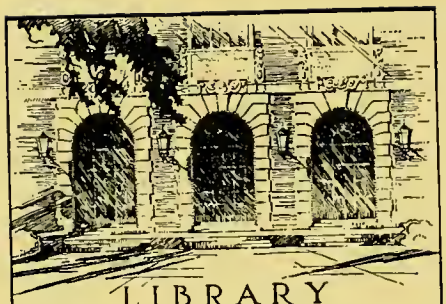

STATE OF ILLINOIS
Dwight H. Green, Governor
DEPARTMENT OF REGISTRATION AND EDUCATION
Frank G. Thompson, Director

LAKE MANAGEMENT REPORTS

5. Winterkill of Fishes in an Illinois Lake

George W. Bennett

Printed by Authority of the State of Illinois

NATURAL HISTORY SURVEY
Harlow B. Mills, Chief

Biological Notes No. 19 Urbana, Illinois January, 1948

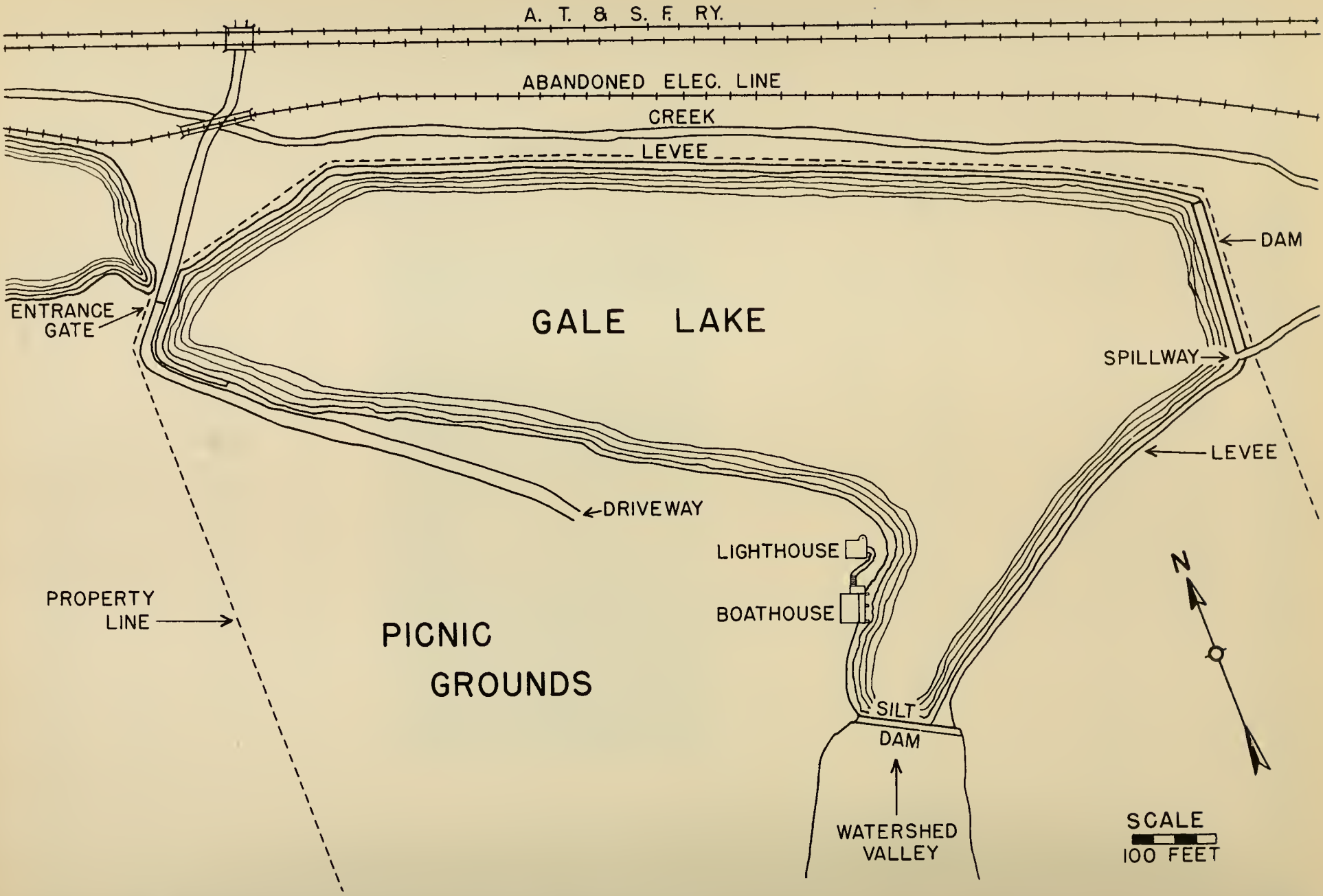

FIG. 1.—Map of Gale Lake area, showing the lake, dam, spillway, lower part of watershed valley, and, at extreme left of map, part of pond from which water once flowed through culverts into Gale Lake. Picnic grounds are on a wooded hill.

5. Winterkill of Fishes in an Illinois Lake

George W. Bennett
Aquatic Biologist

The death of fishes resulting from unfavorable conditions under ice is a common occurrence in several north central states (Greenbank 1945). In Illinois, it occurs with some frequency in the north and central sections when winters are severe and the ice on lakes and ponds is covered with snow for periods longer than about 15 days.

The supply of oxygen for the respiration of fish under ice is often dependent upon the ability of free-floating microscopic plants (phytoplankton) to carry on photosynthetic activity. When light that normally penetrates ice is excluded by a blanket of snow, photosynthesis stops, and such dissolved oxygen as is present in the water is used up by the decay of organic matter and the respiration of aquatic organisms.

According to Greenbank (1945): "Changes in oxygen concentrations, even from week to week, were definitely correlated with changes in the depth of snow on the ice. Measurements of light intensities showed that only a small amount of light penetrates through even a few inches of snow. Unquestionably a foot or more of dry snow transmits too little light to actuate photosynthesis. On the other hand, ice, even though it is cloudy, permits the penetration of considerable light."

Most of the losses of fish occur during winters when snows are heavy and lie unmelted for prolonged periods. In these cases, fish die and sink to the lake bottom, to appear when the ice breaks up and their carcasses decay sufficiently to give them buoyancy.

In other cases, fish have been observed to die during the period immediately following the breakup of the ice. These fish, weakened by adverse conditions under ice, are subject to the attacks of aquatic fungi (Saprolegniales), which reach their maximum abundance in the warming waters of early spring. The mycelia of the fungi grow upon the weakened fish, producing a toxin that causes death. Dying in the fish population usually stops when the water warms up to 60 or 65 degrees F.

More Illinois reports of winterkill and post-thaw deaths of fishes from fungi were received in the spring of 1945 than in any other year since 1938. During the winter of 1944-45 there were two periods of several weeks in duration when ice-covered ponds in the region of central Illinois were observed to be blanketed with snow. This situation was probably more or less general over central and northern Illinois.

In almost every case in which fish are killed by adverse conditions under ice, only a part of the fish population dies; in no case reported in Illinois is there evidence of a complete kill. However, loss of part of a fish population may constitute a greater disaster from the standpoint of future fishing than death of the entire population.

If the loss of fishes were complete, the body of water could be restocked with desirable species during the following spring in order to produce good fishing by the second summer. In the case of a partial kill, the relative abundance of the individual species making up a population is often radically changed; some species may be entirely eliminated and those that survive may be the kinds of fishes least desirable for angling. Once these undesirable fishes spawn, and the young replace the lost population, the body of water may require draining and restocking if it is to produce a crop of hook-and-line fishes. Even in lakes that contain only game and pan fishes, as for example largemouth bass, crappies, bluegills, and bullheads, the elimination of the predatory bass by winterkill will allow the others to overpopulate the lake rapidly, with the result that stunting will eventually ruin fishing.

Early in the summer of 1941, I visited a water-filled gravel pit of about 50 acres, located in Kane County, Illinois, where winterkill of fishes during the winter of 1940-41 was said to have been complete. Hundreds of pounds of largemouth bass, white crappies, bluegills, and bullheads were reported to have been piled along the shores following the melting of the ice. However, at the time of my visit, seine hauls in shallow water took thousands of small bluegills and golden shiners. No adults of these species were taken and probably only a few survived. The fish population then present could not produce good fishing because of the elimination of the largemouth bass. Without bass to hold the bluegills in check, overpopulation and stunting naturally followed. The introduction of several thousand bass fingerlings during the summer of 1941 might have resulted in good fishing in 1942 for both bass and bluegills.

Following the winter of 1944-45, a severe winterkill of fishes was apparent in Gale Lake, near Galesburg, Illinois. About 4,000 pounds of fish carcasses were collected after the ice went out in March. Local observers reported that the fishes consisted of largemouth bass, white crappies, bluegills, green sunfish, black bullheads, carp, buffaloes, and golden shiners. On the basis of the carrying capacity of the lake, it is estimated that about 80 per cent of the population (by weight) had been killed.

In September, 1946, the lake level was lowered and the fish population was censused. This census showed clearly the composition of the population that survived the winter of 1944-45, and the ability of this reduced population to replenish the lake. The species composition of the new population was highly undesirable from the standpoint of angling.

DESCRIPTION OF GALE LAKE

Gale Lake was built by the Chicago, Burlington, and Quincy Railroad Company in 1870-71 to furnish a water supply. This 10-acre lake (map, frontispiece) originally had a maximum depth of about 20 feet, which by 1944 had been reduced to 10 feet by the deposition of silt in a period of over 70 years. As the valley floor is relatively flat, the average depth in the main body of the lake is approximately 9 feet. Runoff water from the land south of the lake enters the lake proper through a south bay a few hundred yards in length. Deposition of silt has made this bay much shallower than the rest of the lake.

According to local information, Gale Lake was built with horse-drawn scrapers; the greater part of two years was required for its completion. A double row of wooden sheet piling was driven into the base of the dam and along the entire north side (parallel to the railroad right-of-way). In several places the ends of the planks are still visible. Riprapping of broken concrete protects the banks from wave action on the east, north, and west shores. Most of the south shore is not riprapped, but shows considerable gravel. Underground seepage of water is in evidence along the south shore below the picnic grounds, where a hill rises above the lake. At the west end of Gale Lake, two 5-foot culverts originally allowed water to enter from a nearby pond fed by overflow from a stream. These culverts have been closed for several years.

In 1945, Gale Products, a division of Outboard, Marine & Manufacturing Company, purchased the lake from the Chicago, Burlington, & Quincy Railroad Company and the surrounding lands from a local estate with the object of developing a recreational area for its employees. Much of the information on winterkill in Gale Lake was obtained by J. F. Furry, manager of Gale Products.

EARLY HISTORY OF THE FISH POPULATION

No stocking records are available for Gale Lake. Local people who fished this lake report that fishing was fairly good previous to 1945, although carp, buffalo, and catfish predominated in the catch. Some of these fishes probably entered the lake from the stream by way of the overflow pond and culverts. Bass, bluegills, and crappies also were taken occasionally.

After the winterkill of 1944-45, fishing is said to have been very poor. It is probable that little fishing was done in Gale Lake because of the opinion of local people that most of the fish had died.

Following the purchase of the lake by Gale Products, plans were laid to renovate the lake for fishing. In March, 1946, a seining crew from Oquawka made two hauls with a 900-foot seine with the object of removing rough fishes. This operation was largely unsuccessful, as the catch consisted of two buffaloes weighing 15 pounds each and a few bullheads and large crappies.

1946 FISH CENSUS

In order to remove the undesirable fishes in Gale Lake it was necessary to lower the water level and poison the entire fish population. Partial draining was accomplished by cutting a trench through the old spillway at the southeast corner of the lake. This trench was screened to prevent the escape of fish. By August 30, 1946, the water level had lowered until not more than 1 foot of water covered about 5 acres of the valley bottom; the movements of many fish could be observed in this shallow water.

Two growing seasons had elapsed since the winterkill of 1945. As fishes respond to artificial or natural thinning of their numbers by increased rates of growth and increased success in spawning and survival of young, it seemed probable that the fish population present in Gale Lake had expanded in both numbers and weight to replace the loss that occurred during the winter of 1944-45. Thus, the population of September, 1946, probably represented the carrying capacity (by weight) of the lake for fishes.

On September 10, 1946, Guy Taylor, Inspector of the Illinois Department of Conservation, with a fish rescue crew, made several seine hauls and removed the following fishes:

Large white crappies	58 weighing	79 pounds
Small white crappies	15,000 weighing	300 pounds
Large black bullheads	1 weighing	1 pound
Small black bullheads	5,000 weighing	100 pounds
Large buffaloes	10 weighing	250 pounds
Small buffaloes	23 weighing	34 pounds
Large carp	7 weighing	77 pounds

The crappies and bullheads were transported alive to other waters.

On September 18, the fishes remaining in Gale Lake were poisoned. As many as possible of the fishes were collected. The large ones were counted and weighed with the assistance of a crew of men supplied by Gale Products. An estimate was made of the poundage of small crappies, green sunfish, bullheads, and golden shiners.

Table 1 shows the 1946 fish population of Gale Lake.

Table 1.--Census of all fishes* in Gale Lake (10.0 acres), Gale Products Recreation Grounds, Galesburg, Illinois, September, 1946.

Kind of Fish		Total Number	Total Weight, Pounds	Average Weight Per Fish, Pounds	Per Cent of Total Weight
			Fine Fish		
White crappie	(large)	76	97.25	1.279	
White crappie	(small)	42,500	752.74	0.018	
Green sunfish	(large)	17	3.75	0.221	
Green sunfish	(small)	4,580	75.12	0.016	
		47,173	928.86		17.6
			Catfish		
Black bullhead	(large)	120	82.75	0.689	
Black bullhead	(small)	48,700	721.48	0.015	
		48,820	804.23		15.3
			Rough Fish		
Carp	(large)	219	1,572.75	7.182	
Carp	(small)	1,331	583.75	0.439	
Buffalo	(large)	31	626.13	20.198	
Buffalo	(small)	424	618.96	1.460	
		2,005	3,401.59		64.5
			Forage Fish		
Golden shiner		8,500	139.77	0.016	
		8,500	139.77		2.6
	Grand total	106,498	5,274.45		
	Per acre	10,646	527.45		

*This census includes the fishes taken by Guy Taylor and those taken after poison had been applied to the lake.

In making the census it was of unusual interest to find that almost without exception each fish species was represented by very large and by comparatively small individuals. Obviously, the large fishes represented those that survived the winterkill of 1944-45, and the small fishes were those spawned during 1945 and 1946. The effect of thinning upon the population surviving the winter of 1944-45 was evidenced by the unusually large sizes of some of the fishes.

As may be seen in table 1, fish of the following species survived the winter of 1944-45; white crappie, green sunfish, black bullhead, carp, buffalo, and golden shiner.

Many thousands of small fishes were in evidence. In the cases of crappies, green sunfish, bullheads, and golden shiners, the number of these small individuals for each species was estimated by the following procedure: (1) for each species, five lots of 100 small fish were weighed in order to obtain a good average weight figure for individuals. (2) The remaining fishes that had been collected were separated according to species and weighed in lots of 25 to 30 pounds; the number of individuals in each lot was calculated on the basis of the average weight figures obtained from (1). (3) Visual estimates of the numbers that could not be reached by boat were made for each species, and corresponding weight was calculated by use of the average weight. Thus, the total numbers and total weights of these four species are approximations.

At least 76 white crappies survived the winter of 1944-45. They averaged 1.3 pounds each in 1946 and varied in weight from 0.75 to 1.5 pounds. These crappies were not exceptionally large but may be considered to have grown rapidly after the winterkill if, previous to 1945, they were of average weight for white crappies in most artificial lakes (less than 0.5 pound each). The 42,500 small white crappies varied in length from 2.8 to 3.2 inches and were spawned probably in the spring of 1945.

Only 17 green sunfish were believed to represent the survival by this species of the winter of 1944-45. These were quite uniform in size and averaged less than 0.25 pound each. The spawn of 1945 was estimated at 4,580 individuals averaging 1.9 inches in length and 0.016 pound each in weight.

No largemouth bass were taken in the census, and only one bluegill, weighing approximately 0.25 pound, was collected.

One hundred twenty large black bullheads were collected, averaging .069 pound each. These varied in weight from 0.5 to 1.0 pound. Their young were even more numerous than those of the white crappies and were estimated at 48,700. These little bullheads averaged 2.8 inches in length and few of them varied more than one-fourth inch from the average.

The carp population consisted of 219 large fish, which ranged in weight from 4 to 15 pounds (average weight, 7.18 pounds) and 1,331 small fish averaging 0.44 pound each. The small carp were spawned probably in 1945.

Thirty-one large buffaloes were taken. These were of two species, the redmouth buffalo, *Megastomatobus cyprinella* (Valenciennes), and the mongrel or black buffalo, *Ictiobus niger* (Rafinesque). Only five black buffaloes were observed by the author; buffaloes were not identified as to species in the seining preceding the poisoning. Some of the buffaloes were extremely large -- 11 fish ranged from 25 to 40 pounds in weight; the smallest fish in the group that survived the winterkill of 1944-45 weighed 10.5 pounds.

Four hundred twenty-four small buffaloes were collected and all were redmouths. These fish were relatively uniform in size and most of them weighed between 1.4 and 2.0 pounds each. There was no evidence of a successful buffalo spawn in 1946.

Approximately 8,500 golden shiners were taken in the census; these were all relatively small, averaging 3.0 inches in length. No large adult shiners, such as are occasionally found in artificial lakes, were seen. It is possible that adults survived the winterkill of 1944-45 but died following the 1945 spawning season. Otherwise, it is impossible to account for the large number of young shiners.

DISCUSSION

The fish population of Gale Lake as shown by the 1946 census clearly illustrated a number of points associated with winterkill of fishes:

(1) Under winterkill conditions, the mortality rate of fishes may be high, but usually it is not 100 per cent; that is, while the bulk of the fish population in a lake may die as a result of oxygen deficiencies under ice, a few fishes usually manage to survive.

(2) It is impossible to predict the survival of fishes under winterkill conditions. As is well known, some species are more tolerant of low oxygen tensions than others. Although, as a general rule, those that are most tolerant are most likely to survive, survival rate is not always proportional to tolerance. Apparently, unfavorable conditions are not uniform throughout a body of water, and it is possible that, where fishes are concentrated in some localized areas, all of them may die, while scattered individuals away from these concentrations may survive.

(3) No matter what kinds and numbers of fishes survive a partial winterkill, the replacement population (after the survivors have spawned) is radically different, in relative numbers of individual species, from the population just previous to the winterkill. This change is usually unfavorable for angling.

(4) The survival of spawn is high in the fish population thinned by winterkill, with the result that, after approximately one spawn and one growing season, the lake again supports a fish population equal in total weight to the carrying capacity of the water.

SUMMARY

Gale Lake, at one time a railroad water supply reservoir of 10 acres, was subjected to oxygen deficiencies below the ice in the winter of 1944-45. As a result 4,000 pounds of dead fish were collected after the ice went out in March. Species represented were largemouth bass, white crappie, bluegill, green sunfish, carp, buffalo, bullhead, and golden shiner.

Eighteen months later, when the lake was censused, it contained 5,275 pounds of fish (527.45 pounds per acre). The population was made up of a relatively small number of large fishes that survived the winter of 1944-45 and a very large number of small fishes representing the spawn of 1945. No largemouth bass were collected in the census and only one bluegill was taken. Other species present were white crappie, green sunfish, carp, buffalo, bullhead, and golden shiner. The lake had furnished practically no fishing since the winterkill of 1944-45, although the weight of the fish population at the time of the census was estimated to equal the carrying capacity of the water.

LITERATURE CITED

Greenbank, John 1945. Limnological conditions in ice-covered lakes, especially as related to winter-kill of fish. Ecol. Mono. 15(4):343-92. 34 figs., bibliog.