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Investigations of Lake Trout and Whitefish Management in Trout Lake, Vilas County, Wisconsin

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ABSTRACT

Fin-clipped lake trout (Salvelinus namaycush) were stocked in Trout Lake over a twenty year period since 1956. Fish from all but two of sixteen stockings were subsequently recovered in fall gill netting and/or winter censuses of the sport fishery although percent return was low. An average of 38% of the lake trout captured during fall 1957-1976 gill netting operations were stocked trout; the highest proportion of stocked trout recovered was 64% in the 1968 netting sample. Winter censuses of anglers during 1963-1971 revealed an average of 45% of the legal size lake trout bagged were stocked fish. The highest proportion of stocked trout in the catch was 80%, in 1967. Considering fin regeneration, the possibility of incomplete fin removal, and some stockings prior to 1956 without fin clips, the percentages of stocked fish in the harvest and netting samples are considered minimal. No significant trends in numbers or sizes of whitefish (Coregonus clupeaformis) were evident from the fall netting or winter checks of anglers, except in 1976 when the net catch dropped somewhat, but average size increased. No obvious optimum stocking size, age, egg source, numbers or time of year to plant lake trout were indicated by analyses of recoveries from the various stockings.

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INTRODUCTION

During the past 20 years (1956-76), marked lake trout (Salvelinus namaycush) have been stocked periodically in Trout Lake. The purpose of this report is to evaluate these stockings and subsequent recoveries in fall netting and winter angling, and provide a record of past management and investigative efforts. Catches of whitefish (Coregonus clupeaformis), another cold water sport fish in Trout Lake, are also analyzed. Recommendations for future management and investigations of lake trout and whitefish in Trout Lake are provided at the end of this report.

Study Area

Trout Lake is a 3,816-acre lake located in west central Vilas County, Wisconsin. The maximum depth is approximately 115 feet and the average depth is about 50 feet (See Appendix, Fig. 1-4). The lake is a borderline oligotrophic-mesotrophic, ice-block lake of low fertility, and has large volumes of cool, well-oxygenated water below its thermocline during the summer months. Some of the

deepest waters become anoxic during mid-summer, so the lake is not considered the "classical type" oligotrophic lake. Examination of summer oxygen and temperature profiles taken in 1969 in Trout Lake indicate no significant changes in the size of the anoxic zone in the past fifty years. Most of the shoreline and shoal areas of the lake are rock, gravel, sand, muck, silt and/or sand, and range from low and swampy to steep banks. The water is somewhat infertile; the total alkalinity range is 27-42 ppm. The water color is clear and has secchi disk readings of 13 or more feet. The lake has four inlets and an outlet.

Trout Lake is one of the few inland Wisconsin lakes containing an indigenous lake trout population. The lake also contains a number of other species (Table 1). Bullheads, darters, logperch and other minnow species may also be present but have not been documented.

Table 1. Species of fish known to inhabit Trout Lake.

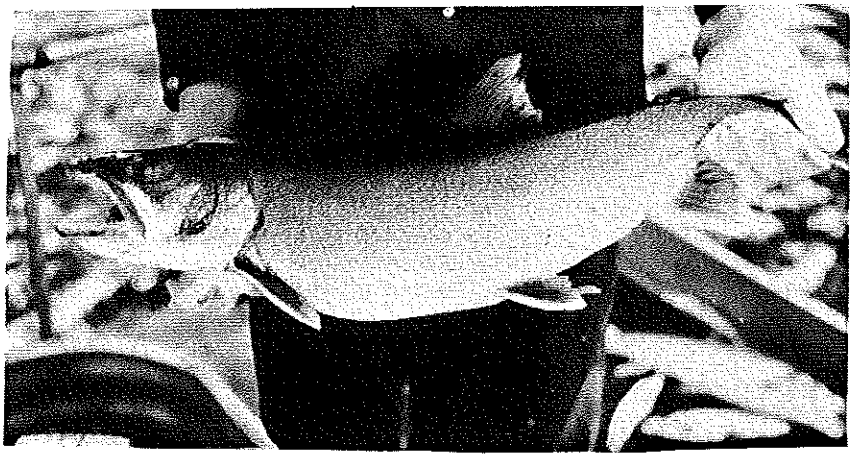
Common Name	Scientific Name	Relative Abundance
Cisco	Coregonus artedii	Common
Lake Whitefish	Coregonus clupeaformis	Common
Brook trout	Salvelinus fontinalis	Present
Lake trout	Salvelinus namaycush	Common
White sucker	Catostomus commersoni	Common
Shorthead redhorse	Moxostoma macrolepidotum	Common
Northern pike	Esox lucius	Present
Muskellunge	Esox masquinongy	Present
Yellow perch	Perca flavescens	Common
Walleye	Stizostedion vitreum vitreum	Common
Smallmouth bass	Micropterus dolomieui	Present
Largemouth bass	Micropterus salmoides	Present
Pumpkinseed	Lepomis gibbosus	Present
Bluegill	Lepomis macrochirus	Present
Rock bass	Ambloplites rupestris	Present
Black crappie	Pomoxis nigromaculatus	Present
Stickleback	-	Present
Burbot	Lota lota	Present
Chubs	Semotilus sp.	Present
Shiners	Notropis spp.	Present

It is unknown when northern pike first entered Trout Lake, but it was probably sometime after the 1930's (Greene, 1935), and prior to 1952 (DNR area fish management files).

Past Management

Past fishery management of Trout Lake by the Department of Natural Resources consisted mainly of stocking lake trout, muskellunge and walleye on a periodic basis. Attempts to establish rainbow trout (Salmo gairdneri) and landlocked salmon (Salmo salar) were unsuccessful. The salmon were stocked as fry in 1907. Largemouth bass were also stocked several times with unknown success. Early stockings of lake trout consisted mainly of fry or small fingerlings. From 1920 through 1949, lake trout were stocked five times. No lake trout were stocked from 1950 to 1956.

Lake trout stocking records since 1956 are listed in Table 2.



A lake trout from Trout Lake

Table 2. Lake trout stocking records for Trout Lake since 1956.

Date Stocked (mo/yr)	Number	Age(Average)	Weight (No. per lb.)	Fin Clip*	Origin of Eggs
10/56	7,122	9 mo. (fgl)	45	Adipose	Trout Lake
3/59	6,448	13 mo. (yrl)	28	R. P.	Green Lake
6/60	6,250	16 mo. (yrl)	26	Adipose	Trout Lake
11/60	10,000	9 mo. (fgl)	54	R. V.	Trout Lake
11/60	10,000	9 mo. (fgl)	33	L. V.	Green Lake
10-11/61	21,270	20 mo. (yrl)	11-16	L. P.	Trout Lake+
10/62	21,150	20 mo. (yrl)	15-25	R. P.	Trout Lake
10/62	10,050	8 mo. (fgl)	36	R. V.	Michigan **
5/63	20,000	15 mo. (yrl)	13	L. V.	Michigan**
10/63	867	20 mo. (yrl)	6	L. V. & Adipose	Michigan**
6/64	20,000	14 mo. (yrl)	14	Adipose	Michigan**
7/66	7,640	18 mo. (yrl)	26	L. P.	Michigan**
6/67	9,500	18 mo. (yrl)	25	R. P.	Michigan**
6/68	7,936	17 mo. (yrl)	8	R. V.	Michigan**
1/69	25,000	13 mo. (yrl)	22	L. V.	Michigan**
6/70	28,670	17 mo. (yrl)	34-40	Adipose	Trout Lake
5/71	42,650	16 mo. (yrl)	50	L. P.	Trout Lake
5/72	6,100	16 mo. (yrl)	41	R. P.	Trout Lake
10/76	80,000	9 mo. (fgl)	35	R. V.	Michigan**

* L. P. & R. P. = Left and Right Pectoral, L. V. & R. V. = Left and Right Ventral (Pelvic)

** Eggs taken from "domestic" brood stock, Marquette, Michigan. These brood fish are mostly Lake Superior in origin.

\+ The 10/61 plant also included a few (about 1,000) trout of Green Lake origin.

Most lake trout fingerlings planted were 4 to 5 inches long (3-6 inch range); most yearlings were 7 to 8 inches long (4-12 inch range). Fish stocked in open-water months were usually scatter planted from boats.

Past Regulations

Prior to 1953, fishing seasons for lake trout opened on April 1 and closed on September 30. The first winter fishing season for lake trout opened January 1, 1953. From 1953 to 1967, the lake trout season opened January 1 each year. Since 1967, the season opened on the first Saturday of January. The September 30 closing remained constant. Prior to 1957, the daily bag limit was 5 lake trout and the size limit was 17 inches. Since 1957, the bag limit has been 2 fish. The size limit remained at 17 inches.

Local DNR wardens and some residents reported that during the first two winter seasons (1953 and 1954) fishing pressure was fairly heavy and catches of lake trout were good. They also reported that catch and pressure dropped off considerably during the next several winters. Unfortunately, there are no quantitative data on harvest or pressure to substantiate these reports.

Fishing seasons for whitefish or cisco have been continuous many years. Daily bag limits have been 25 pounds and 1 fish in aggregate of both species since 1955. Prior to 1955, the bag limits were the same as for panfish (25 fish daily - continuous season). Fall dipnetting and seining regulations have remained unchanged: 25 pounds and 1 fish of whitefish and cisco (in aggregate) permitted.

Motor trolling is prohibited on Trout Lake.

METHODS AND MATERIALS

Records of past stockings of lake trout were obtained from DNR files, stocking slips and hatchery records. Fishing regulations were compiled from DNR regulation pamphlets.

Past investigational fieldwork consisted mainly of fall gill netting on the lake trout spawning grounds and a partial census of winter fishermen. The 1956 angler census information was from Burdick (1956). The 1959 and 1960 fall netting data are from Helm and Kmiotek (1960) and Helm (1961). The 1962 fall netting information is from Radonski (1963). Other data in this report are from the author's work (1966-1971), or from memoranda or other file materials in the DNR Fish Management offices in Woodruff and Rhinelander, by A. Niebuhr, H. Carlson, J. Helm, G. Radonski, or unknown workers.

Fall gill netting was done for egg taking purposes, marking experiments, assessment of the lake trout population, or a combination of these purposes. Netting was usually done between mid-October and mid-November. Most gill netting was with 6-foot deep nylon nets, fished overnight 17-28 hours, singly and in gangs on the bottom in depths from 15 to 75 feet. In 1959, fyke nets were tried, but their efficiency was so poor that the practice was abandoned after one year. In 1957 and 1958, 3" and 4½" stretch-mesh gill nets were used. These mesh sizes were effective in capturing lake trout, but a high incidence of dead fish (despite 4-5 hour net lifting schedules) prompted a change to 2½" stretch mesh in subsequent years. With the smaller mesh, mortality was minimal (about 5-10%). Live lake trout were marked with lower caudal fin clips to identify them should they be recaptured. Recaptures were rare, and generally not tabulated. Since the lake is often rough, a 20-foot pontoon boat was often used for netting operations.

Winter censuses for anglers were conducted mainly on weekends because of low weekday fishing pressure and other commitments. Most checks were made in the afternoons to see a maximum of creeled fish for a minimum of census effort. Foot travel, snowmobile and auto patrol of the landings were used to reach fishermen. Information was obtained for both completed and incomplete angling trips. The censuses' designs do not permit estimations of total annual catches. Numbers of census periods and census hours spent each period are not available.

All measured lake trout were measured to the nearest 0.1 inch (total length); notations were made of any fin clips observed. Since 1956, all stocked lake trout were fin clipped for identification. Years in which recovered lake trout were stocked were identified by analyzing fin clips and lengths of fish. When older lake trout could have been assigned to more than one stocking year, comparison of these lengths to trout of known age in Trout Lake was the primary determinant.

One family kept records of their winter lake trout catches and submitted these to us (Table 7).

RESULTS AND DISCUSSION

Return of Stocked Lake Trout in Fall Spawning Runs

Water temperatures during past fall netting operations have ranged from 36°F to 51°F. The peak of the lake trout spawning run appears to occur about the last week of October, often when water temperatures are in the mid-forties (°F).

Lake trout usually mature in the sixth to eighth year of life in Trout Lake. The smallest ripe males taken were 20.5 inches; the smallest ripe females were 22.3 inches. A number of immature 17-to 19-inch fish were also taken on the spawning grounds.

Catches of lake trout per unit of effort during 1957-76 are summarized in Table 3. Catches of lake trout per unit of effort varied from 0.90 to 4.26 during 14 different years of sampling. The abnormally low catch rate of lake trout in 1962 can be partially explained by the fact that a large number of nets were set in exploration for unknown spawning grounds. Most of these exploratory sets were unproductive.

Few conclusions concerning the relative abundance or trends of lake trout numbers can be drawn from fall netting data due to variables in spawning run activity that are not well understood. One of the factors apparently affecting fall net catches is wind. Although significant data are lacking, it appears that strong west, northwest or north winds produced the better lake trout catches through the years. This relationship was most obvious in the Allequash Creek region, which is the most successful fall netting area. Net sets perpendicular or oblique to shore, north and west of the outlet of Allequash Creek were usually the most productive for lake trout.

Catches usually declined drastically after the first good catch. The reasons for this are not understood. Perhaps the thrashing of fish caught in gill nets on the spawning grounds tends to scare other lake trout away. Several ripe lake trout marked in the Allequash Creek region were recaptured 1-2 days later near the opposite (west) shore.

Table 3. Fall netting effort, catch per unit of effort and average sizes of lake trout and whitefish sampled from Trout Lake..

Year	Netting Effort*	Lake Trout			Whitefish		
		Total No. Taken	No. per 300 feet of Gill Net	Average Size(in.)	Total No. Taken	No. per 300 feet of Gill Net	Average Size(in.)
1955	35 fyke net days	1	--	24.0	25	--	13
1957	5,500 ft. 3" & 4½" stretch gillnet	78	4.26**	26.4	--	--	--
1958	9,200 ft. 3" & 4½" stretch gillnet	133	4.32**	25.9	113	3.66	13+
1959	28,200 ft. 2½" stretch gillnet	133	1.41	25.7	419	4.47	--
1960	38,400 ft. 2½" stretch gillnet	187	1.44	25.8	446	3.48	--
1961	6,190 ft. 2½" stretch gillnet	74	3.57	25.4	78	3.78	--
1962	20,080 ft. 2½" stretch gillnet	61	0.90	24.4	317	4.71	--
1966	3,200 ft. 2½" stretch gillnet	22	2.07	25.4	41	3.84	--
1967	3,000 ft. 2½" stretch gillnet	19	1.89	23.8	78	7.80	12.5
1968	8,950 ft. 2½" stretch gillnet	76	2.55	24.6	164	5.49	12.0
1969	10,100 ft. 2½" stretch gillnet	96	2.85	24.5	163	4.84	12.6
1970	14,700 ft. 2½" stretch gillnet	73	1.49	22.3	199	4.06	12.0
1971	10,500 ft. 2½" stretch gillnet	55	1.57	20.7	161	4.72	12.0
1972	1,800 ft. 2½" stretch gillnet	17	2.83	19.7	136	22.66	14.0
1976	6,700 ft. 2½" stretch gillnet	43	1.93	23.7	54	2.42	15.1

* For gillnet, sets were overnight (example 300 ft. gillnet set three nights = 900 ft.)

**3" and 4½" mesh produced higher catches.

The more successful catch rates in 1968 and 1969 were due largely to the better surviving plants of 1960 and possibly 1962. Netting for lake trout was less successful in 1970 and 1971, but success rose in 1972 and 1976. Average trout lengths in 1970, 1971, and 1972 fall nettings were slightly below averages of previous falls, but the 1976 average rose somewhat. Size ranges and sex ratios of fall-netted lake trout may be found in Table 10, Appendix.

One of the limitations of fall gill netting was the inability to capture immature trout in sufficient numbers to assess their abundance. Some trawling was attempted in the past, but little success was realized.

Fin clipped, stocked lake trout began to appear in the 1962 fall netting operations. The adipose-clip stock from 1960 and right ventral clip stocks from 1960 or 1962 had the greatest representation in the net catches (Table 4). Unfortunately, a right ventral fin clip was used to identify both the 1960 and 1962 stocks. Consequently, it has been impossible to separate these stocks in later years. Ohter similarly marked stocks were separated primarily by their sizes.

Table 4. Capture of fin-clipped lake trout in fall netting on Trout Lake.

Mark (fin clip)	Year Stocked	No. of Fish Captured by Year										
		1961	1962	1966	1967	1968	1969	1970	1971	1972	1976	Total
Adipose	1956	-	-	-	1	7	3	2	-	-	-	13
Right pectoral	1959	-	-	-	-	1	-	1	-	-	-	2
Adipose	1960	-	1	7	3	13	19	4	-	-	4	51
Right ventral	1960 or 1962	-	-	-	3	18	18	9	9	-	2	59
Left ventral	1960	-	-	-	-	-	1	-	-	-	-	1
Left pectoral	1961	-	-	-	1	4	7	4	4	1	1	22
Right pectoral	1962	-	-	-	-	4	2	2	3	-	-	11
Left ventral	1963	-	-	-	-	2	-	-	1	-	1	4
Left ventral and adipose	1963	-	-	-	-	-	-	-	-	-	-	-
Adipose	1964	-	-	-	1	-	-	1	-	-	5	7
Left pectoral	1966	-	-	-	-	-	1	2	3	1	1	8
Right pectoral	1967	-	-	-	-	-	4	9	3	5	-	21
Right ventral	1968	-	-	-	-	-	1	4	7	1	-	13
Left ventral	1969	-	-	-	-	-	-	-	-	1	-	1
Adipose	1970	-	-	-	-	-	-	-	-	1	3	4
Left pectoral	1971	-	-	-	-	-	-	-	-	-	8	8
Right pectoral	1972	-	-	-	-	-	-	-	-	-	1	1
Right ventral	1976	-	-	-	-	-	-	-	-	-	-	-
Total Marked Fish		-	1	7	9	49	56	38	30	10	26	226
Total Unmarked Fish*		74	60	15	10	27	40	35	25	7	17	310
Total No. Lake Trout taken		74	61	22	19	76	96	73	55	17	43	536
% Marked		0	2	32	47	64	58	52	55	59	60	-

*Includes a few fish tagged as adults in the 1950's with Peterson or strap tags. These fish are of unknown origin (native and/or planted).

The proportion of stocked lake trout in the catches is a minimum figure since regeneration or missed clips were possible. A few small trout (5") taken by anglers in 1969-1970 confirmed that some natural reproduction was occurring. The proportion of stocked fish taken in the fall netting operations increased significantly from 1961 to 1968, leveling off somewhat from 1969 to 1976. This indicates increasing amounts of stocked lake trout in the population, and possibly a decline in natural reproduction (Table 4).

Fall Whitefish Catches

Whitefish were captured at rates of 2.42 to 22.66 per unit of effort during 13 sampling years (Table 3). Whitefish catches do not show any strong trends during 1958-71, but the catch rate rose sharply in 1972 and dropped considerably in 1976. The exceptionally (unexplained) high catch rate of 22.66 in 1972 was a year when less netting was done than usual. No trend of decreasing whitefish average sizes was noted; in fact, the 1972 and 1976 average lengths were greater than other years (Table 3). Size ranges of fall-netted whitefish may be found in Table 10 of the Appendix and information on fish other than lake trout and whitefish appears in Table 11.

Possible Crayfish Predation

In most years of fall netting after the late 1950s, investigators noted several hundred crayfish entangled in the lead lines of gill nets lifted from 15 to 50 foot depths (Alton Niebuhr, personal communication). The predominant species of crayfish in Trout Lake in recent years has been Orconectes propinquus; Orconectes virilis is present in lesser numbers. Prior to the 1950's, it is believed that Orconectes virilis may have been predominant, and possibly the only crayfish in Trout Lake, Greg Capelli, College of William and Mary, Williamsburg, Virginia (pers. comm.).

Past experiments confirmed that crayfish ate lake trout eggs in aquaria (Helm and Kmiotek, 1960), but their importance as a limiting factor in Trout Lake remains unknown. The catches of crayfish in the 1967 and 1968 netting operations were noticeably lower than previous years. Stomachs were examined from 12 crayfish and approximately 25 cisco, whitefish, suckers and perch, captured in 1967 on the lake trout spawning grounds. None contained trout eggs, but this small sample is considered inadequate for conclusion on egg predation.

Angling Harvest

From 1955 - 1971, approximately 2,362 fishermen were contacted during the winter creel census. They fished a total of 12,326 hours. Winter fishing pressure was generally light in the latter years censused; it was rare to encounter over 100 fishermen in a day, usually there were 50 anglers or less. Spot checks and local information indicated that apparently few cold-water fishermen fished Trout Lake in spring, summer or fall.

Since 1967, stocked fish have accounted for 38% to 80% of the lake trout examined in the angler-harvest (Table 5). This contribution of stocked fish is substantial. The 1969 through 1971 data are probably not as reliable as data for 1967 or 1968 when more fish were checked. Unfortunately, no censuses were conducted in 1964, 1966, or 1972-77. Since there were occasional stockings of lake trout fry or fingerlings prior to 1956 (in 1942, 1945, 1946, and 1949), and some regeneration or missed clips may have occurred, the above percentages are regarded as minimal contributions of stocked fish to angler harvest.

Table 5. Marked lake trout noted in winter angling censuses on Trout Lake.

Mark (fin clip)	Year Stocked	No. of Marked Fish Checked by Year							
		1963	1965	1967	1968	1969	1970	1971	Total
Adipose	1956	-	-	4	-	-	-	-	4
Right pectoral	1959	-	-	-	-	-	-	-	-
Adipose	1960	-	+	30	7	1	3	1	42
Right Ventral	1960 or 1962	-	-	13	5	-	1	4	23
Left Ventral	1960	-	-	3	-	-	-	-	3
Left Pectoral	1961	-	-	1	5	4	-	2	12
Right Pectoral	1962	-	-	2	4	-	1	-	7
Left Ventral	1963	-	-	-	-	-	-	-	-
Left Ventral-Adipose	1963	-	-	-	-	-	-	-	-
Adipose	1964	-	-	3*	-	-	1	-	4
Left Pectoral	1966	-	-	-	2**	-	-	-	2
Right Pectoral	1967	-	-	-	-	3*	4*	6	13
Right Ventral	1968	-	-	-	-	2*	2*	-	4
Left Ventral	1969	-	-	-	-	-	9*	1*	10
Adipose	1970	-	-	-	-	-	-	2*	2
Total No. Marked Legal Lake Trout Checked		-	-	53	21	5	6	13	
Total No. Legal Lake Trout Checked		4	0	66	29	13	11	19	
% of Legal Lake Trout Marked		0	0	80	72	38	54	68	

* Sublegal fish

** Two sublegal trout checked in 1968 are located between the 1966 and 1967 pectoral clips because the anglers had noted pectoral clips, but could not recall whether they were left or right.

\+ Only 3 fishermen checked, but others reported fair numbers of sublegal trout taken, mostly adipose clip.

Table 5 includes data for a few marked, sublegal fish noted by anglers before the fish were released. Undoubtedly other marked sublegal fish were also returned to the water by less observant anglers. These fish are not accounted for. Anglers also reported additional numbers of sublegal lake trout of unknown origins (Table 12).

The 1960 adipose-marked plant was the most successful documented stocking thus far (Table 5). A number of other plants have also shown up in lesser numbers, but fish from several stockings have never been observed in the catches by anglers. The reasons are not clear. When examining both fall netting and creel census returns of stocked fish, only two (left ventral and adipose 1963, and right ventral 1976) stockings of the 16 separate plantings made since 1956 have not appeared (Tables 2, 4 and 5). However, the 1976 stocking would not normally begin to show up so soon after stocking. It is noteworthy that one of the smallest plants (6,250 yearlings in 1960) has been the most successful to date. The reasons are unknown.

Angler catch rates for lake trout, whitefish and ciscoes during the 1956-71 winter fishing seasons are summarized in Table 6. No strong trends in catch rates for lake trout are apparent. Whitefish and cisco catch rates appear to have gradually improved. The best catch rate of lake trout (in 1967) can be attributed mainly to the adipose-clipped fish stocked in 1960, which predominated in the catch. The average of over 50 hours necessary for capturing a lake trout is high. It is felt that effective management could improve this catch rate significantly.

Table 6. Lake trout, whitefish and cisco catch rates during the winter 1956-71 fishing seasons.*

Year	Number Fishermen Contacted	Man-hours Fished	Catch Rate (Fish/Hour) Legal Lake Trout	Whitefish	Cisco
1956	633	3,490	0.03	0.05	0.03
1959	126	563	0.02	0.19	0.04
1961	445	2,554	0.02	0.22	0.12
1963	107	517	0.01	0.18	0.09
1967	262	1,355	0.05	0.20	0.16
1968	348	1,546	0.02	0.20	0.12
1969	135	757	0.02	0.23	0.15
1970	119	694	0.02	0.23	0.30

*Years when more than 100 anglers were contacted. Far less fishing was noted in years other than those presented (Appendix Table, 12).

There was some opinion among winter anglers interviewed that whitefish fishing has deteriorated through the years. Some felt that fall whitefish seining was detrimental. This was not substantiated in the angler censuses. The more recent years' whitefish and cisco catch rates were better than average, and average sizes of fish cropped have remained stable (Tables 6 and 8).

One family (which prefers to remain anonymous) kept records on lake trout fishing in Trout Lake from 1962-1976 (Table 7).

Table 7. One family's fishing records on Trout Lake.

Year	No. Legal Lake Trout Taken	Legal Lake Trout/Hour
1962	56	0.12
1963	59	0.12
1964	38	0.08
1965	29	0.07
1966	47	0.11
1967	32	0.05
1968	36	0.07
1969	35	0.08
1970	11	0.03
1971	19	0.03
1972	17	0.03
1973	21	0.05
1974	24	0.05
1975	16	0.03
1976	14	0.03

This family had a significantly more successful fishing technique than the average angler on Trout Lake. They took more lake trout some winters than all the other anglers checked during our interviews. Despite their skill, recent years' fishing efficiency has been below average for this group. This may indicate a decreased number of harvestable fish available.

In addition to the legal lake trout listed in Table 7, this family caught and returned the following number of undersize trout each year from 1972 through 1976: 5, 7, 11, 20, 24. From 1972 - 1976, the party took an average of 6 ciscoes and 12 whitefish/7-hour day. The party stated that whitefish sizes seemed to increase from 1972-1976.

If population trends, overfishing or other significant changes were taking place in the cold water fishery of Trout Lake, perhaps there would be some reflection in the sizes of fish taken. Table 8 is a summary of sizes of lake trout, whitefish and cisco taken in winter angling for various years when creel census was conducted.

Table 8. Total length of fish censused during winter angling in various years on Trout Lake.

	Legal Lake Trout			Whitefish			Cisco		
Year	No. Fish	Size Range (in.)	Avg. Leng. (in.)	No. Fish	Size Range (in.)	Avg. Leng. (in.)	No. Fish	Size Range (in.)	Avg. Leng. (in.)
1955	12+	17+ - 24.0	21.0	2	-	-	2	-	-
1956	103	17.0 - 30.0	22.9	187	8.0 - 21.0	-	99	5.0 - 7.0	-
1959	11	19.0 - 27.0	24.5	106	7.0 - 18.0	-	21	5.0 - 8.0	-
1960	2	18.0 - 23.0	20.5	18	8.0 - 20.0	-	-	-	-
1961	43	17.5 - 33.0	23.8	598	8.0 - 20.0	-	259	6.0 - 8.0	-
1963	4	19.0 - 28.0	24.0	93	10.0 - 19.0	-	46	-	-
1967	66	17.0 - 29.5	20.9	270	8.0 - 17.0	11.6	220	5.0 -10.0	7.0
1968	29	17.0 - 30.0	21.2	318	6.0 - 20.0	11.5	190	4.0 -10.0	6.0
1969	13	18.0 - 29.5	22.9	172	8.0 - 19.5	12.0	111	5.9 - 9.0	7.0
1970	11	18.5 - 27.5	23.4	158	8.0 - 20.0	11.5	209	6.0 -12.0	7.2
1971	19	18.0 - 27.5	23.5	199	-	12.0	135	-	6.0

Existing information indicates that the average length of lake trout, whitefish and ciscoes harvested remained fairly stable. With an overharvest situation, one would expect a decrease in the average size of fish as well as increases in the hours of fishing required per fish. The Trout Lake whitefish and cisco fisheries seem to be holding their own or possibly improving. There is no factual evidence to date to indicate that their populations are being harmed by the fall sport netting operations.

A detailed summary of creel census data from various years is presented in Table 12 of the Appendix; blanks for some years' data are due to lack of continuity among the various investigators who acquired the information.

Lake Trout Stocking Conclusions

Table 9 recaps the details of stocking for the most successful releases of lake trout according to fall netting and/or winter creel census.

Table 9. Stocking Details for the most Successful Lake Trout Stockings

Fin Clip	Year Stocked	No. Stocked	Egg Source	Month Stocked	Size (No/lb)	Age Stocked
Adipose	1960	6,250	Trout Lake	June	26	16 mo.
RV	1960 or 1962	20,050	Trout Lake or Michigan	Oct. - Nov.	36;54	8-9 mo.
LP	1961	21,270	Trout Lake	Oct. - Nov.	11-16	20 mo.
RP	1967	9,500	Michigan	June	25	18 mo.
RV	1968	7,936	Michigan	June	8	17 mo.
LV	1969	25,000	Michigan	January	22	13 mo.
LP	1971	42,650	Trout Lake	May	50	16 mo.

Examination of the most successful lake trout plants reveals that a number of both yearling and fingerling stockings have been successful. Both spring-early summer, and fall stockings have survived, as well as a winter plant. Stocking of trout hatched from eggs from Trout Lake and Michigan brood stock from Lake Superior have survived.

Unfortunately, no obvious optimum stocking size, age, egg source, number to plant, or time of year to plant are indicated by the measured results, especially since similar types of plants varied considerably in their survivals. It appears that if specific lake trout stocking guidelines are to be developed for Trout Lake, they should be preceded by specific evaluation studies of controlled experimental stockings.

In no year were more than 0.3% of a single stocking sampled by fall netting (Tables 2 and 4), or 0.5% noted by angling census (Tables 2 and 5). Although the total numbers of lake trout taken are not high, the large percentages of marked lake trout in angler catches and fall netting demonstrate that stocked fish comprise a significant portion of the lake trout population and fishery. The reasons for the varying success among stockings are unknown. Although total harvest is also unknown, indices of fishing success provided by our angler census (20.5 to 103.4 man-hours per legal lake trout) indicate that the lake trout fishery is not entirely satisfactory (Table 6).

The average lake trout catch rate for three Minnesota lakes in 1954-56 was 0.29 lake trout/hour (Schumacher, 1960). In Big Green Lake, Green Lake County, Wisconsin, an average catch rate for several years was reportedly about .09 lake trout/hour. The overall average catch rate in Trout Lake appears to be about 0.025 lake trout/hour. Stocking rates in Big Green Lake have often been about 5 trout/acre annually, whereas in Trout Lake they have been from 2 to 10 or more trout/acre. In Green Lake, stocking practices have been confined mainly to yearlings planted in the spring months, sometimes from local rearing ponds (Douglas Morrissette, Wis. DNR, pers. comm.).

Local residents commonly believe that the lake trout fishery in Trout Lake declined considerably sometime prior to the 1950's, but this has not been documented.

Determination of limiting factors to natural reproduction of lake trout deserves further attention. Apparently the lake supported good lake trout populations through natural reproduction for many years. A large sample of lake trout eggs was taken in the fall of 1968 to determine if the eggs would hatch well under controlled (hatchery) conditions. The hatch was excellent (31,120 fry from 38,500 eggs - 81%), and no problem such as pesticides in the eggs is suspected. Several other good hatches and successful fingerling and/or yearling production have resulted from Trout Lake lake trout eggs reared in a hatchery since then.

In Trout Lake, predation on lake trout eggs and/or younger fish, lack of proper food for younger trout, or a combination of these and other factors may be responsible for the low recruitment of naturally-produced fish. Direct or indirect competition from warm water forage species such as suckers and redhorse may also be important.

MANAGEMENT AND INVESTIGATION RECOMMENDATIONS

Due to the size and complexity of the Trout Lake ecosystem, substantial effort would be required to develop a refined management plan for the cold water fishery. Considering the uniqueness of the lake and its lake trout fishery, however, some effort is justified.

The following recommendations are made for consideration by the DNR and other interested agencies with the objective of improving the sport fishery. Highest priorities are preceded by asterisks*.

I. Stocking

There are two approaches that can be taken. One is to aim at increasing abundance of lake trout. The other is to try new species not endemic to Trout Lake. Including Trout Lake, it appears that there were only between 4 and 7 lakes with indigenous lake trout populations in inland Wisconsin (Greene, 1935). The lake trout populations of two of these lakes have probably disappeared (Richard W. Wendt and William J. Weiher, Wisconsin DNR, pers. comm.) Because of the scarcity of lakes in Wisconsin that can sustain healthy populations of lake trout and because of the high survival of some of the lots of lake trout stocked to date, I recommend improving the lake trout population without the introduction of exotics. If this does not prove satisfactory after an adequate evaluation period, exotic species should be considered. Therefore, the following stocking recommendations are made:

*(A) Continue stocking lake trout.

1. Plant between 6,000 and 40,000 lake trout/year until further guidelines can be refined for numbers, sizes and time(s) of year to stock. Depending on the supply of fish, this may have to be restricted to alternate year stocking.

2. Continue to mark all trout planted. Use combinations of fin clips or other methods for more definitive identification.

3. Initiate controlled studies to evaluate success of various stockings in relation to egg sources, time of year stocked, age and size at stocking, and numbers stocked.

4. Lake Trout should be carefully tempered at the time of stocking and considerations given to evaluating scatter planting over the deeper portions of the lake.

II. Fish Removal

If there is competition between rough fish and lake trout for the food chain, extensive rough fish removal might result in a positive response in trout food. This, of course, would require intensive evaluation. There are reportedly heavy spring runs of redhorse out the lake's outlet, but this has not yet been verified. With present technology, the considerable effort required to effectively remove rough fish from a lake the size of Trout Lake would probably exceed the value from such a project.

III. Regulations

Regulations appear to be generally adequate, but the value of retaining the 17-inch size limit for lake trout and a regulation allowing motor trolling both need further consideration and testing.

IV. Investigations, Evaluation and Habitat Management

*A. Winter censuses of the sport fishery should be conducted. Intensity should be related to fishing pressure.

*1. A stratified creel sampling program, sampling various days and times of day should be conducted. Estimates of total harvest, percent of stocked trout returned to anglers, and weights of various lake trout stockings at harvest (compared to total weight when stocked) would help assess the success of the stocking program.

*2. More information on spring and summer angling catches is needed, including warm water species.

*B. Monitor adult lake trout population by fall netting during the spawning run.

C. Conduct studies of the plankton resource to determine whether food supplies are critical to younger trout.

*D. Examine bottom types in the lake trout spawning areas. Dredging and skin diving observations could determine particle sizes, egg deposition and perhaps indications of egg predation. Recommend and take action to improve spawning facilities if indicated.

*E. The relationship between crayfish and lake trout needs to be explored. The hypothesis that Orconectes propinquus could be a significant predator on lake trout eggs and/or fry should be tested. Lake experiments should provide comparisons between lake trout egg survival in crayfish-proof containers with gravel versus reference areas with crayfish. If crayfish predation on trout eggs is a serious limiting factor, experiments should be attempted to control the crayfish population and/or limit crayfish access to the lake trout spawning grounds.

*F. More quantitative information is needed on the sport netting of whitefish in the fall. The whitefish population should be monitored for abundance and sizes, and the scope and effect of fall sport netting should be evaluated.

*G. Determination of the abundance and roles of warm water fishes.

*1. Determine the impact of warmwater predators on survival of lake trout juveniles. Electrofishing and/or netting the lake shortly after planting lake trout and examining stomaches of warmwater predators might indicate the extent of short-term predatory losses to stocked trout. If warmwater gamefish competition and predation are important, management measures that encourage these warmwater fishes would be contrary to lake trout production goals, and consideration of suppression measures would be in order.

*H. A basic fisheries survey of the lake is recommended. Further information on the species and abundance of minnows and other forage fishes present in Trout Lake might also be helpful in attempting to understand this ecosystem.

I. Determine food habits of lake trout during all phases of their life cycle in the lake.

J. Methods of sampling juvenile lake trout in Trout Lake should be explored.

*K. All possible efforts should be made to preserve Trout Lake's water quality and prevent any acceleration of eutrophication.

Trout Lake is a large, complicated and complex system. In order to learn "what makes it tick", considerable amount of effort would be needed. Since the lake trout is a rather rare sport fish the inland lakes of Wisconsin, but is highly desired and not prospering, the proposed studies surely worth serious consideration. An intensive effort on Trout Lake should provide the necessary guidelines for improving the lake trout fishery for many years.

APPENDIX

Table 10. Lake trout sex ratios and lake trout and whitefish size ranges sampled during fall netting on Trout Lake.*

Year	Lake Trout Sex Ratio	Lake Trout Size Range (in.)	Whitefish Size Range (in.)
1955	1F	24.0	12-14
1957	2.5M: 1F	20.5-29.7	-
1958	1.8M: 1F	19.5-37.8	12-18
1959	2.4M: 1F	19.2-34.0	-
1960	2.0M: 1F	12.1-31.3	-
1961	1.7M: 1F	9.1-32.0	-
1962	2.0M: 1F	8.3-31.2	-
1966	3.5M: 1F	21.5-31.2	-
1967	6.0M: 1F	13.5-32.8	9.2-18.5
1968	1.3M: 1F	12.6-33.1	11.0-19.5
1969	1.2F: 1M	12.7-33.5	9.0-20.9
1970	1.9M: 1F	12.3-33.5	10.0-23.8
1971	2.2M: 1F	11.9-34.0	10.0-19.9
1972	2.0M: 1F	9.0-30.5	10.0-16.5
1976	1.5M: 1F	13.3-33.8	9.8-20.5

* Numbers of fish and netting effort are in Table 3.

White sucker	96	-	31	44	17	72	-	13	76	1	6	31	-	15**
Yellow perch	104	-	17	74	11	8	1	13	13	37	79	67	-	4
Muskellunge	-	-	4	6	-	4	-	1	-	3	2	-	-	1
Northern pike	1	1	-	5	-	1	-	-	1	3	2	3	-	-
Black crappie	17	-	5	-	-	-	-	-	-	-	-	-	-	-
Rock bass	231	-	6	20	8	6	-	-	23	8	87	46	-	-
Smallmouth bass	1	-	1	1	-	-	-	-	-	1	1	-	-	-
Cisco	2	-	4	4	35	16	3	2	11	10	7	9	1	-
Burbot	-	3	4	-	-	2	-	1	3	2	2	4	-	3
Brook trout	-	-	-	-	1	-	-	-	-	-	-	-	-	-

* Since the netting intensity varied considerably among the years, the above figures are not to be interpreted as reflections of abundance changes.

+ During the 1957 netting operations, species other than trout were not tabulated.

**Estimate

Table 12. Winter fishing pressure and numbers of sublegal* lake trout and warm water fish noted.

Year	Number Fishermen Contacted	Man-hours Fished	Lake Trout Noted Sublegal*	Lake Trout Noted Legal	Warm Water Fish Taken
1955	(50 Approx.)	-	-	12+	-
1956	633	3,490	51	103	3 walleyes, 11 burbot
1958	20	75	-	5	
1959	126	563	3	11	-
1960	41	211	-	2	22 yellow perch
1961	445	2,554	23	43	2 walleyes, 31 yellow perch 1 northern pike
1963	107	517	1	4	-
1964	0	No fishermen checked (one day census)			
1965	3	Three fishermen checked. "Very few legal trout taken; quite a few sublegal; many with adipose clip".			
1967	262	1,355	4	66	5 walleyes
1968	348	1,546	19	29	-
1969	135	757	8	13	1 yellow perch
1970	119	694	27	11	1 burbot
1971**	73	564	17	19	3 burbot, 9 yellow perch

* sublegal trout lengths were reported by fishermen who returned the fish.
** one family's voluntary records.

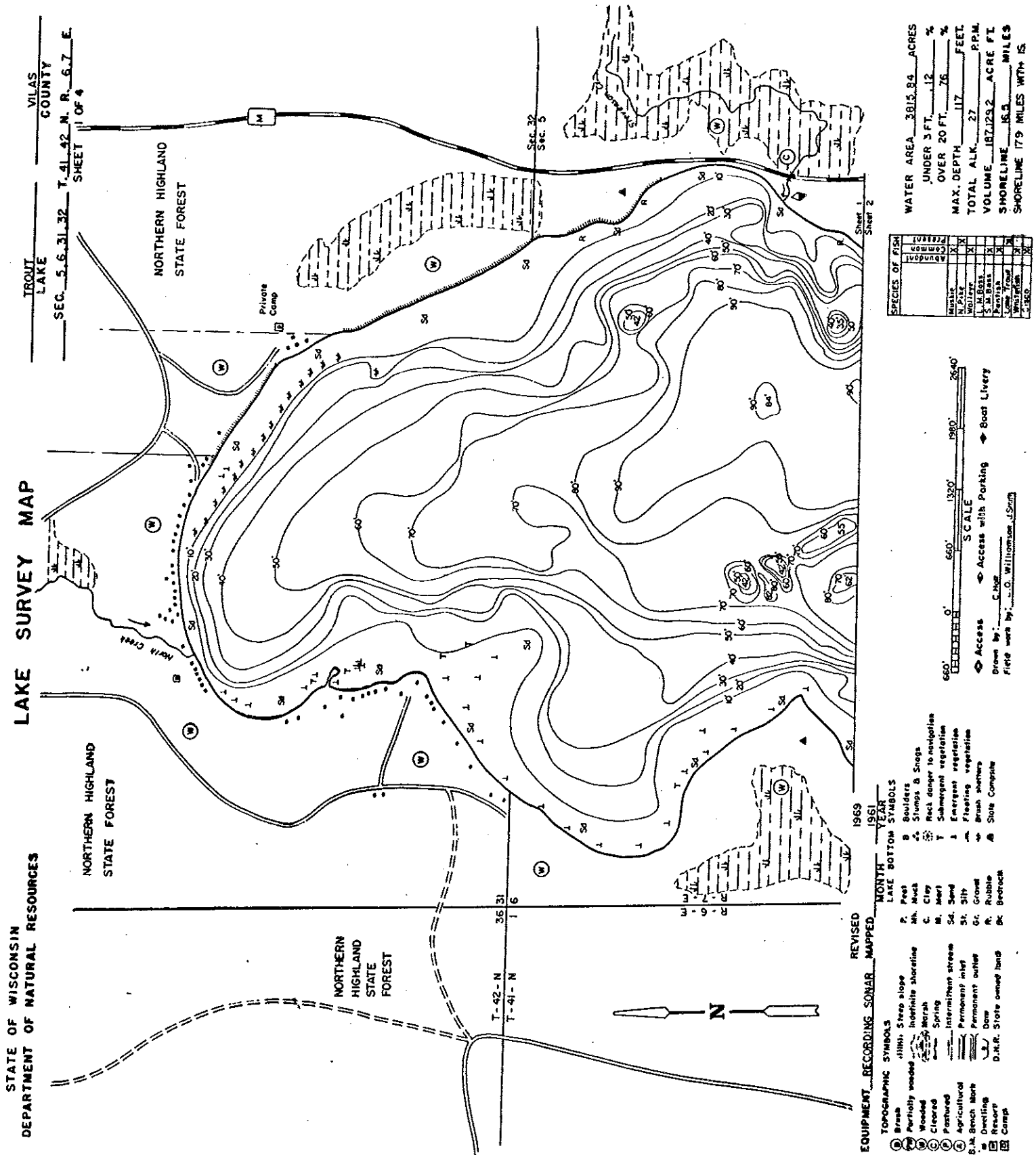
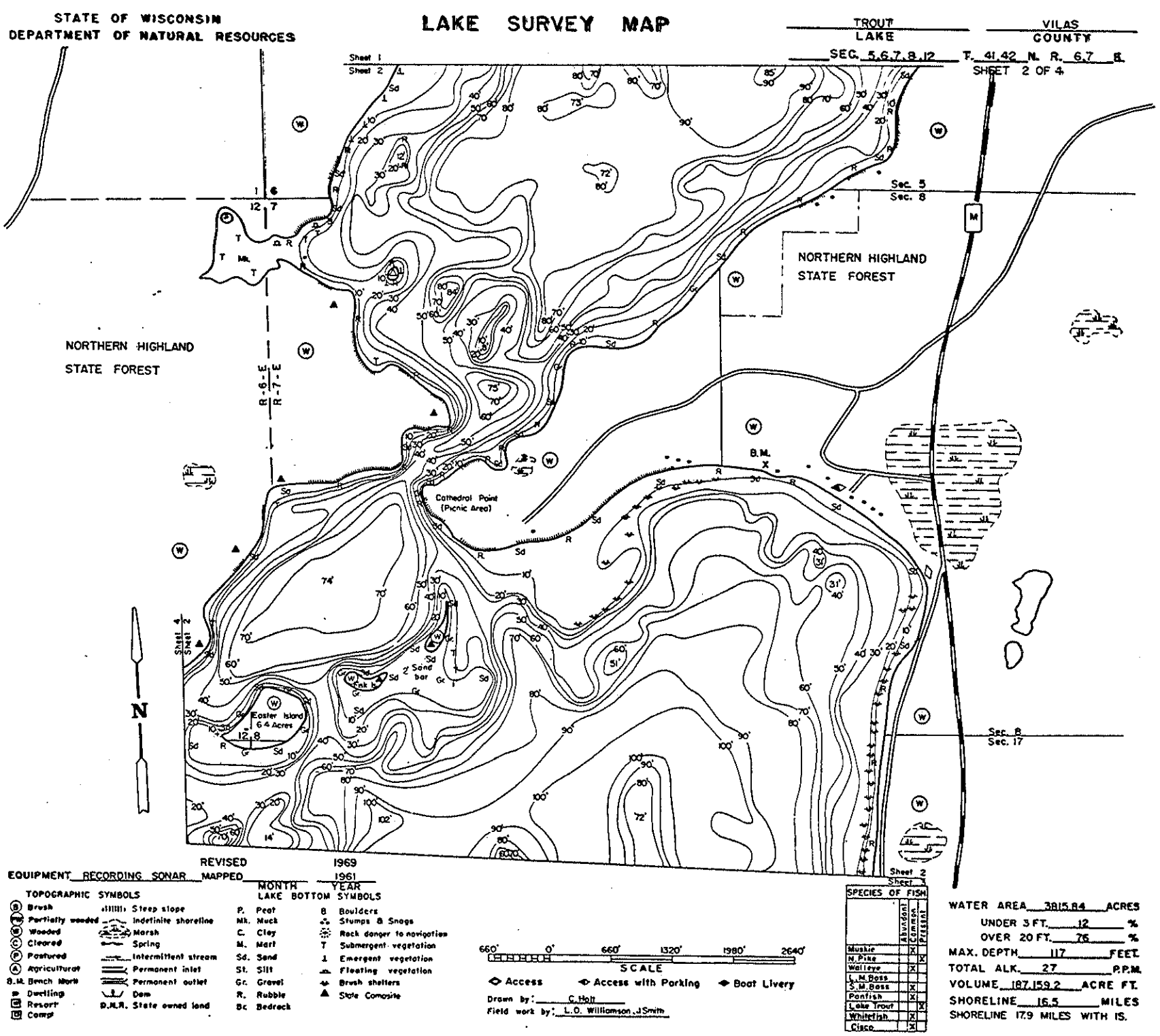

LAKE SURVEY MAP
STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES
TROUT LAKE
VILAS COUNTY
SEC. 5 6 31 32 T. 41 42 N. R. 6 7 E.
SHEET 1 OF 4
NORTHERN HIGHLAND STATE FOREST
Private Camp
North Creek
Sec. 32
Sec. 5
Sheet 1
Sheet 2
T-42-N
T-41-N
R-6-W
N
WATER AREA 3815.84 ACRES
UNDER 3 FT. 12 %
OVER 20 FT. 76 %
MAX. DEPTH 117 FEET
TOTAL ALK. 27 P.P.M.
VOLUME 187,129.2 ACRE FT.
SHORELINE 16.5 MILES
SHORELINE 1.79 MILES WITH IS.
SPECIES OF FISH
Abundant
Common
Present
Muskie
N. Pike
Walleye
L.M. Bass
S.M. Bass
Panfish
Lake Trout
Whitefish
Cisco
SCALE
0'
660'
1320'
1980'
2640'
Access
Access with Parking
Boat Livery
Drawn by: C. Hoe
Field work by: O. Williamson J. Smith
EQUIPMENT RECORDING SONAR MAPPED MONTH YEAR
REVISED 1969
1961
TOPOGRAPHIC SYMBOLS
Brush
Partially wooded
Wooded
Cleared
Pastured
Agricultural
B.M. Bench Mark
Dwelling
Resort
Camp
Steep slope
Indefinite shoreline
Marsh
Spring
Intermittent stream
Permanent inlet
Permanent outlet
Dam
D.N.R. State owned land
LAKE BOTTOM SYMBOLS
P. Peat
Mk. Muck
C. Clay
M. Marl
Sd. Sand
St. Silt
Gr. Gravel
R. Rubble
Bk Bedrock
B Boulders
Stumps & Snags
Rock danger to navigation
Submergent vegetation
Emergent vegetation
Floating vegetation
Brush shelters
Slate Campsite

Figure 1


STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES
LAKE SURVEY MAP
TROUT LAKE
VILAS COUNTY
SEC. 5,6,7,8,12 T. 41,42 N. R. 6,7 E.
SHEET 2 OF 4
Sheet 1
Sheet 2
Sec. 5
Sec. 8
NORTHERN HIGHLAND STATE FOREST
NORTHERN HIGHLAND STATE FOREST
R-6-E
R-7-E
B.M.
Cathedral Point (Picnic Area)
2 Sand bar
Easter Island 6.4 Acres
Sec. 8
Sec. 17
Sheet 4
Sheet 2
Sheet 2
Sheet 3
N
REVISED 1969
EQUIPMENT RECORDING SONAR MAPPED 1961
MONTH YEAR
TOPOGRAPHIC SYMBOLS
Brush
Partially wooded
Wooded
Cleared
Pastured
Agricultural
B.M. Bench Mark
Dwelling
Resort
Camp
Steep slope
Indefinite shoreline
Marsh
Spring
Intermittent stream
Permanent inlet
Permanent outlet
Dam
D.N.R. State owned land
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Bc Bedrock
B Boulders
Stumps & Snags
Rock danger to navigation
T Submergent vegetation
Emergent vegetation
Floating vegetation
Brush shelters
State Campsite
660' 0' 660' 1320' 1980' 2640'
SCALE
Access
Access with Parking
Boat Livery
Drawn by: C. Holt
Field work by: L.O. Williamson, J. Smith
SPECIES OF FISH
Abundant
Common
Present
Muskie
N. Pike
Walleye
L.M. Bass
S.M. Bass
Panfish
Lake Trout
Whitefish
Cisco
WATER AREA 3815.84 ACRES
UNDER 3 FT. 12 %
OVER 20 FT. 76 %
MAX. DEPTH 117 FEET
TOTAL ALK. 27 P.P.M.
VOLUME 187,159.2 ACRE FT.
SHORELINE 16.5 MILES
SHORELINE 17.9 MILES WITH IS.

Figure 2

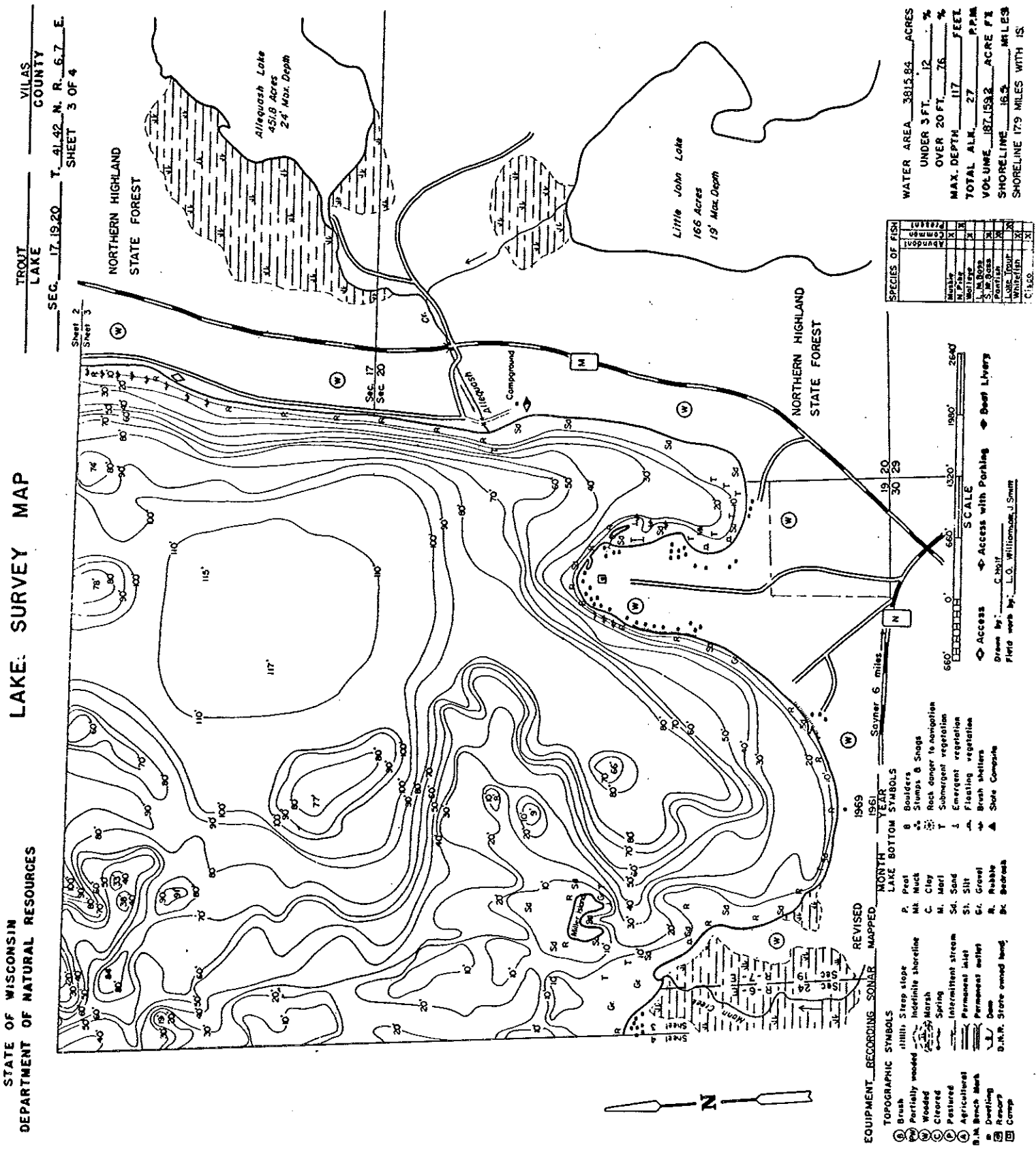
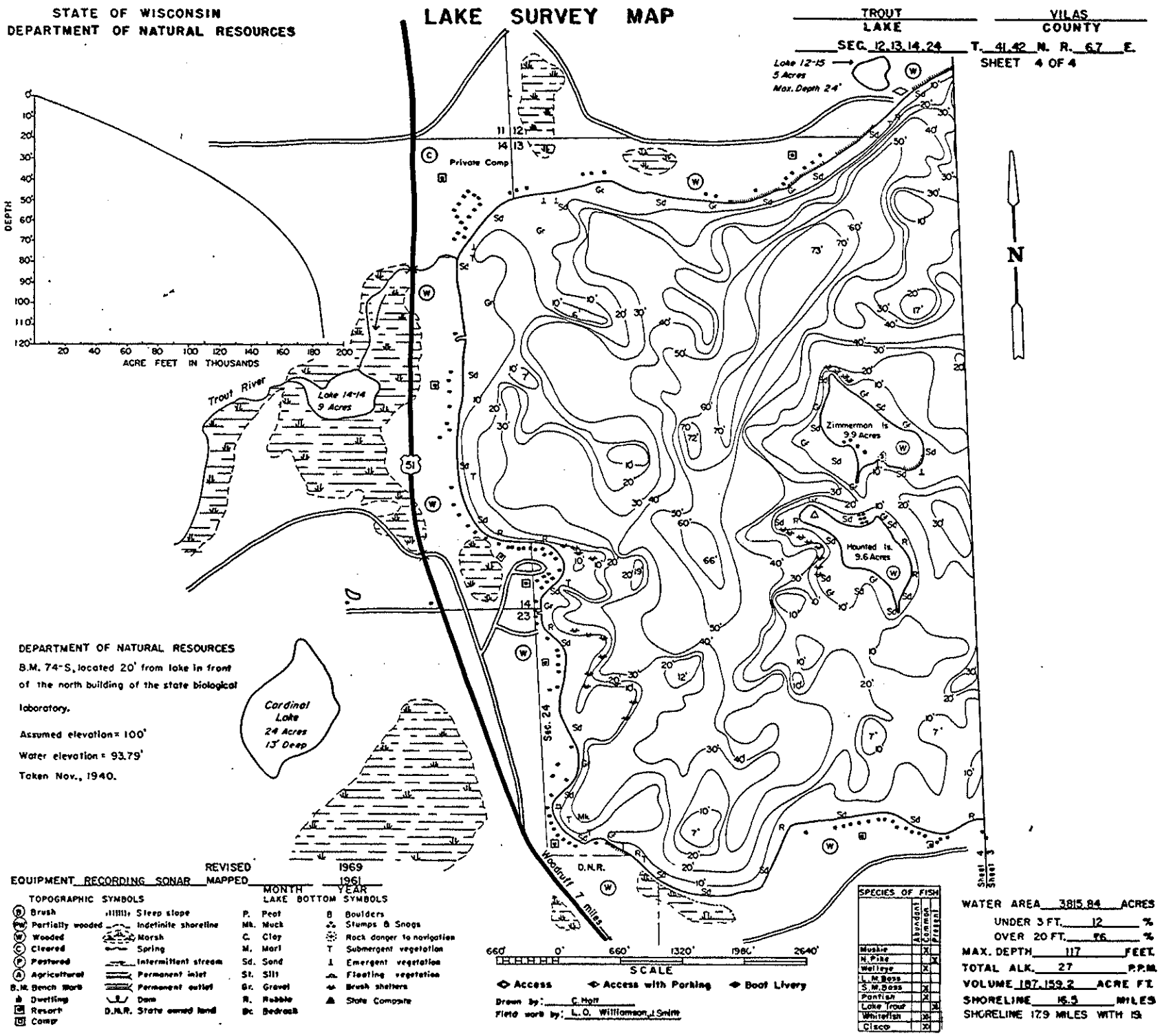

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES
LAKE: SURVEY MAP
TROUT LAKE
VILAS COUNTY
SEC. 17,19,20 T. 41 42 N. R. 6 7 E.
SHEET 3 OF 4
NORTHERN HIGHLAND STATE FOREST
Allequash Lake
45.8 Acres
24' Max. Depth
Little John Lake
166 Acres
19' Max. Depth
Allequash Campground
Sec. 17
Sec. 20
Sec. 19
Sec. 24
Sec. 29
Sec. 30
Sayner 6 miles
SCALE
660' 0 660' 1320' 1980' 2640'
EQUIPMENT RECORDING SONAR MAPPED
REVISED
MONTH
YEAR
1961
1969
Drawn by: C. Holt
Field work by: L.O. Williamson, J. Smith
TOPOGRAPHIC SYMBOLS
LAKE BOTTOM SYMBOLS
SPECIES OF FISH
Abundant
Common
Present
Muskie
N. Pike
Walleye
S. M. Bass
L. M. Bass
Panfish
Lake Trout
Whitefish
Ciscoe
WATER AREA 3815.84 ACRES
UNDER 3 FT. 12 %
OVER 20 FT. 76 %
MAX. DEPTH 117 FEET
TOTAL ALK. 27 P.P.M.
VOLUME 187,139.2 ACRE FT.
SHORELINE 16.2 MILES
SHORELINE 17.9 MILES WITH IS.
Access
Access with Parking
Boat Livery
N

Figure 3


STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES
LAKE SURVEY MAP
TROUT LAKE
VILAS COUNTY
SEC. 12,13,14,24 T. 41,42 N. R. 6,7 E.
SHEET 4 OF 4
Lake 12-15
5 Acres
Max. Depth 24'
Private Camp
Trout River
Lake 14-14
9 Acres
Zimmerman Is.
9.9 Acres
Haunted Is.
9.6 Acres
Cardinal Lake
24 Acres
13' Deep
Sec. 24
D.N.R.
Woodruff 7 miles
DEPTH
ACRE FEET IN THOUSANDS
DEPARTMENT OF NATURAL RESOURCES
B.M. 74-S, located 20' from lake in front of the north building of the state biological laboratory.
Assumed elevation = 100'
Water elevation = 93.79'
Taken Nov., 1940.
EQUIPMENT RECORDING SONAR
REVISED MONTH
MAPPED 1969 YEAR
1961
TOPOGRAPHIC SYMBOLS
LAKE BOTTOM SYMBOLS
SCALE
Access
Access with Parking
Boat Livery
Drawn by: C. Holt
Field work by: L. O. Williamson, J. Smith
SPECIES OF FISH
Abundant
Common
Present
Muskie
N. Pike
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S. M. Bass
Panfish
Lake Trout
Whitefish
Cisco
WATER AREA 3815.84 ACRES
UNDER 3 FT. 12 %
OVER 20 FT. 26 %
MAX. DEPTH 117 FEET
TOTAL ALK. 27 P.P.M.
VOLUME 187,159.2 ACRE FT.
SHORELINE 16.5 MILES
SHORELINE 17.9 MILES WITH 1%

Figure 4

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pm