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Status of Bloater Chubs and Alewives
in Lake Michigan^{1/}

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Annual forage-fish surveys in fall 1979 revealed a continuing substantial improvement in the biological production of young-of-the-year and yearling (age I) bloaters at widespread locations in Lake Michigan. This improved production (1977-1979) should lead to markedly increased recruitment to the fishable (commercial) stocks of bloaters beginning in the early 1980s. A possible reduction in competition from alewives for food and space may be contributing to the chub upsurge in some areas, amplifying positive effects on the (chub) brood stock of recent controls to reduce fishing pressure (i.e., temporary bans on fishing and the introduction of catch quotas by the states).

In contrast to chubs, both adult and/or young-of-the-year alewives were considerably less abundant in 1979 than in the early 1970s at several index stations in eastern and southeastern Lake Michigan, among those where the production of young chubs has increased the most. This apparent decline in abundance along the east shore may partly explain our observations of greatly reduced spawning activity by alewives in the Kalamazoo River at Saugatuck, and the scarcity of larval alewives in monitoring at the Ludington Pump-Storage Plant (Personal communication with Dr. Charles Liston, Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI.) during the cool summer of 1979.

While heavy predation by salmonids undoubtedly continues to dampen oscillations by the alewife population in Lake Michigan, severe winters and lower than average seasonal temperatures in the late 1970s may also have affected survival and production of new year classes. Two of the coldest winters on record were those of 1977-78 and 1978-79, and mean summer air temperatures, at Muskegon, Michigan, for example, were below the longterm average in five of the last six years. Results of a preliminary examination of these data for a cause-and-effort relationship between temperature and alewife abundance were inconclusive, however, with the survey data divided only into

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young-of-the-year and adults. More comprehensive analyses are planned with recruitment and year-class strength estimates from the adult catch subdivided into year classes. We suspect that in some years, year class formation and recruitment may be strongly affected by survival during the first winter of life.

Bloaters

Young-of-the-Year--record catches of young-of-the-year bloaters were made off Saugatuck, Ludington, and Manistique, Michigan as well as off Sturgeon Bay, Wisconsin where the chub population was severely depressed in the 1960s and early 1970s (Table 1). The mean (geometric) catch per transect in 1979 (112.0 fish) for the stations combined was similar to that of 1978 (129.4 fish) and 5.3 times greater than any for the 11-year sampling period from 1967 through 1977.

This lakewide evidence of improved chub production in the late 1970s parallels observations made by other agencies and institutions engaged in fish sampling on Lake Michigan. For the first time during a several-year monitoring period, immature chubs were taken in substantial numbers on intake screens of the Cook Nuclear Power Plant in 1978 and many more were sampled in Lake Michigan proper near the plant (Personal communication with Ms. Nancy Thurber, Great Lakes Research Division, University of Michigan, Ann Arbor, MI). In 1978, unusually good catches of young chubs, as compared to those of earlier years, were also made off the Zion Nuclear Plant near Waukegan, Illinois in August and September (Personal communication with Mr. Bruce Muench, Illinois Department of Conservation, Waukegan, IL) and near Michigan City, Indiana in July (Personal communication with Mr. Robert Koch, Indiana Department of Natural Resources, Michigan City, IN).

Adults--Augmented by 1- and 2-year-old bloaters from the strong 1977 and 1978 year classes, the mean catch per transect of the older age groups combined (arbitrarily classed as "adults") increased sharply from an eleven year low of 22 fish in 1977 to 201 in 1978 and 597 in 1979 (Table 2). More adult chubs were available to our bottom trawls in 1979 than in 1978 at each of the eight index stations lakewide.

Alewives

Young-of-the-year--Because of the characteristically high sampling variation associated with trawl catches of young alewives, one must be cautious about attributing biological significance to year-to-year differences in the catch at a given station. In fall, bottom catches of the young are generally made in warmer waters above the thermocline, and local changes in daily thermal conditions generated by storms and upwellings may temporarily alter their availability. Therefore, comparison of the current year's catch with the average catch since lakewide sampling was commenced in 1973 may give a better perspective on overall reproductive success and production than "between-years" comparisons.

The catch-per-transect of young-of-the-year alewives in 1979 was substantially below the 7-year (1973-79) average off Saugatuck, Ludington, and Frankfort, Michigan (3 locations where young chubs have been very abundant in 2 of the last 3 years--Table 1) and Port Washington, Wisconsin. It was markedly above the longterm average, however, off Benton Harbor and Manistique, Michigan, Sturgeon Bay, Wisconsin and Waukegan, Illinois (Table 3). Consequently, the mean index catch for the stations combined was only 22% or less below the 7-year mean--not evidence in itself to support the notion of a severe lakewide decline.

Adults--adult alewives were scarce at all eastshore locations south of Frankfort, Michigan in 1979 (Table 3). They were more abundant, however, in other areas of the Lake, especially off Sturgeon Bay, Wisconsin where exceptionally large catches were made for the second year in a row. The minimal lakewide biomass estimate made by expanding these catches statistically on an area basis (Hatch 1979) increased 12% over that of 1978 to 86 thousand metric tons--slightly above the average (82 thousand metric tons) of the 7-year survey period.

The apparent reduction of the adult population in the southeastern quarter of the Lake may or may not portend ecological changes that will soon affect the alewife population in other sectors, but it will be closely observed because of the importance of alewives as forage for salmonids.

A shift in the food habits of lake trout from alewives to chubs was not detected in the stomach-content analysis of 200 adult lake trout taken in gillnets off Saugatuck in September 1979. Alewives predominated as in the past, followed by slimy sculpins and smelt in that order. However, one trout stomach contained an immature chub, a rarely-documented incident in recent years. (Young chubs outnumbered young alewives in samples taken at shallow depths with a small bottom trawl off South Haven in September according to personal communication with Dr. Larry Crowder Limnology Laboratory, University of Wisconsin, Madison, WI).

REFERENCES

- Hatch, R. W. 1979. Estimation of alewife biomass in Lake Michigan 1967-78. Administrative Report, Great Lakes Fishery Laboratory, U.S. Fish and Wildlife Service, Ann Arbor, MI.

Table 1. Number of young-of-the-year and yearling¹ chubs per bottom trawl transect² at eight index stations in Lake Michigan, October-November and May-June, 1967-79. [Either one or two (asterisk) transects were fished at each location.]

Year	Benton Harbor 3-40 fathoms	Saugatuck 3-40 fathoms	Ludington 5-40 fathoms	Frankfort ³ 10-50 fathoms	Manistique ³ 5-50 fathoms	Sturgeon ³ Bay 10-50 fathoms	Port ³ Wash. 10-40 fathoms	Waukegan 3-40 fathoms	Mean ⁴	
									Arith- metic	Geomet- ric
1967	10*	2*	5	0	-	0	-	17	6.0	4.7
1968	22*	15*	14*	0	-	2	-	60*	19.4	12.1
1969	20*	16*	22*	36	1	5	2	91*	29.4	19.1
1970	70*	30*	28*	5	2	21	58	72*	32.9	21.2
1971	11*	5*	27	24	1	4	34	8*	10.2	9.3
1972	1	4*	2	5	-	5	-	3*	2.5	3.3
1973	14	52*	44	14	3	4	2	18	18.9	12.5
1974	24	15*	137	76	0	15	4	2	34.1	13.4
1975	7	7	33	6	1	2	2	6	8.0	6.1
1976	4	0	2	4	2	0	-	2	2.0	2.5
1977	6	8	45	390	5	5	1	12	59.0	13.4
1978	62	394	517	451	33	60	87	80	210.5	129.4
1979	48	414	942	116	44	201	39	33	229.6	112.0

¹Yearlings in spring samples, young-of-year in fall.

²Transects varied from 9 to 12 standard 10-minute tows along the contour; catches at several depths not sampled in some years were estimated from those adjacent to simulate equal sampling effort in all years at a given station.

³Spring sampling during 1967-1972, fall sampling in later years; fall sampling entirely at stations if not specified.

⁴Yearling included only in calculating the means of the year preceding the year of capture.

Some years were estimated from those adjacent to simulate equal sampling effort in all years at a given station. Spring sampling during 1967-1972, fall sampling in later years; fall sampling entirely at stations if not specified.

Table 2. Number of adult (≥ 140 mm) chubs per bottom trawl transect¹ at eight index stations in Lake Michigan, October-November and May-June 1967-79. [Either one or two (asterisk) transects were fished at each location.]

Year	Benton Harbor 3-40 fathoms	Saugatuck 3-40 fathoms	Ludington 5-40 fathoms	Frankfort ² 10-50 fathoms	Manistique ² 5-50 fathoms	Sturgeon ² Bay 10-50 fathoms	Port Wash. 10-40 fathoms	Waukegan 3-40 fathoms	Mean ³
1967	411*	213*	319	635	-	58	-	594	372
1968	180*	303*	699*	427	-	30	-	631*	378
1969	151*	120*	542*	533	86	16	136	567*	325
1970	204*	139*	436*	215	25	6	28	484*	247
1971	226	129*	403*	210	141	17	33	134*	187
1972	89	100*	220	139	-	5	-	35*	98
1973	46	22	264	566	51	9	16	33	157
1974	39	33	78	75	18	16	47	48	48
1975	73	43	93	84	20	3	24	63	60
1976	62	14	35	22	41	10	-	17	27
1977	34	39	19	15	42	11	14	14	22
1978	25	483	233	267	33	18	43	178	201
1979	196	1,047	1,324	1,250	108	63	347	438	597

¹Transects varied from 9 to 12 standard 10-minute tows along the contour; catches at several depths not sampled in some years were estimated from those adjacent to simulate equal sampling effort in all years at a given station.

²Spring sampling during 1967-72, fall sampling in later years; fall sampling entirely at stations if not specified.

³Manistique and Port Washington excluded.

Table 3. Numbers of young-of-the-year alewives per bottom-trawl transect at eight index stations in Lake Michigan, October-November 1973-79¹

-136-

Year	Benton Harbor	Saugatuck	Ludington	Frankfort	Manistique ²	Sturgeon ³ Bay	Port ⁴ Wash.	Waukegan	Mean	
	5-50 fathoms	5-50 fathoms	5-50 fathoms	10-50 fathoms	5-50 fathoms	10-50 fathoms	10-50 fathoms	5-50 fathoms	Arith- metic	Geomet- ric
1973	291	5488	884	1320	289	1160	1382	244	1382	823
1974	1260	12778	18667	23953	118	1010	17807	4849	10055	4062
1975	2975	4846	8131	4041	1826	40	2676	258	3099	1487
1976	887	3062	5883	716	244	210	-	4334	2191	1142
1977	178	8452	3680	2280	115	19	3571	89	2298	553
1978	4033	10983	6001	382	1024	598	3093	5543	3957	2391
1979	4466	690	2386	216	958	4562	115	11189	3073	1315
Mean	2013	6614	6519	4701	653	1086	4774	3787	3722	1682
1979 ¹ devi- ation	+122	-90	-63	-95	+47	+320	-98	+195	-17	-22

¹Each transect included standard 10-minute tows at 5-fathom intervals from 5 or 10 to 50 fathoms.

²No tows at 45 and 50 fathoms in 1973, and at 5 fathoms in 1976 and 1979 where a 7-fathom catch was substituted.

³No tow at 45 fathoms in 1973.

⁴Not sampled in 1976.

Table 4. Numbers of adult (≥ 120 mm) alewives per bottom-trawl transect at eight index stations in Lake Michigan, October-November 1973-79.¹

Year	Benton Harbor	Saugatuck	Ludington	Frankfort	Manistique	Sturgeon Bay	Port Wash. ²	Waukegan	Mean
1973	3,716	2,183	7,058	15,253	1,099	2,083	1,288	3,969	4,581
1974	4,125	3,520	3,244	394	101	1,566	2,692	5,104	2,593
1975	4,424	1,558	1,149	11,200	1,095	1,020	3,403	8,994	4,105
1976	1,017	1,142	2,467	2,065	1,955	1,238	-	2,343	1,747
1977	1,055	1,270	931	1,260	2,838	1,848	1,771	1,906	1,610
1978	1,153	1,231	876	1,383	747	10,778	2,540	2,498	2,651
1979	713	434	880	2,834	4,428	15,398	1,790	2,295	3,596
Mean	2,315	1,620	2,372	4,913	1,752	4,847	2,247	3,389	2,983
1979 deviation	-69	-73	-63	-42	+153	+218	-20	-32	+21

¹Each transect included standard 10-minute tows along the contour at 5-fathom intervals from 10 to 50 fathoms.

²Not sampled in 1976.

-137-