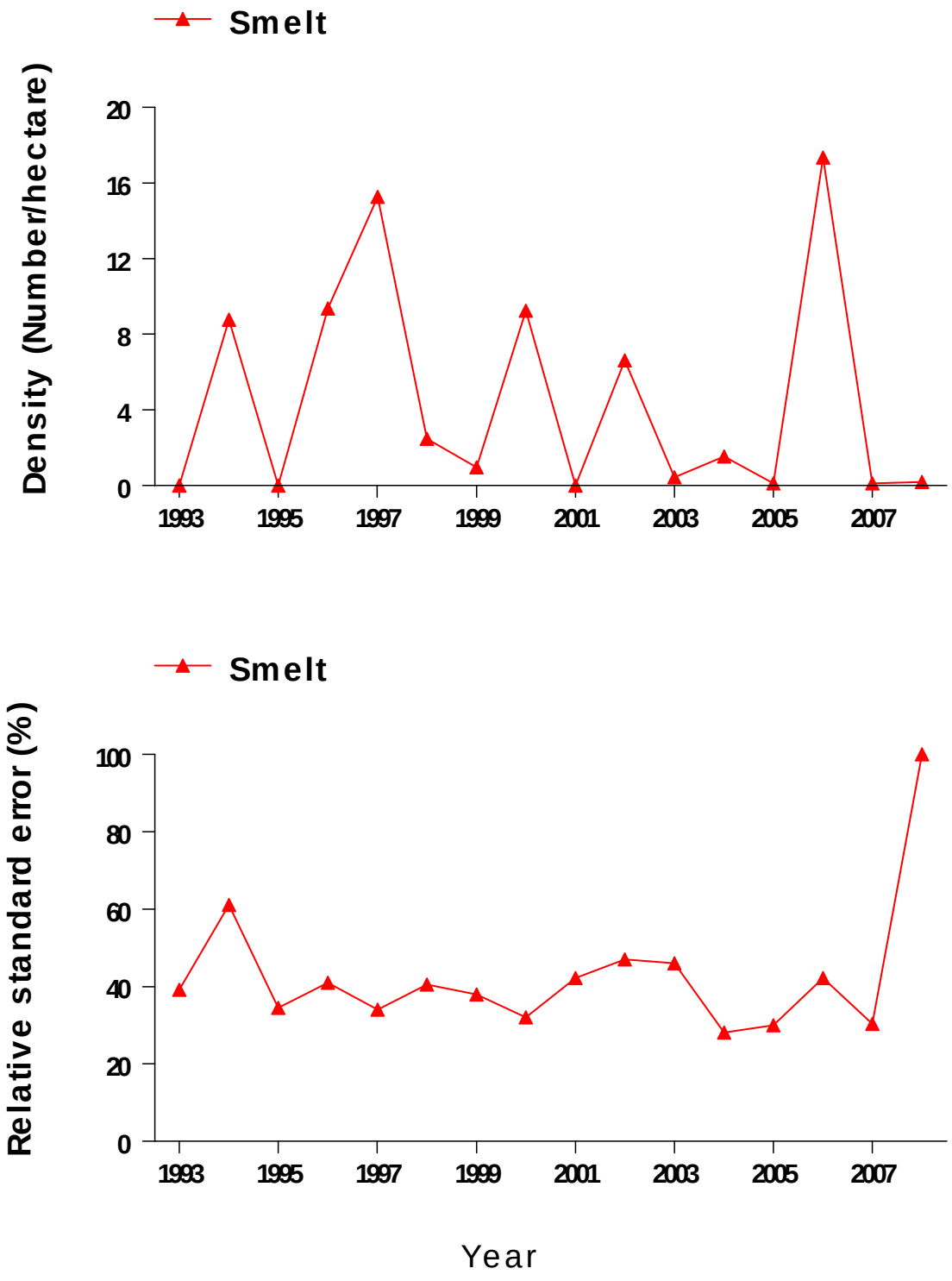

Figure 3. Density (top) and relative standard error (bottom) for age-0 rainbow smelt as number of individuals per hectare in western Lake Erie near East Harbor State Park, Ohio, during autumn 1993-2008.

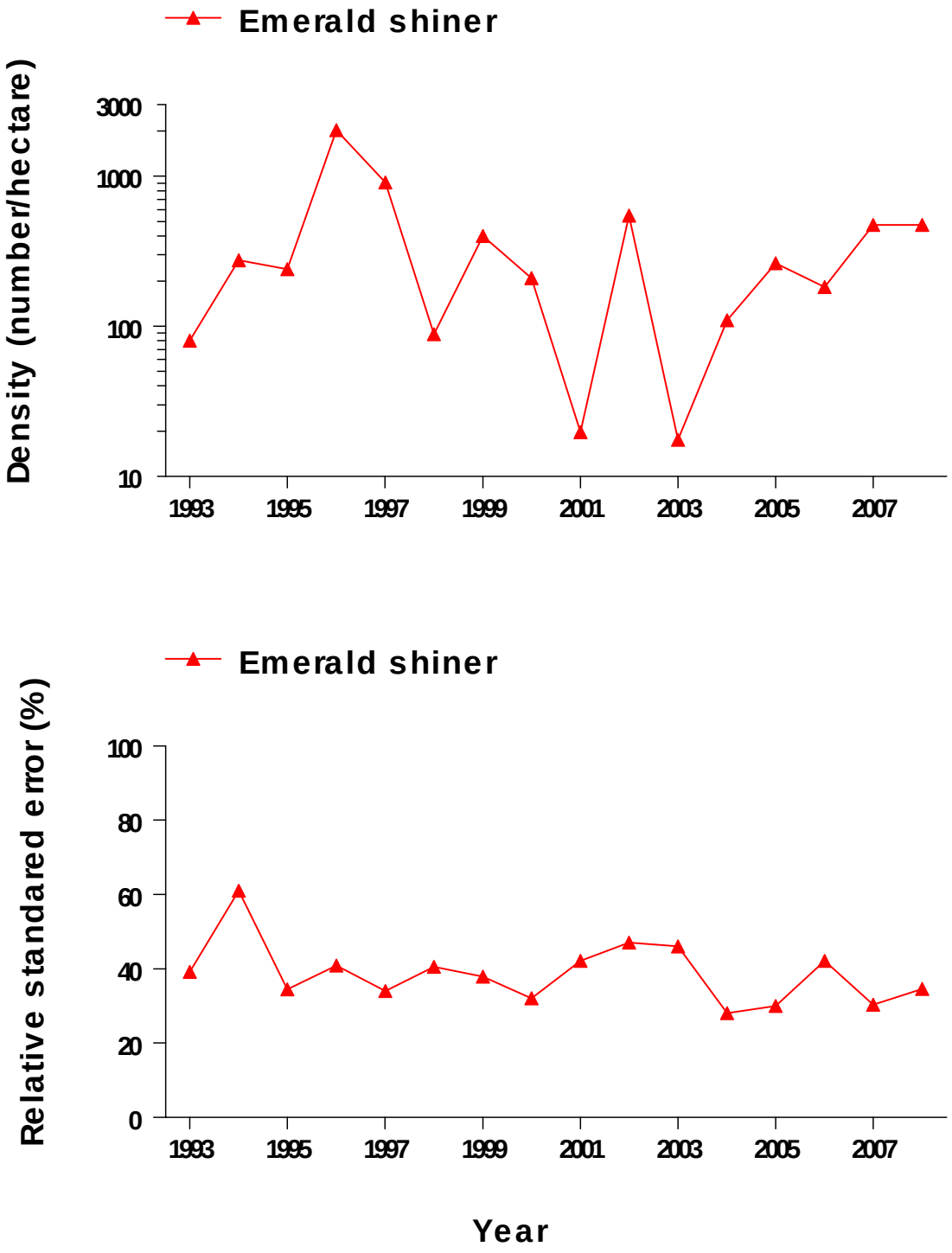

Figure 4. Density (top) and relative standard error (bottom) for age-0 emerald shiner as number of individuals per hectare in western Lake Erie near East Harbor State Park, Ohio, during autumn 1993-2008. Density (number/hectare) is presented in log scale.

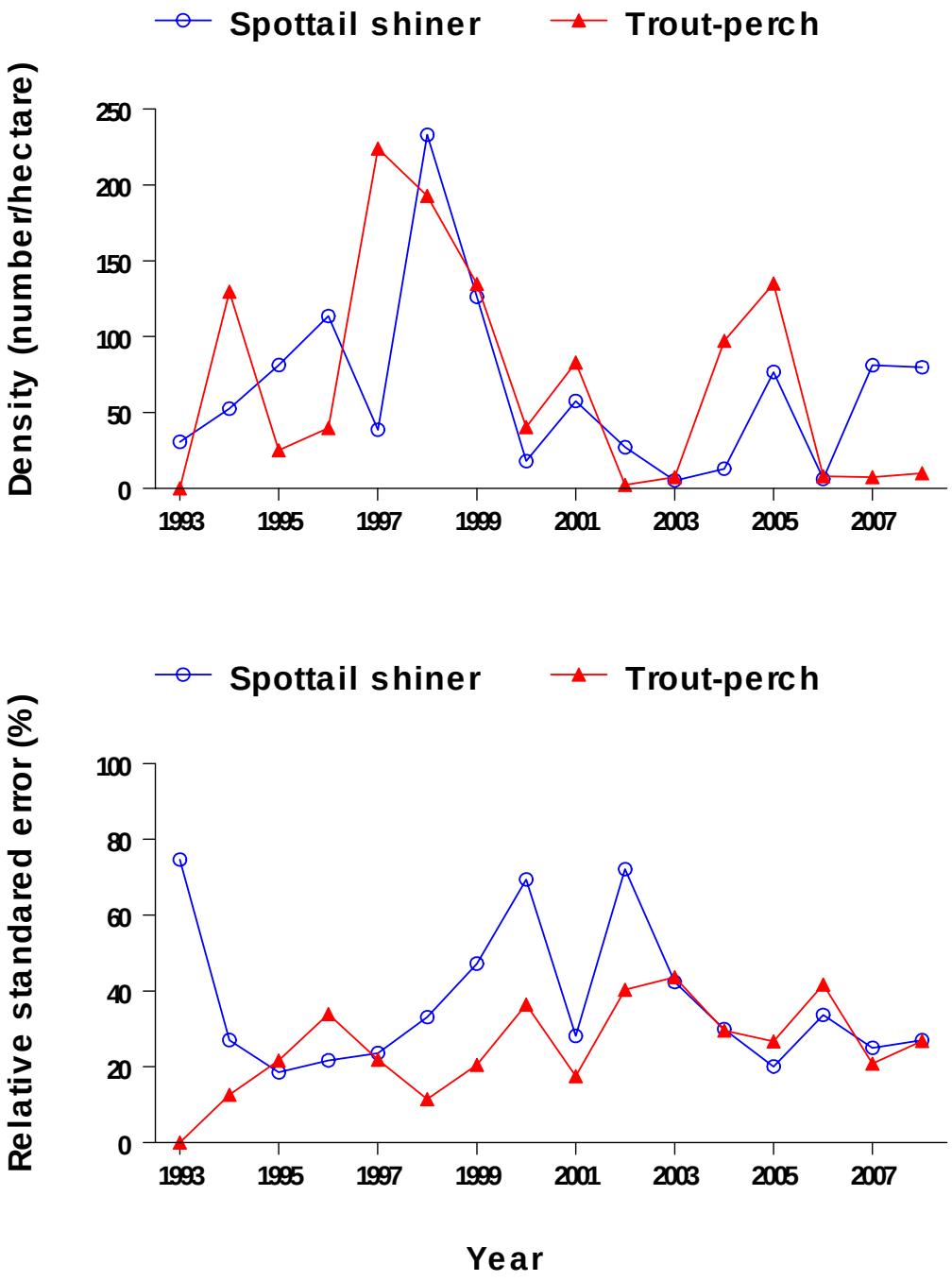

Figure 5. Density (top) and relative standard error (bottom) for age-0 spottail shiner and trout-perch as numbers of individuals per hectare in western Lake Erie near East Harbor State Park, Ohio, in autumn 1996-2008.

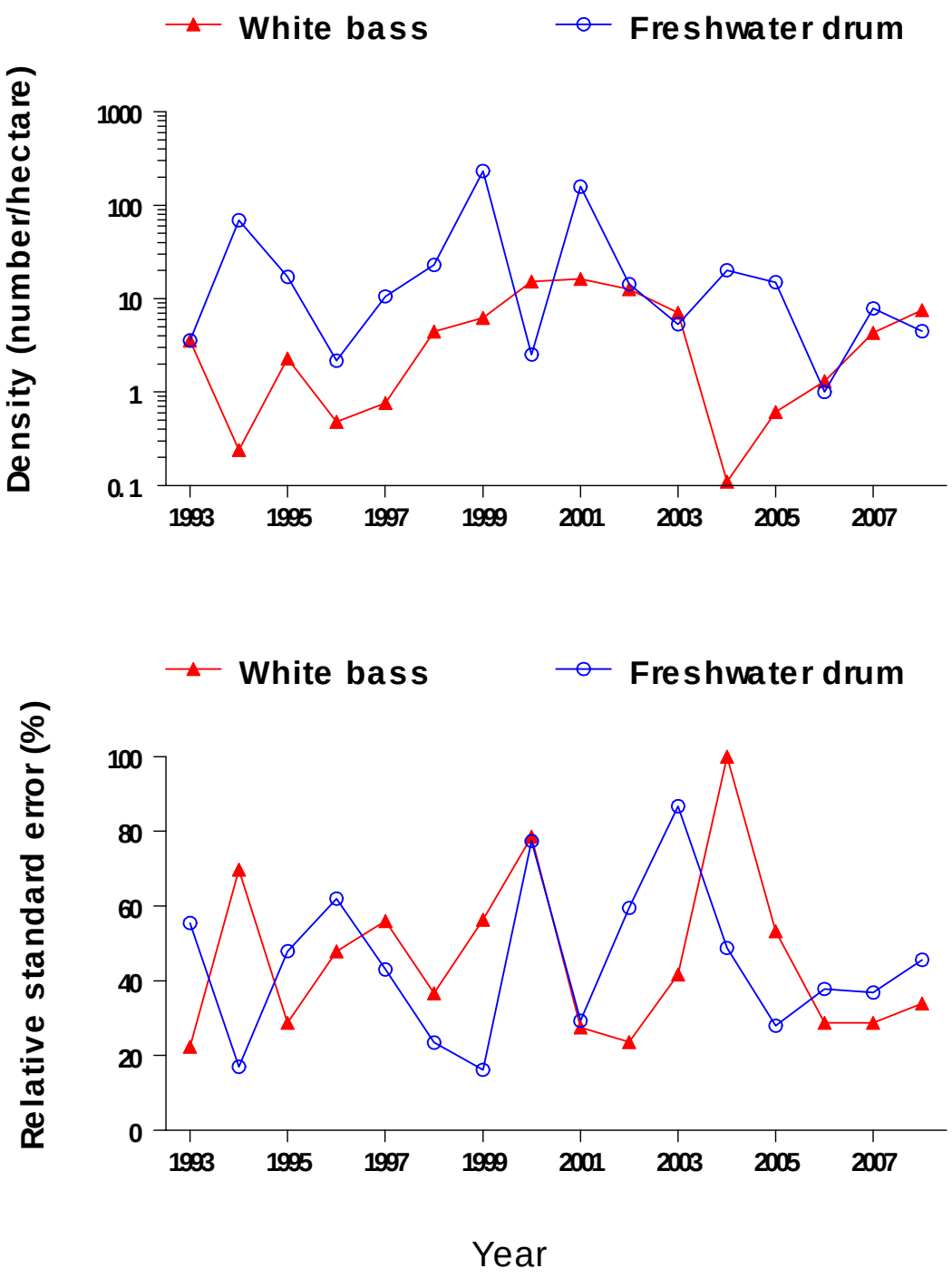

Figure 6. Density (top) and relative standard error (bottom) for age-0 white bass and freshwater drum as number of individuals per hectare in western Lake Erie near East Harbor State Park, Ohio, during autumn 1993-2008. Density (number/hectare) is presented in log scale.

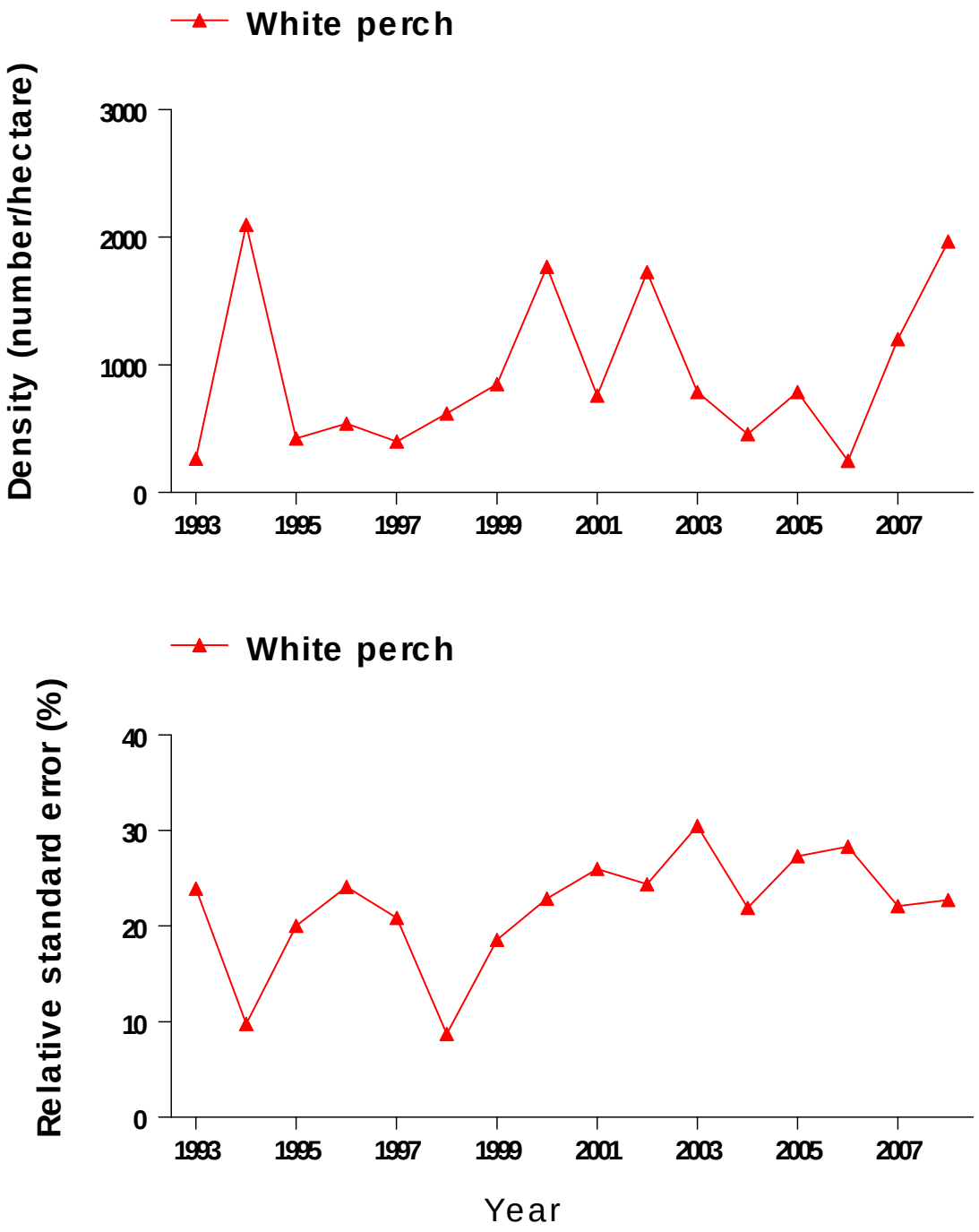

Figure 7. Density (top) and relative standard error (bottom) for age-0 white perch as number of individuals per hectare in western Lake Erie near East Harbor State Park, Ohio, during autumn 1993-2008.

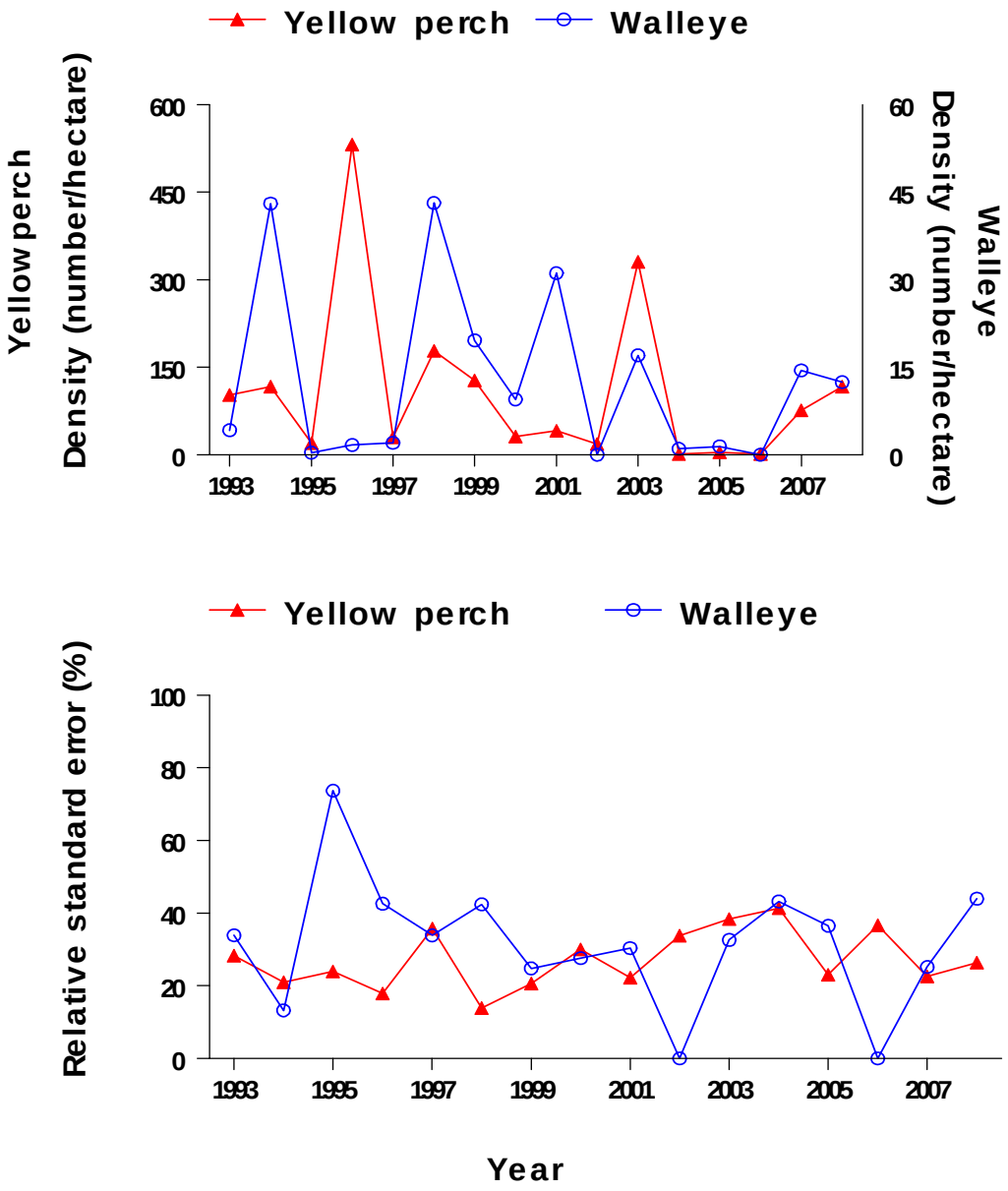

Figure 8. Density (top) and relative standard error (bottom) for age-0 yellow perch and walleye as number of individuals per hectare in western Lake Erie near East Harbor State Park, Ohio, during autumn 1993-2008.

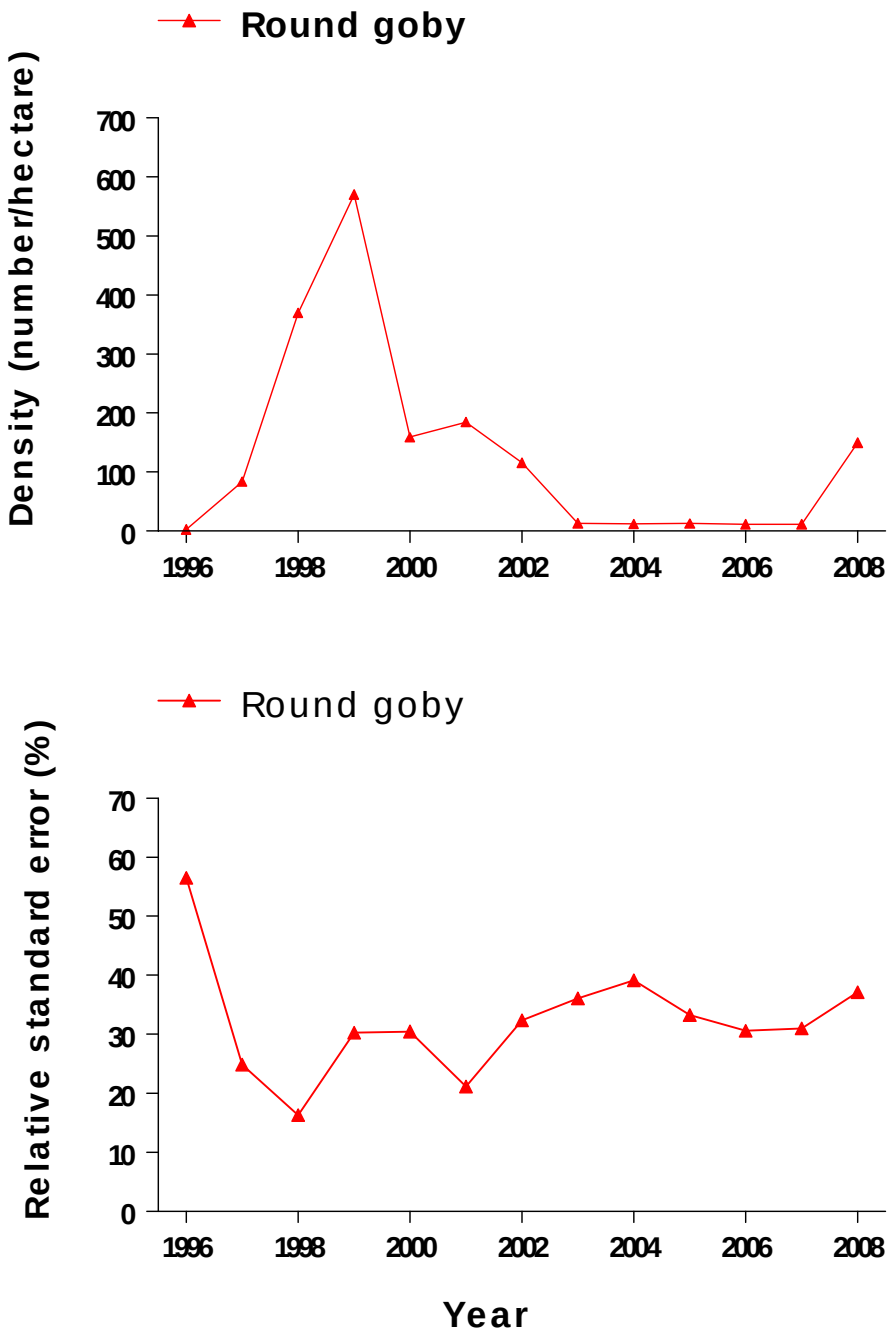

Figure 9. Density (top) and relative standard error (bottom) for age-0 and older round goby as number of individuals per hectare in western Lake Erie near East Harbor State Park, Ohio, during autumn 1996-2008.

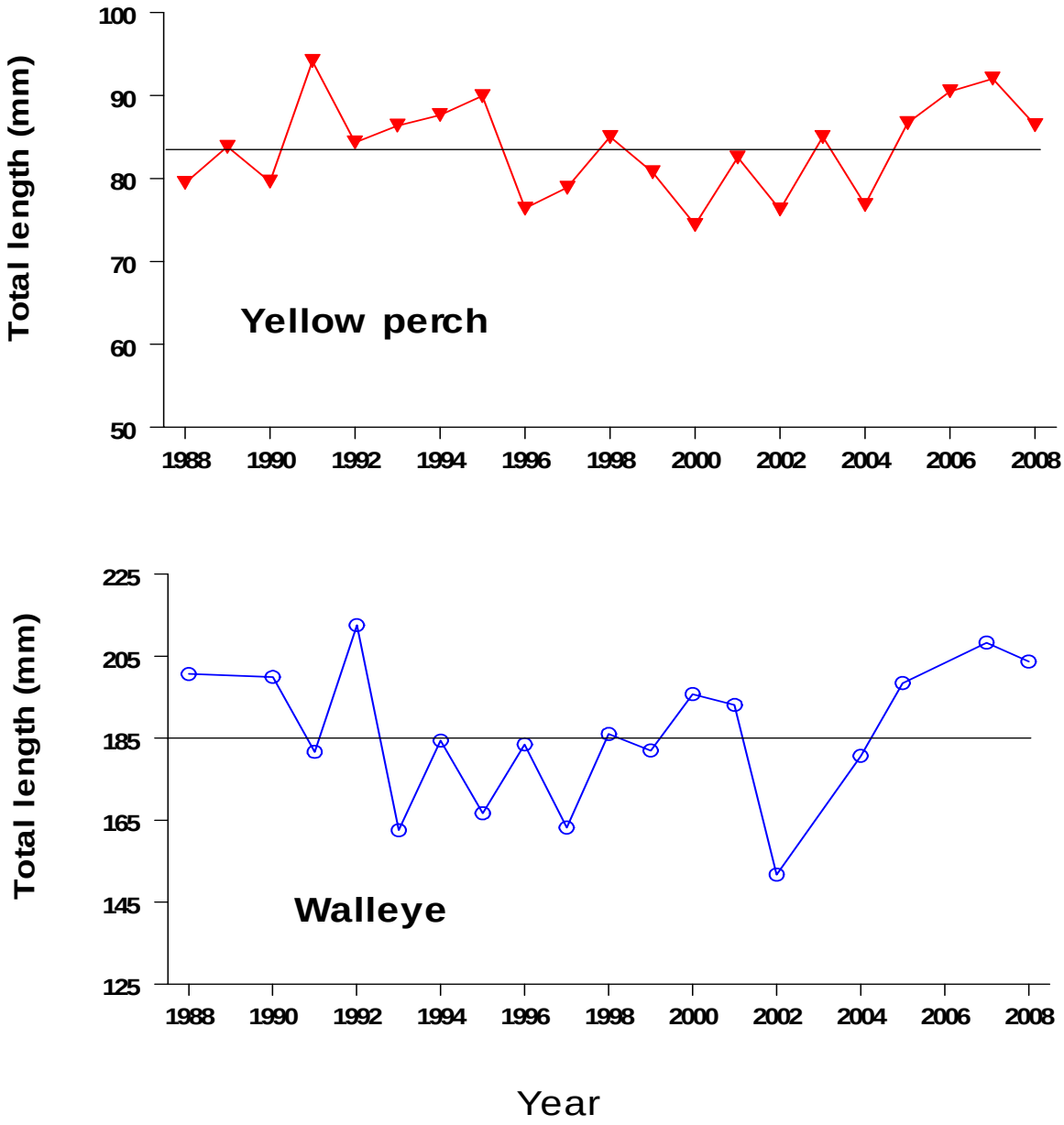

Figure 10. Mean total length of age-0 yellow perch and walleye in western Lake Erie near East Harbor State Park, Ohio, in autumn 1988-2008. The 20-year (1988-2007) mean is indicated by the horizontal red line.

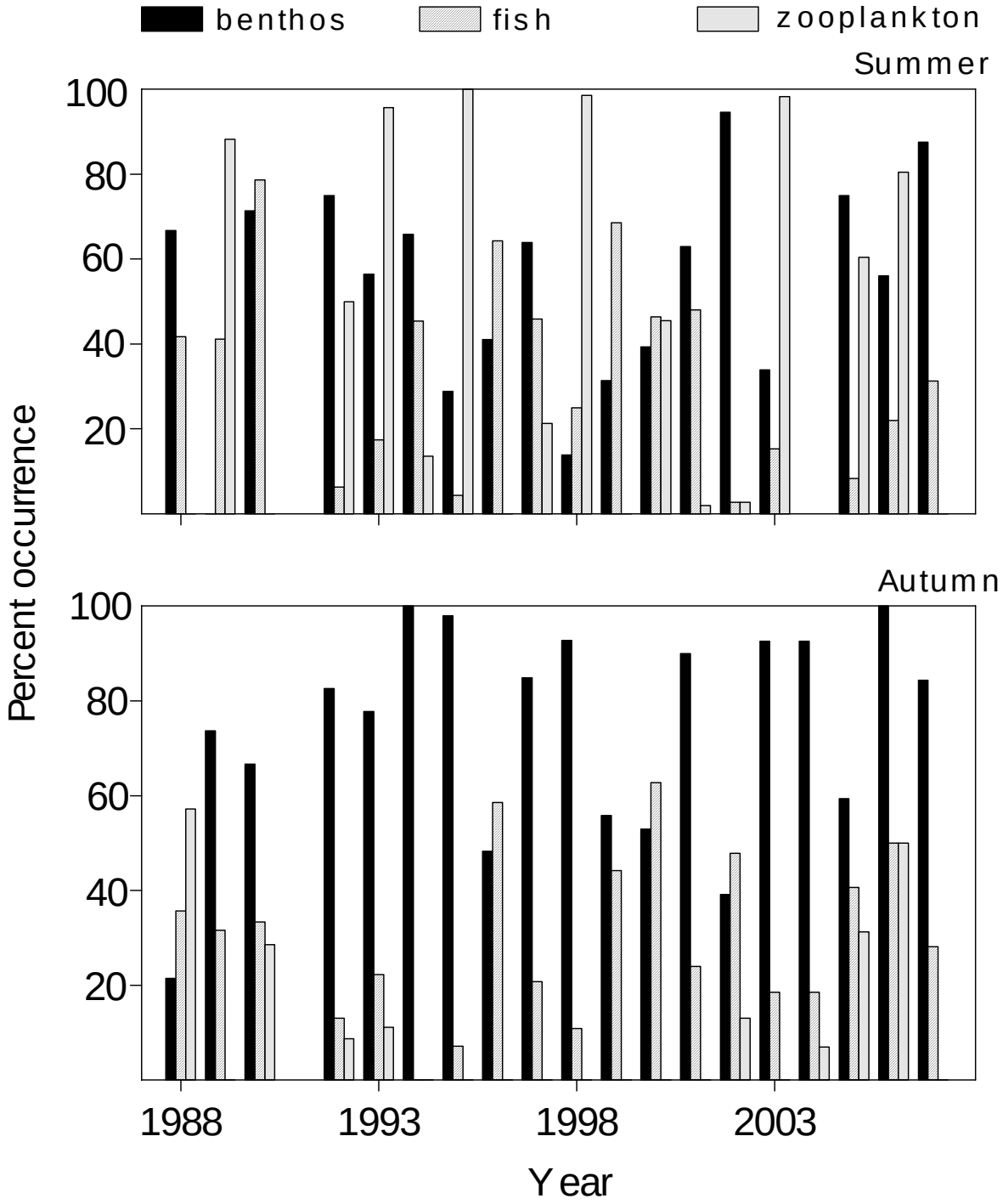

Figure 11. Percent frequency of diet major diet items in stomachs of yellow perch for both summer and autumn during 1988-2007 in western Lake Erie near East Harbor State Park, Ohio.

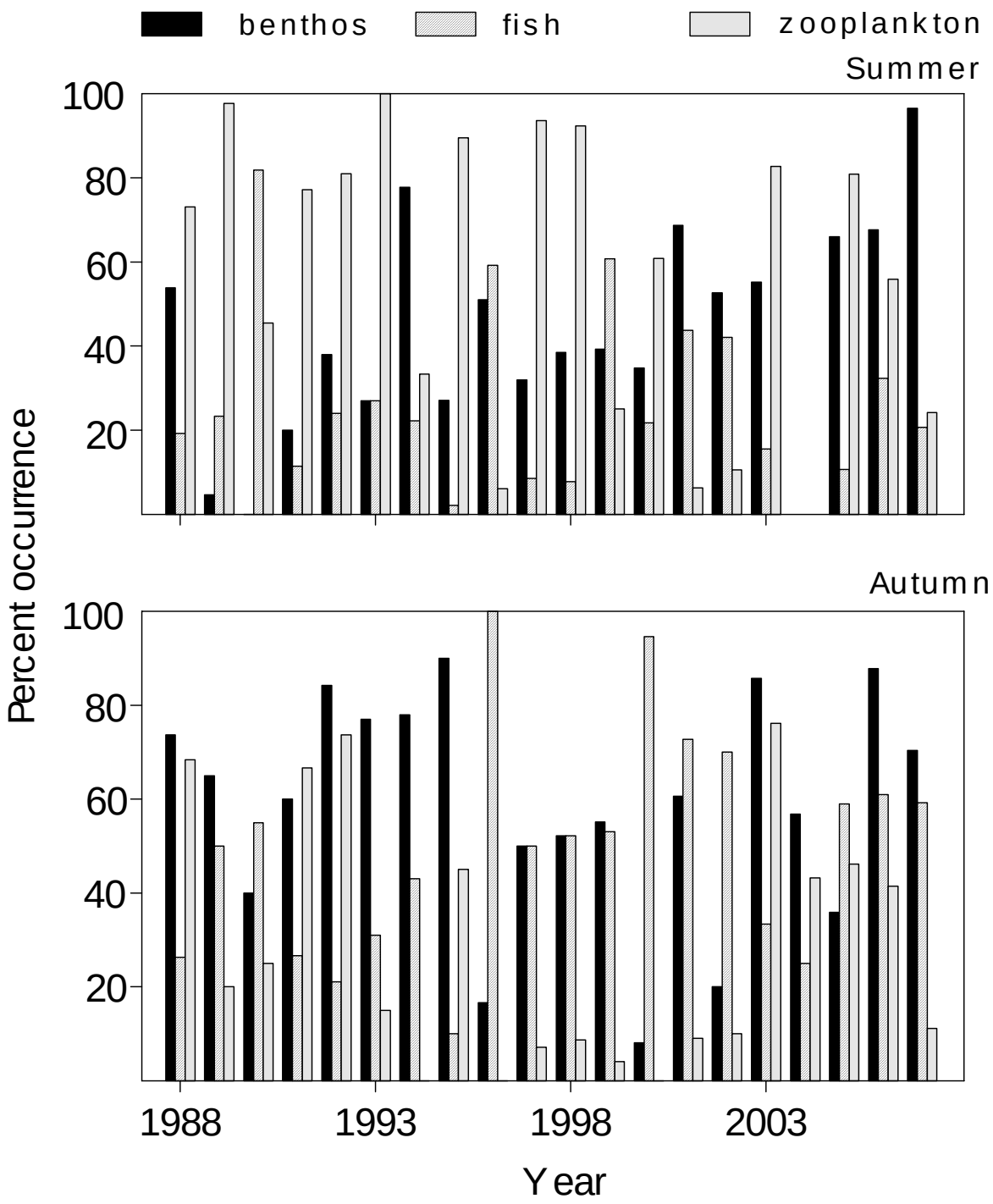

Figure 12. Percent frequency of diet major diet items in stomachs of white perch for both summer and autumn during 1988-2007 in western Lake Erie near East Harbor State Park, Ohio.