

APPENDIX III[a]

Status of Major Species in Lake Michigan^{1/}

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Yellow Perch

Catches of adult yellow perch in fall index sampling with trawls were smaller in 1973 than in 1972 off all ports for which we have comparative data (Saugatuck, Benton Harbor, Waukegan, Ludington). Catches of young-of-the-year perch were slightly higher at Saugatuck and Benton Harbor, but still much smaller than in 1969 and 1970. Young-of-the-year were lacking in the catches in both 1972 and 1973 at Waukegan and Ludington.

In addition to the regular index sampling with trawls, we also sampled perch with graded-mesh gillnets in 10 areas of southern and central Lake Michigan. Catches in nets set at depths of 3 and 6 fathoms during July 18-August 1 were much larger along the east shore at Frankfort, Ludington, Grand Haven, Saugatuck, South Haven, Benton Harbor, and Michigan City, than along the west shore at Waukegan, Milwaukee, and Sheboygan. Catches at localities for which comparative data were available (all the aforementioned except Grand Haven, Milwaukee, and Sheboygan) were smaller in 1973 than in 1972. The decrease in catches in both gillnets and trawls suggests that a general decline in perch populations occurred between 1972 and 1973; the data do not permit quantitative estimates of the decline, however.

Although our perch sampling is providing us with rough estimates of

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population differences from year to year and area to area, we have concluded that it is not giving us as accurate an assessment of population as is desirable. Problems relate mostly to our inability to fish trawls on rough bottom where perch often concentrate, and to variation in the depth distribution of perch according to bottom temperatures. To improve our perch population assessment, we intend to increase our sampling effort considerably in 1974, particularly with gillnets. Emphasis will be placed on fishing the gillnets at particular bottom temperatures, rather than at standard depths as has been the practice in the past. Our sampling program will be coordinated more closely with those of the various state agencies than it has been previously.

Chubs^{1/}

We intensified a continuing synthesis of biological data on Lake Michigan chub stocks for use by state agencies in developing a uniform system of managing chub fisheries on a lakewide basis. Our latest effort to provide needed intelligence was centered on a detailed analysis of changes in age structure of chubs available to bottom trawls in southeastern Lake Michigan during spring 1963-73. A substantial decline in the number of chubs taken during the 10 years of systematic sampling at Saugatuck confirmed the long-term trend previously noted in fall surveys off Saugatuck, Benton Harbor, and Ludington, Michigan, and Waukegan, Illinois (see Appendix VII in minutes of the 1973 annual Lake Michigan Committee Meeting). From the preliminary age study, it is now evident that the decline in chub availability resulted

^{1/} As used here, chubs are considered synonymous with bloaters (Coregonus hoyi) because this species is estimated to represent more than 99 percent of the chubs present in Lake Michigan.

from both a change in vulnerability of younger fish to the sampling gear, and from a seriously diminishing recruitment of new year-classes to the adult population in recent years. Chubs were fully vulnerable at age III in the early 1960's but have not been fully vulnerable until age IV or V since 1967.

Because of the change in vulnerability of the younger chubs, a better indication of year-class strength and recruitment in southeastern Lake Michigan was given by the cumulative catches of each year-class at age V and older, when all year-classes seemed to be fully vulnerable to the standard gear. On this basis, we found that five comparatively strong year-classes appeared each year from 1960 to 1964, and contributed to high commercial production in the late 1960's and 1970 (cf., Fig. 1):

<u>Year</u>	<u>Volume</u> ^{1/}	<u>Year</u>	<u>Volume</u>
1963	7.5	1968	10.9
1964	5.2	1969	10.2
1965	7.4	1970	9.6
1966	7.2	1971	5.7
1967	9.1	1972	5.3

^{1/} Millions of lbs.

Thereafter, year-class strength sharply subsided, and in 1973, the 1968 year-class contributed only 13% as much to the index catch at age V as did the average year-class produced in 1960-64. The low general abundance of chubs resulting from this decreasing recruitment, as summarized for the Saugatuck area, suggests that the density of spawners may now be seriously limiting the innate productivity of this valuable resource. Continued



Fig. 1.--Year-class strength represented by the cumulative catches of age-V and older chubs in trawls off Saugatuck, Michigan, April-May 1963-73: (Years of capture are in parentheses).

heavy exploitation while the resource continues to face sustained pressure from alewives and possibly smelt may negate chances for a recovery.

Fewer adult chubs were taken in our systematic fall surveys with bottom trawls in 1973 (late October and November) off Saugatuck, Benton Harbor, and Waukegan than in any year since the surveys were extended beyond the Saugatuck area in 1967. (Table 1: Note that abundance indices for chubs are expressed as numbers per trawl transect rather than as numbers per 10-minute tow that took chubs, the form used in previous summaries.) Although the total catch off Ludington was substantially higher than at the southerly locations, it was the second lowest recorded at Ludington during the 7-year assessment period (the 1972 catch was slightly smaller). Exclusion of Ludington data from abundance indices based on the several locations combined (unweighted means) did not greatly alter the strong downward trend in relative abundance of chubs in southern Lake Michigan (Table 1, Fig. 2).

Total catches of young-of-the-year chubs at all four index stations in 1973 were the best since the peak catches in fall 1970 (Table 1, Fig. 2). Our sampling to date has revealed no evidence, however, of strong recruitment to adult stocks by the 1970 year-class.

Using the R/V Kaho, now strategically located at Cheboygan, we also sampled chubs and associated species at Frankfort and Manistique, Michigan, and Sturgeon Bay, Wisconsin, for the first time in our fall stock assessment program. The total catch of chubs at Frankfort was greater than that at any other location, including Port Washington, Wisconsin, surveyed by the R/V Cisco (Table 2).

Table 1.--Number of adult (>140 mm) and young-of-the-year chubs per bottom trawl transect ^{1/} at four index stations in Lake Michigan, late October-November 1967-73. (Either one (asterisk) or two transects were fished at each location.)

Life stage and location	1967	1968	1969	1970	1971	1972	1973
Adult							
Ludington	319*	699	542	436	403*	220*	264*
Saugatuck	213	303	120	139	129*	100	22*
Benton Harbor	411	180	151	204	226*	89*	46*
Waukegan	594*	631	567	484	134	35	33*
Mean	384	453	345	316	223	111	91
Mean ^{2/}	406	371	279	276	163	75	34
Young-of-the-year							
Ludington	5*	14	22	28	27*	2*	44 ^{3/} *
Saugatuck	2	15	16	30	5*	4	52*
Benton Harbor	10	22	20	70	11*	1*	14*
Waukegan	17*	60	91	72	8	3	18*
Mean	8	28	37	50	13	2	32

^{1/} The standard transect includes twelve 10-minute tows at depths of 3 (5 minutes only), 5, 7, 10, 12, 15, 17, 20, 25, 30, 35, and 40 fathoms; catches at 3 fathoms were adjusted to 10-minutes except for Ludington where that depth was not sampled.

^{2/} Ludington excluded.

^{3/} Numbers in missing tows at 12 and 17 fathoms were estimated from adjacent tows.



Fig. 2. -- Changes in the availability of chubs to bottom trawls in southern Lake Michigan off Ludington, Saugatuck, and Benton Harbor, Michigan, and Waukegan, Illinois, late October and November, 1967-73.

Table 2.--Number of chubs (>140 mm) per 10-min tow of a 39-foot bottom trawl at eight index stations in Lake Michigan, October 23-November 11, 1973.

Depth (fathoms)	Benton Harbor	Saugatuck	Ludington	Frankfort	Manistique	Sturgeon Bay	Port Washington	Waukegan
3	0	0	-	-	-	-	-	0
5	0	0	0	-	0	-	-	0
7	0	0	0	-	-	-	-	2
10	0	0	0	0	0	0	0	0
12	28	0	-	-	-	-	-	2
15	4	2	0	0	0	0	0	4
17	1	10	-	-	-	-	-	4
20	2	4	0	11	0	0	1	4
25	3	3	0	157	1	0	11	13
30	3	1	117	97	13	0	3	2
35	4	1	91	239	30	2	0	2
40	1	1	56	52	5	5	1	0
45	1	1	7	7	-	-	0	1
50	1	1	0	3	-	0	0	1
60	-	-	0	0	-	0	0	-
70	-	-	0	0	-	-	0	-

Alewives

Availability of adult alewives to bottom trawls improved at all permanent index stations in southern Lake Michigan -- Ludington, Saugatuck, Benton Harbor, and Waukegan -- from fall 1972 to fall 1973 (Table 3). The 1973 increase in availability was slight at Saugatuck, which has shown the least year-to-year variation in relative abundance of the adults, and quite substantial at the other locations. The unweighted mean catch per 10-minute trawl haul for all locations combined increased from 126 alewives in 1972 to 405 in 1973.

Population density of adult alewives was unusually high in bottom waters off Frankfort, Michigan, during our extended 1973 fall coverage of the northern half of the lake (Table 4). The stocks were probably more concentrated in the Frankfort area because of the short linear distance represented by the range of depths sampled compared to that in southern Lake Michigan.

Young-of-the-year alewives were fairly plentiful throughout southern Lake Michigan during the 1973 fall assessment operation (Table 3). The mean catch of 473 young per trawl haul for the ports combined did not compare too unfavorably with a mean of 580 young averaged over the entire 7-year (1967-73) period of sampling. Changes in availability of the young alewives between 1972 and 1973 were not consistent from location to location and may partly represent normal variability in spatial distribution of the highly pelagic young.

The extension of our fall forage fish surveys into areas of central and northern Lake Michigan in fall 1973 provided a basis for estimating

Table 3.--Number of adult and young-of-the-year alewives per 10-minute trawl tow^{1/} at depths of 3-40 fathoms at four index stations in Lake Michigan, late October-November 1967-73. (Number of tows that took alewives in parentheses.)

Life stage and location	1967	1968	1969	1970	1971	1972	1973
Adult							
Ludington	79 (5)	93 (19)	198 (20)	361 (15)	122 (11)	126 (7)	904 (6)
Saugatuck	133 (21)	44 (22)	84 (20)	99 (21)	95 (12)	110 (19)	132 (12)
Benton Harbor	134 (23)	82 (24)	114 (23)	85 (23)	466 (12)	128 (13)	276 (10)
Waukegan	119 (11)	245 (24)	338 (24)	634 (24)	272 (24)	136 (24)	307 (12)
Mean	116	116	184	295	239	126	405
Young-of-year							
Ludington	62 (10)	549 (17)	257 (15)	590 (22)	764 (11)	155 (11)	401 (8)
Saugatuck	112 (22)	1,578 (18)	1,556 (20)	969 (23)	20 (10)	673 (21)	693 (9)
Benton Harbor	435 (20)	98 (18)	1,171 (19)	882 (17)	581 (7)	1,449 (10)	577 (7)
Waukegan	253 (11)	176 (17)	788 (24)	552 (21)	56 (10)	183 (20)	221 (6)
Mean	216	600	943	748	355	615	473

^{1/} Includes only tows that took alewives.

Table 4.--Number of alewives (≥ 120 mm) per 10-min tow of a 39-foot bottom trawl at eight index stations in Lake Michigan, October 23-November 11, 1973.

Depth (fathoms)	Benton Harbor	Saugatuck	Ludington	Frankfort	Manistique	Sturgeon Bay	Port Washington	Waukegan
3	0	4	-	-	-	-	-	18
5	0	7	0	-	0	-	-	12
7	8	12	0	-	-	-	-	299
10	1	1	33	2	1	0	51	465
12	18	88	-	-	-	-	-	599
15	64	9	0	209	0	0	41	169
17	13	6	-	-	-	-	-	307
20	161	7	1,769	582	0	4	48	246
25	1,083	114	1,263	1,843	38	3	86	540
30	535	309	991	2,172	171	338	185	413
35	306	593	452	3,860	220	531	125	231
40	569	436	914	2,915	223	374	197	386
45	495	402	684	2,425	-	-	283	416
50	502	312	952	1,245	-	431	272	1,103
60	-	-	632	1,100	-	408	501	-
70	-	-	378	496	-	-	441	-

the total poundage of alewives and associated species currently available to fishing gear. The stratified geographical frame used in the estimation procedure included eight regional sectors each divided into strata representing depth zones of 0-20, 21-40, 41-60, and 61-80 fathoms. The lakewide estimates were summations over all strata of the catch per acre trawled times the total acreage. Application of the method produced estimates of 220 million lbs. of alewives and 15 million lbs. of chubs age I and older available in the bottom waters of the lake during October 23-November 11, 1973. Comparisons between the 1973 estimates and early gross estimates (unpublished files at GLFL) for all seasons and years of the period 1963-73 (combined) reflect the continued abundance of alewives and the serious drop in abundance of chubs over the last ten years:

Year	Fish available to bottom trawls (millions of lbs.)	
	Alewives	Chubs
1963-65	237	139
1973	220	15

These estimates give us a "feel" for the large quantities of fish in Lake Michigan, but obviously underestimate total biomass because fish at mid-depths are unavailable to the bottom trawl. The trawl is not 100% efficient in capturing fish ahead of it, and trawling has generally been limited to maximum bottom depths of 70 fathoms and less.