MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
ENVIRONMENT SECTION

DISTRIBUTION OF THE LARGER FISHES IN MINNESOTA LAKES, 1948 TO 1967

SPECIAL PUBLICATION NO. 107

August, 1974

DISTRIBUTION OF THE LARGER FISHES IN MINNESOTA LAKES, 1948 TO 1967

By

Arthur R. Peterson
Aquatic Biologist

INTRODUCTION

This report maps the distribution of larger fishes in Minnesota, as indicated by test net catches from routine lake surveys conducted between 1948 and 1967. It does not include fishes that occur in streams and rivers except for river lakes such as Lake Pepin. The net catch data was derived from over 1,700 surveys of 1,580 lakes; a sample of sufficient size to permit working out the distribution of many of the larger fish species. Although lakes in the state are not randomly distributed, a sufficient number of lakes have been surveyed in each climatic region to gain an overall picture of their distribution. Many species of fish occur only in certain areas of the state. The fish distribution maps in this report were compiled to aid administrators, managers, and researchers. The maps should help form the basis for ongoing distribution studies covering all Minnesota fishes.

This discussion is restricted to lakes, because some species occur in lakes in one part of the state and are primarily restricted to streams in another part of the state. A good example is smallmouth bass. Smallmouth bass are frequently found in lakes in the northern part of the state, especially the northeastern counties, and occur commonly in streams and rivers in the southern part of the state. Some comments on the obvious reasons for the various distributions will be made, but an extensive literature review will not be attempted because Underhill (1955) has reviewed the literature and discussed the distribution of small stream fishes which have not been stocked extensively throughout the state. Many of the fishes have been stocked throughout the state so their presence or absence is likely to be regulated by their tolerance of existing environmental conditions, or be regulated by the factors discussed by Underhill.

It is well known that nets are selective so some caution is necessary in using this type of information. This problem is minimized here by using only the presence of absence of a species in a lake. Large fluctuations in numbers caught will have a smaller effect on the data because fish will nearly always be present even if the numbers fluctuate considerably.

Distribution of Lakes

There are extensive areas in Minnesota without fish lakes and the distribution of lake surveys shows where the main lake region is located. Figure 1 shows the parts of the state where there is less than one lake basin per square mile. The largest areas with few or no natural lake basins are the unglaciated areas of southwestern and southeastern Minnesota and the bed of Glacial Lake Agassiz. The smaller areas are the beds of small glacial lakes and outwash plains. In southwestern Minnesota there are a disproportionate number of dry and shallow lake basins which is nearly the same as being in the lakeless areas, because lakes with normal fish populations are sparsely distributed or absent. Species that predominate are fish such as black bullheads that tolerate the conditions found in shallow lakes which frequently winter-kill.

Number of Species

Fifty-five of the sixty species are large enough so that they can regularly be caught in the test nets and of these, seventeen species occur in more than ten percent of the lakes. Only ten species occur in more than 40 percent of the lakes. The ten species are northern pike, yellow perch, white sucker, bluegills, black crappies, pumpkinseeds, walleye, black bullheads, largemouth bass, and brown bullheads. Some species such as carp, tullibee, lake trout, smallmouth bass, and channel catfish are commonly caught in some lakes, but they are not well distributed in lakes throughout the state.

Smith's 1971 Distributional Atlas of the Upper Mississippi River Fishes notes that seven of the ten species occur more commonly north of a

zone located between Mississippi River lock and dam, pools 10 and 20, which are part of the Iowa, Wisconsin, Illinois boundary waters. These species are northern pike, white sucker, brown bullheads, pumpkinseed, black crappie, yellow perch, and walleye. Two species, bluegill and largemouth bass, were recorded as occurring commonly throughout the basin, and the other species, black bullhead, was recorded as widely distributed, but not common. In contrast, Hicks (1943) reports that four of the ten species, northern pike, walleye, common sucker, and yellow perch occur commonly in Manitoba's lakes. These are the species that are most abundant in our northern and central walleye lakes (Eddy 1947). Hicks (1943) also notes that the walleye range was extended into the prairie region by stocking.

Two species, bluegills and pumpkinseeds were absent from the list. Two species, black crappie and largemouth bass, have been occasionally found in fish collections in the southern part of the province. Black and brown bullheads are abundant in the southern part of the province. His notes indicate that smallmouth bass is not a native Manitoba fish and that it persists in the lakes where it was introduced. From the foregoing, it appears that going from south to north that Minnesota is located in a zone where southern species disappear and northern species become abundant.

Table 1. Percent occurrence of the fishes caught in lake survey test nets from 1948 to 1967 and excluding small fishes such as minnows and darters

Occurs in more than 0.5% of lakes			Occurs in less than 0.5% of lakes		
Rank	Species	Percent	Rank	Species	Percent
1	Northern pike	83.8	28	Channel catfish	1.0
2	Yellow perch	82.4	29	Rainbow trout	0.89
3	White sucker	76.8	30	Longnosed gar	0.76
4	Bluegills	64.6	31	Brown trout	0.57
5	Black crappies	63.6	32	Shortnosed gar	0.51
6	Pumpkinseeds	60.6	33	Quillback	
7	Walleye	55.4	34	Sauger	
8	Black bullheads	45.6	35	Gizzard shad	
9	Largemouth bass	43.5	36	American eel	
10	Brown bullheads	39.5	37	Goldeye	
11	Rock bass	36.7	38	Lake sturgeon	
12	Yellow bullheads	33.9	39	Mooneye	
13	Bowfin (Dogfish)	22.0	40	Smelt	
14	Carp	15.5	41	Shovelnosed sturgeon	
15	Northern redhorse	12.4	42	Greater redhorse	
16	Green sunfish	12.3	43	River carpsucker	
17	Tullibee	12.0	44	Smallmouth buffalo	
18	White crappies	6.8	45	Spotted sucker	
19	Smallmouth bass	6.8	46	River redhorse	
20	Burbot	3.5	47	Golden redhorse	
21	Lake whitefish	3.4	48	Plains carpsucker	
22	Bigmouth buffalo	3.4	49	Orangespotted sunfish	
23	Freshwater drum	2.5	50	Longear sunfish	
24	Lake trout	1.7	51	Yellow bass	
25	White bass	1.5	52	Flathead catfish	
26	Brook trout	1.1	53	Stonecat	
27	Silver redhorse	1.1	54	Muskellunge	

Effect of Climate

It is fairly well known that some species of fish occur only in the northeastern part of the state, some occur through out the state, and others are restricted to the southern part of the state. In general, coldwater fishes such as lake trout and tullibee occur commonly only in lakes in the northeastern part of the state, and some warmwater fishes such as carp occur commonly only in lakes in the southern part of the state. In general, it appears that climatic factors can have a marked influence on the distribution of fish. Two of the most critical climatic factors effecting fish distribution are the amount of water present in a lake and water temperatures. The previous information suggests a change in species composition from north to south so a need for a more detailed examination of the data was indicated.

Average summer air temperatures are an approximate measure of summer water temperatures in lakes, so some preliminary statistical tests of the distribution of the fishes were made. By assigning an average summer air temperature to each county, the total number of lakes surveyed with the same average air temperature can be determined. The number of lakes with a fish species at each average summer air temperature can also be determined. In the preliminary tests, the hypothesis was that there was no difference in the number of lakes with a fish species between counties where the average temperature was higher or lower than the average temperature. This hypothesis was not true for three of five species tested, largemouth bass, tullibee, and bowfin (dogfish). It was concluded that the distribution of these fish was related to the average summer air temperature. The distribution of walleyes and northern pike was not related to average summer air temperatures which ranged from 60 to 71° F. The results of another test indicated that there were more lakes with walleyes when the average date of 32° F or lower in the spring was May 16 or 17 and fewer lakes with walleye when the date was earlier than May 11.

To obtain more precise temperature information about each species, graphs showing the precentage occurrence in lakes at each average warmer air temperature were prepared. From these graphs, it was apparent there was a range of temperatures where species did not occur, a range of temperatures where they were found in a very small percentage of the lakes, and a range of temperatures where they occurred in a large or relatively large percentage of the lakes. Using the average percentage occurrence in lakes as a guide, it was possible to determine the range of air temperatures where they were most abundant. Using this information as a guide, the species were arranged into the tentative categories according to the average air temperature information:

I. Coldwater Fishes

   A. Warm intolerant (Max. 63°F or lower)
   B. Warm tolerant fishes

II. Warmwater Fishes

   A. Cold tolerant (Minimum ?)
   B. Intermediate cold tolerance (Minimum 65°F or higher)
   C. Cold intolerant (Minimum 68°F or higher)

Table 2. Average summer air temperatures associated with an optimum distribution of a species of fish

Cold Water Fishes (Upper temperature limits)

Warm Intolerant (63°F. or lower)
- Longnose sucker -- 60°F. or lower
- Lake trout -- 60°F. or lower
- Lake whitefish -- 63°F.
- Burbot -- 63°F.

Warm Tolerant (68°F. or lower)
- Tullibee -- 68°F.
- Smallmouth bass -- 68°F.
- White sucker -- 65°F.

Warm Water Fishes (Lower temperature limits)

Cold Tolerant (above 60°F.)
- Yellow perch -- 60°F. or lower
- Northern pike -- 60°F. or lower
- Walleye -- 60°F. or lower
- Rock bass -- 63°F. (upper limit 67°F.)
- Black crappie -- 63°F.

Intermediate Cold Tolerance (above 65°F.)
- Northern redhorse -- 65°F. (upper limit 69°F.)
- Pumpkinseed -- 65°F.
- Bluegill -- 65°F.
- Largemouth bass -- 65°F.
- Black bullhead -- 66°F.
- Brown bullhead -- 66°F.
- Yellow bullhead -- 66°F.
- Bowfin (Dogfish) -- 67°F.

Cold Intolerant (above 68°F.)
- Green sunfish -- 69°F.
- Carp -- 71°F.
- White crappie -- 71°F. or higher
- Bigmouth buffalo -- 71°F. or higher
- White bass -- 71°F. or higher
- Freshwater drum (Sheepshead) -- 71°F. or higher

Burbot, lake trout, lake whitefish, and longnose sucker appear to be coldwater fish that are not tolerant of the warmer southern waters. No maximums were determined for lake trout or longnose sucker, but the maximum related average summer air temperature appears to be 60°F or lower. The maximum for lake whitefish and burbot appears to be 63°F. Tullibee, smallmouth bass, and white suckers appear to be warm tolerant coldwater fishes where the maximum optimum air temperatures appear to be 68°F for tullibee, 68°F for smallmouth bass, and 65°F for white sucker. Three species of fish, northern pike, walleye, and yellow perch occurred commonly throughout Minnesota and no temperature optimums were apparent in the data so they were included in the group of cold tolerant warmwater fish. Rock bass was also included in the group of cold tolerant warmwater fish, but there is a narrow range of optimum average summer air temperatures associated with its distribution 63 to 67°F. The black crappie was also included in the group of cold tolerant warmwater fish and the minimum optimum average summer air temperature associated with its distribution was 63°F. Warmwater fish with an intermediate amount of cold tolerance associated with their optimum distributions were northern redhorse (65°F minimum and 69°F maximum); pumpkinseed, bluegill, and largemouth bass (minimum 65°F); black, brown, and yellow bullheads (minimum 66°F); and dogfish or bowfin (minimum 67°F). Cold intolerant warmwater fish are primarily restricted to the southern half of the state. This group includes the green sunfish (minimum 69°F) and carp white crappie, bigmouth buffalo, white bass, and freshwater drum (sheepshead) where the minimum optimum temperature appears to be 71°F or higher.

DISCUSSION AND SUMMARY

Apparently, the distribution of many of the species of fish is determined by summer temperatures or by factors regulated by temperatures. There is a distinct change in the species of fish that occur commonly in the state in a north - south direction which is modified by local geographical conditions. The state is divided into distinct zones. In each zone, the type of fish which occur most commonly in a lake are influenced or determined by factors such as basin size and shape, type and amount of water draining into a lake, kinds of soils present, and the extent to which nutrients are available in a lake basin.

In the most northern zone, northeastern Minnesota, northern pike, walleyes, smallmouth bass, yellow perch, white suckers, and tullibees are likely to occur in the shallower fish lakes, and lake trout, burbot, whitefish, and tullibees in the deeper, larger lakes. In general, these are the fish of the infertile soft waters of the coniferous forest zone. In the central zone, fish such as black crappies, bluegills, pumpkinseeds, largemouth bass, and rock bass are commonly found in the smaller deeper hardwater lakes while walleyes, northern pike, yellow perch are characteristic species of the larger hardwater lakes. In addition to the species found in the central zone, fish species such as carp, white crappies, buffalo, freshwater drum, and white bass also occur commonly in lakes in the southern part of the state. Bullheads occur commonly and are frequently abundant in shallow winter-kill lakes except in the northeastern part of the state. Figure six illustrates the approximate extent of the various zones of fish distribution as indicated by average summer air temperatures.

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LAKELESS REGION OF MINNESOTA

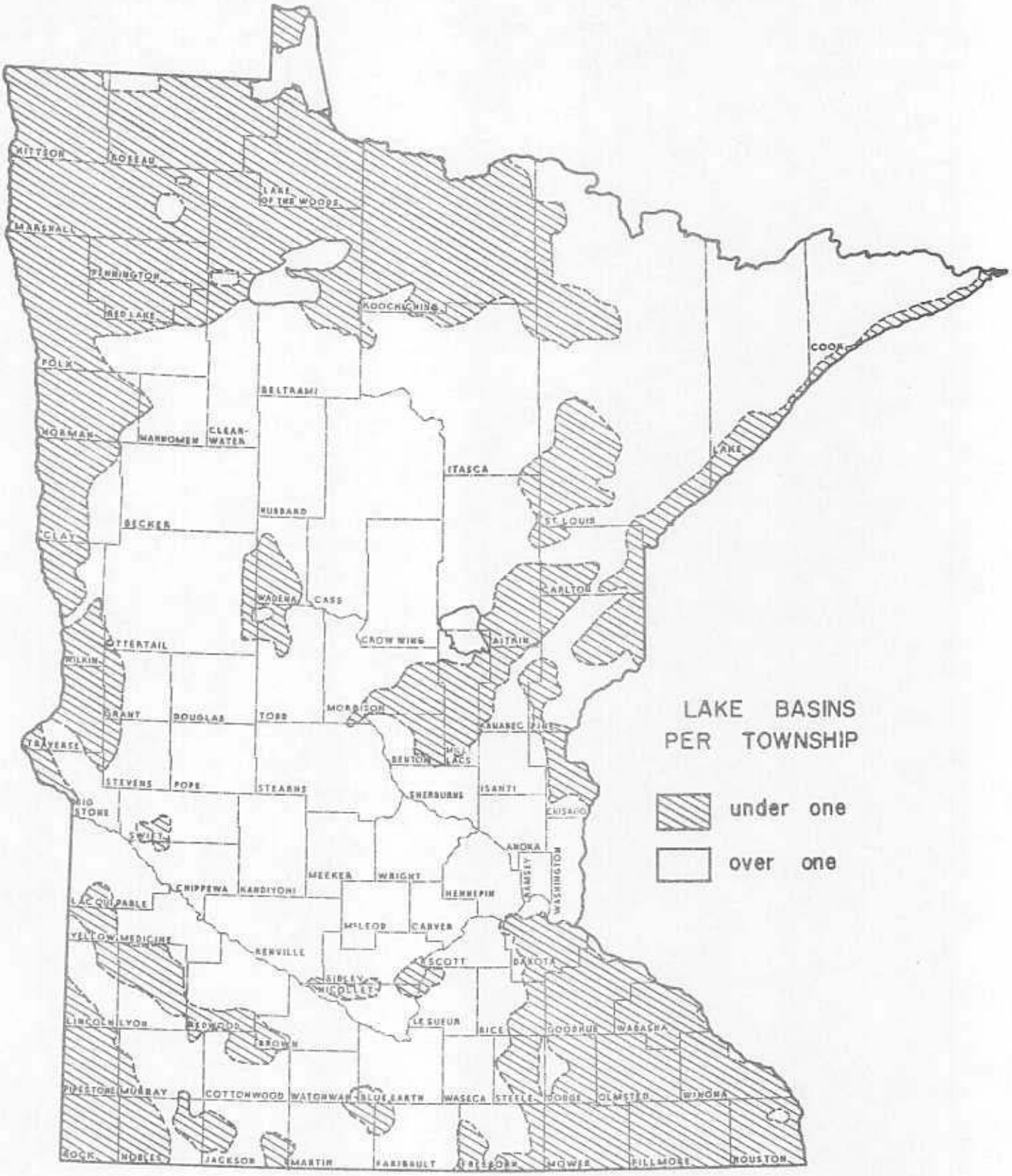


FIGURE 1

AVERAGE DATE OF LAST OCCURRENCE OF 32° F. OR LOWER IN THE SPRING.

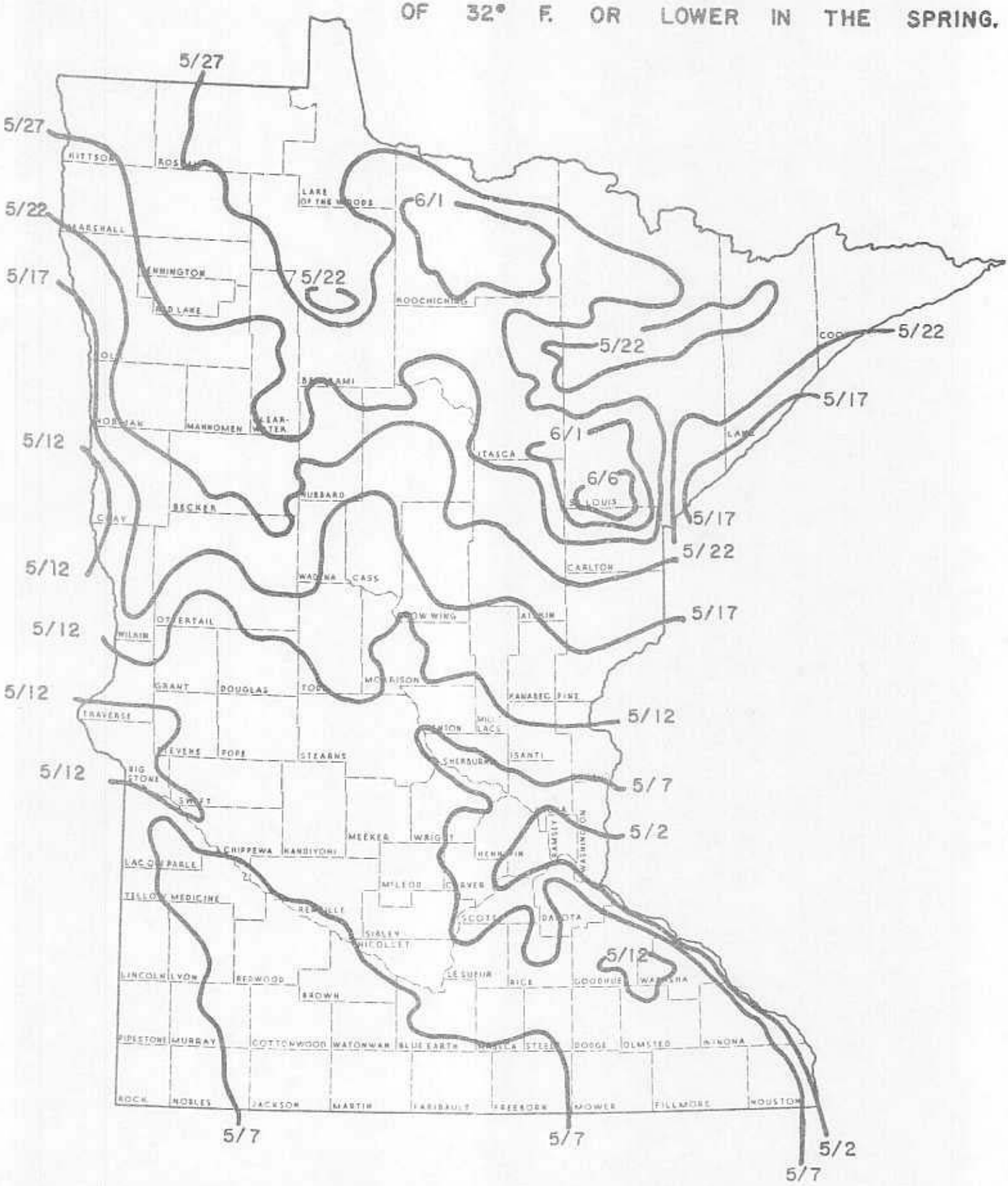
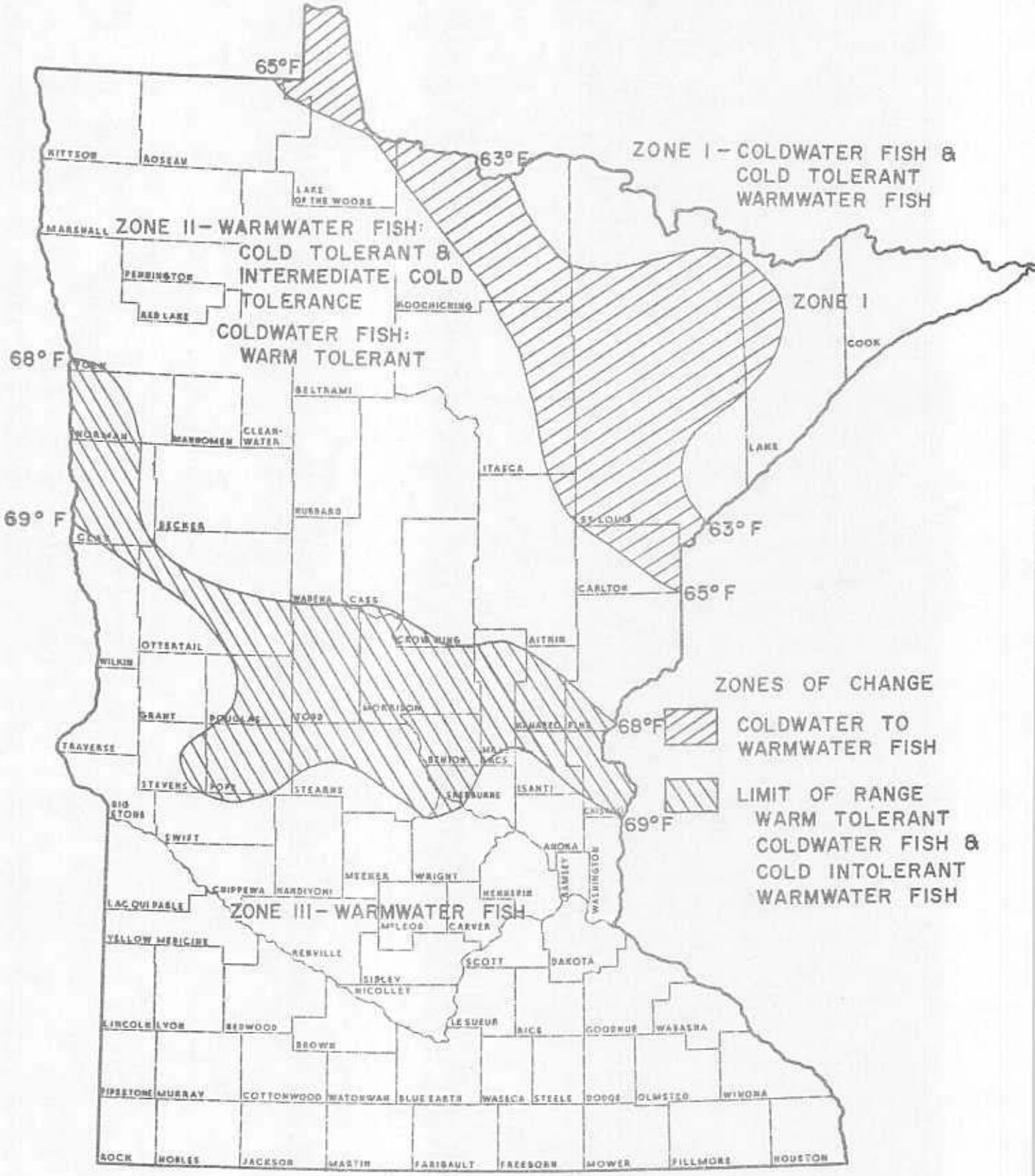


FIGURE 2



AVERAGE SUMMER AIR TEMPERATURES AND LIMITS OF RANGES OF COLDWATER AND WARMWATER FISHES IN LAKES

FIGURE 3

GLACIAL LAKES

FIGURE 4

DISTRIBUTION OF END OR TERMINAL MORAINES OF MINNESOTA (ADAPTED FROM ZUMBERGE'S MAP, 1952)

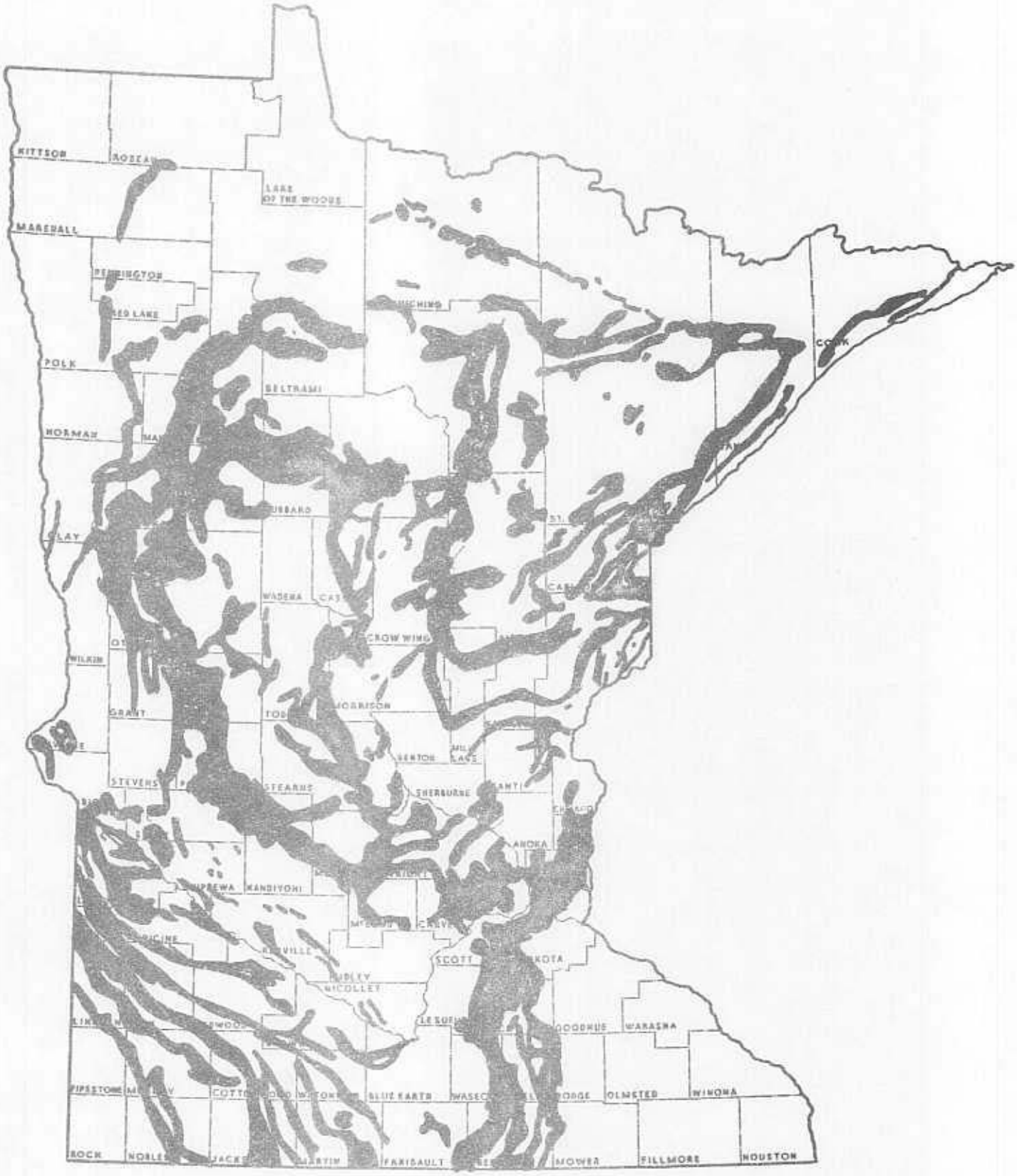


FIGURE 5

MAJOR FOREST TYPES IN MINNESOTA

1962

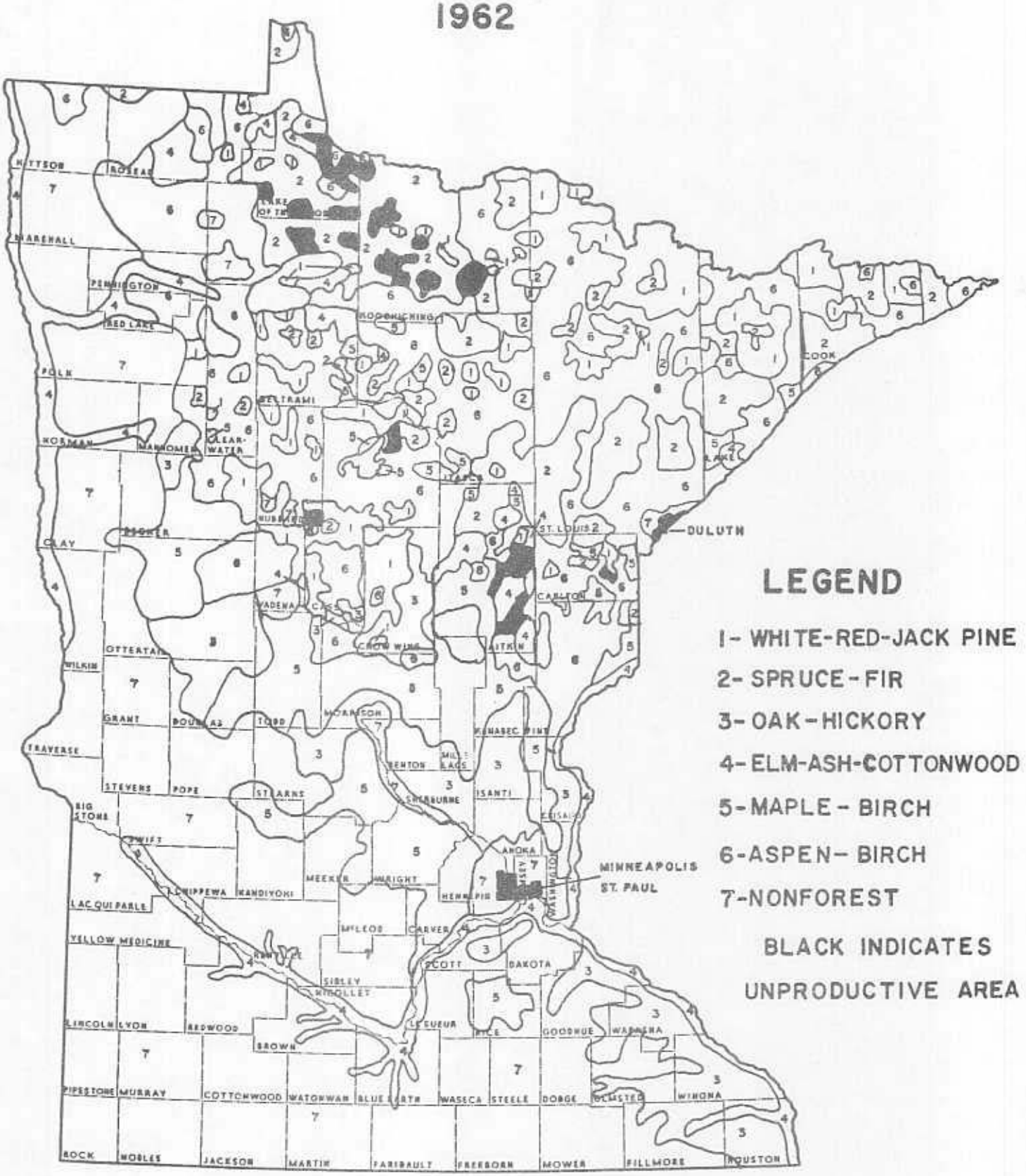


FIGURE 6

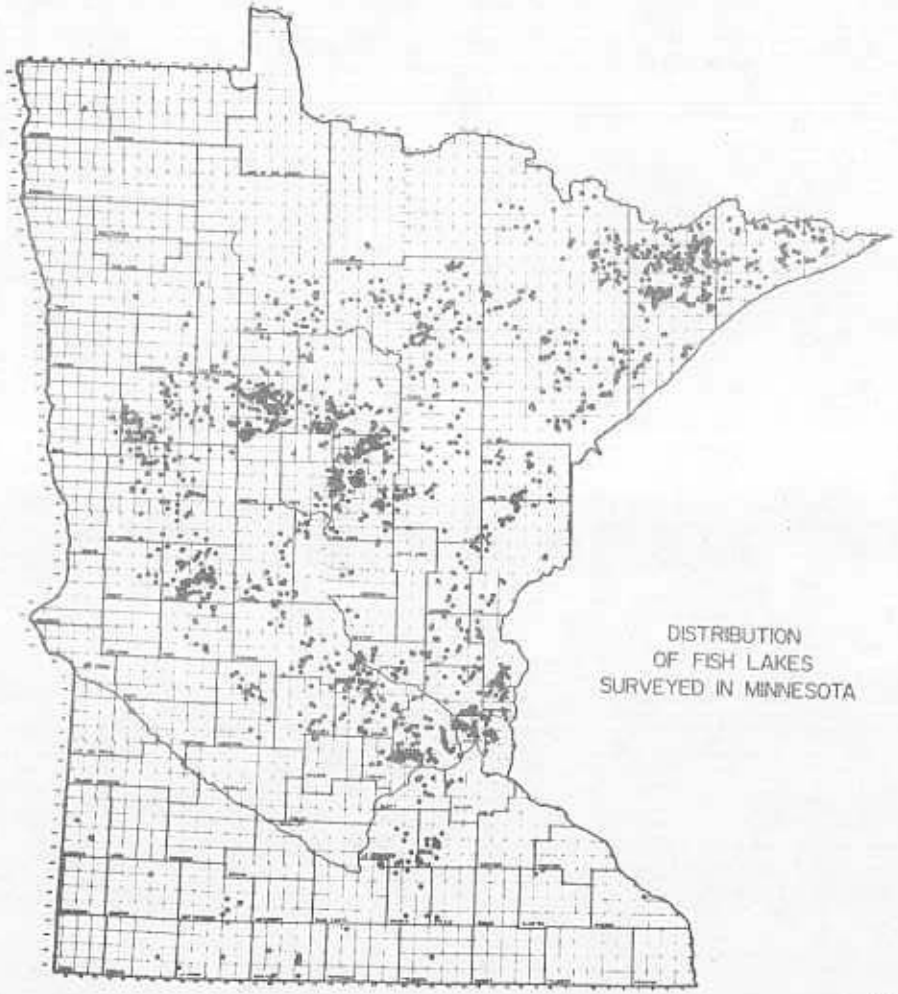


Figure 7.
(Survey dates - 1948 to 1967)

Figure 8
(Survey dates - 1948 to 1967)

Figure 9.
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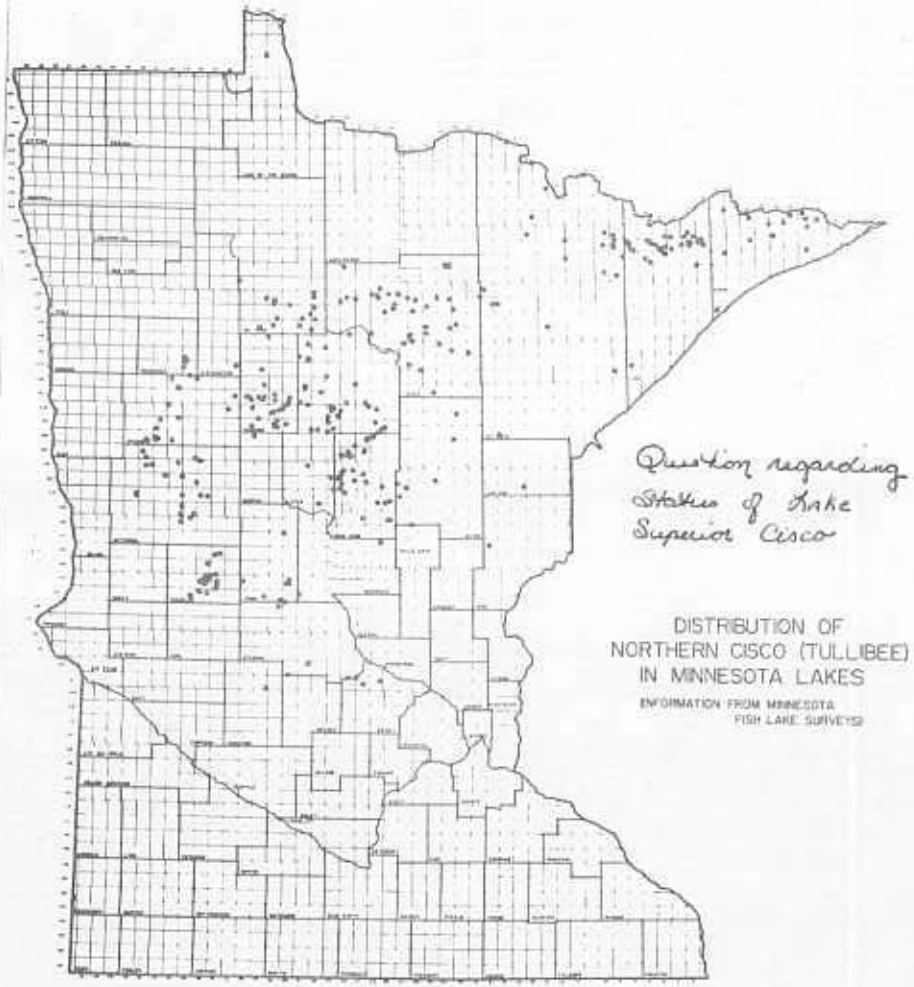

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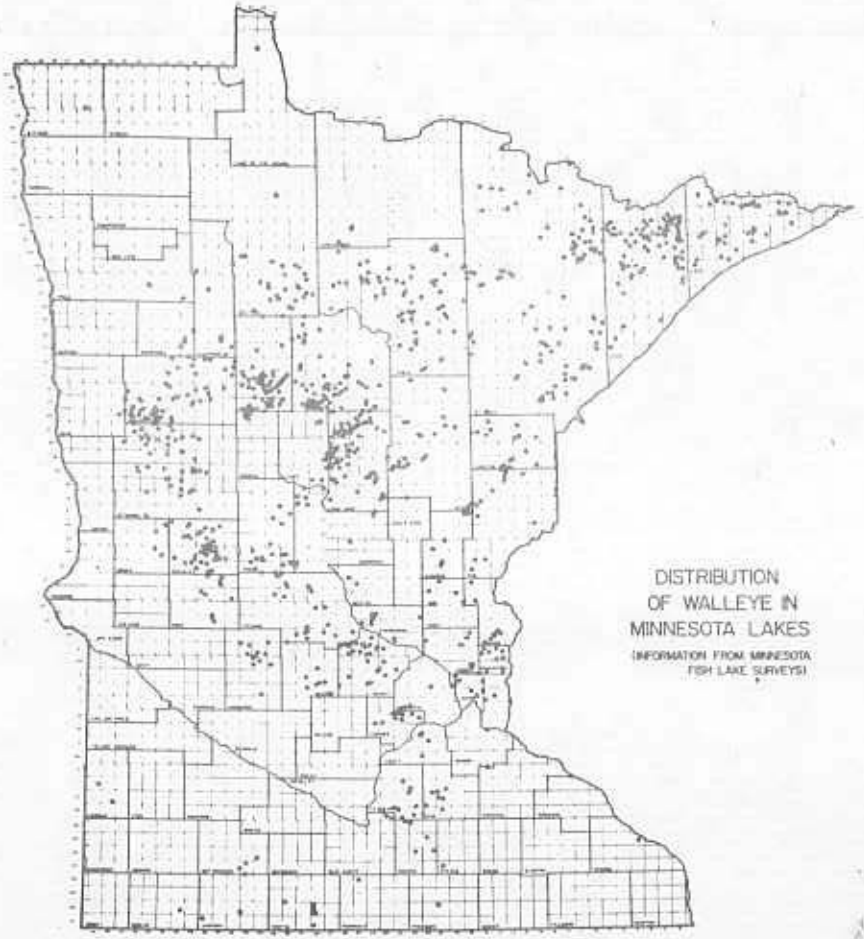

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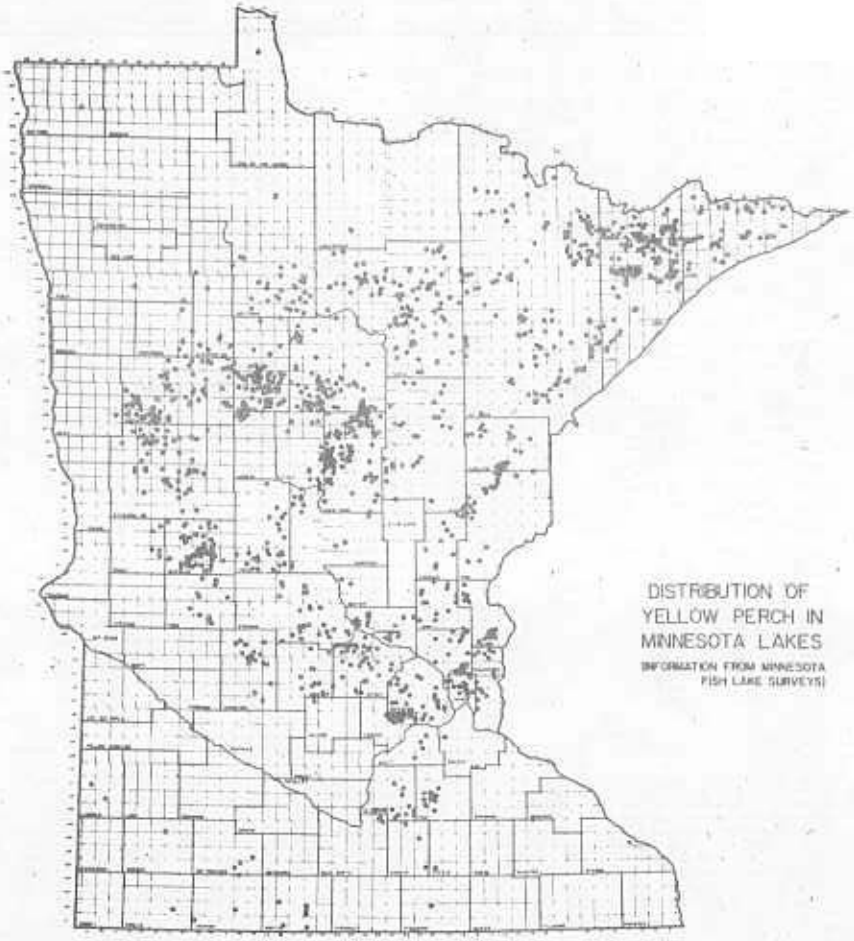

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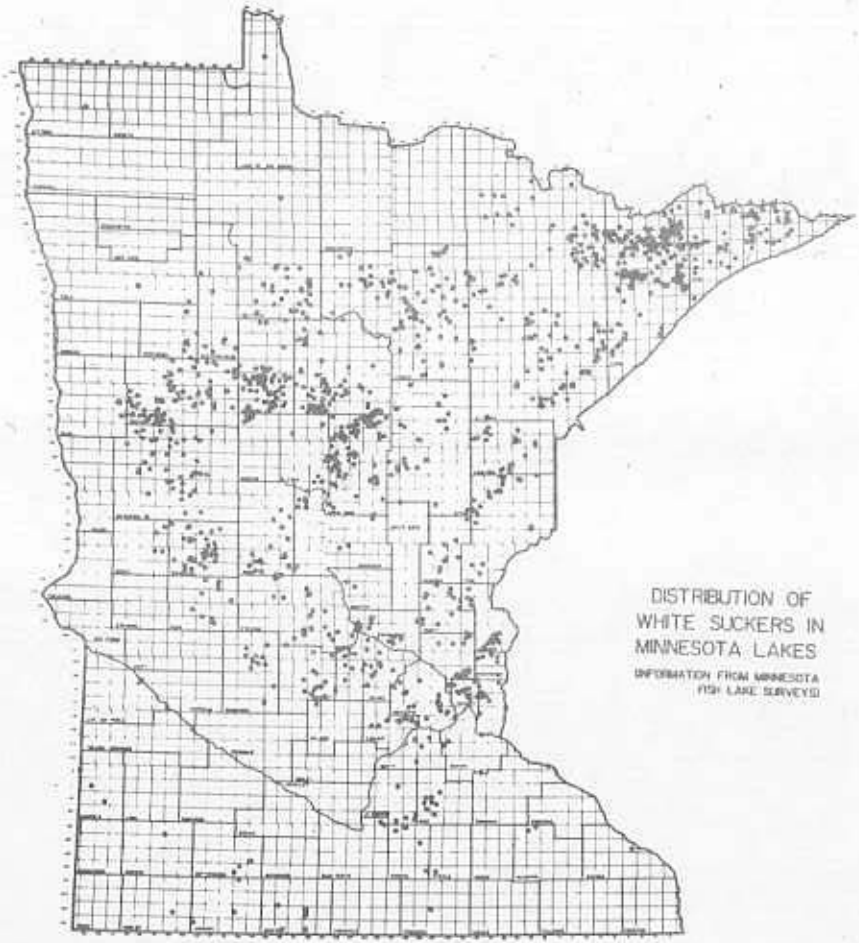

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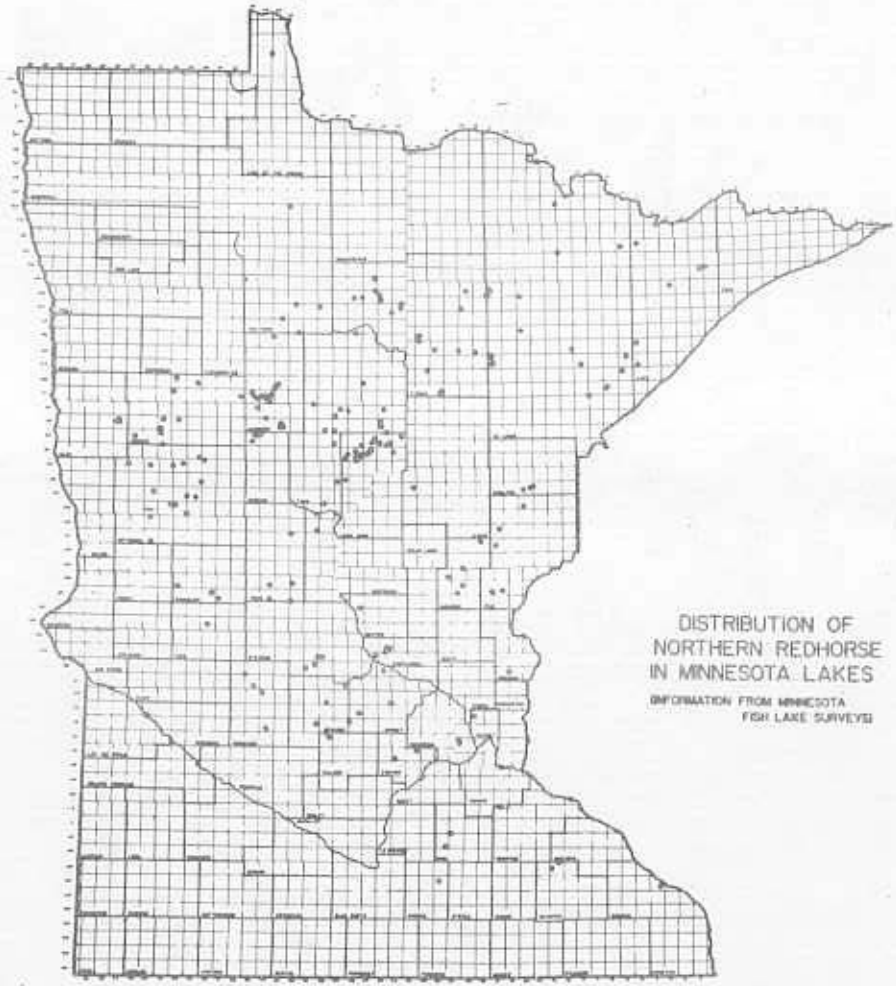

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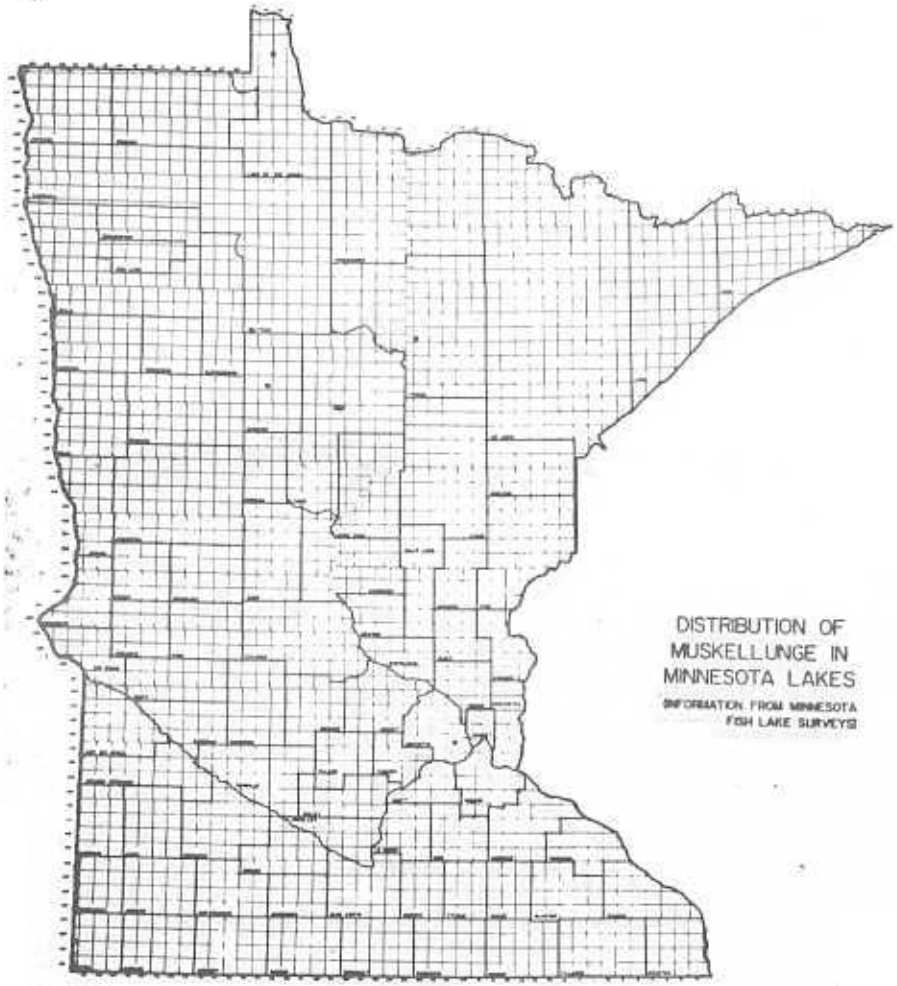

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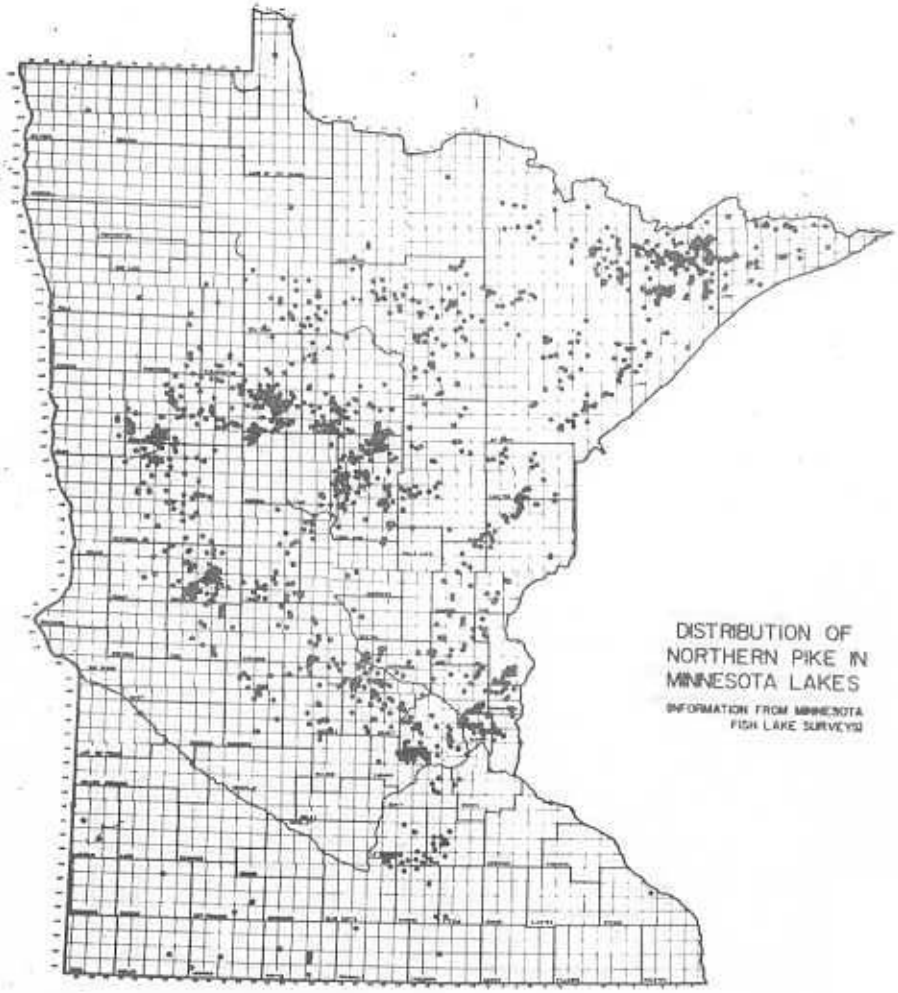

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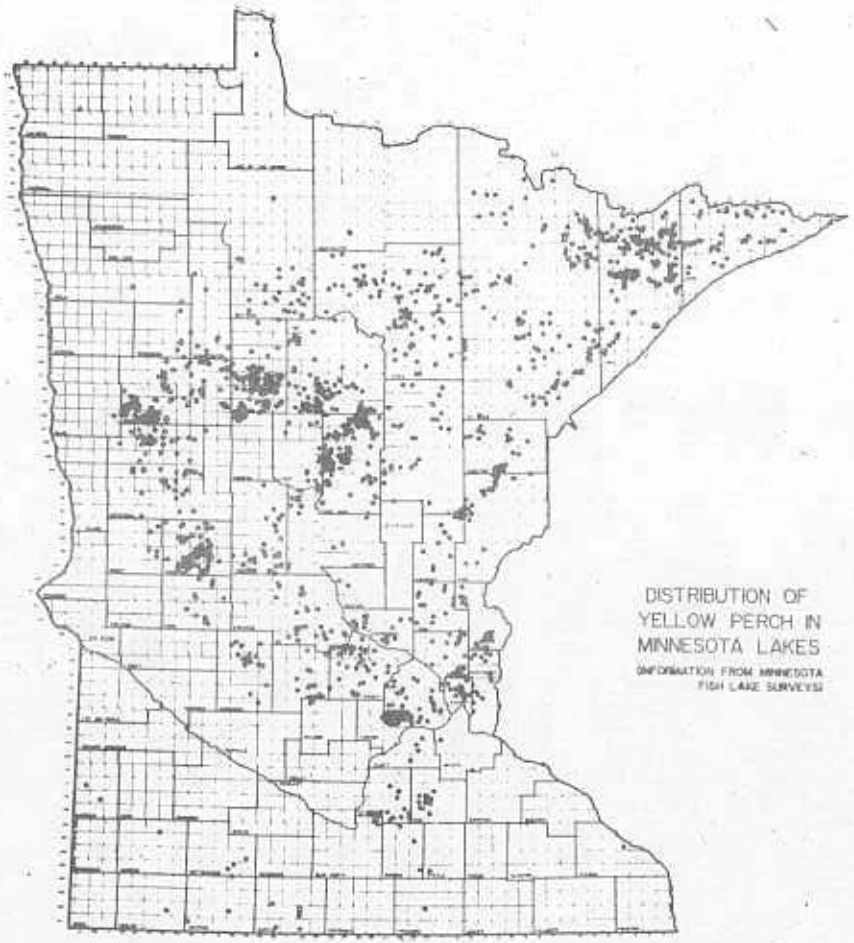

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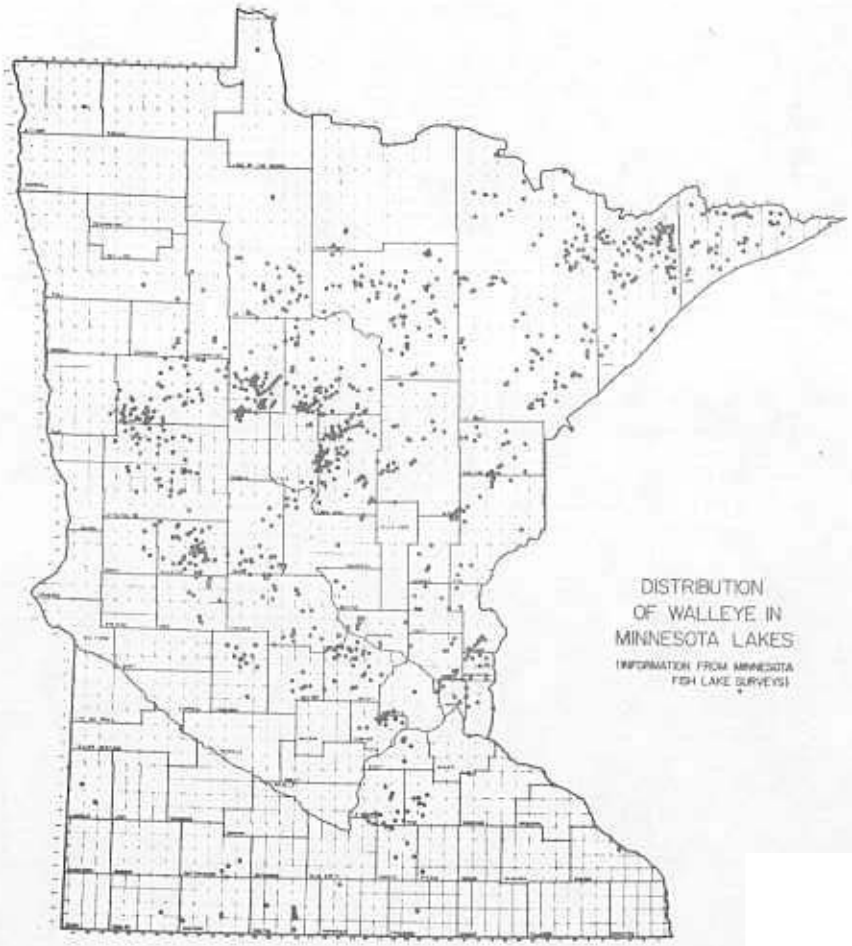

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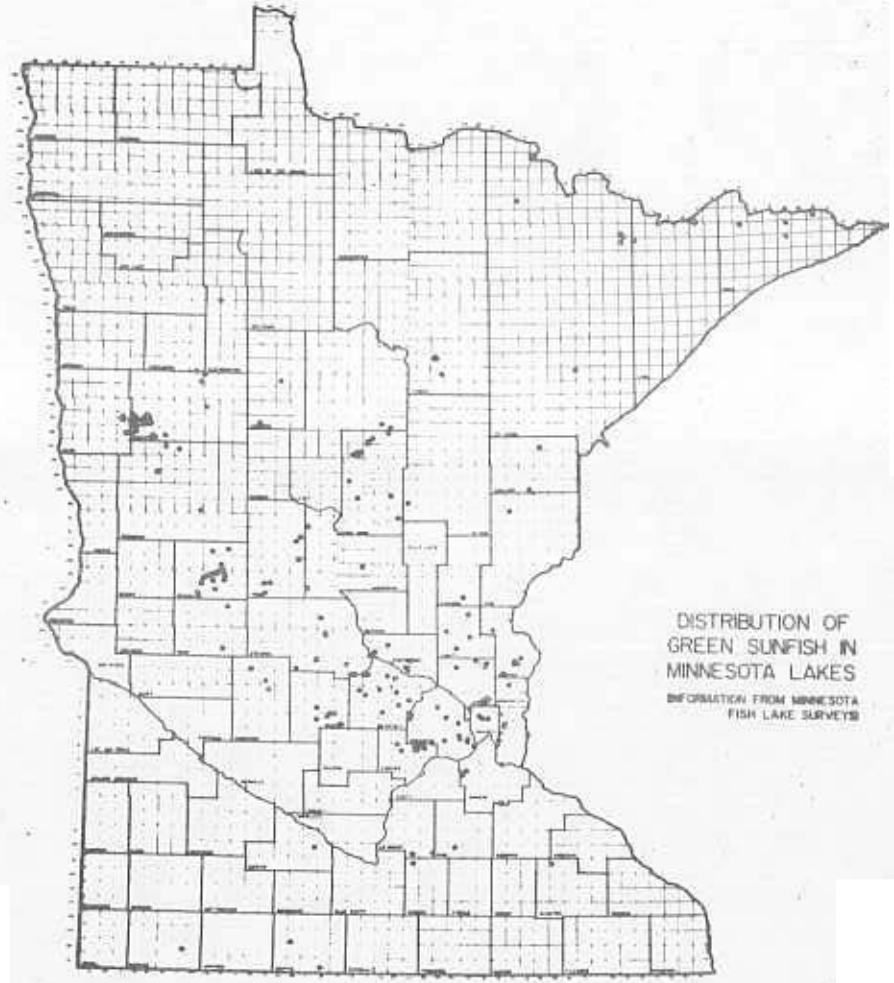

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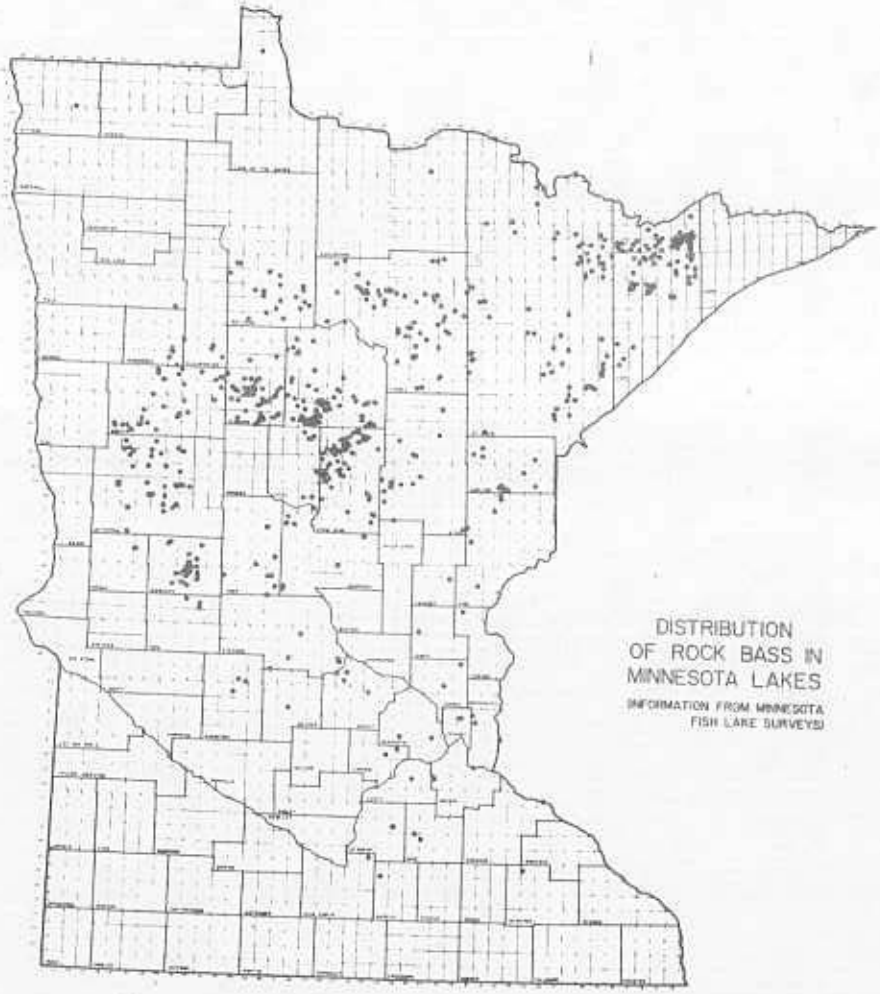

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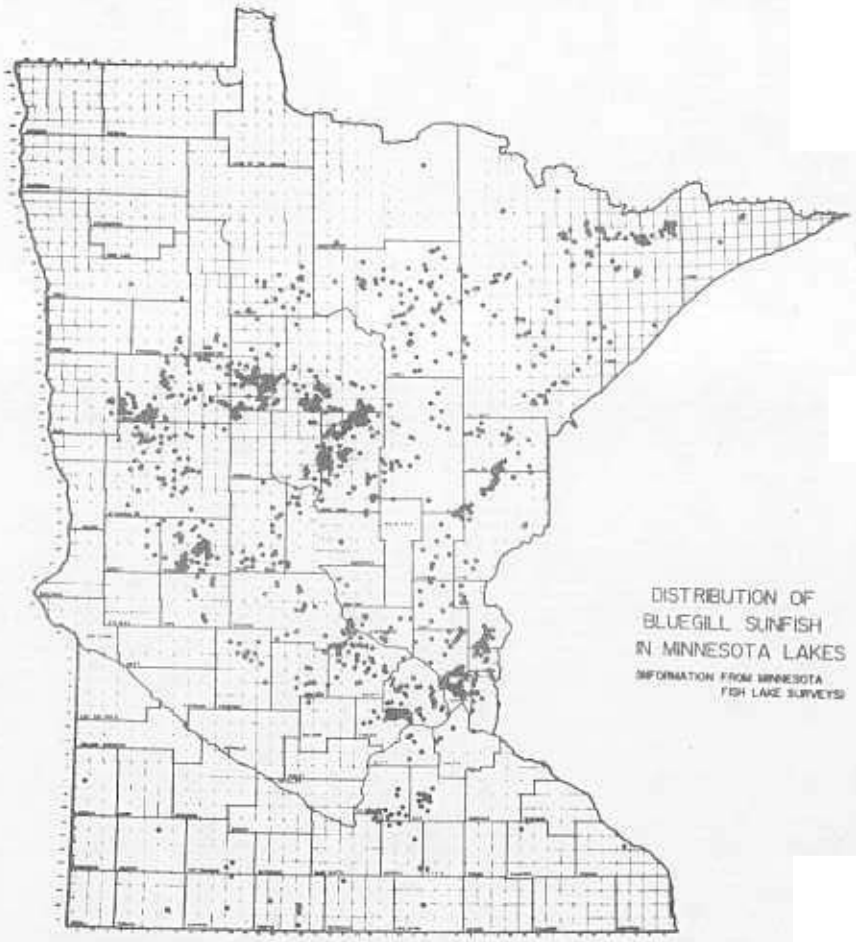

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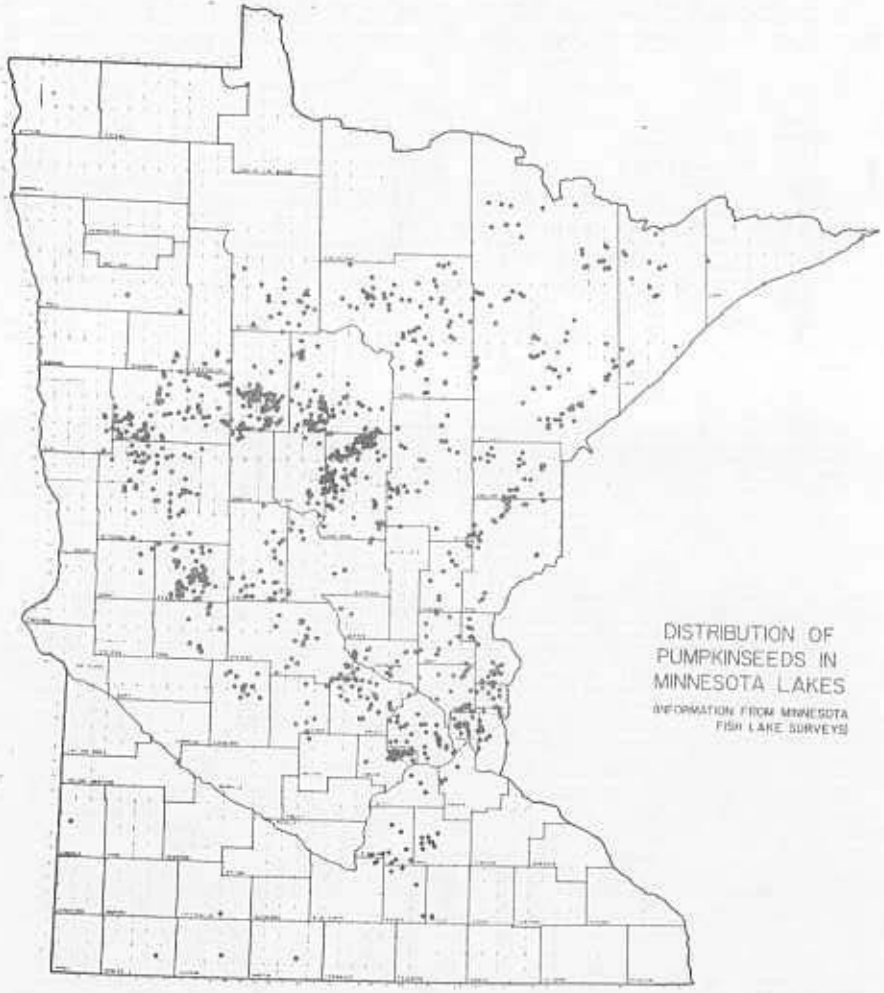

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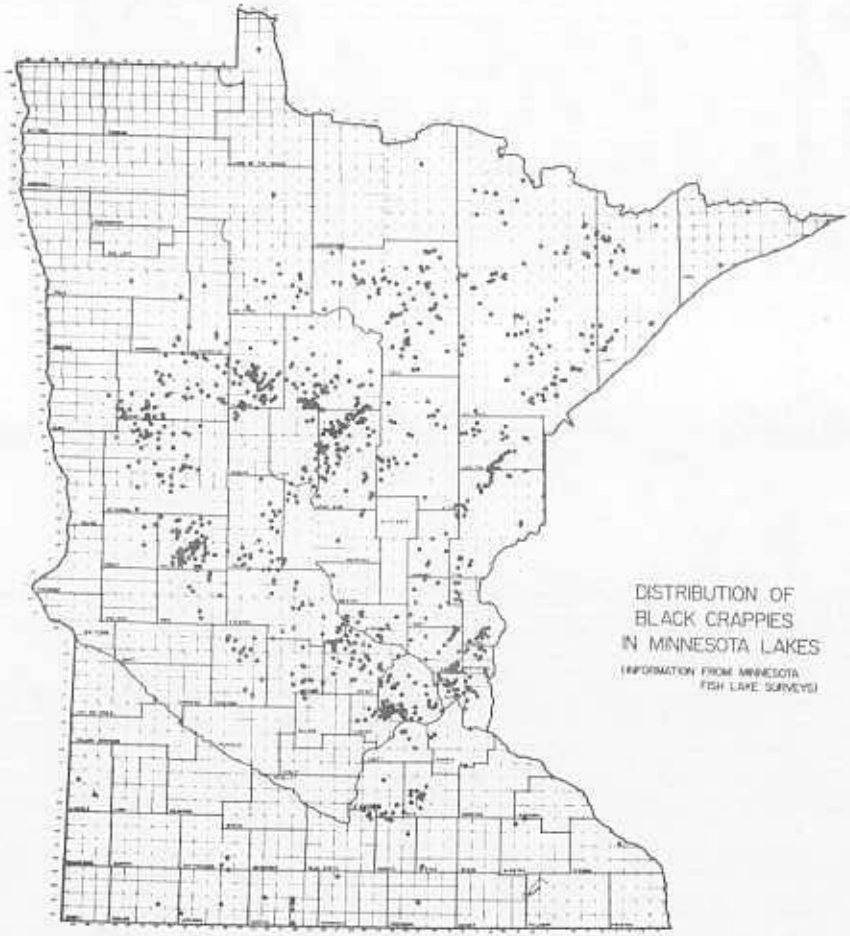

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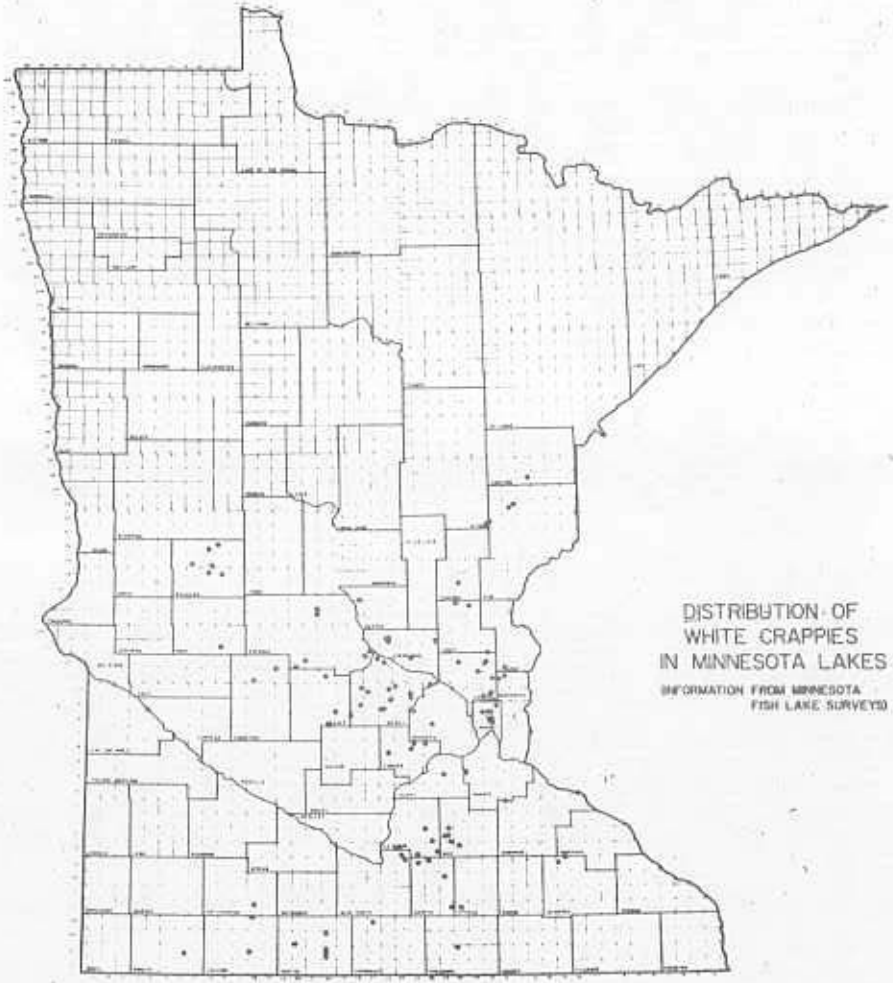

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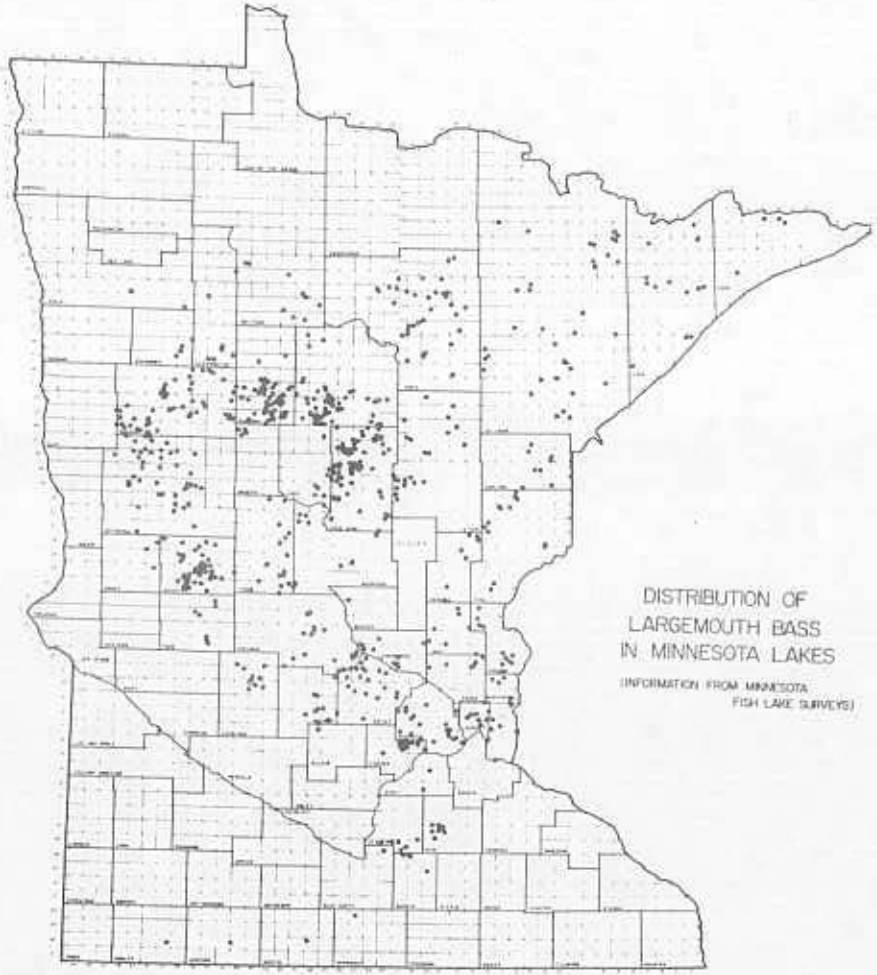

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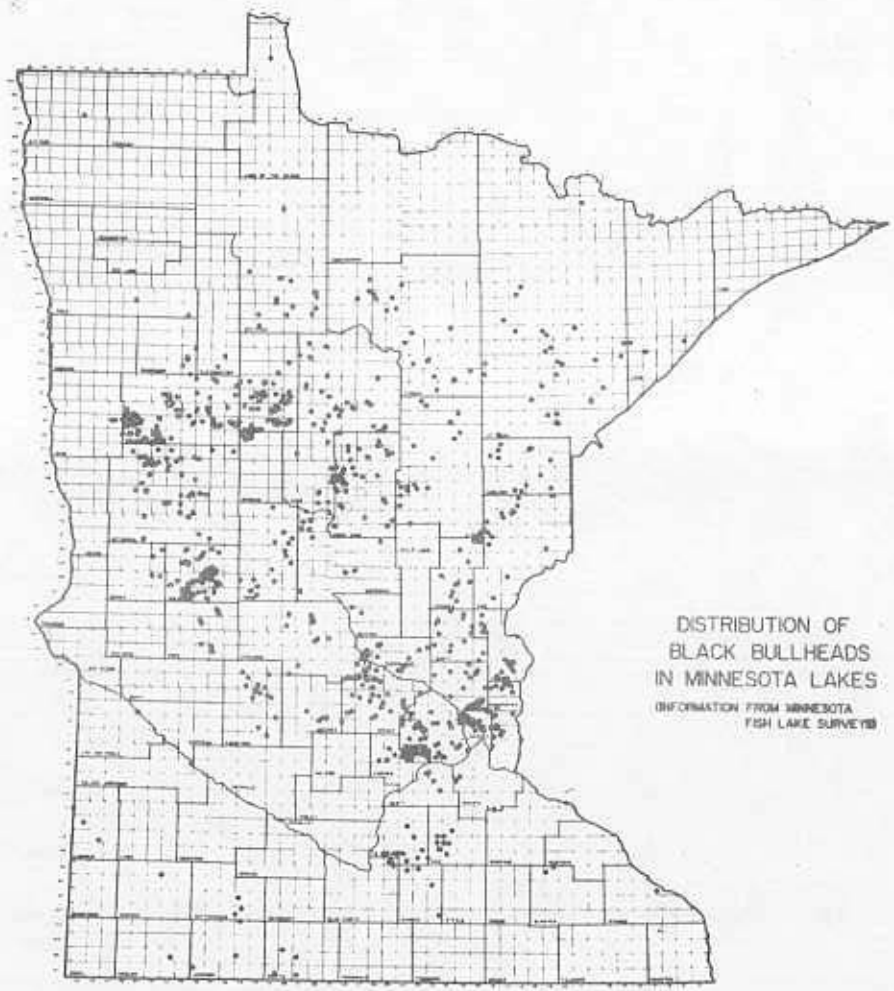

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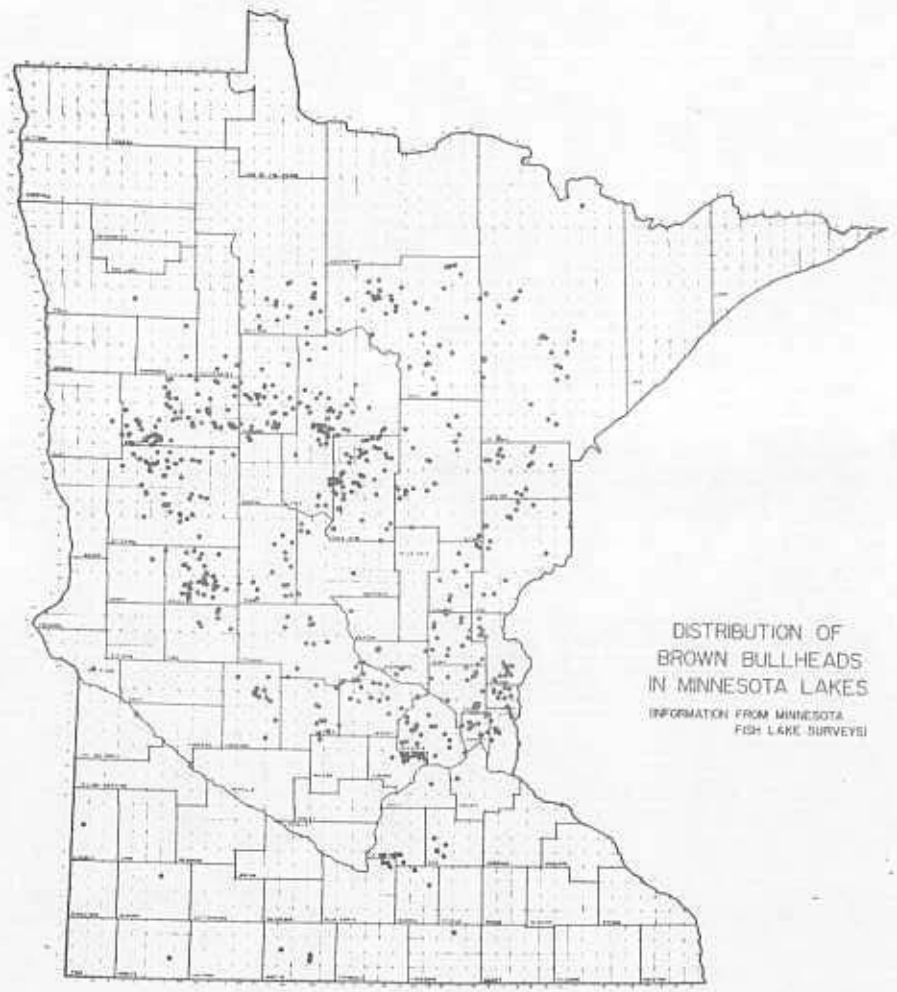

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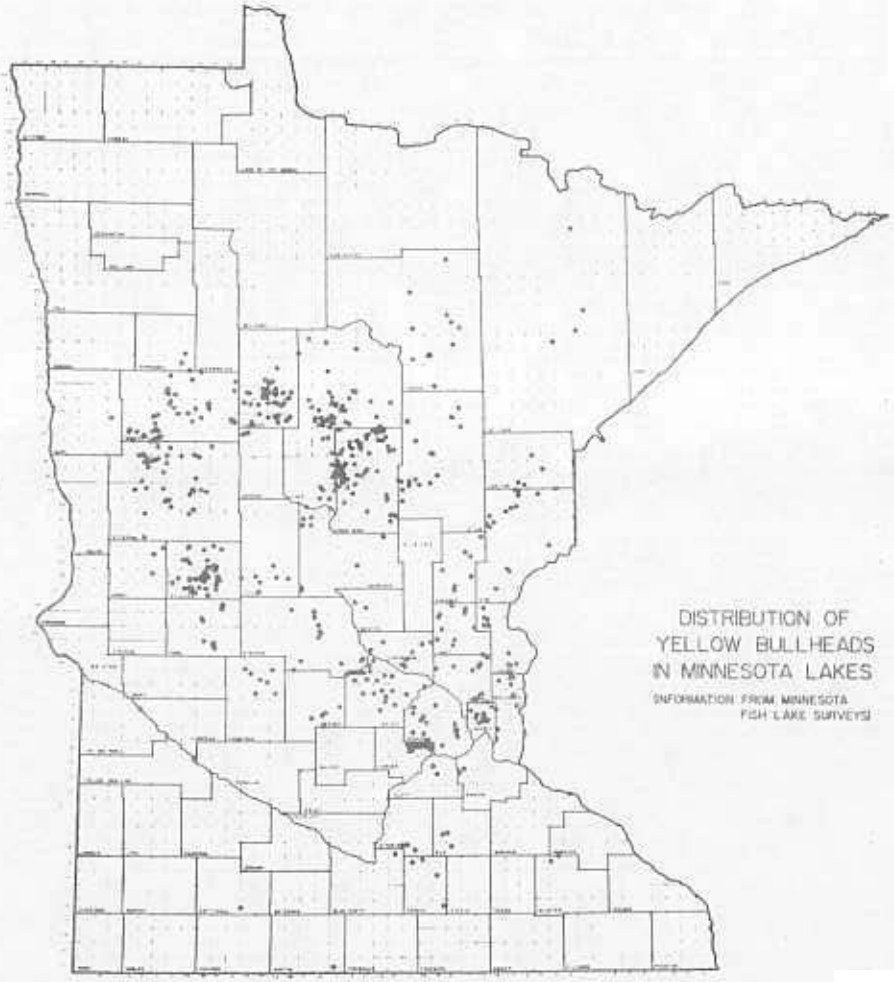

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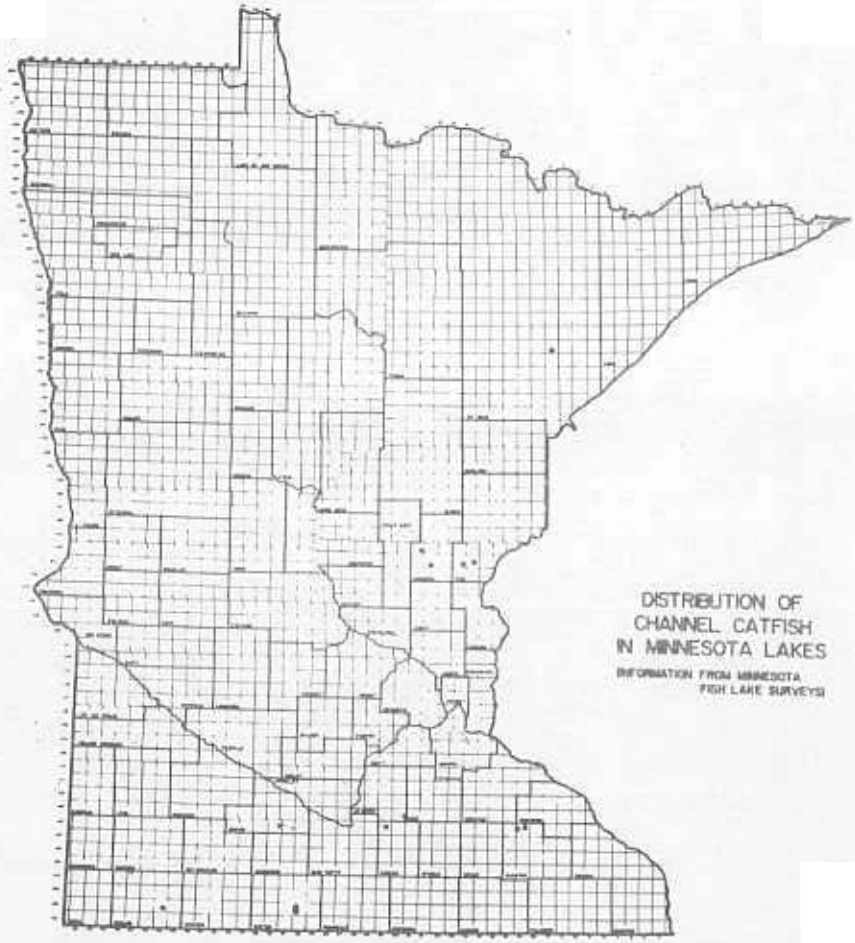

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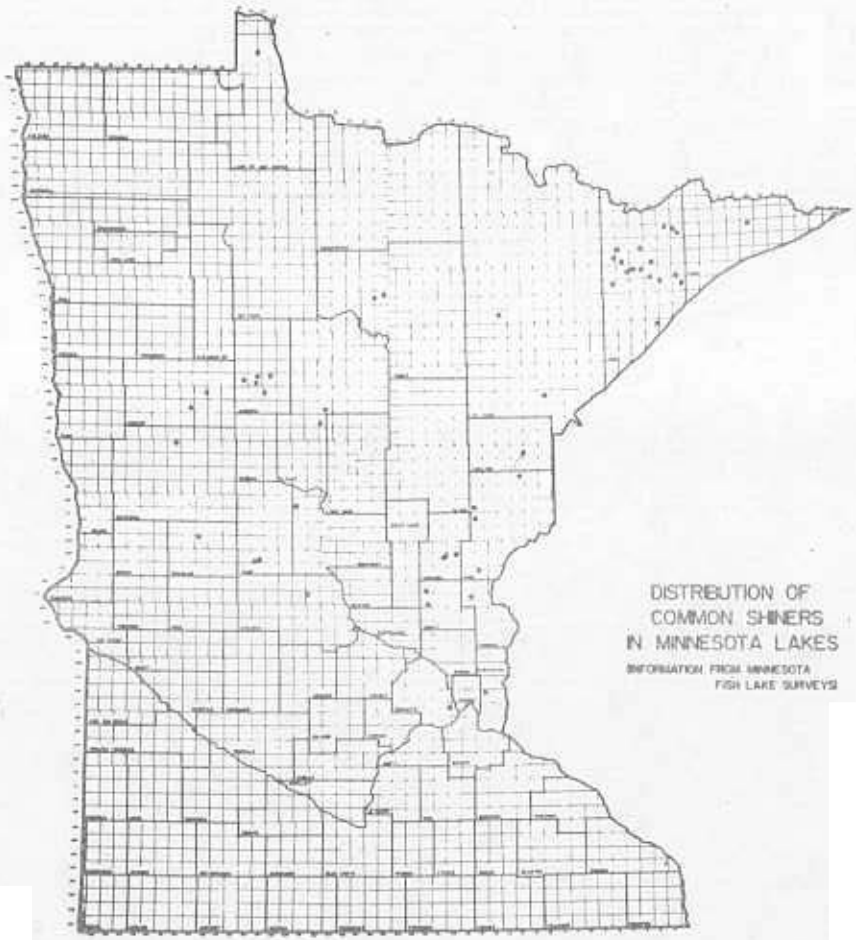

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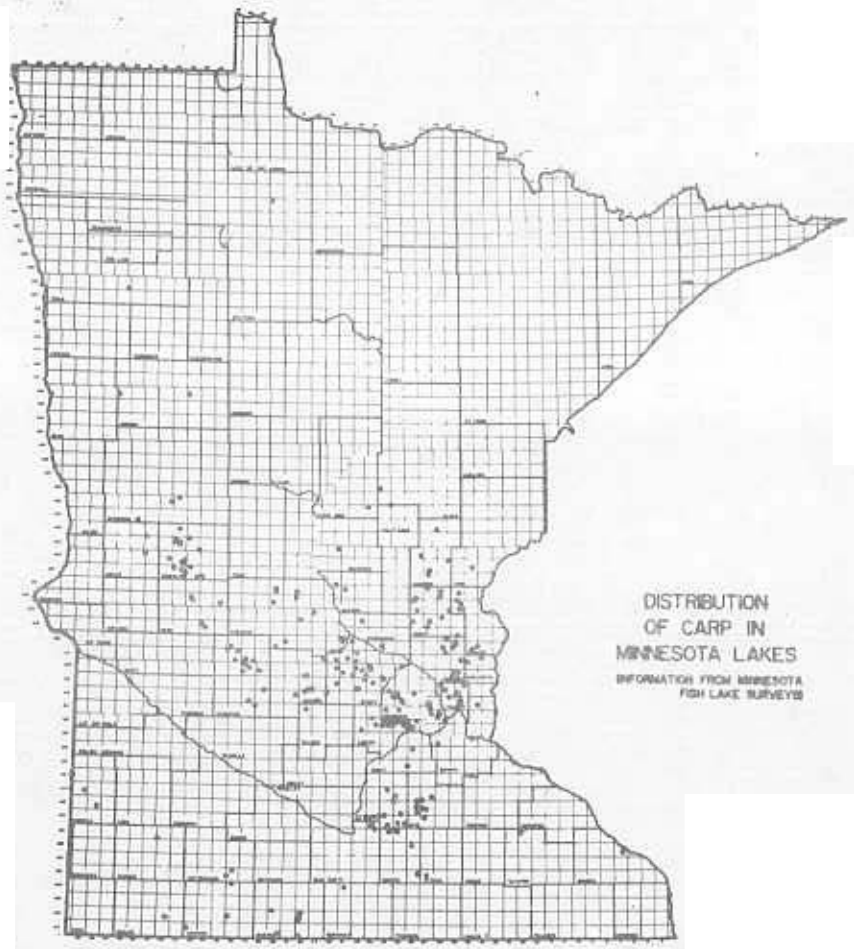

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(Survey dates - 1948 to 1967)

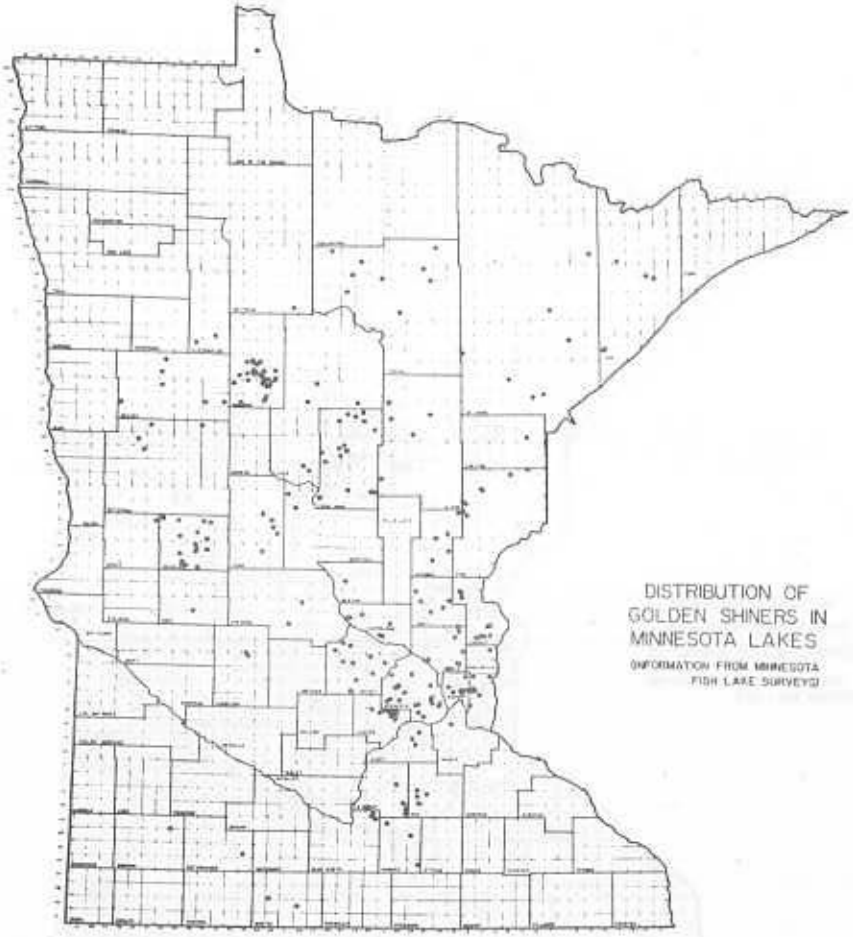

Figure 37.
(Survey dates - 1948 to 1967)

Figure 38.
(Survey dates - 1948 to 1967)

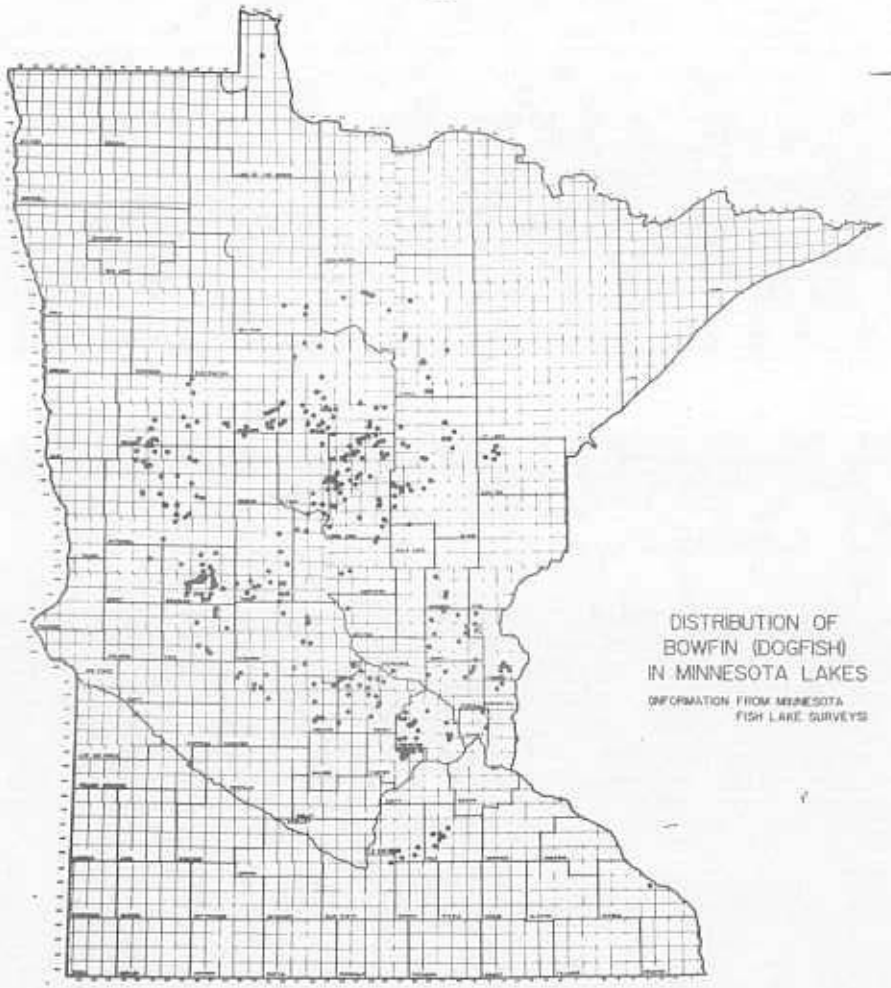

Figure 39.
(Survey dates - 1948 to 1967)

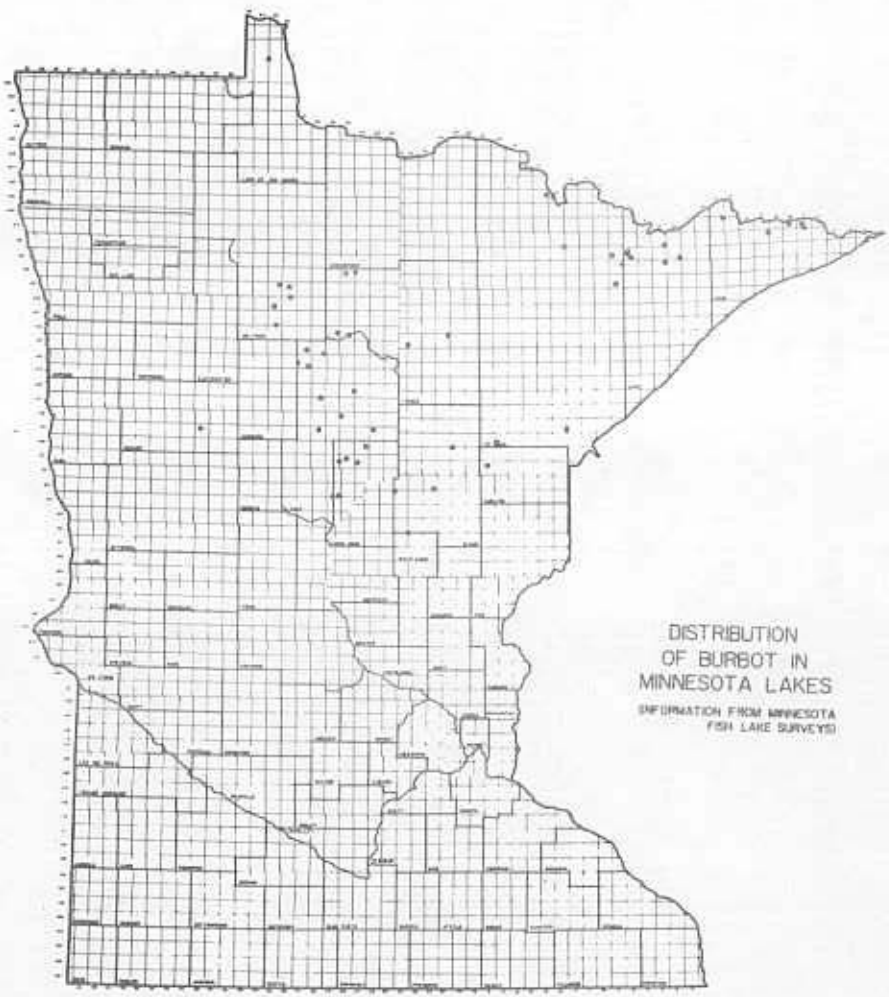

Figure 40.
(Survey dates - 1948 to 1967)

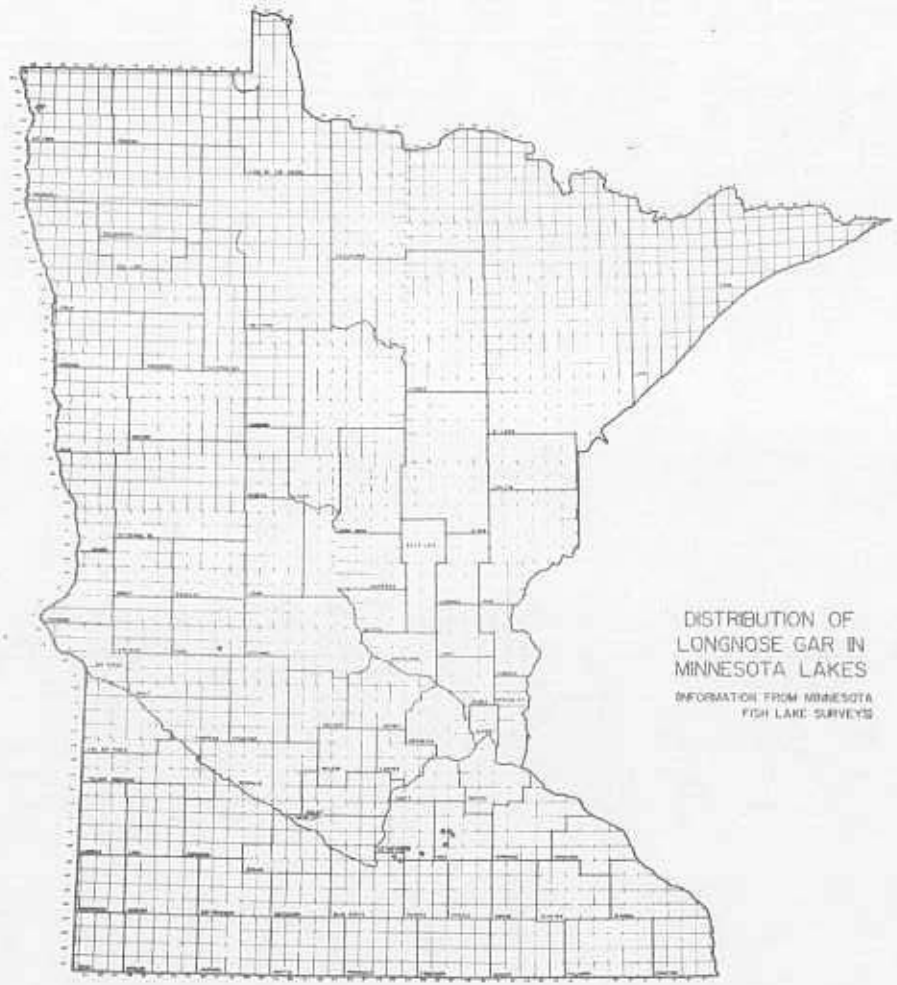

Figure 41.
(Survey dates - 1948 to 1967)

Figure 42.
(Survey dates - 1948 to 1967)

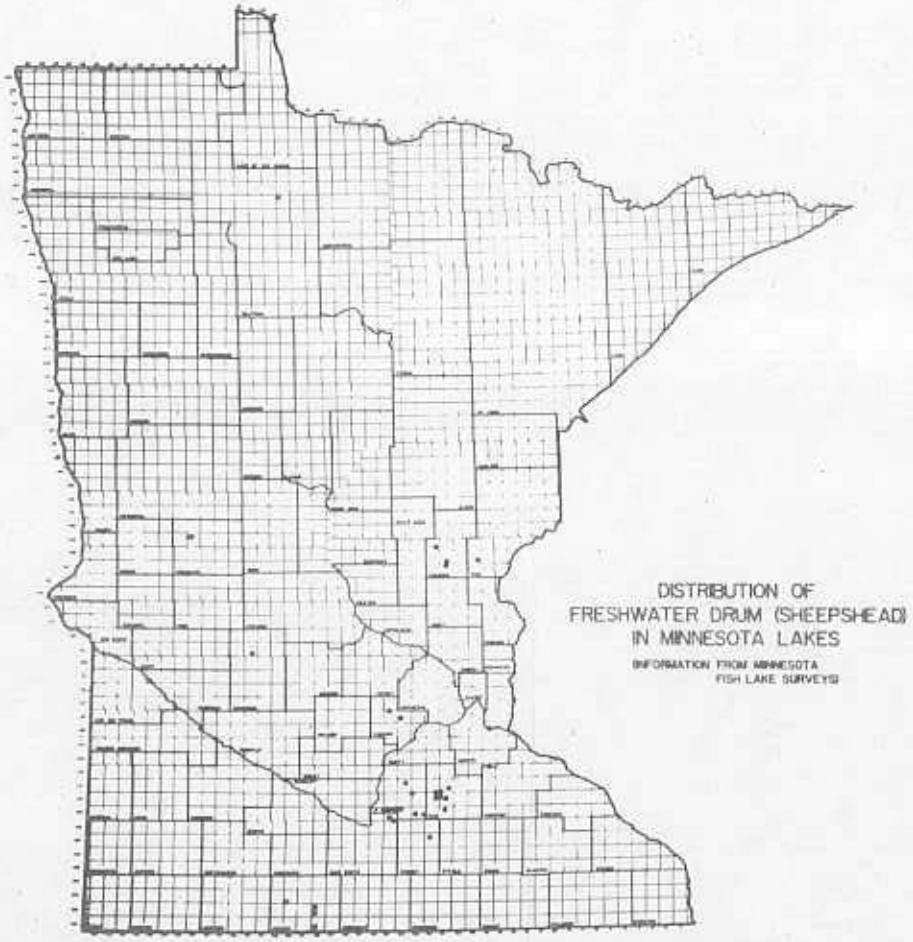

Figure 43.
(Survey dates - 1948 to 1967)