

## STUDY PERFORMANCE REPORT

**State:** Michigan

**Project No.:** F-81-R-2

**Study No.:** 494

**Title:** Continued monitoring of yellow perch and walleye populations in Michigan waters of Green Bay, Lake Michigan

**Period Covered:** October 1, 2000 to September 30, 2001

**Study Objectives:** (1) Continue monitoring population dynamics of yellow perch and walleye populations through creel surveys, netting, and tagging. (2) Intensify efforts to sample age-0 walleye using trawls and seines. (3) Obtain walleye diet information throughout the year from different areas in the Michigan waters of Green Bay. (4) Align yellow perch tagging and early-life history sampling efforts with lakewide programs.

**Summary:** Fish communities in Michigan waters of Green Bay (Big and Little bays de Noc, and open waters south to the Menominee River) were assessed through creel surveys, assessment netting, and a tagging program. Creel surveys have been conducted annually 1985-2001, whereas assessment netting and tagging have been done annually, 1988-2001. Sampling during 2001 was completed according to schedule, and data from these surveys and assessments will be presented in future reports.

Creel surveys were conducted during 2000 at Little Bay de Noc, Big Bay de Noc, Cedar River, and Menominee River sites. All sites were surveyed during the open-water season, but only Little Bay de Noc and Menominee River were surveyed during the ice season. Combining estimates from all sites and seasons, sport anglers harvested 143,671 yellow perch and 33,884 walleyes during 2000.

Assessment netting in 2000 captured 1,609 fish representing 23 species. Fish were identified and counted, and 22% were measured and examined to determine sex, maturity, and stomach contents. The most common species collected was white sucker (46% of the total number), followed by yellow perch (20% of the total). Walleye ranked eighth (2% of the total). Diet information was summarized from 214 yellow perch, 33 walleye, and 111 fish of other species.

The 2000 yellow perch year class was weak in both bays based on trawl catches of young-of-the-year fish. Catches of age-1 and older yellow perch were also relatively low in 2000. Overall, gill net catches of yellow perch were low in both bays relative to 1988-99 averages. No young-of-the-year walleyes were captured during 2000 assessments.

A total of 2,617 walleyes was tagged in spring of 2000. Since 1988, 45,037 walleyes and 19,572 yellow perch have been tagged. Tag-return data were used to estimate exploitation and survival rates, and to document fish movements. Exploitation rates for walleye, unadjusted for non-reporting, were 4.1% for Little Bay de Noc, 2.5% for Big Bay de Noc, 3.0% for Cedar River, and 5.2% for Menominee River. Walleye survival was 56.4% in Little Bay de Noc, 56.0% in Big Bay de Noc, 51.4% in Cedar River, and 38.9% in Menominee River. No yellow perch have been tagged since 1993 and no tagged yellow perch have been reported caught by anglers since 1996.

**Job 1. Title:** Continue monitoring yellow perch and walleye populations.

**Findings:** Creel survey data have been collected for the Michigan waters of Green Bay (statistical district MM-1) by Michigan Department of Natural Resources (MDNR) personnel since 1985 (Table 1). Creel survey methods and results were summarized under F-81-R Study 427 by Rakoczy and Rogers (1987, 1988, 1990), Rakoczy and Lockwood (1988), Rakoczy (1992a, 1992b), and Rakoczy and Svoboda (1994). Creel estimates for 1994-2000 have been calculated (G.P. Rakoczy, personal communication, Charlevoix Fisheries Station, Charlevoix, Michigan), but are as yet unpublished. Sites and seasons covered during the 2000 creel survey were roughly comparable to those surveyed since 1993. Compared to 1993-99 averages, the 2000 catch was 17% lower for walleye and 7% lower for yellow perch. Angling effort during 2000 increased 12% over the 1993-98 average.

Marquette Fisheries Research Station personnel collected monthly samples of adult and juvenile fish from June through September, 2000 in both Big and Little bays de Noc. Samples were obtained from 40 10-min bottom trawl hauls (20 in each bay), 34 overnight gill net sets (18 in Little Bay de Noc and 16 in Big Bay de Noc), and 4 seine hauls (all in Little Bay de Noc). Gear dimensions and configurations were identical to those described by Schneeberger (2000) except 2000 seining was accomplished using a net that was 15.2-m long by 1.2-m high, with 12.7-mm mesh netting and a 6.4-mm mesh bag.

Total length, sex, maturity, and diet data were recorded for 214 yellow perch and 33 walleyes during 2000 (Table 2). An additional 69 yellow perch were measured but not examined internally, and 40 were counted only. Scales and/or spines were collected from 34 walleyes and 147 yellow perch. Ages of these fish will be tabulated in future reports.

Besides walleye and yellow perch, 1,252 fish, representing 21 other species, were caught in 2000 assessment nets. Of these, 111 fish were measured and examined to determine sex, maturity, and stomach contents. The remainder were measured or counted only.

Yellow perch ranked below white sucker in 2000 assessment netting (Table 2), and represented a lower percentage of the total catch compared to 1999 as well as other assessment years. Walleye ranked eighth in total abundance, and only two were collected from Big Bay de Noc. The round goby, an exotic first detected in the study area in 1998, represented about 1% of the fish captured during 2000 sampling.

Catch per unit effort (CPUE) was calculated for yellow perch caught in standard monthly trawl hauls and gill net sets (Table 3). Trawl catches of young-of-the-year (YOY) yellow perch were used as an index of year-class strength, and gill-net catches of yellow perch 178-mm and larger (generally  $\geq$  3-years old) were used as an index of abundance for sizes large enough to interest sport anglers. The 2000 yellow perch year class was weak in both bays, similar to what was found in 1999. Gill net CPUEs for large, catchable yellow perch in 2000 were roughly comparable to those of 1999 for both bays.

In Michigan waters of Green Bay, individually-numbered monel bird leg bands have been used to jaw tag 45,037 walleyes between 1988 and 2000, and 19,572 yellow perch between 1989 and 1993. Virtually all tagged walleyes were of legal size, and 99.8% of the tagged yellow perch were 7 inches or larger. During spring of 2000, a total of 2,617 walleyes were tagged in Michigan waters of Green Bay (Tables 4 and 5). Walleyes were tagged at four locations: Little Bay de Noc (N=500), Big Bay de Noc (N=110), Cedar River (N=948), and Menominee River (N=1,059). Walleyes were tagged coincident with egg-take operations in Little Bay de Noc

where fish were collected in fyke nets. Boomshocking boats were used to catch walleye for tagging at other locations but 662 walleyes were obtained from commercial pound nets set near the mouth of the Cedar River.

Solicitations for the return of tags have appeared in local newspapers, sport-club information bulletins, and notices at launch sites. In addition, the creel clerk surveying Cedar and Menominee river fisheries solicited tag-return data on his personal fishing information web site and some returns were reported on a form available through the Department of Natural Resources web site. Anglers catching tagged fish were asked to contact a creel clerk or an MDNR office to report species, tag number, fish length, date, time of catch, location of catch, fate of the fish (kept or released), and their name, address, and phone number. These data were entered into database files, and a computer-generated letter was sent to cooperating anglers, informing them of the number of days between the tag and capture dates, the distance between the tag and capture sites, and the estimated age and growth of the fish they caught.

A total of 200 walleye tag returns was reported between May 2000 and April 2001 (Tables 4 and 5). Returns from fish tagged in Little Bay de Noc included fish that had been tagged in 1997-2000. Big Bay de Noc returns came from fish tagged in 1995-2000. Returns were reported for fish tagged at Cedar River and Menominee River during 1994-2000.

Exploitation (unadjusted for non-reporting) and survival rates were estimated from tag-return data using formulae provided by Brownie et al. (1985). Based on cumulative tag returns through 2000, walleye exploitation rates were 4.1% in Little Bay de Noc, 2.5% in Big Bay de Noc, 3.0% in Cedar River, and 5.2% in Menominee River. Walleye survival was 56.4% in Little Bay de Noc, 56.0% in Big Bay de Noc, 51.4% in Cedar River, and 38.9% in Menominee River.

Thomas and Haas (2000) examined reward versus non-reward walleye tag returns in Lake Erie to determine an adjustment factor of 2.7 for non-reporting. Using this factor to adjust for non-reporting in Michigan waters of Green Bay, estimated exploitation for walleye was 11.1% in Little Bay de Noc, 6.8% in Big Bay de Noc, 8.1% in Cedar River, and 14.0% in Menominee River.

No tagged yellow perch were caught in 2000. Yellow perch have not been tagged in bays de Noc since 1993, and no tagged yellow perch have been reported since 1996.

Use of drop boxes, placed at 10 access sites throughout the study area, continued for the fifth year in 2000. Signs were posted asking walleye anglers to fill out brief catch summary forms that were available from a compartment in the drop boxes. During 2000, 21 forms were received. But rather than being deposited in the separate slotted portion of the drop boxes, all were reported on a simulation of the form available on the web site administered by the creel clerk mentioned above. These forms provided extra information on the fisheries both for tagged (three reported) and non-tagged walleye.

Lymphocystis is an endemic viral skin disease common to walleye, especially during spawning (Scott and Crossman 1973). Presence or absence of lymphocystis was noted for fish at each tagging location. Compared to 1999, incidence of lymphocystis in spawning populations during 2000 stayed the same or nearly the same in Little Bay de Noc (from 7 to 9%) and Big Bay de Noc (12% for both years), but increased dramatically in Cedar River (from 7 to 20%) and Menominee River (from 17 to 26%). Lymphocystis was seen on only one of the 34 walleyes caught in 2000 assessment nets.

Fish stomach contents were examined in the field during assessment netting, and food items were identified and counted. Fish prey were measured, weighed, and identified to species when possible, insects were identified to order or family, and zooplankton was considered a broad, inclusive category excepting *Bythotrephes cederstroemi* which was differentiated from other zooplankton. Predation on *Bythotrephes cederstroemi* during 2000 was very minimal for the second year in a row compared to previous years (Schneeberger 1989, 1991, 2000). Despite high abundance in both bays, zebra mussels *Dreissena polymorpha* were found only in one yellow perch stomach (5 zebra mussels) and one round goby stomach (20 zebra mussels).

In Little Bay de Noc, diet data were obtained from 101 yellow perch and 31 walleyes. Fish (mostly unidentified), aquatic insects, and zooplankton were prominent in yellow perch stomachs (Table 6). Ten walleye stomachs were empty, but six contained fish (alewife, rainbow smelt, and unidentified) and one contained aquatic insects (Table 7).

Stomachs were examined from 113 yellow perch and 2 walleyes in Big Bay de Noc. Yellow perch ate aquatic insects, crayfish, amphipods, and fish (unidentified) for the most part (Table 8). The single walleye without an empty stomach contained nothing that could be identified (Table 9).

**Job 2. Title:** Intensify efforts to obtain an index of walleye recruitment.

**Findings:** Two extra overnight gill net sets were made in Little Bay de Noc to try to collect fish for contaminant analysis, but also as an extra effort to catch YOY walleye. Four seine hauls were made in Little Bay de Noc targeting locations and times thought to be suitable for capture of walleye YOY. No YOY walleyes were captured in 2000 by any sampling method, regular or supplemental.

**Job 3. Title:** Obtain year-round walleye diet from different areas.

**Findings:** Supplemental walleye diet data were obtained through cooperation with the proprietors of a resort located at the head of Little Bay de Noc and from individual members of a Menominee-area sports club. Anglers saved, labeled, and froze walleye stomachs in containers provided by the Marquette Fisheries Research Station. Twenty-five stomachs collected in this way during 2000 were processed and tabulated in the lab. Most (19) stomachs were empty, one contained a rainbow smelt, two contained unidentifiable fish remains, two contained Hexagenia, and one contained miscellaneous matter that could not be identified.

**Job 5. Title:** Evaluate results and write report.

**Findings:** The 2000-01 Study Performance Report (F-81-R-1) was prepared during this study segment.

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**Date:** September 30, 2001

Table 1.—Estimated sport catch (number and kilograms) and effort (angling hours) of walleye and yellow perch in Michigan waters of Green Bay, Lake Michigan (Statistical District MM-1), 1985-2000. Data from G. Rakoczy, Michigan DNR, Charlevoix.

Year	Effort (hours)	Walleye		Yellow perch	
		Number	Kilograms	Number	Kilograms
1985 <sup>a,b</sup>	523,167	18,738	18,699	459,089	52,060
1986 <sup>a,b</sup>	486,339	21,682	20,653	432,646	41,212
1987 <sup>a,b</sup>	303,077	12,005	17,425	210,872	26,782
1988 <sup>a,c</sup>	551,750	25,535	35,906	323,294	33,729
1989 <sup>a,c</sup>	656,462	42,029	40,035	291,003	35,640
1990 <sup>a,b</sup>	736,599	43,144	43,054	372,402	38,851
1991 <sup>a,b</sup>	948,456	50,009	56,710	564,597	76,830
1992 <sup>a,b</sup>	692,284	23,374	28,627	399,671	36,258
1993 <sup>a,b,d,e</sup>	734,400	25,425	29,985	104,902	9,516
1994 <sup>a,b,d,e</sup>	609,360	32,508	39,813	139,409	12,647
1995 <sup>a,b,d,e</sup>	666,976	80,323	87,442	156,720	14,218
1996 <sup>a,b,d,e</sup>	627,900	62,752	74,007	323,789	29,374
1997 <sup>b,d,e,f</sup>	452,044	30,016	~34,492	43,908	~4,595
1998 <sup>a,b,d,e</sup>	532,829	27,863	~32,015	151,310	~15,844
1999 <sup>a,b,d,g</sup>	575,561	28,348	~32,572	158,297	~16,576
2000 <sup>a,b,d,g</sup>	672,377	33,884	~85,831	143,671	~33,166

<sup>a</sup> Little Bay de Noc open water and ice seasons

<sup>b</sup> Big Bay de Noc open water season

<sup>c</sup> Big Bay de Noc open water and ice seasons

<sup>d</sup> Cedar River open water season

<sup>e</sup> Menominee River open water season

<sup>f</sup> Little Bay de Noc open water season

<sup>g</sup> Menominee River open water and ice seasons

Table 2.—Numbers of each fish species captured in assessment nets in Little Bay de Noc (LBDN) and Big Bay de Noc (BBDN), Lake Michigan, June-September, 2000.

Common name	Measured and examined <sup>a</sup>		Measured or counted only		Totals			
	LBDN	BBDN	LBDN	BBDN	LBDN	BBDN	All	%
White sucker	5	2	728	12	733	14	747	46.43
Yellow perch	101	113	108	1	209	114	323	20.07
Spottail shiner	4	4	167	13	171	17	188	11.68
Brook stickleback	0	7	0	67	0	74	74	4.60
Alewife	0	8	2	48	2	56	58	3.60
Johnny darter	0	15	6	30	6	45	51	3.17
Smallmouth bass	6	0	1	31	7	31	38	2.36
Walleye	31	2	1	0	32	2	34	2.11
Northern pike	23	5	1	0	24	5	29	1.80
Trout-perch	2	0	15	0	17	0	17	1.06
Round goby	5	0	9	0	14	0	14	0.87
White perch	5	4	2	0	7	4	11	0.68
Rock bass	4	2	0	0	4	2	6	0.37
Rainbow smelt	0	0	5	0	5	0	5	0.31
Black bullhead	0	4	0	0	0	4	4	0.25
Common carp	0	2	0	0	0	2	2	0.12
Pumpkinseed	0	0	2	0	2	0	2	0.12
Burbot	0	1	0	0	0	1	1	0.06
Coho salmon	0	1	0	0	0	1	1	0.06
Common shiner	0	1	0	0	0	1	1	0.06
Golden redhorse	0	0	1	0	1	0	1	0.06
Mottled sculpin	0	0	0	1	0	1	1	0.06
Splake	1	0	0	0	1	0	1	0.06
Total	187	171	1,048	203	1,235	374	1,609	100.00

<sup>a</sup> Stomach contents, sex, and maturity.

Table 3.—Catch-per-unit-effort for yellow perch in 10-min trawl hauls and 24-hr, 18-m experimental gill net sets in Little Bay de Noc and Big Bay de Noc, Lake Michigan, 1988-2000.

Bay	Year	Number of yellow perch per trawl haul			Number of yellow perch per gill-net lift		
		<90 mm	≥90 mm	All	<178 mm	≥178 mm	All
Little Bay de Noc	1988	35.3	43.1	71.8	15.1	4.8	16.8
	1989	17.7	10.7	21.3	11.0	2.7	12.5
	1990	10.3	18.0	24.0	9.4	1.8	9.8
	1991	33.1	11.3	36.7	6.4	4.3	9.6
	1992	4.3	11.0	13.2	12.6	5.9	16.1
	1993	64.1	17.6	67.1	9.9	1.8	10.5
	1994	9.7	3.2	12.9	14.4	3.2	17.5
	1995	34.3	3.8	28.6	10.8	4.0	12.7
	1996	5.4	0.9	4.2	7.9	0.7	8.6
	1997	20.0	1.8	15.9	9.3	2.3	10.7
	1998	81.0	7.1	58.3	6.8	5.2	8.5
1999	12.0	1.7	3.4	4.6	4.7	6.3	
2000	9.6	2.2	8.4	4.4	4.2	6.2	
Big Bay de Noc	1988	34.7	34.0	51.5	3.0	3.0	5.0
	1989	3.5	3.7	3.6	14.9	7.1	20.2
	1990	70.3	12.0	70.4	6.6	4.2	9.7
	1991	205.0	1.5	205.2	8.4	3.8	9.4
	1992	2.9	2.8	3.8	11.6	3.6	13.6
	1993	23.4	1.7	24.0	9.4	2.0	9.5
	1994	141.7	8.5	150.2	3.9	1.9	5.8
	1995	44.1	60.0	52.6	5.2	1.4	5.9
	1996	22.8	27.8	35.2	15.2	2.0	17.2
	1997	20.8	1.0	7.0	12.5	2.1	13.8
	1998	69.2	6.0	72.6	4.9	1.4	5.1
1999	3.0	10.0	9.8	16.9	2.0	17.9	
2000	3.5	0	3.5	5.4	3.2	7.7	



Table 4.—Number of walleyes tagged and tag returns by year from Little Bay de Noc and Big Bay de Noc, Lake Michigan, 1988-2000. (Recovery year = May-Apr).

Tag year	Number tagged	Recovery year													Total
		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
Little Bay de Noc															
1988	2,496	167	141	72	42	12	21	14	5	2	1	0	0	0	477
1989	2,486	-	150	58	25	20	7	7	8	1	3	1	1	0	281
1990	1,744	-	-	94	33	13	15	3	0	0	0	0	0	0	159
1991	1,886	-	-	-	79	30	10	5	2	1	1	0	0	0	128
1992	1,690	-	-	-	-	50	18	14	5	4	3	1	2	0	97
1993	1,563	-	-	-	-	-	69	22	10	5	1	3	3	0	113
1994	1,246	-	-	-	-	-	-	69	23	7	7	2	0	0	108
1995	711	-	-	-	-	-	-	-	33	18	6	3	1	0	61
1996	700	-	-	-	-	-	-	-	-	25	19	6	0	0	50
1997	700	-	-	-	-	-	-	-	-	-	17	9	6	4	36
1998	470	-	-	-	-	-	-	-	-	-	-	19	6	9	34
1999	530	-	-	-	-	-	-	-	-	-	-	-	16	12	28
2000	500	-	-	-	-	-	-	-	-	-	-	-	-	22	22
Big Bay de Noc															
1990	867	-	-	22	19	1	2	1	0	1	1	0	0	0	47
1991	354	-	-	-	6	3	3	1	2	1	0	0	0	0	16
1993	617	-	-	-	-	-	20	13	11	1	1	1	1	0	48
1994	1,458	-	-	-	-	-	-	37	15	5	3	0	0	0	60
1995	1,993	-	-	-	-	-	-	-	67	29	20	9	0	2	127
1996	1,324	-	-	-	-	-	-	-	-	36	26	12	6	4	84
1997	868	-	-	-	-	-	-	-	-	-	21	17	3	3	44
1998	77	-	-	-	-	-	-	-	-	-	-	0	0	2	2
1999	609	-	-	-	-	-	-	-	-	-	-	-	3	7	10
2000	110	-	-	-	-	-	-	-	-	-	-	-	-	2	2

Table 5.-Number of walleyes tagged and tag returns by year from Cedar River and Menominee River, 1993-2000. (Recovery year = May-Apr).

Tag year	Number tagged	Recovery year								Total
		1993	1994	1995	1996	1997	1998	1999	2000	
Cedar River										
1993	1,312	50	27	9	1	1	1	0	0	89
1994	1,500	-	73	17	6	2	0	0	1	99
1995	1,677	-	-	36	23	9	3	3	4	78
1996	445	-	-	-	7	11	0	0	4	22
1997	925	-	-	-	-	26	9	3	8	46
1998	1,290	-	-	-	-	-	31	14	10	55
1999	1,203	-	-	-	-	-	-	31	19	50
2000	948	-	-	-	-	-	-	-	15	15
Menominee River										
1993	1,280	100	24	6	4	0	0	0	0	100
1994	1,500	-	127	16	4	2	0	0	1	150
1995	1,879	-	-	103	25	15	6	0	4	153
1996	544	-	-	-	20	8	5	1	2	36
1997	1,758	-	-	-	-	77	28	14	3	122
1998	1,155	-	-	-	-	-	52	19	9	80
1999	1,503	-	-	-	-	-	-	47	21	68
2000	1,059	-	-	-	-	-	-	-	32	32

Table 6.—Diet data from 101 yellow perch collected in assessment nets in Little Bay de Noc, Jun-Sep, 2000.

Food category	Observed occurrence in yellow perch stomachs			Total length (mm) of yellow perch	
	Frequency	Mean number per fish	Months	Min	Max
Fish <sup>a</sup>	19	1.3	6, 7, 8, 9	5.7	12.7
Miscellaneous	15	1.0	6, 7, 9	2.6	8.4
Zooplankton	13	30.0	8, 9	2.5	4.1
Bythotrephes	9	7.2	9	2.7	4.8
Diptera	9	2.9	7, 9	2.7	3.9
Hexagenia	8	6.1	6, 7, 9	2.9	6.0
Amphipods	7	4.0	7, 8, 9	2.9	6.3
Aquatic insects	2	1.0	6, 7	5.7	6.6
Crayfish	1	1.0	6	8.0	8.0
Isopoda	1	1.0	6	5.2	5.2
Seeds	1	30.0	6	5.4	5.4
Vascular plants	1	1.0	8	7.3	7.3
Worms	1	1.0	7	5.9	5.9
Zebra mussel	1	5.0	8	7.3	7.3
Empty	23	-	6, 7, 8, 9	2.5	11.0

<sup>a</sup> Trout-perch (2), unidentified (17)

Table 7.—Diet data from 31 walleyes collected in assessment nets in Little Bay de Noc, Jun-Sep, 2000.

Food category	Observed occurrence in walleye stomachs			Total length (mm) of walleyes	
	Frequency	Mean number per fish	Months	Min	Max
Miscellaneous	14	1.0	6, 10	9.4	21.3
Fish <sup>a</sup>	6	1.5	6, 7, 9	10.2	20.8
Hexagenia	1	3.0	9	20.4	20.4
Empty	10	-	6, 7, 10	12.6	25.5

<sup>a</sup> Alewife (2), rainbow smelt (1), unidentified fish (3)

Table 8.—Diet data from 113 yellow perch collected in assessment nets in Big Bay de Noc, Jun-Sep, 2000.

Food category	Observed occurrence in yellow perch stomachs			Total length (mm) of yellow perch	
	Frequency	Mean number per fish	Months	Min	Max
Hexagenia	51	10.0	6, 7, 8, 10	2.3	9.6
Crayfish	14	1.6	6, 7, 8, 10	5.9	10.3
Amphipods	12	4.5	7, 8	2.2	5.9
Fish <sup>a</sup>	8	1.5	6, 8, 10	4.2	10.1
Miscellaneous	4	1.0	6, 7, 10	4.0	8.6
Diptera	3	1.3	8	2.3	2.8
Eggs	2	106.0	6	4.0	7.4
Vascular plants	2	1.0	6, 10	6.7	9.6
Aquatic insects	1	1.0	6	3.7	3.7
Zooplankton	1	20.0	8	2.4	2.4
Empty	27	-	6, 7, 8, 10	2.2	13.6

<sup>a</sup> Unidentified (8)

Table 9.—Diet data from 2 walleyes collected in assessment nets in Big Bay de Noc, Jun-Sep, 2000.

Food category	Observed occurrence in walleye stomachs			Total length (mm) of walleyes	
	Frequency	Mean number per fish	Months	Min	Max
Miscellaneous	1	1.0	10	16.5	16.5
Empty	1	-	10	17.8	17.8