STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-81-R-6

Study No.: 230466

Title: Fish community status in Saginaw Bay, Lake Huron

Period Covered: October 1, 2004-September 30, 2005

Study Objective: To assess responses of the Saginaw Bay fish community to changing environmental and biological conditions. Of special interest is to monitor the response of the fish community to management actions and nonnative species.

Summary: The annual gillnetting and trawling surveys were performed in September 2005 as planned and data analysis is under way. Analysis of the 2004 survey indicates that walleye (See Table 1 for a complete list of common and scientific names of fishes and aquatic organisms mentioned in this report) and yellow perch again produced large year classes as measured at age-0. The record 2003 walleye year class was observed as yearlings in the 2004 survey and that year class tied with the previous high record level of production (1998) for walleye recruitment measured as yearlings. This, however, represents a substantial decline in abundance for the 2003 walleye year class given that it was originally 4.8x larger than the 1998 year class of walleye when measured at the age-0 stage. The record 2003 yellow perch year class diminished at an even greater extent with trawl catch-per-unit-of-effort (CPUE) declining by 99.1% by age-1 as measured in the 2004 survey. Walleye and yellow perch young-of-the-year (YOY) are growing slower in 2003 and 2004 than past years and is a reflection of the intraspecific competition they are experiencing at these high densities. Losses of young perch and walleye are believed to be from a combination of predation and over-winter thermal stress. Analysis of stomach contents of walleye and other predators indicates that YOY perch and walleye are being widely eaten. The smaller average size of the abundant juvenile walleye and perch is suspected to leave the vulnerable to thermal-stress induced mortality during winter months. The factors behind the increased levels of percid production in Saginaw Bay are believed to include the near absence of alewives. Alewives were scarce in Saginaw Bay for the second year and have similarly been in decline in the main basin of Lake Huron. The absence of this larval fish predator and competitor is believed to provide for better survival of percid fry. Ideal spring climate conditions for spawning and hatching may also have contributed to size of the 2003 year class. Saginaw Bay's fish community continues to exhibit tremendous change. The increased percid production is a very positive development but also raises new questions.

Findings: Jobs 1 through 4 were scheduled for 2004-05, and progress is reported below.

Job 1. Title: Relative abundance and community structure.–As part of the recent amendment to this study, a total of 16 gillnet sets were performed in September of 2005 reflecting the merging of four previous net sets (Table 2). Those stations were Pt. Lookout (1 net set), AuGres River (1 net set), and Pt. AuGres (2 net sets). Under the amendment, one net set was performed at Pt. Lookout and one at Pt. AuGres and collectively referred to as Pt. AuGres. This change combined two stations that were in close proximity, decreasing total field effort with little or no loss of ability to measure fish community changes. The adjustment to the sampling locations also slightly affected the distribution of sampling effort between inner and outer bay environments (Table 3).

Laboratory and data analysis of the 2005 survey is still under way. The 2004 findings, however, are presented here in addition to some past years added for perspective.

In 2004, the gillnet portion of the fish community survey collected a total of 1,707 specimens representing a total of 17 different species. Because two outer bay stations were added in 1995, and because the 38mm (1 ½”) mesh panel was added in 1993, trends in catch-per-unit-of-effort (CPUE) have been compiled two ways. Omitting the added stations and mesh size, we can eliminate some induced variability and observe trends in species composition (Table 4). A similar organization of the gillnet CPUE, but with the added stations and mesh size, reflects trends based on the entire survey catch (Table 5). From this we see that yellow perch failed to produce significant increases in abundance in 2004 based on the gillnet collections. Previously, survey collections in 2003 documented the largest walleye and yellow perch year classes ever measured in this survey series at the age-0. The 2004 survey was the first real measure of the true resulting year class strength at the age-1 size, reflecting their first year losses.

The strong 2002 walleye year class had resulted in a high overall walleye CPUE in 2003 (22.5) and despite the record 2003 walleye year class, the 2004 CPUE was just 12.2 (Table 6). The lower CPUE in 2004, however, may not have been statistically different from the 2003 CPUE given the variability of the catch (Table 5). The 2003 walleye year class resulted in an age-1 CPUE that was still strong by survey series standards and was very similar to the past record of 1998 (Table 6). Consequently, it is expected that the 2003 walleye year class will become a pervasive component of the fishery in years to come. Still it is disappointing that the overall magnitude initially measured at the age-0 size in 2003 did not fully translate through to proportionate numbers of yearlings in 2004. The 2003 walleye year class was 4.8 times the size of the old record 1998 year class when measured at the age-0 size but only equal in magnitude when measured at fully recruited at age-1.

Yellow perch CPUE also failed to detect any appreciable increase in 2004, the first year after the record 2003 year class (Table 5). Age-1 yellow perch, however are not fully recruited to the 38mm mesh size, however, and trends in the trawling are a better indicator of yellow perch production and survival. The poor survival of the walleye and yellow perch 2003 year classes may be partly tied to the smaller average size at the age-0 stage (Table 7). Age-0 walleye were the smallest ever measured in the gillnet collections in 2003. Walleyes produced in 2004 were even smaller, growing below the state average rate for the first time in this survey series (Table 7). Often the fastest growing walleye young-of-the-year (YOY) are first recruited to the gillnet collections and the size distribution of juvenile walleyes in the trawl catch is a better reflection of true age-0 growth rate. The mean length at capture of the age-1 walleyes in 2004 (from the 2003 year class) recovered to 118% the state average rate. Despite this improvement, they were still exhibiting a lower mean length-at-age compared to any past year in the survey series (Table 7). The slower growth of the 2003 walleye year class is not unexpected given the magnitude of the year class. There are also relatively strong walleye year classes on either side of the 2003 year class (2002 and 2004) probably contributing to the intraspecific competition for food and habitat.

The circumstances behind the production of the strong percid year classes of 2003 and now 2004 have been the source of extensive supposition. Despite considerable stocking in both years, the two year classes are dominated by wild, naturally reproduced fish which is a dramatic departure from past year classes (Table 8). It has been reported that similar record levels of percid production occurred in 2003 in parts of Lake Erie and in Green Bay, Lake Michigan. This suggests that there was a regional climate effect that year that favored good production or survival of walleye and perch fry. In 2004, however, the trend has continued in Saginaw Bay suggesting that other factors are allowing for continued very strong percid production. Alewives have been documented to be a formidable predator and competitor on newly hatched percid fry

(Kohler and Ney 1980; Wells 1980; Brandt et al. 1987; Brooking et al. 1998) and have been reported as obstacles to walleye recovery in some Great Lakes locations (Hurley and Christie 1977; Bowlby et al. 1991). The virtual absence of alewives in Saginaw Bay in 2003 and 2004 and much of the rest of Lake Huron is likely one of the factors allowing for this strong ongoing percid production in Saginaw Bay. This raises many questions such as what is limiting walleye and yellow perch year class strength when initial age-0 production is not limiting. How sustainable is the higher level of percid production? What is the future of walleye stocking in light of this? These issues will need to be addressed through a combination of research and management initiatives. The management action, if any, will likely draw upon the Saginaw Bay walleye recovery plan (Fielder and Baker 2004).

Outside of the strong 2003 and 2004 year classes, walleye have generally continued to grow very fast with age-3 walleyes achieving a mean length at capture that is 121% of the Michigan average in 2004 (Table 7). Yellow perch continued to exhibit the improved growth rate in 2004 exceeding the overall state average since 2001. The improved yellow perch growth rate likely reflects the ongoing overall lower recruitment level of age-1 and older perch. Considerably slower growth has been documented by the trawl collections at the age-0 size however.

Diet of walleyes exhibited a dramatic shift away from alewives and gizzard shad to yellow perch and walleye (Table 9). Yellow perch began to figure more prominently in walleye diet in 2003 and was by far the most abundant dietary item in 2004. Nearly all of the perch observed in stomachs of walleye were YOY. Walleye cannibalism was documented for the first time in 2004 reflecting the large abundance and perhaps the lower average size of walleye YOY that year. Predation by walleye and many other species in Saginaw Bay is likely one of the reasons that yellow perch age-0 production in 2003 failed to translate through to a strong year class at age-1. Other causes may factor in as well including vulnerability to over winter mortality resulting from thermal stress and insufficient fat reserves for juvenile percids stemming from their smaller average size.

The age structure of the adult yellow perch population was dominated by age-3 perch in 2004 tracing back to the 2001 year class (Table 10). Yellow perch as old as age 8 were collected in 2004. Trends in lower recruitment of yellow perch are evident in the age structure when contrasted to years such as 1999 when the larger production of the 1998 year class bolstered the perch population.

Other species of notable abundance in the gillnet catch included freshwater drum, white perch, white sucker, and channel catfish (Table 5). Overall abundance of channel catfish has not changed in the bay but the age structure continues to be dominated by the 1998 year class (Table 11).

A total of 36 trawl hauls were made on the waters of inner Saginaw Bay in 2004 (Table 12), collecting 75,314 fish. Trawl CPUEs for fish species commonly captured in Saginaw Bay fall trawls are summarized in Table 13. Yellow perch were the most abundant species in the trawls with a CPUE of 490 per tow. Trout-perch were the second most abundant species, followed by round goby, smelt, and spottail shiners. Alewives were conspicuously rare in the trawls with a CPUE of 10 per tow, the lowest recorded since 1974. Since all alewife captured in the trawls in Saginaw Bay are age-0 fish, this low value suggests that alewife adult abundance in 2005 will remain low in Lake Huron. The soft-rayed forage index value (sum of catch rates for alewives, emerald shiner, gizzard shad, rainbow smelt, round gobies, spottail shiner, and trout-perch) in 2004, of 1,253 fish per 10 minute tow, is the lowest since 1996 and is mainly a result of low catch rates for alewife and spottail shiners. Yellow perch CPUE was largely a function of a strong cohort of age-0 fish (Table 14), which ranked third strongest since 1970, behind the 1982 and

2003 year classes. However, as with the 2003 cohort, yellow perch young-of-year in 2004 were exceptionally small with the lowest mean total length for the times series. The CPUE for age-1 yellow perch in 2004 was only 22.9 per tow (Table 15), representing a decline of 99.1% from the record age-0 CPUE of 2,450 in 2003. We suspect that the small size of fish in the 2004 cohort will also lead to high levels of over-winter mortality. This mortality is likely a function of both low energy reserves due to small body size as well as high predation losses due to abundance of walleye.

Walleye recruitment in 2004 was also strong, with an age-0 walleye CPUE of 23 (Table 16). This value is second highest behind the record 2003 cohort, and nearly 3 times higher than the third strongest cohort which was recorded in 1998 (8.55). Trawl and gillnet surveys in 2005 will provide an evaluation of the survival of the 2004 yellow perch and walleye cohorts through the winter of 2004-05.

Round gobies have become well established throughout Saginaw Bay and are now included in the food web. Examination of stomachs of fish caught in trawls in 2004 and 2005 indicated that yellow perch, walleye, and freshwater drum are frequently preying on round gobies in Saginaw Bay. Impacts of round gobies on the fish community of Saginaw Bay will be evaluated with data collected during this study. The exotic Eurasian ruffe has been collected from Thunder Bay within the Lake Huron watershed but has not yet been documented from Saginaw Bay.

Mean length-at-age for age-1 and older yellow perch captured in trawls indicates improved growth rates since the mid-1990s (Table 17). Yellow perch growth in Saginaw Bay is believed to be density dependent (Haas and Schaeffer 1992). This improvement in growth is likely a density-dependent response to the dramatic decline in yellow perch abundance since 1989. An improvement in food resources may also be involved. Zebra mussels first became abundant throughout Saginaw Bay in 1992. The subsequent redirection of energy into benthic production may be contributing to improved yellow perch growth.

Trawling was conducted during September 2005. A total of 29 trawl hauls were made in the inner bay quadrants (Table 12). Lab processing of 2005 trawl and gillnet samples as well as data entry and analysis will be conducted during the winter and spring of 2006.

Job 2. Title: <u>Process and analyze survey data.</u>–Analysis of the study data has been performed by Michigan Department of Natural Resources Fisheries Division personnel from the Alpena Fisheries Research Station, and the Lake St. Clair Fisheries Research Station. Data and specimens from the 2005 survey are still being analyzed and will be reported on in 2006.

Job 3. Title: <u>Determine year class composition.</u>–Walleyes stocked in Saginaw Bay in 2004 & 2005 were again marked with oxytetracycline (OTC). All stocked fish now since 1997 in Saginaw Bay have been marked with OTC. A total of 863 specimens were collected in 2005 from multiple age groups to assess year class composition (Table 8). These results build upon similar analyses performed in some past years. These results are discussed above in the context of other findings in Job 1. A similar number of specimens was also collected in 2005 and are awaiting laboratory analysis.

Job 4. Title: <u>Prepare annual, final, and other reports.</u>–This Performance Report summarizes data from 2004, those reported previously in performance reports since 1998, under Fielder et al. (2000), and fulfills the requirements of Job 4. Although this study was renewed in 2005, a seven year summary report is being written to document the collective findings spanning the survey years of 1998 through 2004. That report is expected to be published as a Michigan DNR, Fisheries Division Research Report in 2006.

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Prepared by: David Fielder and Mike Thomas
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Table 1.–Common and scientific names of fishes and other aquatic organisms mentioned in this report.

Common name	Scientific name
Alewife	*Alosa pseudoharengus*
Bigmouth buffalo	*Ictiobus cyprinellus*
Black crappie	*Pomoxis nigromaculatus*
Bluegill	*Lepomis macrochirus*
Bowfin	*Amia calva*
Brown trout	*Salmo trutta*
Burbot	*Lota lota*
Channel catfish	*Ictalurus punctatus*
Chinook salmon	*Oncorhynchus tshawytscha*
Common carp	*Cyprinus carpio*
Emerald shiner	*Notropis atherinoides*
Eurasian ruffe	*Gymnouphalus cernuus*
Freshwater drum	*Aplodinotus grunniens*
Gizzard shad	*Dorosoma cepedianum*
Goldfish	*Carassius auratus*
Johnny darter	*Etheostoma nigrum*
Lake trout	*Salvelinus namaycush*
Lake whitefish	*Coregonus clupeaformis*
Longnose gar	*Lepisosteus osseus*
Longnose sucker	*Catostomus catostomus*
Ninespine stickleback	*Pungitius pungitius*
Northern pike	*Esox lucius*
Northern redhorse	*Moxostoma macrolepidotum*
Pumpkinseed	*Lepomis gibbosus*
Quillback	*Carpiodes cyprinus*
Rainbow smelt	*Osmerus mordax*
Rainbow trout	Oncorhynchus *mykiss*
Rock bass	*Ambloplites rupestris*
Round goby	*Neogobius melanostomus*
Round whitefish	*Prosopium cylindraceum*
Shorthead redhorse	*Moxostoma macrolepidotum*
Smallmouth bass	*Micropterus dolomieu*
Spottail shiner	*Notropis hudsonius*
Stone cat	*Noturus flavus*
Trout-perch	*Percopsis omiscomaycus*
Walleye	*Sander vitreus*
White bass	*Morone chrysops*
White perch	*Morone americana*
White sucker	*Catostomus commersonii*
Yellow perch	*Perca flavescens*
Zebra mussel	*Dreissena polymorpha*

Table 2.–Number of fall gillnet sets (by location) for Saginaw Bay, Lake Huron, 1992–2005.

Station	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Pt. Lookout	1	1	1	4	3	1	1	1	1	1	1	1	1	–
AuGres River	1	–	1	1	1	1	1	1	1	1	1	1	1	–
Pt. AuGres	2	2	2	6	6	2	2	2	2	2	2	2	2	2
Black Hole	2	2	2	6	5	2	2	2	2	2	2	2	2	2
Coreyon Reef	2	2	2	3	2	2	2	2	2	2	2	2	2	2
Fish Pt.	–	2	2	3	5	2	2	2	2	2	2	2	2	2
North Island	–	–	1	6	5	2	2	2	2	2	2	2	2	2
Oak Pt.	–	1	1	6	5	2	2	2	2	2	2	2	2	2
Charity Is.	–	–	–	3	2	2	2	2	2	2	2	2	2	2
Tawas	–	–	–	2	2	2	2	2	2	2	2	2	2	2
Total	8	9	12	40	36	18	18	18	18	18	18	18	18	16

Table 3.–Number of fall gillnet sets in Saginaw Bay, Lake Huron, divided by inner and outer bay environments for 1992–2005.

Location	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Inner	7	7	10	28	24	11	11	11	11	11	11	11	11	10
Outer	1	2	2	12	12	7	7	7	7	7	7	7	7	6
Total	8	9	12	40	36	18	18	18	18	18	18	18	18	16

Table 4.–Mean catch-per-unit-of-effort (CPUE; number per 305 m gillnet) and two standard errors of the mean (2SE) by species for Saginaw Bay, 1998–2004, at traditional netting locations. Table omits four net lifts from Charity Islands and Tawas Bay added in 1995.

	1998 (4,270m) 14 sets		1999 (4,270m) 14 sets		2000 (4,270m) 14 sets		2001 (4,270m) 14 sets		2002 (4,270m) 14 sets		2003 (4,270m) 14 sets		2004 (4,270m) 14 sets	
Species	Mean	2SE	Mean	2SE	Mean	2SE	Mean	2SE	Mean	2SE	Mean	2SE	Mean	2SE
Alewife	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Black crappie	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
Brown bullhead	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Brown trout	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.4	0.1	0.1	0.0	0.0
Burbot	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Carp	0.1	0.1	1.6	1.0	0.1	0.2	0.1	0.2	0.9	0.8	0.3	0.3	0.1	0.2
Channel catfish	6.7	4.7	15.3	8.2	8.8	5.2	10.7	5.4	12.9	6.1	11.1	5.1	6.0	4.0
Chinook salmon	0.1	0.1	0.0	0.0	0.0	0.0	0.5	0.5	0.2	0.2	0.0	0.0	0.0	0.0
Freshwater drum	4.8	2.7	17.4	12.0	13.1	8.2	13.6	10.3	8.8	5.3	6.9	3.5	6.9	4.3
Gizzard shad	40.0	29.6	11.9	5.8	1.7	1.1	4.1	4.5	7.0	4.3	2.1	1.3	1.7	1.9
Lake trout	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lake whitefish	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Longnose gar	0.2	0.3	0.1	0.1	0.2	0.3	0.1	0.1	0.0	0.0	0.3	0.3	0.4	0.5
Longnose sucker	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Northern pike	0.2	0.3	0.1	0.2	0.6	0.4	0.1	0.2	0.1	0.1	0.4	0.3	0.1	0.2
Northern redhorse	0.4	0.4	0.2	0.2	0.2	0.2	0.0	0.0	0.2	0.3	0.2	0.2	0.4	0.3
Quillback	0.1	0.1	3.0	2.0	1.9	1.6	1.7	1.6	1.4	1.3	1.5	0.9	2.1	1.6
Rainbow smelt	0.0	0.0	0.1	0.3	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Rock bass	0.1	0.2	0.5	0.7	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1
Round whitefish	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Smallmouth bass	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.1	0.2
Stone cat	0.2	0.2	0.0	0.0	0.1	0.2	0.5	0.9	0.1	0.2	0.1	0.1	0.0	0.0
Walleye	12.6	4.8	12.9	4.3	7.1	3.5	8.1	6.5	8.0	3.4	22.5	10.7	11.0	3.7
White bass	0.8	0.6	0.6	0.6	0.2	0.2	0.1	0.2	0.1	0.1	1.6	1.4	0.1	0.1
White crappie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0
White perch	3.4	3.4	21.2	6.8	23.2	9.0	12.8	11.1	10.2	13.4	21.4	17.1	20.6	31.4
White sucker	18.4	6.4	20.3	8.0	11.8	4.4	13.0	5.3	8.6	4.4	19.0	10.0	13.1	5.9
Yellow perch	12.4	4.7	24.9	8.2	14.6	5.8	48.0	20.3	12.5	3.0	18.4	7.5	30.7	13.7

Table 5.–Mean catch per unit of effort (CPUE; number per 335 m gillnet) by species for Saginaw Bay, 1998–2004. Table includes the four net lifts from Charity Islands and Tawas Bay added in 1995. Includes 38mm (1½ inch) mesh panel.

	1998 (6,030m) 18 sets		1999 (6,030m) 18 sets		2000 (6,030m) 18 sets		2001 (6,030m) 18 sets		2002 (6,030m) 18 sets		2003 (6,030m) 18 sets		2004 (6,030m) 18 sets	
Species	Mean	2SE	Mean	2SE	Mean	2SE	Mean	2SE	Mean	2SE	Mean	2SE	Mean	2SE
Alewife	0.5	0.8	0.1	0.1	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Black crappie	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Bluegill	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Brown bullhead	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Brown trout	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.1	0.1	0.0	0.0
Burbot	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Carp	1.4	0.8	0.1	0.2	0.2	0.2	0.2	0.2	0.7	0.6	0.5	0.5	0.1	0.2
Channel catfish	12.7	6.9	5.8	3.8	7.8	4.4	9.3	4.6	10.6	5.3	8.9	4.6	9.2	6.0
Chinook salmon	0.0	0.0	0.2	0.2	0.1	0.1	0.1	0.2	0.2	0.3	0.0	0.0	0.2	0.2
Freshwater drum	14.4	9.8	4.6	2.4	10.8	6.7	11.2	8.4	7.8	4.3	5.4	3.1	8.4	5.1
Gizzard shad	13.3	7.3	50.2	33.8	3.3	2.0	9.1	10.4	11.9	6.3	7.8	5.5	1.9	2.1
Goldfish	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lake trout	0.1	0.2	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.2
Lake whitefish	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Longnose gar	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.0	0.0	0.3	0.3	0.3	0.4
Longnose sucker	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.0	0.0
Northern pike	1.7	3.1	0.3	0.4	1.9	2.5	0.5	0.8	0.2	0.3	0.3	0.3	0.2	0.2
Northern redhorse	0.2	0.2	0.3	0.3	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.2
Quillback	2.3	1.7	0.1	0.1	1.5	1.3	1.3	1.3	1.1	1.0	1.2	0.8	1.6	1.3
Rainbow smelt	0.1	0.2	0.0	0.0	0.0	0.0	0.3	0.4	0.0	0.0	0.3	0.7	0.0	0.0
Rock bass	0.7	0.7	0.4	0.6	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.2	0.1	0.1
Round goby	0.1	0.2	0.0	0.0	0.4	0.3	0.3	0.4	0.2	0.2	0.1	0.1	0.0	0.0
Round whitefish	0.0	0.0	0.2	0.2	0.0	0.0	0.4	0.4	0.1	0.1	0.0	0.0	0.0	0.0
Shortnose gar	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Smallmouth bass	0.2	0.3	0.2	0.3	0.0	0.0	0.3	0.3	0.2	0.3	0.0	0.0	0.1	0.2
Stone cat	0.0	0.0	0.2	0.2	0.1	0.2	0.4	0.7	0.1	0.2	0.2	0.3	0.0	0.0
Walleye	12.8	4.0	13.0	4.1	6.6	2.9	7.3	5.3	7.2	3.1	22.0	11.6	12.2	5.0
White bass	0.5	0.5	1.8	1.0	0.2	0.2	0.2	0.2	0.1	0.1	4.3	2.8	0.1	0.1
White crappie	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0
White perch	25.0	9.1	2.9	2.8	20.8	8.9	11.6	10.2	8.3	10.8	19.2	15.5	16.8	25.2
White sucker	20.6	7.7	17.4	5.2	11.9	4.4	11.3	4.7	7.6	3.7	14.9	8.6	12.4	5.4
Yellow perch	66.6	17.4	31.3	9.7	34.4	15.7	59.7	25.6	32.7	11.3	34.6	14.4	38.7	15.4

Table 6.–Catch-per-Unit-of-Effort (CPUE) by year class of walleye in the fall gillnet survey catches, Saginaw Bay, Lake Huron, 1998–2004. Catch-per-unit-effort is catch per 335m, 18 net sets were made each survey year.

Year	1998		1999		2000		2001		2002		2003		2004	
class	Age	CPUE	Age	CPUE	Age	CPUE	Age	CPUE	Age	CPUE	Age	CPUE	Age	CPUE
2004	–	–	–	–	–	–	–	–	–	–	–	–	0	0.2
2003	–	–	–	–	–	–	–	–	–	–	0	5.5	1	6.3
2002	–	–	–	–	–	–	–	–	0	0.3	1	6.1	2	2.9
2001	–	–	–	–	–	–	0	0.8	1	2.6	2	4.0	3	0.7
2000	–	–	–	–	0	–	1	1.0	2	1.0	3	1.1	4	0.7
1999	–	–	0	0.1	1	0.4	2	0.9	3	0.6	4	1.5	5	0.6
1998	0	0.7	1	6.8	2	3.1	3	2.4	4	1.4	5	1.8	6	0.3
1997	1	4.2	2	2.2	3	1.1	4	0.3	5	0.4	6	1.1	7	0.1
1996	2	0.2	3	0.2	4	0.1	5	0.2	6	0.3	7	0.7	8	0.1
1995	3	1.3	4	0.6	5	0.4	6	0.4	7	0.2	8	0.4	9	0.1
1994	4	2.4	5	0.8	6	0.2	7	0.2	8	0.2	9	0.1	10	0.1
1993	5	0.7	6	0.3	7	0.2	8	0.3	9	0.2	–	–	11	0.1
1992	6	0.6	7	0.8	8	0.8	9	0.4	10	0.1	–	–	–	–
1991	7	0.9	8	0.5	9	0.3	10	0.1	11	0.1	–	–	–	–
1990	8	0.8	9	0.3	10	0.1	11	0.1	–	–	–	–	–	–
1989	9	0.4	10	0.2	–	–	–	–	–	–	–	–	–	–
1988	10	0.4	11	0.1	–	–	–	–	–	–	–	–	–	–
1987	11	0.1	–	–	–	–	–	–	–	–	–	–	–	–
1986	12	0.1	–	–	–	–	–	–	–	–	–	–	–	–
Mean	3.7		2.8		3.8	–	3.4		3.0		2.2		2.1	
Total [a]		12.7		12.8		6.6		7.3		7.2		22.3		12.0

[a] Data based on aged sample and therefore may differ slightly from value reported in Tables 4 and 5.

Table 7.–Mean length (mm) at age and two standard errors of the mean for walleyes and yellow perch from Saginaw Bay, Lake Huron, from fall gillnet data for 1998–2004, compared with Michigan average lengths from August–September catches. Saginaw Bay historic average for 1926–38 is also included for walleyes.[b] No means included for sample sizes less than 5 specimens. Growth Index is calculated with methodology from Schneider et al. (2000) and is expressed in mm.

Age	1998		1999		2000		2001		2002		2003		2004		Michigan average[a]	Bay historic average[b]
									Walleye							
	Mean	2SE	Mean	2SE	Mean	2SE	Mean	2SE	Mean	2SE	Mean	2SE	Mean	2SE		
0	227	9.7	–	–	–	–	200	5.0	203	14.1	193	5.4	171	23.5	180	–
1	341	4.2	361	2.9	333	7.8	350	5.1	344	5.7	349	3.6	296	5.0	250	254
2	–	–	438	8.1	436	6.5	426	6.9	434	8.8	434	9.3	418	5.0	338	320
3	482	25.4	–	–	497	14.1	496	7.9	490	15.9	494	15.1	470	15.0	386	371
4	508	22.0	505	20.1	–	–	524	20.4	504	25.9	515	12.1	520	14.2	437	411
5	496	42.1	544	13.3	512	34.2	–	–	567	26.6	548	10.9	545	34.8	472	457
6	565	16.4	570	28.1	–	–	553	25.2	588	57.3	554	13.5	553	27.4	516	483
7	551	13.9	560	25.9	–	–	–	–	–	–	559	18.4	–	–	541	505
8	570	18.5	563	35.4	581	27.6	552	17.3	–	–	599	33.3	–	–	561	533
9	612	45.9	588	15.9	576	66.3	578	25.3	–	–	–	–	–	–	582	582
10	624	45.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Growth index	+52.8		+62.2		+57.2		+53.1		+78.0		+62.7		+56.3			-15.2
									Yellow perch							
0	–	–	–	–	–	–	91	14.0	–	–	–	–	–	–	84	–
1	153	3.7	149	2.4	149	11.1	147	1.7	152	1.2	154	2.1	166	42.3	127	–
2	154	2.0	159	1.8	157	1.7	174	4.2	188	5.5	181	3.2	207	4.6	160	–
3	172	3.7	184	5.0	175	3.3	189	4.4	227	5.0	217	4.8	227	4.0	183	–
4	198	9.3	199	4.3	194	4.4	215	4.9	247	6.1	237	9.1	263	9.4	208	–
5	217	4.8	212	4.3	211	6.2	245	6.5	277	13.0	244	10.4	294	23.0	234	–
6	235	10.4	226	4.8	230	7.6	267	21.7	296	31.0	248	31.3	305	14.5	257	–
7	251	12.9	252	9.9	250	6.4	288	19.1	–	–	–	–	–	–	277	–
8	–	–	269	13.1	264	9.3	–	–	–	–	–	–	–	–	292	–
9	–	–	284	13.2	–	–	–	–	–	–	–	–	–	–	302	–
Growth index	-9.4		-11.7		-13.5		+10.7		+36.1		+18.8		+48.8			–

[a] From Schneider et al. (2000).
[b] From Hile (1954).

Table 8.–Percent hatchery contribution to walleye year classes sampled in Saginaw Bay since 1997 and expressed by age group over subsequent collections, based on marking of hatchery fish with oxytetracycline. Percent wild contribution is the inverse of these hatchery proportions.

Year	Age								Composite
class	0	1	2	3	4	5	6	7	for year class
1997	81	50	73	69	–	55	11	–	71
1998	81	83	92	86	85	67	–		82
1999	85	84	–	71	61	–			80
2000	96	94	94	68	62				83
2001	61	61	42	–					57
2002	85	91	77						84
2003	28	21							24
2004	19								19

Table 9.–Incidence of void stomachs and percent-abundance of food items found in stomachs of walleyes from fall gillnets in Saginaw Bay, 1989–2004.

Year	Stomachs examined	% void	Unidentified fish remains	Gizzard shad	Yellow perch	Spottail shiner	Rainbow smelt	Alewife	Ninespine stickleback	White sucker	Round goby	White perch	Channel catfish	Walleye	Freshwater drum
1989	257	26	27	63	0	0	<1	8	1	0	0	<1	0	0	0
1990	508	37	22	76	0	0	<1	1	<1	0	0	<1	0	0	0
1991	669	36	34	63	<1	<1	0	2	0	<1	0	0	0	0	0
1992	171	56	62	2	2	2	14	17	0	2	0	0	0	0	0
1993	371	52	39	59	0	0	<1	2	0	0	0	0	0	0	0
1994	84	45	24	70	3	3	0	0	0	0	0	0	0	0	0
1995	291	45	31	28	1	<1	0	37	0	<1	0	1	0	0	0
1996	148	61	72	23	4	0	0	1	0	0	0	0	0	0	0
1997	204	35	59	12	3	7	0	17	0	0	0	2	0	0	0
1998	234	47	40	2	1	2	0	54	0	0	0	0	1	0	0
1999	231	49	36	<1	8	13	<1	41	0	0	0	<1	0	0	0
2000	119	48	57	9	2	1	0	22	0	0	1	1	8	0	0
2001	114	57	27	<1	2	<1	0	59	0	0	0	9	0	0	0
2002	129	63	49	23	0	0	0	20	0	0	8	0	0	0	0
2003	363	57	17	21	18	0	0	42	0	2	0	0	0	0	0
2004	216	66	24	0	57	1	0	0	0	<1	2	0	0	13	<1

Table 10.–Catch-per-Unit-of-Effort (CPUE) by year class of yellow perch in the fall gillnet survey catches, Saginaw Bay, Lake Huron, 1998–2004. Catch-per-unit-effort is catch per 335m.

	1998 (9 net lifts)		1999 (9 net lifts)		2000 (9 net lifts)		2001 (9 net lifts)		2002 (14 net lifts)		2003 (10 net lifts)		2004 (10 net lifts)	
Year class	Age	CPUE	Age	CPUE	Age	CPUE	Age	CPUE	Age	CPUE	Age	CPUE	Age	CPUE
2004	–	–	–	–	–	–	–	–	–	–	–	–	0	0.4
2003	–	–	–	–	–	–	–	–	–	–	–	–	1	9.6
2002	–	–	–	–	–	–	–	–	0	–	1	6.1	2	7.0
2001	–	–	–	–	–	–	0	1.8	1	18.9	2	22.1	3	16.3
2000	–	–	–	–	–	–	1	10.0	2	3.2	3	5.8	4	2.1
1999	–	–	0	0.2	1	4.2	2	10.7	3	4.1	4	3.0	5	1.0
1998	0	0.1	1	22.0	2	13.7	3	21.9	4	5.1	5	2.3	6	0.7
1997	1	0.9	2	15.3	3	7.9	4	11.4	5	1.2	6	0.6	7	0.0
1996	2	9.2	3	5.0	4	4.1	5	3.3	6	0.6	7	0.1	8	0.1
1995	3	5.7	4	5.4	5	4.1	6	1.4	7	0.1	8	0.1	–	–
1994	4	3.2	5	6.2	6	2.7	7	0.7	–	–	–	–	–	–
1993	5	4.7	6	4.9	7	1.2	8	0.4	–	–	–	–	–	–
1992	6	1.9	7	2.1	8	0.8	9	0.1	–	–	–	–	–	–
1991	7	0.6	8	1.1	9	0.4	–	–	–	–	–	–	–	–
1990	8	0.4	9	0.6	10	0.1	11	0.1	–	–	–	–	–	–
1989	–	–	10	0.2	–	–	–	–	–	–	–	–	–	–
1988	–	–	11	0.1	–	–	–	–	–	–	–	–	–	–
Number aged	240		569		353		557		464		401		372	
Mean age	3.4		2.9		3.3		2.9		2.0		2.4		2.4	
Total CPUE [a]		26.7		63.2		39.2		61.9		33.1		40.1		37.2

[a] Data based on aged subsample and therefore may differ slightly from values reported in Tables 4 and 5.

Table 11.–Catch-per-Unit-of-Effort (CPUE) by year class of channel catfish in the fall gillnet survey catches, Saginaw Bay, Lake Huron, 1998–2004. Catch-per-unit-effort is catch per 335m.

	1998 (13 net lifts)		1999 (11 net lifts)		2000 (7 net lifts)		2001 (5 net lifts)		2002 (11 net lifts)		2003 (6 net lifts)		2004 (10 net lifts)	
Year class	Age [a]	CPUE [a]	Age	CPUE	Age	CPUE	Age	CPUE	Age	CPUE	Age	CPUE	Age	CPUE
2004	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2003	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2002	–	–	–	–	–	–	–	–	–	–	–	–	2	0.1
2001	–	–	–	–	–	–	–	–	–	–	–	–	3	0.5
2000	–	–	–	–	–	–	–	–	2	0.1	3	0.5	4	0.0
1999	–	–	–	–	–	–	2	0.6	3	0.5	4	6.7	5	1.6
1998	0	0.1	1	0.5	2	1.9	3	5.4	4	5.0	5	3.5	6	6.4
1997	1	0.2	2		3	0.7	4	1.0	5	0.1	6	0.5	7	0.7
1996	2	0.6	3	0.5	4	0.9	5	2.4	6	0.8	7	0.0	8	0.9
1995	3	2.0	4	4.8	5	3.0	6	2.0	7	1.1	8	0.3	9	1.5
1994	4	0.6	5	0.4	6	1.0	7	0.4	8	0.4	9	0.2	10	0.3
1993	5	0.2	6	0.5	7	0.3	8	0.2	9	0.3	10	0.0	–	–
1992	6	0.0	7	0.1	8	0.0	–	–	–	–	11	0.0	–	–
1991	7	0.2	8	0.3	9	0.3	–	–	–	–	12	0.2	–	–
1990	8	0.0	9	0.1	10	0.0	–	–	–	–	–	–	–	–
1989	9	0.2	10	0.0	11	0.0	–	–	–	–	–	–	–	–
1988	10	0.2	11	0.1	12	0.0	–	–	–	–	–	–	–	–
1987	11	0.0	12	0.0	13	0.1	–	–	–	–	–	–	–	–
1986	12	0.0	13	0.0	14	0.0	–	–	–	–	–	–	–	–
1985	13	0.0	14	0.0	15	0.1	–	–	–	–	–	–	–	–
1984	14	0.0	15	0.1	–	–	–	–	–	–	–	–	–	–
Number aged	56		80		60		60		90		71		120	
Mean age	4.2		4.4		4.8		4.2		4.9		4.6		6.4	
Total CPUE [b]		4.3		7.4		8.3		12.0		8.3		11.9		12.0

[a] Includes a CPUE of 0.08 for ages 15 & 16 each.
[b] Data based on aged sample and therefore may differ slightly from value reported in Tables 4 and 5.

Table 12.–Location of trawl stations and number of tows performed in Saginaw Bay, 1992–2005. All sampling was conducted in fall except where indicated otherwise.

Quadrant	Site description	1992	1993	1994	1995 [a]	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Northeast	North Island and Wildfowl Bay	16	5	6	6	6	13	13	9	9	3	10	4	9	7
Southeast	Fish Point	6	5	3	9	6	16	12	15	6	3	7	9	9	3
Southwest	Pinconning	3	13	13	9	12	15	17	20	6	9	10	7	9	6
Northwest	AuGres	11	15	10	15	6	23	22	20	6	12	10	10	9	9
Total		36	38	32	39	30	31	27	27	33	33 [b]	43 [b]	30	42 [b]	29
Study total															757 [c]

[a] Total for northwest quadrant includes six experimental trawls near Charity Islands
[b] Total number of tows includes 6 tows made at Outer Bay sites.
[c] Study total includes 15 tows from 1989.

Table 13.–Mean catch-per-unit effort of fish collected from trawling in Saginaw Bay, Lake Huron, during fall 1998–2004. Total number of tows is in parentheses. Soft-rayed forage index value is the sum of catch rates for alewife, emerald shiner, gizzard shad, rainbow smelt, round goby, spottail shiner, and trout-perch. See Table 1 for complete listing of scientific names for each species.

Species	1998 (27)	1999 (27)	2000 (30)	2001 (27)	2002 (35)	2003 (27)	2004 (36)	Mean 1980s	Mean 1990s	Mean 2000–04
Alewife	1,590	82	337	1,242	348	831	10	228	307	554
Channel catfish	3	4	6	7	5	3	1	4	3	4
Common carp	7	6	6	9	6	4	7	3	5	6
Emerald shiner	1	1	1	1	1	1	2	47	8	1
Freshwater drum	26	9	16	10	11	9	7	7	17	11
Gizzard shad	23	3	3	9	19	20	2	36	20	11
Johnny darter	5	6	4	1	<1	0	0	2	12	1
Lake whitefish	0	<1	<1	0	1	<1	<1	<1	<1	<1
Pumpkinseed	0	2	0	0	<1	0	0	<1	<1	0
Quillback	0	4	1	4	2	3	1	2	1	2
Rainbow smelt	70	32	390	496	147	431	210	265	272	335
Rock bass	<1	5	<1	0	<1	<1	0	0	1	<1
Round goby	0	4	127	385	356	164	369	0	<1	280
Shorthead redhorse	0	<1	0	0	<1	0	<1	0	0	<1
Spottail shiner	665	1,935	1,011	863	967	1,340	210	489	539	896
Trout perch	1,730	406	619	422	411	529	444	145	530	485
Walleye	10	7	2	2	4	42	28	1	4	16
White bass	2	<1	<1	0	<1	13	39	4	2	10
White perch	346	141	895	544	339	474	282	256	318	507
White sucker	12	10	7	24	26	38	19	7	12	23
Yellow perch	170	90	37	146	70	2,469	491	556	110	269
Soft-rayed forage index value	3,391	2,464	2,641	2,869	2,394	3,269	1,253	1,210	1,548	2,485

Table 14.–Number of young-of-the-year yellow perch caught per ten-minute tow (CPUE) from Saginaw Bay, Lake Huron and their mean total length, fall 1970–2004[a].

Year	CPUE	Mean total length (mm)
1970	29.5	96.5
1971	20.2	91.4
1972	13.9	83.8
1973	30.6	91.4
1974	27.9	88.9
1975	247.9	88.9
1976	11.1	91.4
1977	52.9	91.4
1978	99.8	86.4
1979	166.7	78.7
1980	39.0	86.4
1981	71.3	83.8
1982	686.7	76.2
1983	251.9	76.2
1984	171.0	78.7
1985	147.8	78.7
1986	71.4	73.7
1987	131.5	81.3
1988	56.6	76.2
1989	252.8	71.1
1990	39.0	79.5
1991	110.8	70.2
1992	7.1	76.2
1993	0.5	90.7
1994	3.9	85.0
1995	98.9	72.8
1996	37.3	81.9
1997	83.3	73.8
1998	74.4	76.1
1999	19.5	92.4
2000	9.4	83.2
2001	133.9	77.1
2002	36.7	76.2
2003	2,450.7	69.7
2004	461.8	66.1

[a] Data prior to 1990 from Haas and Schaeffer (1992).

Table 15.–Mean CPUE (catch per 10-minute tow) by age for yellow perch from fall trawls in Saginaw Bay, 1986 to 2004 and by pre and post zebra mussel (zm) colonization.

Survey year	Age 0	1	2	3	4	5	6	7	8	9	10	All ages	Yearling and older
1986	117.6	132.8	125.9	128.4	21.2	3.0	0.7	0.5	0.0	0.0	0.0	530.0	412.4
1987	258.0	61.0	98.6	66.8	37.6	6.6	1.8	0.4	0.0	0.0	0.0	530.9	272.9
1988	458.9	263.8	248.6	309.4	171.6	56.8	13.5	1.7	0.9	0.0	0.0	1525.3	1066.4
1989	280.2	168.7	180.3	128.0	81.1	33.3	12.9	4.4	0.3	0.3	0.0	889.6	609.4
1990	34.0	37.8	20.2	20.5	12.6	6.1	2.8	0.9	0.3	0.1	0.1	135.3	101.3
1991	102.6	15.6	29.3	19.2	13.5	8.6	2.5	0.4	0.0	0.0	0.0	191.8	89.1
1992	7.7	44.5	8.5	6.6	4.0	2.5	0.7	0.3	0.0	0.0	0.0	74.9	67.2
1993	0.5	2.2	20.7	7.6	4.4	1.9	0.3	0.1	0.2	0.0	0.0	37.8	37.3
1994	3.5	1.4	2.8	10.1	2.5	1.0	0.2	0.1	0.0	0.0	0.0	21.7	18.2
1995	100.6	12.0	2.6	3.5	5.2	1.1	0.6	0.1	0.1	0.0	0.0	125.8	25.2
1996	37.9	30.9	5.9	3.7	2.7	3.2	0.8	0.0	0.0	0.0	0.0	85.0	47.1
1997	89.1	11.3	16.9	2.9	0.5	0.5	0.4	0.2	0.0	0.0	0.0	122.0	32.8
1998	74.4	54.1	11.7	6.6	1.7	0.4	0.3	0.1	0.0	0.0	0.0	149.2	74.8
1999	19.5	28.1	25.3	10.7	4.7	1.2	0.2	0.2	0.0	0.0	0.0	89.7	70.3
2000	9.4	4.0	11.6	8.3	4.3	1.0	0.5	0.2	0.0	0.0	0.0	39.2	29.8
2001	134.0	3.2	3.8	11.3	4.2	0.7	0.1	0.1	0.0	0.0	0.0	157.2	23.3
2002	36.7	28.1	1.1	1.6	2.0	0.5	0.2	0.1	0.0	0.0	0.0	70.3	33.6
2003	2450.3	4.6	11.1	1.1	0.5	0.8	0.3	0.1	0.0	0.0	0.0	2468.7	18.4
2004	461.8	22.9	2.0	2.8	0.5	0.4	0.3	0.0	0.0	0.1	0.0	490.7	28.9
Mean all years	246.1	48.8	43.5	39.4	19.7	6.8	2.1	0.5	0.1	0.0	0.0	407.1	161.0
Mean 98 to 04	455.1	20.7	9.5	6.1	2.5	0.7	0.3	0.1	0.0	0.0	0.0	495.0	39.9
Mean Pre-zm (86 to 90)	229.7	132.8	134.7	130.6	64.8	21.2	6.3	1.6	0.3	0.1	0.0	722.2	492.5
Mean Post-zm (93 to 04)	284.8	16.9	9.6	5.8	2.8	1.1	0.4	0.1	0.0	0.0	0.0	321.4	36.6

Table 16.–Number of age-0 walleyes caught, number of trawl tows, and age-0 walleye catch rate (expressed as mean catch per 10-minute tow) for fall trawls on Saginaw Bay from 1986 to 2004.

Year	Number of age-0 walleyes captured	Age-0 walleye catch rate	Mean length (mm)
1986	20	0.43	
1987	34	0.46	
1988	39	0.59	
1989	19	1.27	
1990	0	0.00	
1991	28	1.89	
1992	6	0.16	
1993	1	0.02	
1994	22	0.64	
1995	14	0.36	
1996	0	0.00	
1997	83	2.18	
1998	149	8.55	212
1999	20	0.74	198
2000	5	0.30	180
2001	27	0.98	N/A
2002	84	2.54	176
2003	1,114	40.80	171
2004	822	22.93	117

Table 17.–Mean length (mm) at age for yellow perch from fall Saginaw Bay trawls, 1988–2004[a]. SWA=statewide average.

		Survey year																
Age	SWA	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
										Males								
1		119	120	124	124	124	131	145	135	132	131	123	136	140	139	128	134	128
2		137	141	146	146	149	155	159	169	166	166	146	154	157	172	166	165	175
3		150	157	165	167	164	178	176	179	189	195	172	155	169	180	190	187	201
4		164	170	175	184	181	194	191	192	200	202	202	183	172	190	203	211	225
5		177	185	186	201	187	202	200	203	211	219	211	196	210	227	213	215	240
6		201	194	195	212	209	213	200	211	219	219	219	–	218	264	228	243	235
										Females								
1		123	123	126	127	127	132	148	142	137	136	129	140	143	141	135	140	132
2		143	149	157	155	159	169	172	179	183	179	145	160	171	179	196	183	188
3		160	169	176	179	173	188	195	193	203	210	179	178	186	198	214	205	225
4		183	184	201	202	204	210	214	211	220	232	208	177	174	216	239	248	230
5		207	208	215	221	236	242	235	225	233	230	227	203	203	229	248	272	267
6		217	222	235	246	249	245	246	247	260	286	250	252	231	–	274	–	295
										Sexes combined								
1	127	123	128	127	131	127	133	148	138	135	133	125	138	144	139	132	137	130
2	160	147	150	167	154	155	158	165	173	172	173	149	171	169	172	194	175	183
3	183	158	153	167	165	163	186	184	184	197	202	178	204	183	186	196	198	212
4	208	157	162	177	184	184	206	200	197	205	217	206	222	210	207	213	219	227
5	234	167	181	167	208	183	235	213	210	216	222	225	212	253	233	217	222	244
6	257	189	205	172	230	218	237	214	226	235	239	237	–	230	264	255	243	245

[a] Data prior to 1990 from Haas and Schaeffer (1992), data for 1990 to 1997 from Fielder et al. (2002).