

2006 SPAWNING LAKE TROUT ASSESSMENT

INTRODUCTION

Recovery of historical spawning populations has been an essential component of lake trout rehabilitation in the Wisconsin waters of Lake Superior. Creation of refuges/special use areas adjacent to spawning shoals, more restrictive fishing regulations, stocking of fertilized lake trout eggs in astro-turf bundles, and sea lamprey control has increased lake trout abundance. Although wild lake trout abundance has increased dramatically since the 1960s and stocking was concluded in 1995 for WI-2, maintaining or continuing to increase spawner biomass is essential to a self-sustaining population. The objective of this assessment is to monitor lake trout abundance on historically important spawning shoals and to collect lake trout eggs for the Les Voight Fish Hatchery for lake trout and splake stocking programs.

METHODS

The standard index gang set on Gull Island Shoal (GIS) was 2,700 ft of 5.5-in and 6-in (stretch measure) monofilament mesh (6, 5.5, 6, 5.5, 6, 5.5, 6, 5.5, 6). Each net within the gang was 300 feet long. The standard index gang off Northeast Michigan Island (NMI) was divided: 1,500 ft (6, 5.5, 6, 5.5, 6) set off Michigan Island, and 1,200 ft (6, 5.5, 6, 5.5) set off Gull Island.

The standard index gang set on Sand Cut Reef (SCR) was 3,900 ft of graded monofilament mesh. Each net was 300 ft long and meshes were arranged in the following sequence: 6, 5.5, 7, 4.5, 6.5, 5, 6, 5, 6.5, 4.5, 7, 5.5, 6. On SCR the gang was divided between the two humps: 1,800 ft on the west hump and 2,100 ft on the east hump.

An index gang (3,900 ft of graded monofilament mesh) was set on Devils Island Shoal (DIS). Each net was 300 ft long and meshes were arranged in the following sequence: 6, 5.5, 7, 4.5, 6.5, 5, 6, 5, 6.5, 4.5, 7, 5.5, 6.

All fish were measured to the nearest tenth of an inch, sexed, inspected for sea lamprey marks, and inspected for fin clips and t-bar tags. Live lake trout were marked with individually numbered t-bar tags and released. Otoliths and scales were removed from the dead, wild fish.

Fish ages were estimated by examining sectioned sagittal otolith planes.

Mean length-at-age was calculated from ages estimated for lake trout in 2004 through 2006. The von Bertalanffy growth parameters were derived to estimate lake trout growth (Devries and Frie 1996). Sample mean lengths-at-age (directly from fish caught) were compared to those predicted by the von Bertalanffy growth equation. Residuals weighted by sample size at each age were calculated. Iterative changes were made to the von Bertalanffy growth parameters until the residual sum of squares was minimized.

Results/Discussion

GULL ISLAND SHOAL

In 2006, 862 spawning lake trout were sampled on GIS and 98% were wild fish. Female lake trout constituted 35% of the sample. Catch-per-unit-effort (CPUE) from 5.5 and 6 in mesh decreased from 2005 to 2006 (Table 1) and total CPUE decreased (Figure 1). Spawning lake trout CPUE has increased dramatically since 1960, when no fish were caught during the spawning assessments (Figure 1). Mean lengths of male and female lake trout were 28.0 in (SD=3.1) and 30.5 in (SD=2.8), respectively.

MICHIGAN ISLAND SHOAL

In 2006, 269 lake trout were sampled on NMI. Wild fish constituted 96% of the catch and female lake trout comprised 35% of the catch. Lake trout CPUE increased from 2005 to 2006 (Table 1). Mean lengths of male and female lake trout were 27.2 in (SD=2.7) and 30.0 in (SD=2.6), respectively.

GULL - MICHIGAN ISLAND COMPLEX

The GIS-NMI data for wild and hatchery-origin female lake trout were combined to monitor trends. Lake trout CPUE for all size intervals except 21-25 in decreased from 2005 to 2006 (Table 2). Although variable between 1985 and 1995, the abundance of wild female lake trout has increased gradually since 1964 (Figure 2). The annual proportion of female lake trout in the catch, also highly variable, has not consistently increased since the 1970s (Figure 3). The annual proportion of hatchery lake trout in the catch continues to decrease, however hatchery fish were a large component of the catch during assessments in the 1960s and 1970s (Figure 4).

Lake trout caught in 2004 through 2006 were combined to evaluate mean length-at-age and age distribution of spawners at GIS complex (Figure 5-7). Under representation of younger lake trout and aging error for older fish can influence von Bertalanffy parameter estimates. In this case, growth curves are still useful in examining mean length-at-age of the population. Twenty-nine lake trout year classes were represented in the sample of GIS complex in 2004 through 2006 (Figure 7). Average age of spawning lake trout at GIS was 18 (range 10-39) in 2006.

Fresh sea lamprey wounds (per 100 fish) were highest for lake trout sampled at GIS complex (Table 3).

SAND CUT REEF

In 2006, 142 lake trout were sampled on SCR. Wild fish comprised 96% of the catch and female lake trout comprised 34% of the catch. Catch-per-effort of spawning lake trout decreased from 2005 to 2006 (Table 4). Mean lengths of male and female lake trout were 27.1 in (SD=3.4) and 28.5 in (SD=3.5), respectively

Lake trout captured from SCR had fewer sea lamprey wounds than those from GIS (Table 3). Close proximity to a major sea lamprey spawning river (Bad River) and low wounding rates indicate that sea lamprey apparently do not feed near the river or the lake trout that spawn on SCR do not spend substantial time near the river when not spawning.

DEVILS ISLAND SHOAL

In 2006, 207 lake trout were captured on DIS of which 98% were unclipped, wild fish. Devils Island Shoal CPUE decreased from 2004 to 2006 but the percentage of females in the catch was higher than in previous years (Table 5). Mean lengths of male and female lake trout were 26.7 in (SD=2.6) and 28.6 in (SD=2.5), respectively

The spawning lake trout stock at DIS was composed of primarily of young fish (Figure 8). Although the sample size was low (35) the oldest lake trout captured was estimated at 20 years old.

Sea lamprey wounding rates from DIS were lower than at GIS complex (Table 3).

2006 EGG HARVEST

Lake trout eggs were collected by the Les Voight Fish Hatchery for the lake trout (211,240) and splake (247,522) stocking programs.

References

Devries, D. R. and R. V. Frie. 1996. Determination of age and growth. Pages 483-512. *In* B. R. Murphy and D. W. Willis, editors. Fisheries Techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

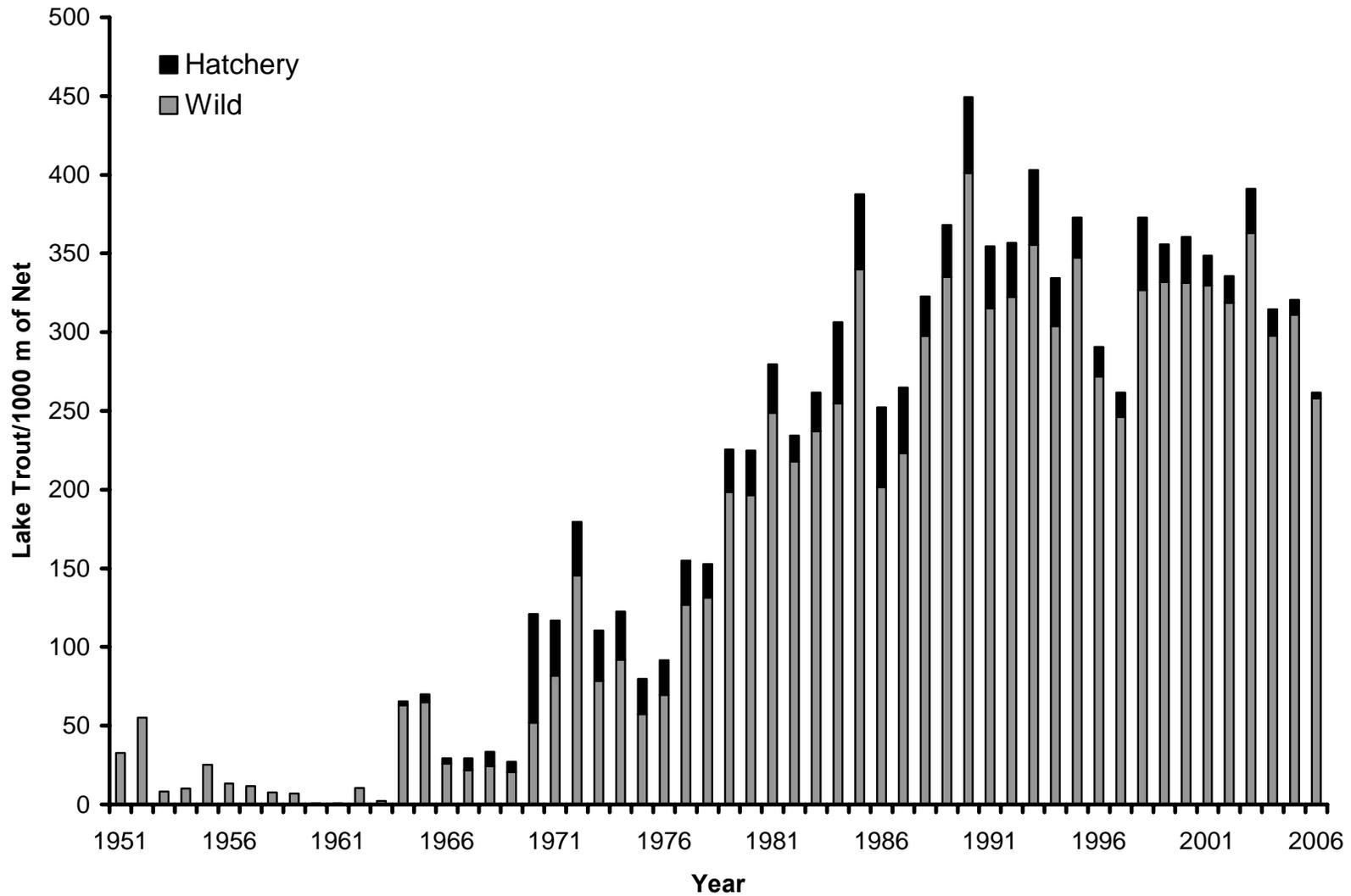


Figure 1. Catch-per-unit-effort of lake trout from spawning assessment at Gull Island Shoal, 1951-2006.

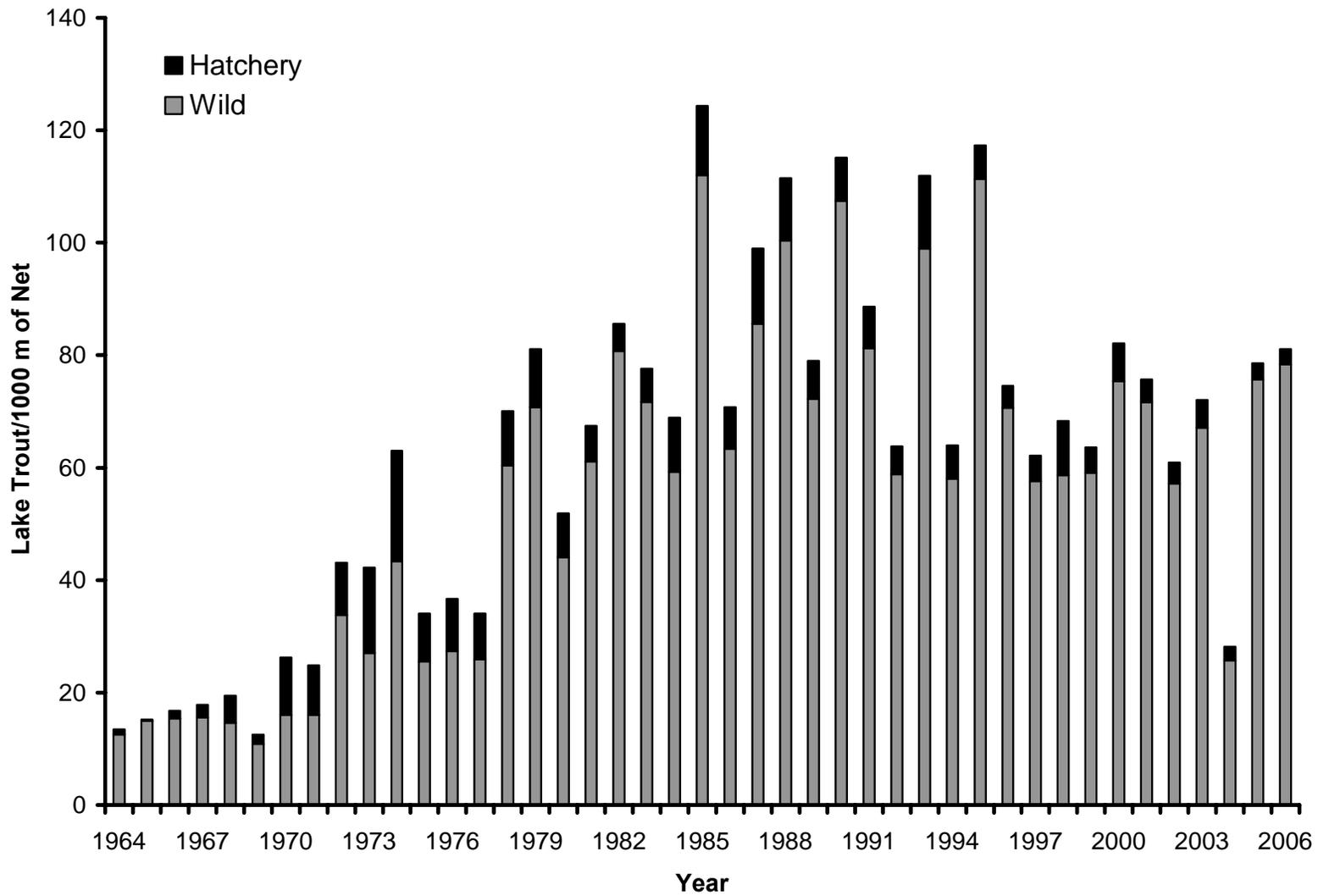


Figure 2. Female lake trout catch-per-unit-effort from spawning assessment at Gull-Michigan Island Complex, 1964-2006.

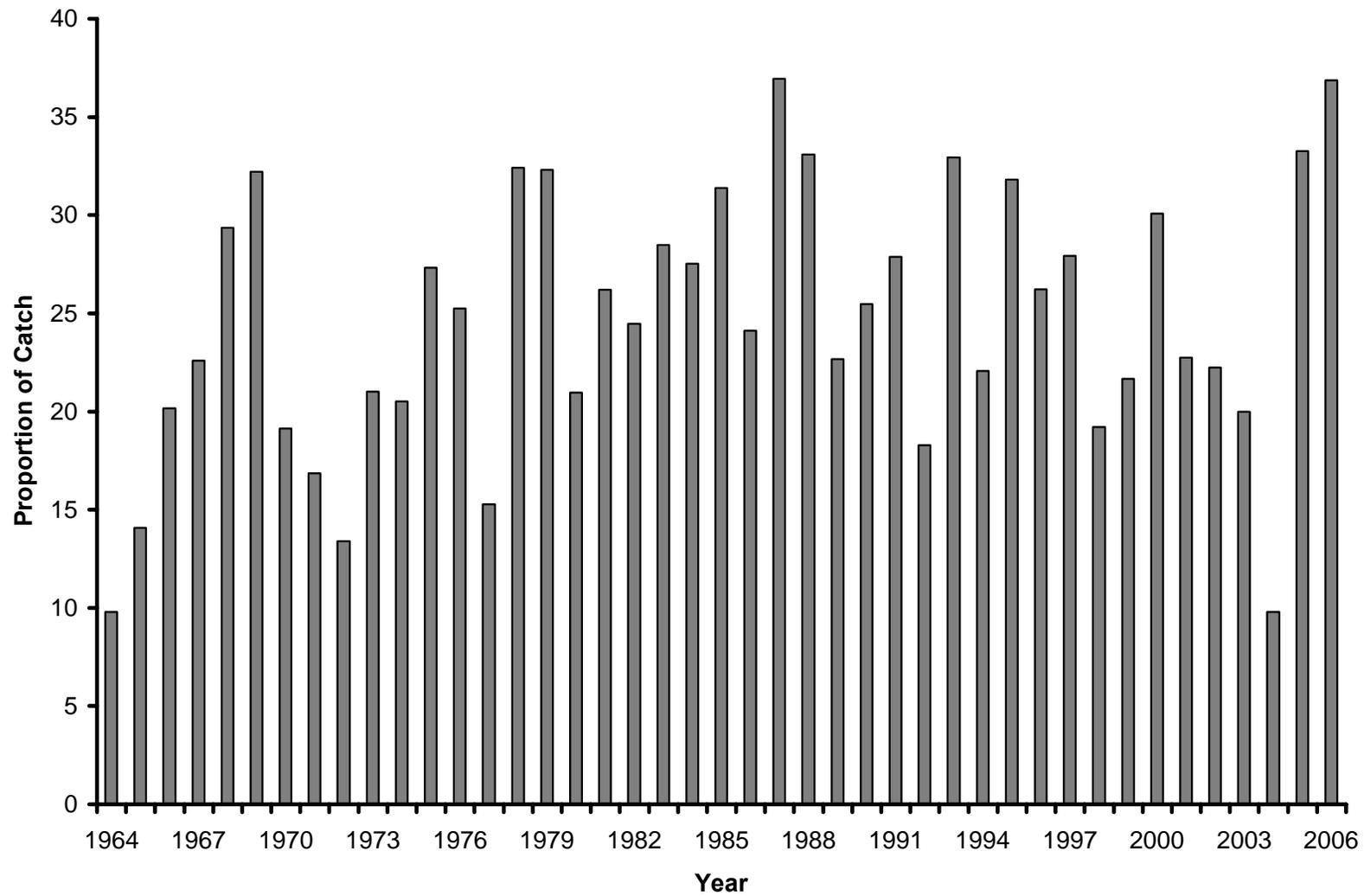


Figure 3. Mean proportion of female lake trout in the catch from the Gull-Michigan Island Complex during the spawning assessment, 1964-2006.

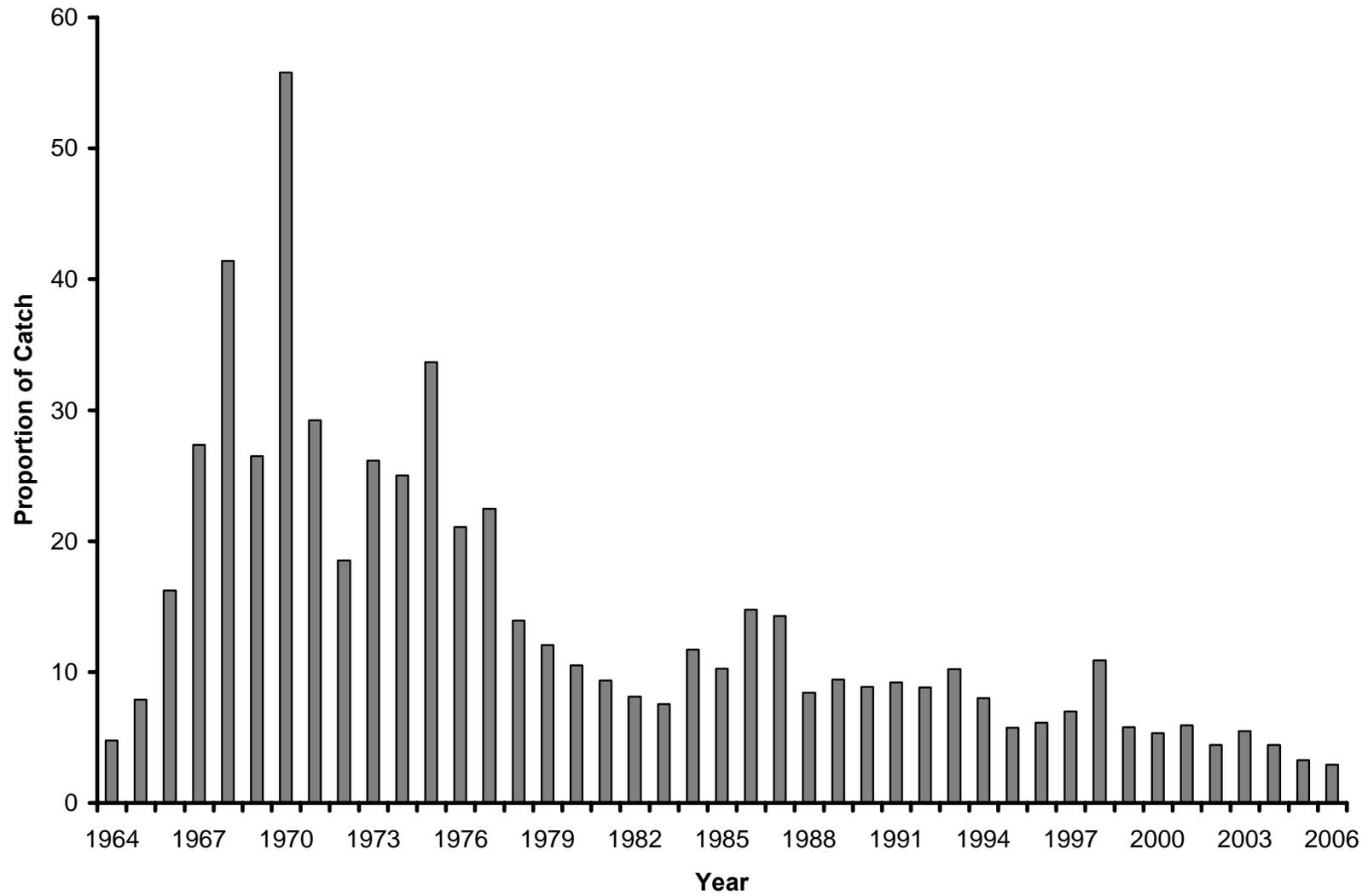


Figure 4. Mean proportion of hatchery lake trout in the catch from Gull-Michigan Island Complex during the spawning assessment, 1964-2006.

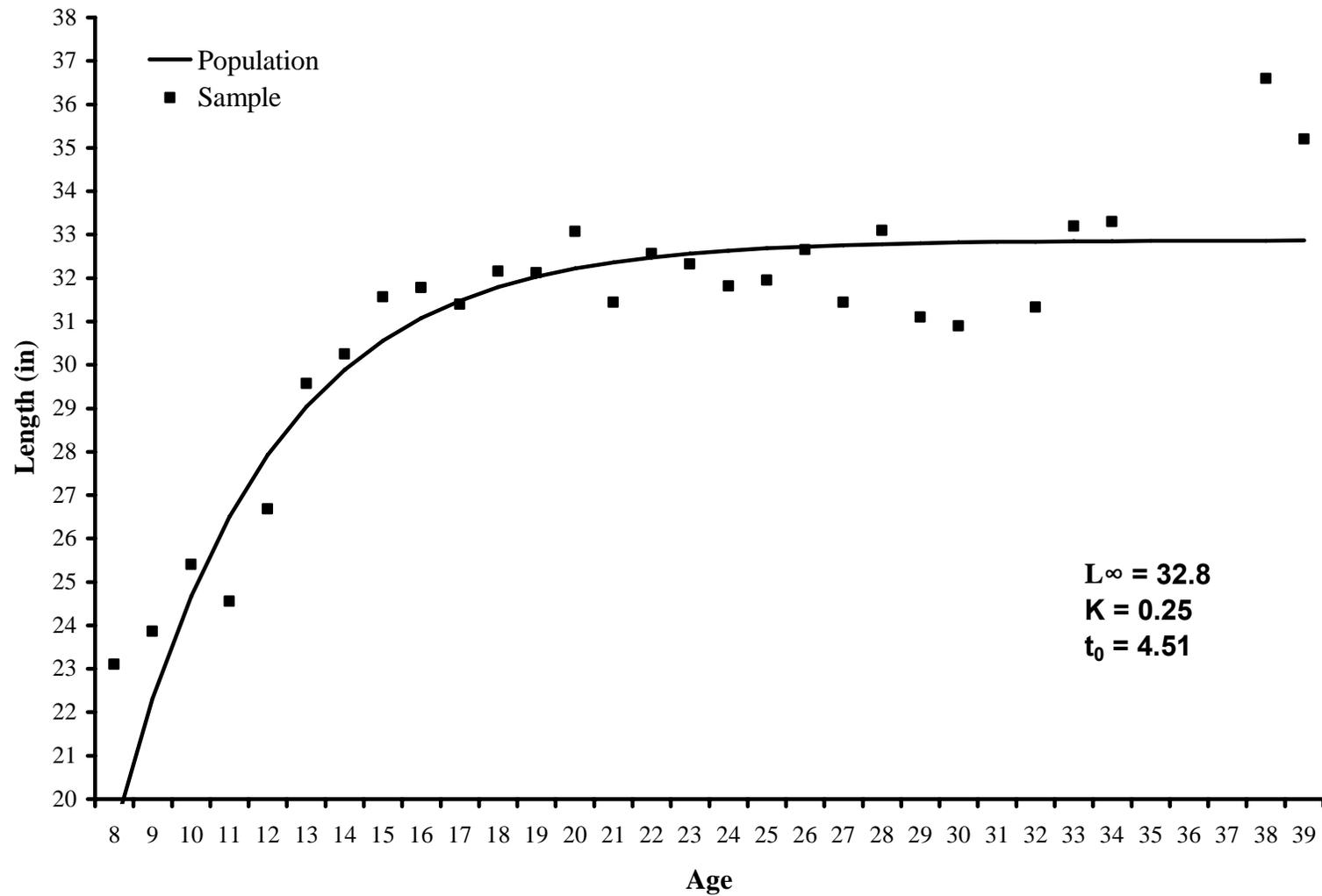


Figure 5. Mean length-at-age of *male* spawning lake trout caught at Gull Island Complex, 2004-2006. Solid line indicates mean lengths-at-age estimated from von Bertalanffy growth equation.

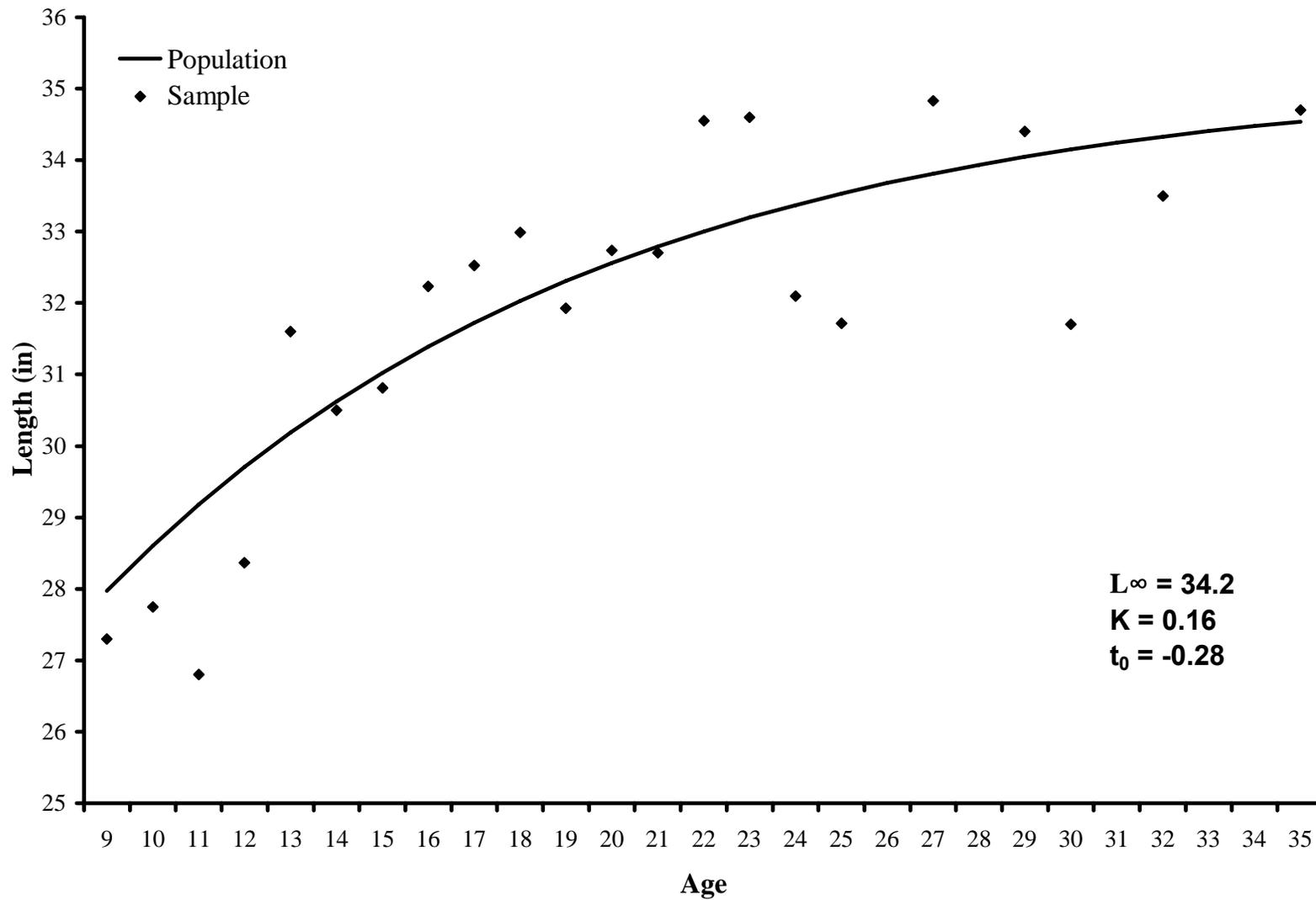


Figure 6. Mean length-at-age of *female* spawning lake trout caught at Gull Island Complex, 2004-2006. Solid line indicates mean lengths-at-age estimated from von Bertalanffy growth equation.

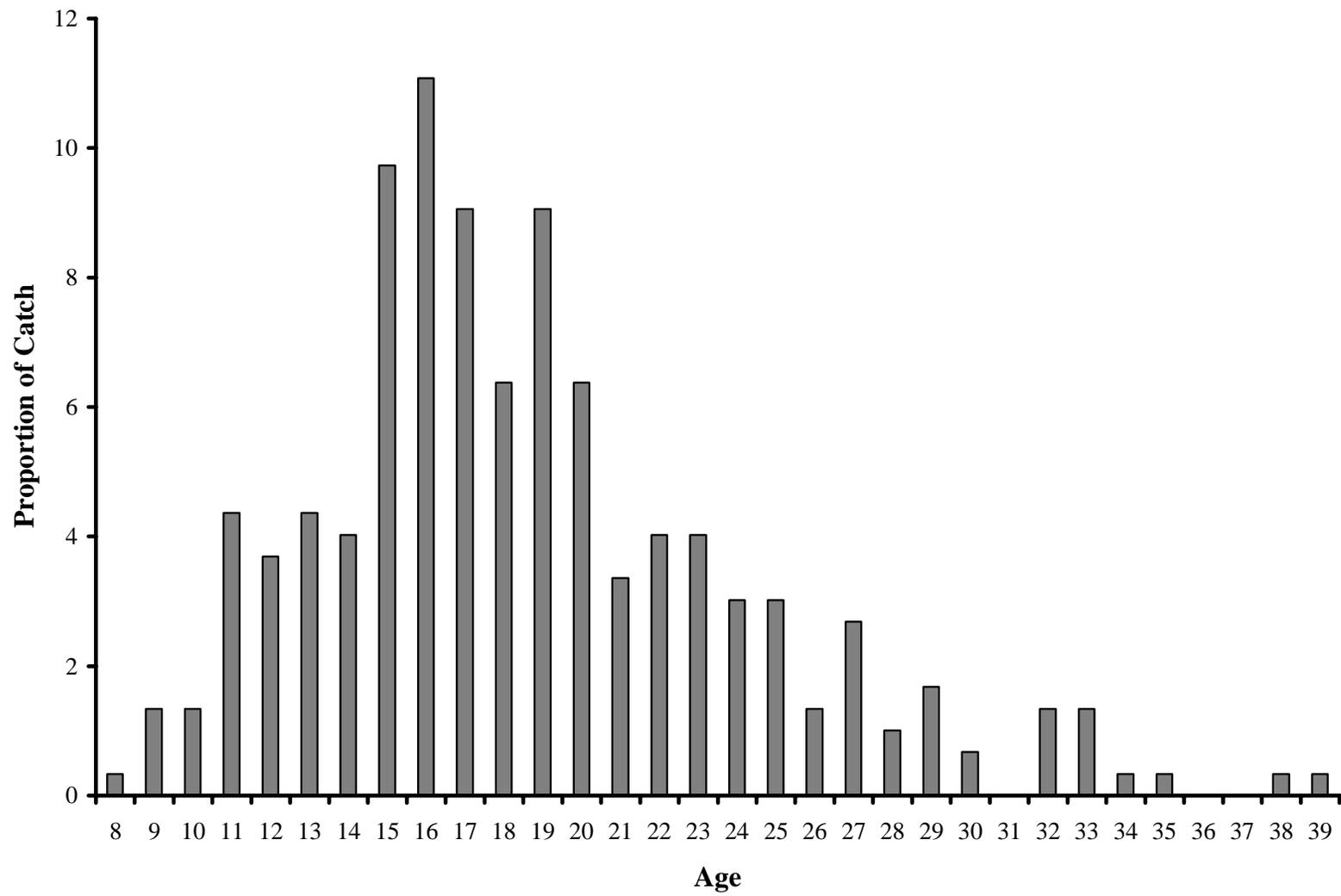


Figure 7. Age distribution of lake trout sampled during spawning assessment at Gull Island Shoal, 2004 through 2006.

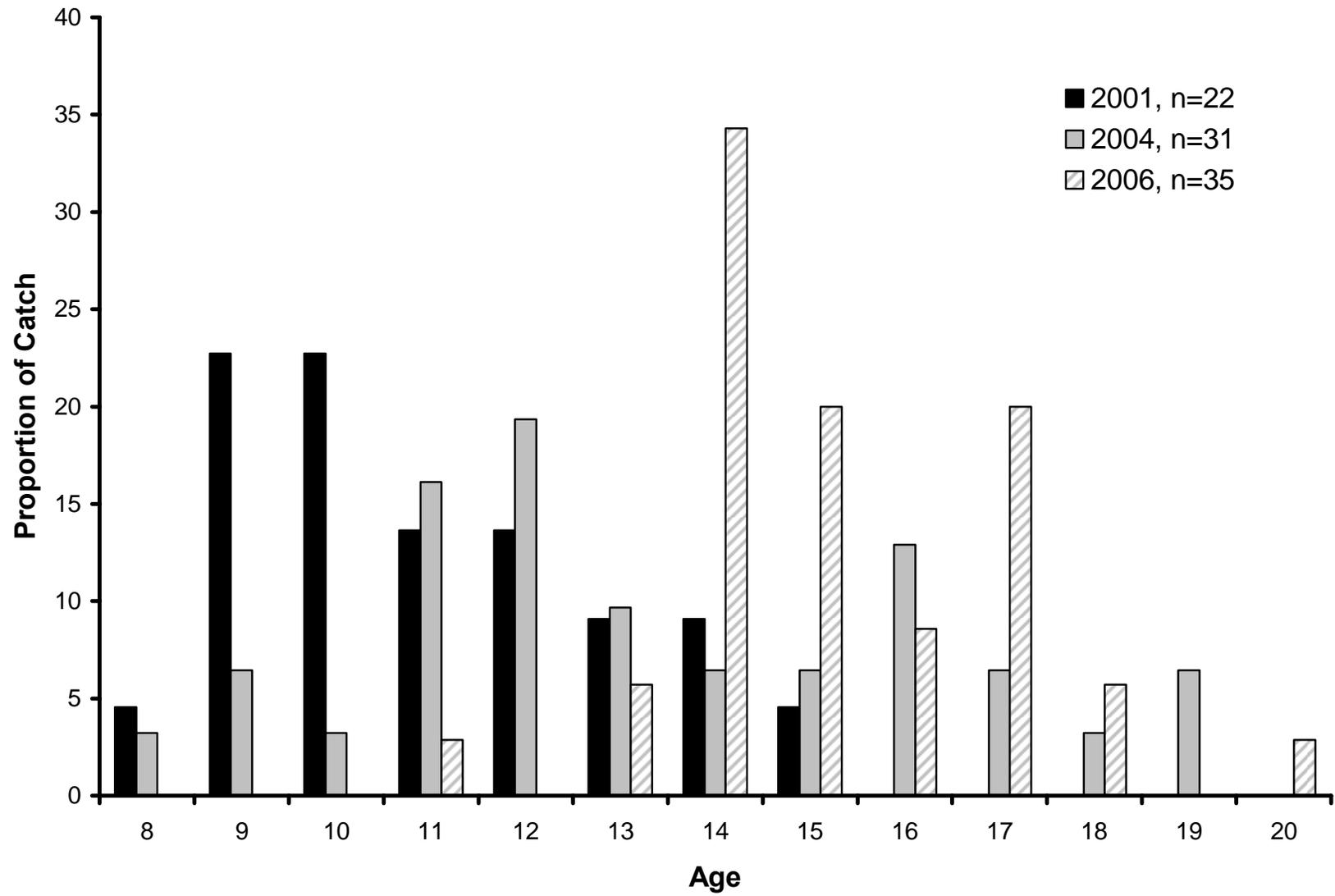


Figure 8. Age distribution of lake trout sampled during spawning assessment at Devils Island Shoal, 2001-2006.

Table 1. Lake trout catch per 1,000 feet of net (CPUE) and effort (ft) fished for 5.5-in and 6-in mesh nets on Gull Island and Michigan Island Shoals, 1982-2006.

Year	Gull Island Shoal				Michigan Island Shoal			
	5.5" CPUE	Ft. of Net	6" CPUE	Ft. of Net	5.5" CPUE	Ft. of Net	6" CPUE	Ft. of Net
1982	136.7	3,000	68.9	5,400	143.3	1,200	87.9	2,400
1983	101.4	5,700	62.9	7,500	140.0	1,500	58.1	2,100
1984	125.0	4,500	74.4	8,100	135.5	2,700	75.9	6,300
1985	149.6	2,400	82.0	3,000	253.3	1,800	73.9	3,600
1986	97.7	4,800	73.2	6,000	174.2	2,400	103.0	3,000
1987	95.6	4,800	66.7	6,000	117.1	2,400	68.3	3,000
1988	115.4	4,800	82.5	6,000	137.5	2,400	94.3	3,000
1989	148.5	4,800	80.3	6,000	132.1	2,400	84.7	3,000
1990	173.3	2,400	104.0	3,000	187.5	2,400	105.7	3,000
1991	111.5	4,800	102.0	6,000	103.8	2,400	68.0	3,000
1992	119.8	4,800	96.8	6,000	98.3	2,400	89.3	3,000
1993	153.3	4,800	121.2	6,000	92.1	2,400	74.7	3,000
1994	116.9	4,800	87.0	6,000	95.0	2,400	58.7	3,000
1995	136.7	3,600	92.0	4,500	151.3	2,400	108.3	3,000
1996	101.3	4,800	77.0	6,000	94.2	1,200	73.3	1,500
1997	87.1	4,800	71.7	6,000	55.8	2,400	55.3	3,000
1998	122.7	4,800	99.8	6,000	110.4	2,400	82.0	3,000
1999	111.3	4,800	103.2	6,000	85.8	2,400	72.3	3,000
2000	117.7	4,800	100.8	6,000	76.3	2,400	58.3	3,000
2001	118.1	4,800	93.8	6,000	105.0	2,400	69.3	3,000
2002	113.1	4,800	91.2	6,000	72.9	2,400	60.3	3,000
2003	135.8	4,800	100.0	6,000	112.9	2,400	95.0	3,000
2004	102.1	4,800	98.7	6,000	84.2	2,400	64.0	3,000
2005	102.5	4,800	93.8	6,000	52.9	2,400	39.0	3,000
2006	88.8	4,800	72.7	6,000	56.3	2,400	44.3	3,000

Table 2. Effort (ft) fished, lake trout catch, and lake trout catch per 1,000 feet of net (CPUE) from 5.5-in and 6-in mesh nets on the Gull-Michigan Island Complex, 1982-2006.

Year	Effort (Ft)	21 – 24.9"		25 – 28.9"		29" ≤	
		Catch	CPUE	Catch	CPUE	Catch	CPUE
1982	12,000	63	5.3	721	60.1	380	31.7
1983	18,600	171	9.2	838	45.1	519	27.9
1984	18,000	242	13.4	898	49.9	417	23.2
1985	10,800	191	17.7	862	79.8	286	26.5
1986	16,200	199	12.3	1,035	63.9	308	19.0
1987	16,200	171	10.6	823	50.8	351	21.7
1988	16,200	228	14.1	1,139	70.3	294	18.1
1989	16,200	292	18.0	1,259	77.7	213	13.1
1990	10,800	201	18.6	1,047	96.9	247	22.9
1991	16,200	155	9.6	945	58.3	505	31.2
1992	16,200	206	12.7	948	58.5	506	31.2
1993	16,200	111	6.9	1090	67.3	707	43.6
1994	16,200	73	4.5	946	58.4	464	28.6
1995	13,500	118	8.7	1,034	76.6	441	32.7
1996	13,500	73	5.4	646	47.9	452	33.5
1997	16,200	88	5.4	542	33.4	518	31.9
1998	16,200	104	6.4	786	48.5	808	49.9
1999	16,200	219	13.5	724	44.7	632	39.0
2000	16,200	158	9.8	687	42.4	683	42.2
2001	16,200	182	11.2	790	48.8	619	38.2
2002	16,200	144	8.9	677	41.8	623	38.5
2003	16,200	175	10.8	916	56.5	716	44.2
2004	16,200	102	6.3	736	45.4	575	35.5
2005	16,200	97	6.0	620	38.3	582	35.9
2006	16,200	127	7.8	521	32.2	483	29.8

Table 3. Sea lamprey wounds on lake trout captured during spawning assessment, 2006.

GIS COMPLEX											
Length (in)	#	A1	A2	A3	A4	Sum A1-3	A1-A3 Rate	B1	B2	B3	B4
<17	0										
17-20.9	0										
21-24.9	127	0	0	1	4	1	0.79	0	1	1	2
25-28.9	521	1	2	19	54	22	4.22	0	2	3	4
>28.9	483	5	18	74	334	97	20.08	0	5	3	0
Total	1131	6	20	94	392	120		0	8	7	6

Sand Cut Reef											
Length	#	A1	A2	A3	A4	Sum A1-3	A1-A3 Rate	B1	B2	B3	B4
<17											
17-20.9	1	0	0	0	0	0	0.00	0	0	0	0
21-24.9	42	0	0	0	1	0	0.00	0	0	0	0
25-28.9	70	0	0	0	4	0	0.00	1	0	0	0
>28.9	30	0	2	1	19	3	10.00	0	1	1	0
Total	143	0	2	1	24	3		1	1	1	0

Devils Island Shoal											
Length	#	A1	A2	A3	A4	Sum A1-3	A1-A3 Rate	B1	B2	B3	B4
<17	0										
17-20.9	0										
21-24.9	43	0	0	2	0	2	4.65	0	0	0	0
25-28.9	109	1	1	9	18	0	0.00	0	0	2	1
>28.9	55	0	1	4	23	5	9.09	0	0	0	1
Total	207	1	2	15	41	7		0	0	2	2

Table 4. Catch per 1,000 feet of net (CPUE; total and for wild fish) and catch statistics of spawning lake trout at Sand Cut Reef, 1968-2006.

Year	Total CPUE	% Female	Wild CPUE	% Wild
1968	17.1	18.3	0.4	2.4
1969	18.7	12.3	1.8	9.6
1970	37.5	17.3	2.5	6.7
1971	23.3	16.3	5.7	24.6
1972	48.0	22.7	12.1	25.2
1973	19.9	26.6	5.7	28.6
1974	19.9	18.1	7.3	36.2
1975	17.5	17.6	8.0	45.7
1976	17.7	28.3	8.4	45.2
1977	26.0	10.8	11.6	44.6
1978	27.0	36.0	17.0	63.9
1979	43.9	25.5	25.2	57.4
1980	28.3	14.7	18.7	66.0
1981	22.8	22.1	12.9	56.6
1982	58.3	23.7	27.6	47.0
1983	12.2	26.7	8.1	66.7
1984	39.5	23.7	26.6	59.7
1985	41.5	25.9	22.6	54.3
1986	32.7	32.2	19.6	60.0
1987	13.8	46.3	10.5	75.9
1988	23.5	20.8	17.3	73.8
1989	46.2	14.2	35.9	77.8
1990	45.0	23.3	37.1	82.3
1991	25.8	30.8	21.9	85.1
1992	40.5	22.5	32.9	81.3
1993	34.1	16.5	25.9	75.9
1994	37.2	30.3	31.0	83.4
1995	38.2	16.5	31.0	81.2
1996	18.7	18.3	17.0	90.8
1997	30.0	19.7	25.0	83.3
1998	33.2	16.2	26.3	79.2
1999	47.1	15.0	42.1	89.4
2000	27.3	23.0	24.1	88.3
2001	52.1	18.2	47.2	90.6
2002	20.9	25.7	19.4	92.7
2003	36.4	26.4	33.8	92.9
2004	41.8	12.3	38.7	92.6
2005	28.9	31.6	23.3	90.0
2006	18.2	33.1	17.4	95.8

Table 5. Effort (ft) fished, catch per 1,000 feet of net (CPUE), and catch composition of lake trout from spawning assessment at Devils Island Shoal, 1974-2006.

Year	Effort (ft)	CPUE	% Female	% Native
1974	3,900	0.5	0.0	0
1975	3,900	0.8	0.0	0
1978	7,800	0.6	0.4	38
2001	3,900	93.3	10.0	97
2004	3,900	67.9	1.0	98
2006	3,900	53.1	31.4	98