2005 SPRING LAKE TROUT ASSESSMENT

INTRODUCTION

Lake trout were nearly extirpated in Lake Superior during the 1950s due to over-fishing and sea lamprey predation. Sea lamprey control, reduction of commercial fishing and establishment of refuges have contributed to the increase of lake trout abundance in Wisconsin waters. However, lake trout population characteristics are still important to determine the progress of rehabilitation. Biological data collected are required for critical management decisions such as setting the lake trout quota and recreational fishing regulations. The objective of the spring lake trout assessment is to monitor lake trout population dynamics such as abundance, diet, and sea lamprey wounding rates.

METHODS

Thirty stations were sampled in the Apostle Islands (WI-2) (Figure 1) with the R/V *Hack Noyes*. Each site was sampled with 2,700 ft of multifilament nylon gill net with 4.5-in stretch mesh. Nets were set for one night (24 hr) at each station.

Sixteen stations were sampled in western Wisconsin waters (WI-1) (Figure 1) with the R/V *Hack Noyes*. Each site was sampled with 900 ft of multifilament nylon gill net with 4.5-in stretch mesh. Nets were set for one night (24 hr) at each station.

All live fish were measured (total length), tagged (lake trout only), checked for sea lamprey marks and fin-clips, and then released. Dead fish were processed in the same manner except not tagged, stomach contents were collected and frozen, individual weights were taken when lake conditions permitted, scale samples were taken, and otoliths removed from wild lake trout. Although whitefish were not tagged they were processed similarly to lake trout.

Fish ages were estimated using scales and otoliths.

Following the protocol established by the Lake Superior Technical Committee, diet was analyzed by examination of stomach contents. Frequency of occurrence and percent composition by weight of food items were calculated from the stomach contents.

RESULTS/DISCUSSION

SEA LAMPREY WOUNDING

Sea lamprey wounding data are collected annually to monitor the effectiveness of control programs and follow trends. Sea lamprey wounding has been consistently lower in WI-2 than WI-1 (Table 1 and 2). Wounding rates increased for all size categories in WI-2 from 2004 to

2005 (Table 2).

LAKE TROUT - CATCH STATISTICS

In 2005, 613 lake trout were captured within WI-2. Wild fish comprised 91% of the lake trout catch. Mean length of wild lake trout was 23.4 in (SD = 3.7)(Figure 2). Geometric mean catch-per-unit-effort (CPUE) of wild fish increased 32.5% from 2004 to 2005 (Figure 3, Table 3). Mean length of hatchery-reared lake trout was 22.0 in (SD = 4.5)(Figure 2). Geometric mean CPUE of hatchery fish increased 37.5% from 2004 to 2005 (Figure 3, Table 3).

In 2005, 196 lake trout were sampled within WI-1. Wild lake trout abundance has been gradually increasing and wild fish accounted for 62% of the catch. Mean length of wild fish was 23.3 in (SD = 3.1)(Figure 4). Geometric mean CPUE of wild fish increased 19% from 2004 to 2005 (Figure 5, Table 4). Mean length of hatchery-reared lake trout was 25.1 in (SD = 3.8)(Figure 4). Geometric mean CPUE of hatchery fish decreased 13.6% from 2004 to 2005 (Figure 5, Table 4).

LAKE TROUT - MEAN LENGTH-AT-AGE

Mean age of lake trout captured in WI-1 was 7 (Range 5-13). Mean age of lake trout captured in WI-2 was 9 (Range 4-25). Mean length-at-age was calculated for wild lake trout sampled in WI-2 (Table5). Mean lengths-at-age of wild lake trout were derived from von Bertalanffy growth equations (Figure 6).

LAKE TROUT - DIET ANALYSIS

In 2005, the stomach contents of 168 lake trout from WI-2 were examined (38 were empty). Excluding unknown fish species, rainbow smelt were present in more stomachs and generally constituted more of the lake trout's diet by weight (Table 6). Unlike mean length of coregonines consumed, mean length of smelt consumed did not increase consistently with increasing lake trout size (Table 7).

REHABILITATION PROGRESS

Wild lake trout abundance continues to increase within WI-2 and WI-1. Lake trout stocking is no longer necessary in WI-2 and the 1994 year class was the last to be stocked. This is a sign of continued progress in lake trout rehabilitation. Maintenance of the refuges in combination with sport and commercial regulations, and sea lamprey control, are needed for rehabilitation to continue. Lake trout will continue to be stocked in WI-1 until the stocking protocol established by the Lake Superior Technical Committee indicates otherwise.

SISCOWETS

Few siscowet (fat) lake trout were caught during the spring lean lake trout assessment (Table 8 and 9). Abundance has increased over the years, but sampling does not occur in siscowet habitat, consequently trends may only be marginal indicators of abundance.

WHITEFISH CATCH STATISTICS

In 2005, 412 whitefish were captured in WI-2 (mean length = 19.1, SD = 1.5)(Figure 7). Geometric mean CPUE of whitefish increased from 2004 to 2005 (Figure 8).

In 2005, 63 whitefish were captured in WI-1 (mean length = 18.8, SD = 1.7)(Figure 7). Geometric mean CPUE of whitefish increased from 2004 to 2005 (Figure 8). Whitefish abundance in WI-1 has increased slowly since1987 but has been much lower than in WI-2. The majority of whitefish captured in WI-1 are at sites in the eastern end of the management area.

Table 1. Sea lamprey wounds per 100 lake trout from spring assessment, 4.5-in nylon gill nets (sample size) in WI-1, 1987-2005.

Year	< 17"	17-20.9"	21-24.9"	25-28.9"	28.9"<	Total
1987	0.0 - (6)	8.7 - (208)	18.8 - (335)	31.4 - (105)	66.7 - (9)	18.1 - (663)
1988	0.0 - (5)	7.5 - (40)	11.6 - (241)	22.2 - (117)	0.0 - (10)	13.8 - (413)
1989	0.0 - (4)	3.2 - (62)	12.4 - (209)	16.4 - (152)	31.6 - (19)	13.2 - (446)
1990	0.0 - (14)	2.8 - (144)	16.1 - (112)	28.6 - (98)	33.3 - (15)	14.4 - (383)
1991	0.0 - (11)	6.7 - (102)	15.0 - (140)	19.8 - (86)	11.1 - (9)	13.2 - (348)
1992	0.0 - (5)	6.3 - (64)	17.9 - (95)	34.0 - (47)	16.7 - (12)	17.5 - (223)
1993	0.0 - (22)	0.0 - (98)	14.4 - (187)	23.0 - (148)	29.2 - (41)	14.7 - (496)
1994	0.0 - (32)	0.0 - (59)	13.0 - (54)	5.8 - (52)	0.0 - (16)	4.7 - (213)
1995	0.0 - (6)	1.0 - (101)	6.3 - (126)	14.1 - (85)	14.8 - (27)	7.2 - (345)
1996			No Sampling			
1997	0.0 – (39)	0.0 – (71)	7.8 – (115)	11.6 – (86)	26.7 – (30)	7.9 – (341)
1998	0.0 - (32)	1.4 - (69)	2.9 - (69)	7.3 - (55)	41.2 - (17)	5.8 - (242)
1999	0.0 – (25)	0.0 – (116)	1.1 – (181)	2.4 – (41)	15.8 – (19)	1.6 – (382)
2000	9.1 – (11)	1.5 – (65)	5.3 – (169)	16.7 – (36)	100 – (16)	11.1 – (297)
2001			No Sampling			
2002	0.0 – (6)	2.1 – (48)	1.3 – (159)	19.3 – (109)	38.3 – (47)	11.4 – (369)
2003	0.0 – (4)	0.0 – (21)	4.5 – (66)	4.3 – (47)	21.7 – (23)	6.2 – (161)
2004	0.0 – (1)	0.0 – (18)	5.6 – (72)	6.4 – (47)	53.3 – (15)	9.8 – (153)
2005	0.0 – (0)	2.8 – (36)	6.9 – (101)	26.9 – (41)	44.4 – (18)	13.8 – (196)

Table 2. Sea lamprey wounds per 100 lake trout from spring assessment, 4.5-in nylon gill nets (sample size) in WI-2, 1985-2005.

Year	< 17"	17-20.9"	21-24.9"	25-28.9"	28.9"<	Total
1985	1.9 - (52)	3.2 - (318)	6.7 - (556)	7.9 - (241)	12.5 - (32)	6.0 - (1,199)
1990	0.0 - (35)	1.9 - (471)	3.7 - (484)	10.6 - (339)	8.3 - (84)	5.0 - (1,413)
1991	1.7 - (58)	1.8 - (391)	4.5 - (584)	6.7 - (374)	11.3 - (106)	4.7 - (1,513)
1992	0.0 - (45)	1.6 - (316)	9.2 - (601)	12.4 - (315)	23.0 - (74)	8.6 - (1,351)
1993	0.0 - (59)	1.0 - (302)	5.6 - (393)	6.0 - (318)	10.5 - (105)	4.7 - (1,177)
1994	0.0 - (58)	0.9 - (230)	1.2 - (485)	3.0 - (370)	8.2 - (98)	2.2 - (1,241)
1995	0.0 - (30)	0.7 - (426)	1.9 - (643)	7.2 - (375)	8.7 - (127)	3.3 - (1,601)
1996	No Sampling					
1997	0.0 – (90)	0.3 – (356)	2.1 – (533)	4.9 (347)	5.1 – (158)	2.5 – (1,484)
1998	0.0 - (46)	0.6 - (357)	0.9 - (462)	4.8 - (147)	8.6 - (93)	1.9 - (1,105)
1999	0.0 – (37)	0.8 – (479)	1.0 – (707)	2.9 – (138)	10.1 – (99)	1.7 – (1460)
2000	0.0 – (33)	0.9 – (437)	4.3 – (1036)	15.4 – (247)	31.8 – (107)	6.5 – (1860)
2001	No Sampling					
2002	0.0 – (17)	0.0 – (166)	3.3 – (398)	7.4 – (203)	23.4 – (64)	5.1 – (848)
2003	0.0 - (8)	0.0 - (62)	2.5 - (244)	5.1 - (98)	12.5 - (40)	3.5 - (452)
2004	0.0 - (6)	0.8 - (131)	2.8 - (179)	5.4 - (112)	9.4 - (32)	3.3 - (460)
2005	0.0 – (15)	3.4 – (147)	2.9 – (279)	6.9 – (117)	23.7 – (55)	5.5 – (613)

Table 3. Catch data for spring sampled lake trout in 4.5-in nylon gill nets from WI-2, 1981-2005. Nets were set for three nights from 1981-2000 and for one night since 2002.

Year	Effort (Feet)	Sample Size	Wild Sample Size	Wild Geometric Mean CPUE	Wild Mean Length (in)	% Wild	Hatchery Geometric Mean CPUE
1981	63,300	763	227	5.1	23.9	29.9	11.1
1982	90,000	814	250	2.6	23.5	30.7	5.6
1983	17,400	139	43	2.5	24.1	30.9	5.5
1984	18,000	208	62	2.9	23.7	29.8	9.0
1985	78,300	1,303	459	3.5	23.2	35.2	6.9
1986	88,200	2,093	1,039	8.1	22.7	49.7	8.9
1987	83,700	1,730	1,047	7.0	22.2	60.5	6.9
1988	83,700	1,166	628	6.2	23.1	53.9	5.4
1989	83,700	1,728	954	8.9	23.6	55.2	6.6
1990	83,700	1,395	883	7.4	23.6	63.3	4.5
1991	83,700	1,487	1,031	8.5	23.5	69.3	4.9
1992	83,700	1,351	967	8.5	23.6	71.6	3.7
1993	83,700	1,176	893	9.5	24.0	75.9	3.4
1994	83,700	1,241	967	10.2	24.0	77.9	3.3
1995	83,700	1,601	1,132	12.1	23.8	70.7	3.4
1996	No Sampling						
1997	83,700	1,484	1,032	11.2	24.4	69.5	4.0
1998	83,700	1,105	775	8.0	23.2	70.1	3.0
1999	83,700	1460	926	11.2	22.9	63.4	4.8
2000	83,700	1860	1233	14.9	23.3	66.3	5.7
2001	No Sampling						
2002	83,700	848	719	21.5	23.7	84.8	3.4
2003	81,000	452	414	12.4	24.0	91.6	0.9
2004	83,700	460	428	12.6	23.4	93.0	0.8
2005	83,700	613	556	16.7	23.4	90.7	1.1

Table 4. Catch data for spring sampled lake trout in 4.5-in nylon gill nets from WI-1, 1987-2005. Nets were set for three nights from 1987-2000 and for one night since 2002.

Year	Effort (Feet)	Sample Size	Wild Sample Size	Wild Geometric Mean CPUE	Wild Mean Length (in)	% Wild	Hatchery Geometric Mean CPUE
1987	17,100	665	85	0.8	20.7	12.8	3.0
1988	17,100	415	35	0.5	23.0	8.4	2.2
1989	17,100	449	29	0.3	21.7	6.5	2.0
1990	17,100	384	52	0.6	20.5	13.5	1.9
1991	17,100	348	68	0.8	22.0	19.5	2.0
1992	17,100	223	68	0.7	21.3	30.5	1.6
1993	17,100	496	103	1.1	21.6	20.8	2.7
1994	17,100	213	62	0.8	21.6	29.1	1.5
1995	17,100	345	146	1.4	22.3	43.2	2.1
1996	No Sampling						
1997	17,100	341	137	1.4	23.2	40.2	2.1
1998	17,100	242	90	1.0	23.1	37.2	1.6
1999	17,100	382	101	1.1	22.7	26.4	2.5
2000	17,100	297	109	1.5	22.3	36.7	2.4
2001	No Sampling						
2002	14,400	369	125	2.6	23.9	33.9	3.7
2003	14,400	161	48	1.2	22.9	29.8	2.2
2004	14,400	153	80	2.1	23.6	52.3	2.2
2005	14,400	196	121	2.5	23.3	61.7	1.9

Table 5. Mean length-at-age of wild lake trout sampled from WI-2, 2005.

	Female		Male	
Age	Length (in)	Sample	Length (in)	Sample
4			13.4	1
5	18.4	1	16.8	3
6	19.9	7	19.5	4
7	20.3	15	20.7	15
8	21.6	10	20.8	22
9	22.4	15	23.2	16
10	24.4	9	23.8	6
11	26.2	6	25.7	10
12	27.0	5	25.9	5
13	29.6	1	26.3	4
14	28.1	1		
15			24.7	1
16	31.9	2		
17	26.8	1	30.6	2
18				
19	30.9	1		
20				
21	27.2	1		
22				
23				
24				
25			27.1	1
Sum		75		90

Table 6. Diet composition of lake trout captured from WI-2 in 2005 (percent frequency of occurrence (%FO) and percent composition by weight (%CW)).

Length Class (in)	<15.7			15.7-23.5			23.6-31.4			>31.4		
No. examined	3			93			69			3		
No. empty (%)	2 (67)			21 (22)			9 (13)			1 (33)		
Food Item	Occur-ence	%FO	Mean %CW	Occur-ence	%FO	Mean %CW	Occur-ence	%FO	Mean %CW	Occur-ence	%FO	Mean %CW
Coregonus Sp.		0.0		3	3.2	2.1	7	10.1	35.7		0.0	
Rainbow Smelt	1	33.3	100.0	50	53.8	89.8	20	29.0	26.1		0.0	
Burbot		0.0			0.0		4	5.8	13.7	2	66.7	95.3
Sculpins		0.0		5	5.4	1.2	12	17.4	5.9		0.0	
Sticklebacks		0.0		2	2.2	0.3	3	4.3	0.2		0.0	
Unidentified Fish		0.0		25	26.9	6.5	27	39.1	9.7		0.0	
Mysis relicta		0.0		1	1.1	0.0	1	1.4	1.1		0.0	
Aphipods		0.0		1	1.1	0.0	9	13.0	7.1	1	33.3	0.6
Terrestrial Insects		0.0			0.0		1	1.4	0.0	1	33.3	0.6
Other		0.0		4	4.3	0.1	4	5.8	0.4	1	33.3	3.5

Table. 7 Mean length (in) of prey consumed by lake trout captured in WI-2, 2005.

	<15.7		15.7-23.5		23.6-31.4		>31.4	
Food Item	Avg.	Std. Dev.	Avg.	Std. Dev.	Avg.	Std. Dev.	Avg.	Std. Dev.
Coregonus Sp.			4.2	0.0	11	3.5		
Rainbow Smelt	3.7	0.7	4.8	0.7	4.5	1.0		
Burbot					9.9	2.2	11.8	-
Sculpins			1.9	0.8	2.8	1.8		
Sticklebacks			2.8	0.6	2.3	0.1		

Table 8. Catch data of siscowet lake trout from WI-2, 1981-2005. Nets were set for three nights from 1981-2000 and for one night since 2002.

Year	Effort (ft)	Sample Size	Fish/1000 ft	CPUE > 25”	Mean Length (in)
1981	63,300	1	0.16	0.16	25.2
1982	90,000	0	0.00	0.00	--
1983	17,400	7	0.40	0.00	20.3
1984	18,000	20	1.10	0.14	20.5
1985	78,300	0	0.00	0.00	--
1986	88,200	1	0.01	0.00	22.4
1987	83,700	9	0.11	0.00	21.5
1988	83,700	7	0.08	0.00	20.5
1989	83,700	17	0.20	0.00	21.5
1990	83,700	9	0.11	0.04	24.2
1991	83,700	29	0.50	0.04	21.9
1992	83,700	22	0.26	0.02	22.1
1993	83,700	40	0.48	0.04	21.7
1994	83,700	42	0.50	0.01	21.1
1995	83,700	30	0.36	0.06	22.3
1996			No Sampling		
1997	83,700	30	0.36	0.13	22.5
1998	83,700	45	0.18	0.18	23.4
1999	83,700	41	0.50	0.07	21.4
2000	83,700	70	0.84	0.18	22.5
2001			No Sampling		
2002	83,700	21	0.30	--	22.7
2003	81,000	24	0.30	0.05	22.7
2004	83,700	9	0.11	0.04	23.0
2005	83,700	20	0.24	0.08	24.1

Table 9. Catch data of siscowet lake trout from WI-1, 1987-2005. Nets were set for three nights from 1987-2000 and for one night since 2002.

Year	Effort (feet)	Sample Size	Fish/1000 ft	CPUE > 25”	Mean Length (in)
1987	17,100	1	0.06	0.00	17.6
1988	17,100	1	0.06	0.00	20.0
1989	17,100	0	0.00	0.00	--
1990	17,100	2	0.12	0.06	22.9
1991	17,100	6	0.35	0.06	20.6
1992	17,100	1	0.06	0.06	27.8
1993	17,100	16	0.94	0.00	--
1994	17,100	1	0.06	0.00	--
1995	17,100	1	0.06	0.00	20.7
1996			No Sampling		
1997	17,100	8	0.47	0.23	25.5
1998	17,100	31	1.8	0.82	22.8
1999	17,100	14	0.82	0.11	20.8
2000	17,100	6	0.35	0.12	23.2
2001			No Sampling		
2002	14,400	1	0.1	0.00	17.5
2003	14,400	8	0.55	0.35	26.2
2004	14,400	2	0.14	0.00	21.9
2005	14,400	3	0.21	0.00	18.3

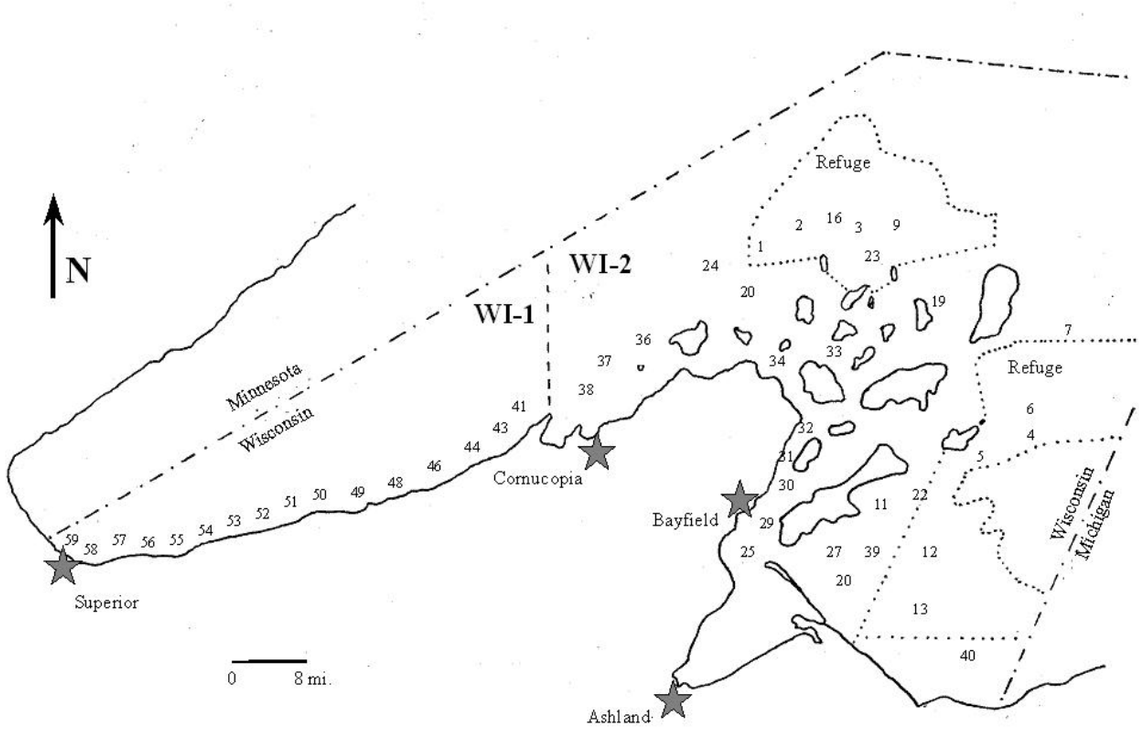

Figure 1. Gill net sites for spring lake trout assessment in the Wisconsin waters of Lake Superior, 2005. Wisconsin waters are divided into two management regions, WI-1 and WI-2.

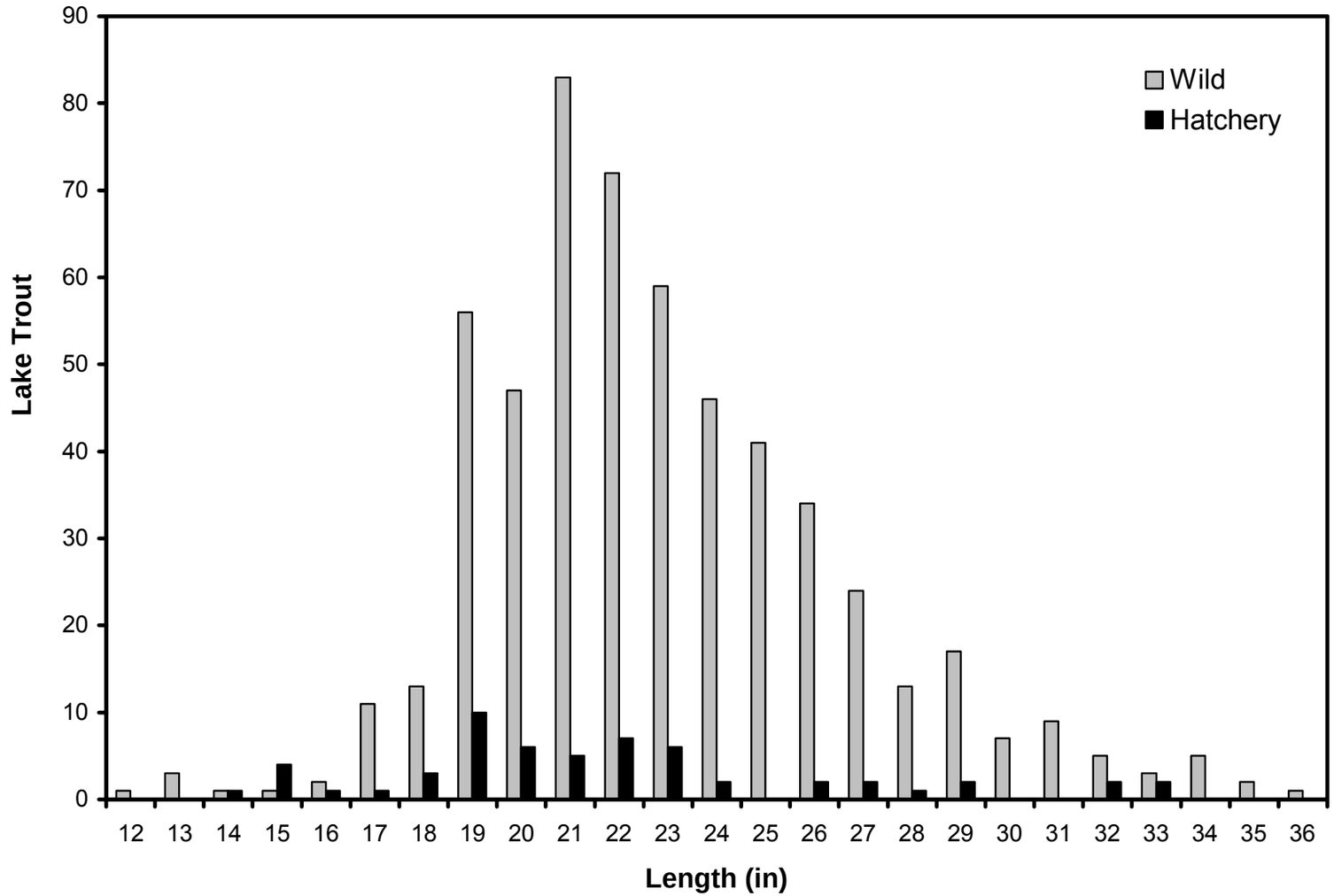

Figure 2. Length distribution of wild and hatchery lake trout caught in WI-2, 2005.

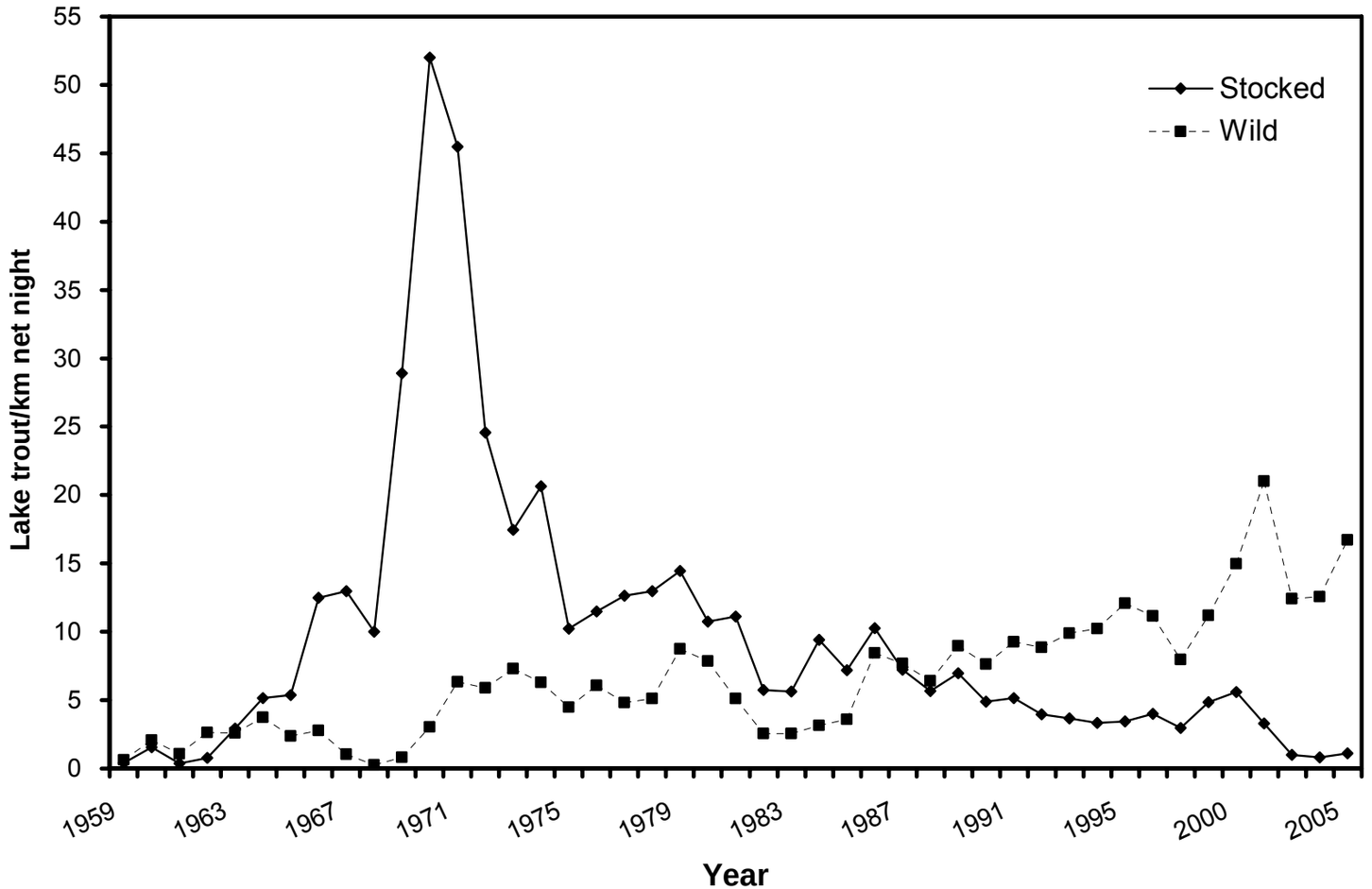

Figure 3. Geometric mean catch-per-unit-effort of wild and hatchery lake trout in WI-2, 1959-2005. Lake trout were not sampled in 1996 and 2001.

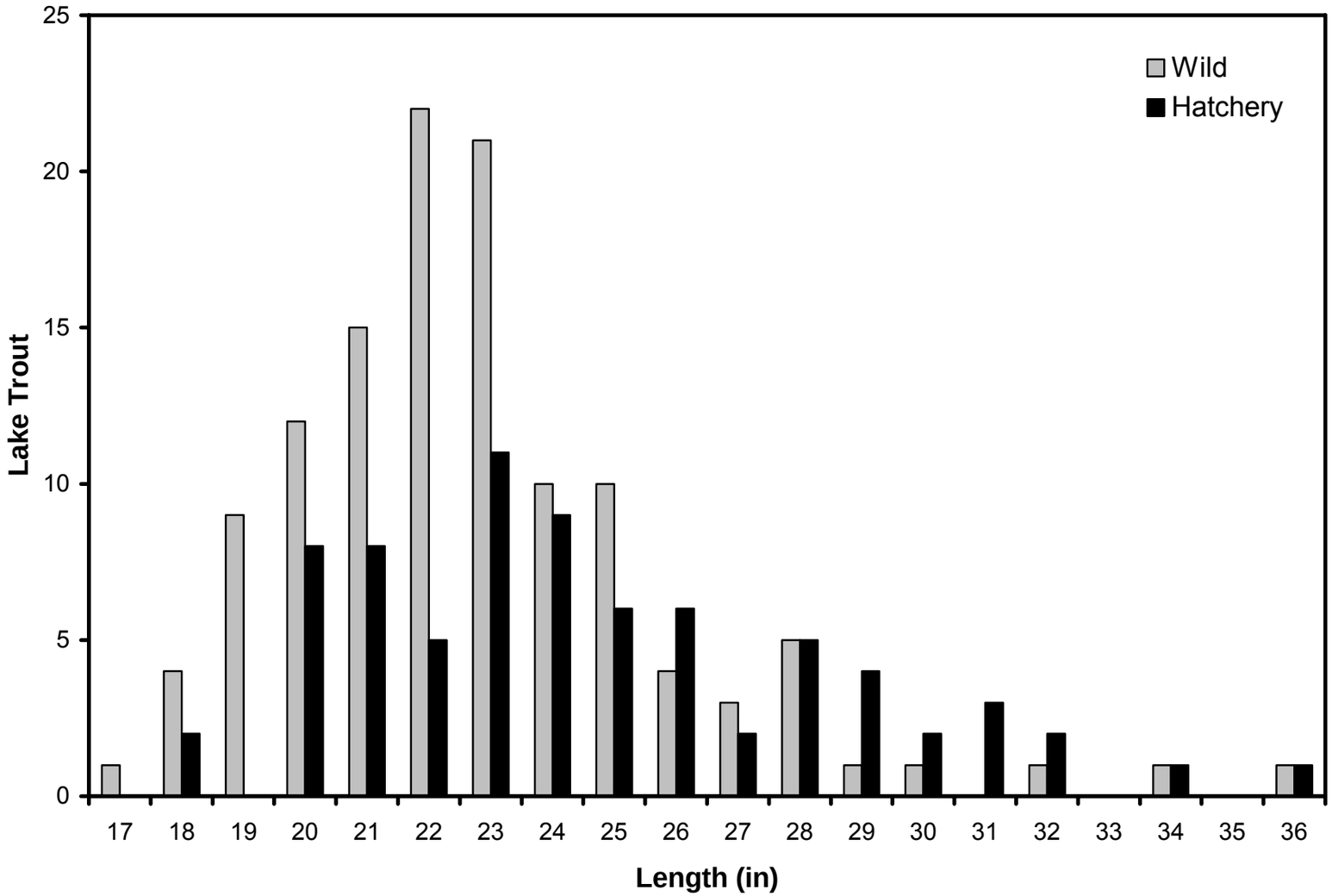

Figure 4. Length distribution of wild and hatchery lake trout caught in WI-1, 2005.

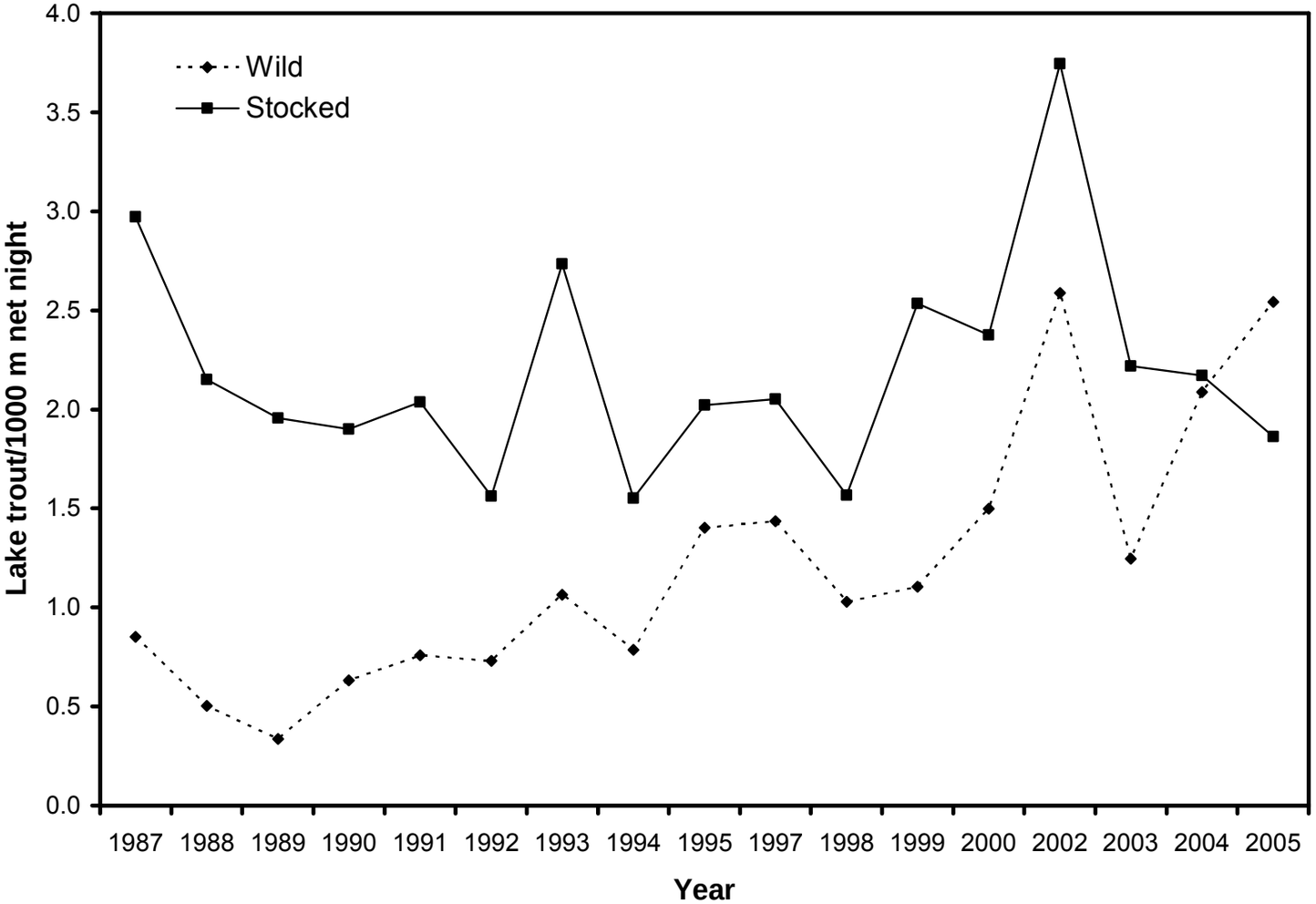

Figure 5. Geometric mean catch-per-unit-effort of wild and hatchery lake trout in WI-1, 1987-2005. Lake trout were not sampled in 1996 and 2001.

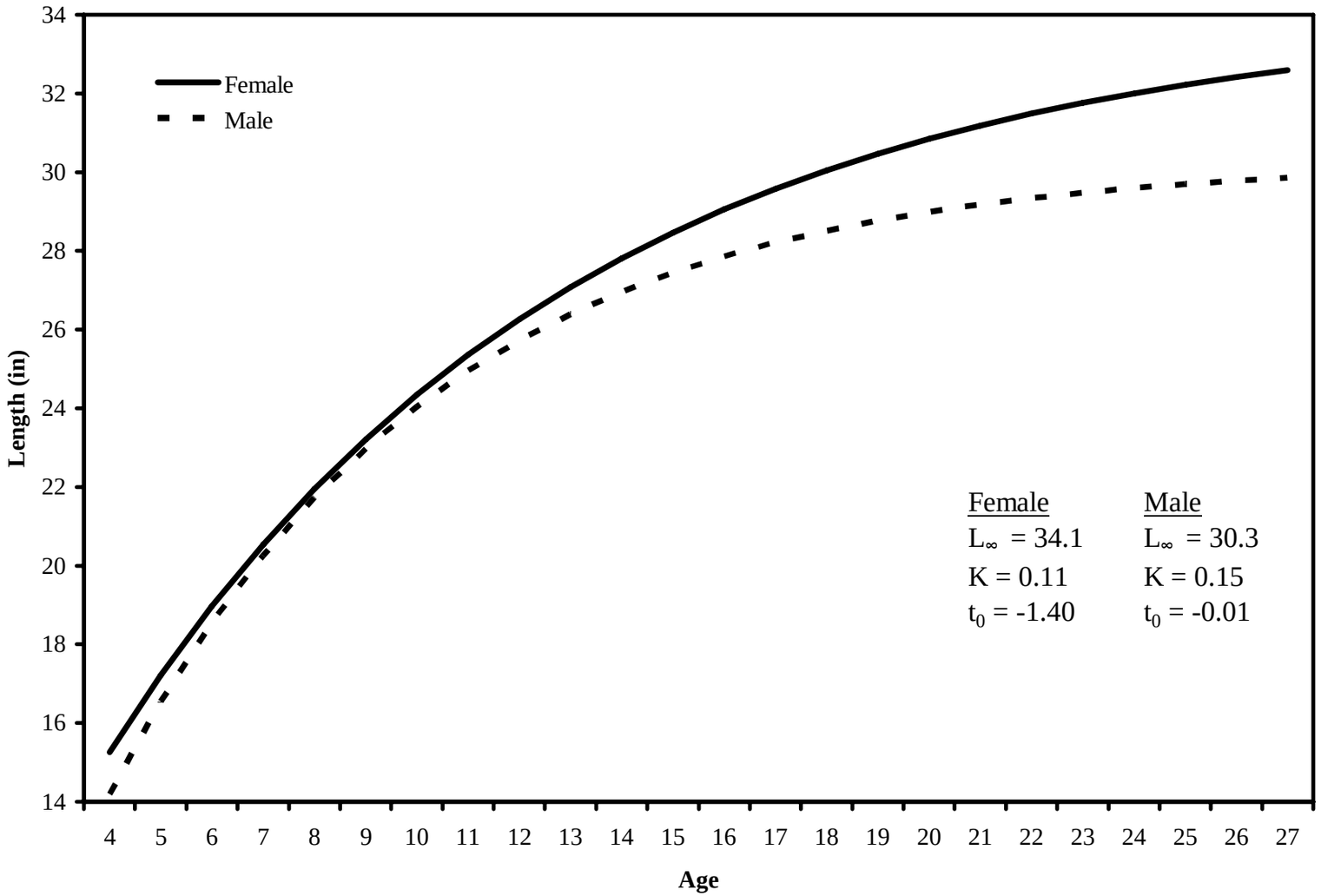

Figure 6. Mean length-at-age for wild lake trout in WI-2 derived from von Bertalanffy growth equation.

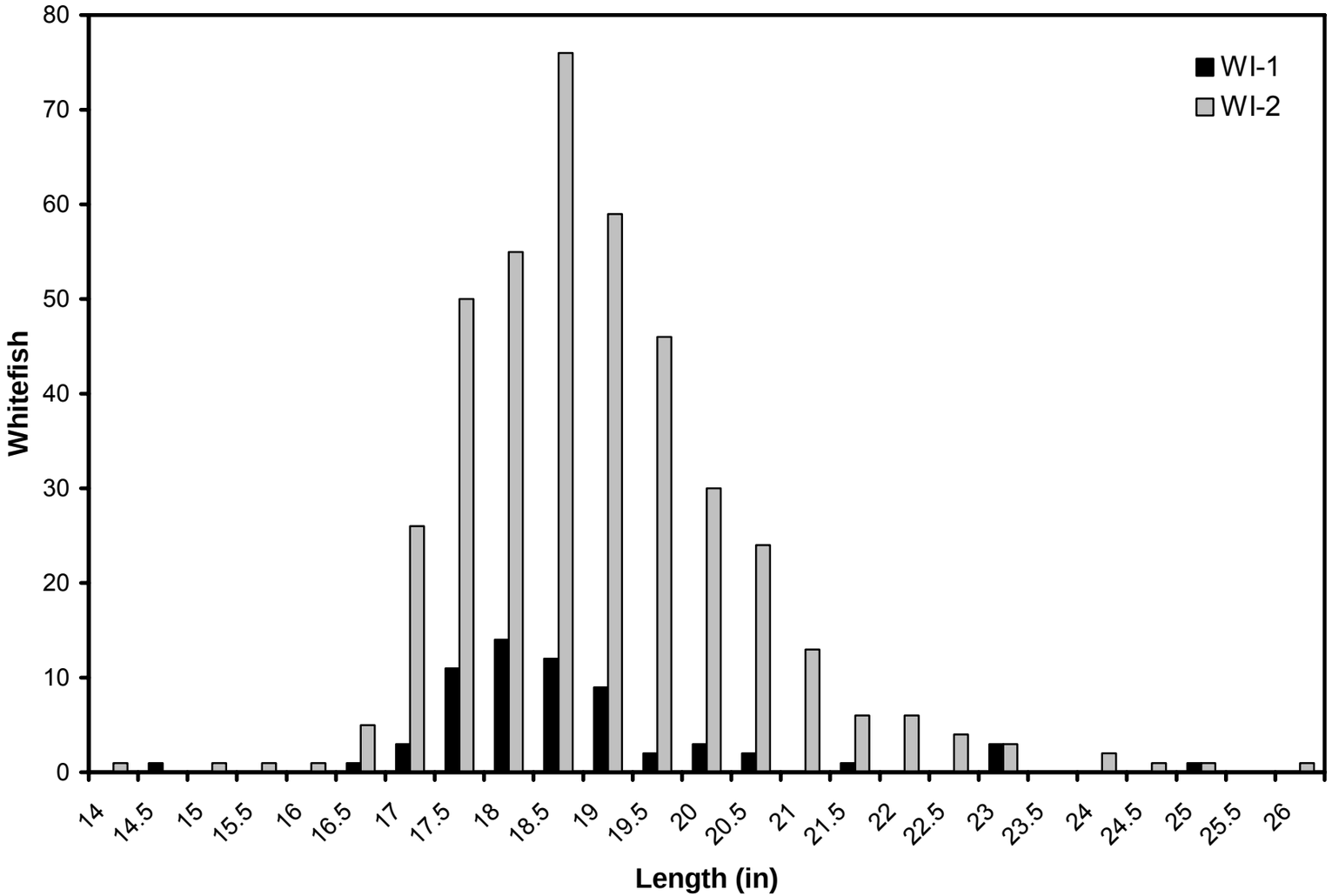

Figure 7. Length distribution of whitefish captured in Wisconsin waters of Lake Superior, 2005.

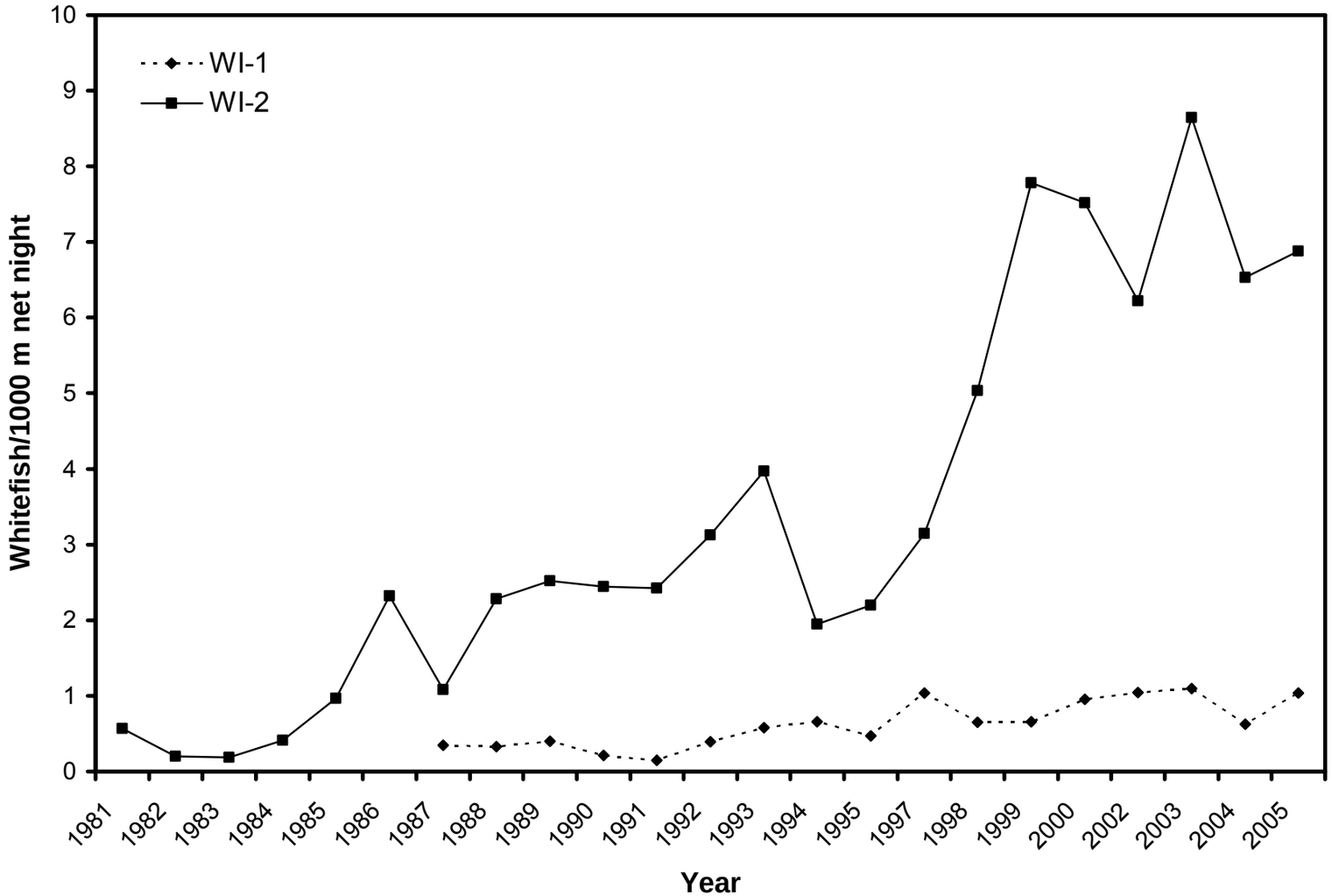

Figure 8. Geometric catch-per-unit-effort of whitefish in Wisconsin waters of Lake Superior, 1981-2005.