Cox Hollow Lake : the first eight years of impoundment. Report 47 1969

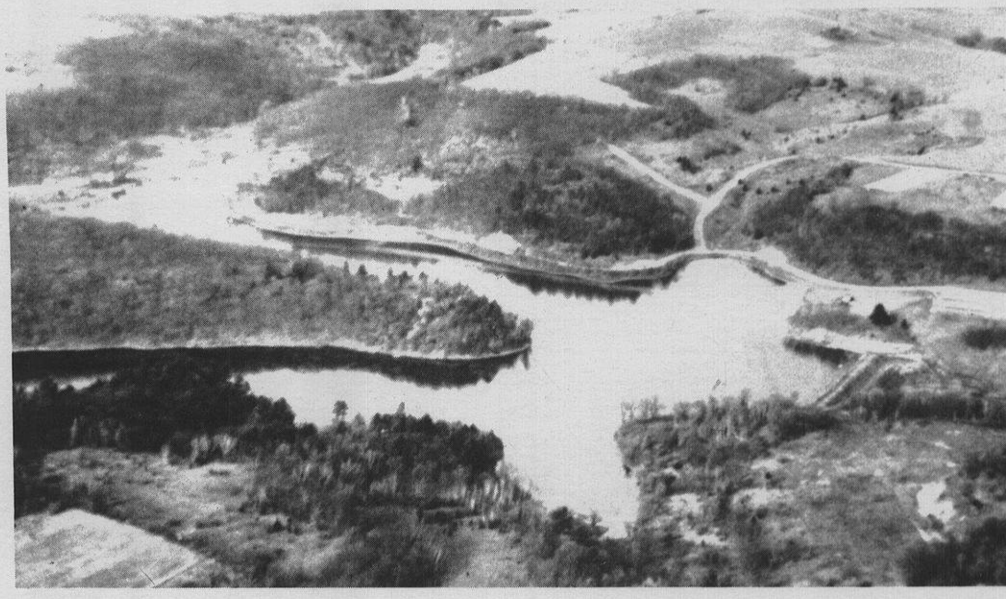
Dunst, Russell C.
Madison, Wisconsin: Dept. of Natural Resources, 1969

https://digital.library.wisc.edu/1711.dl/XCLDTTYGCFPX28M

RESEARCH REPORT 47

COX HOLLOW LAKE

THE FIRST EIGHT YEARS OF IMPOUNDMENT



By
Russell C. Dunst

Department of Natural Resources

Madison, Wis.

1969

ABSTRACT

Development of the fishery was studied from 1958 to 1966 in Cox Hollow Lake, a new impoundment in southwestern Wisconsin. The 3 main species of fish -- bluegill, largemouth bass and northern pike -- showed initial rapid population expansion and superior growth, followed by a tremendous decline in both population size and growth. By the end of the study, few game fish were being caught and 90 percent of the bluegills taken were less than 6.0 inches long.

Water quality analyses indicate that: (1) although summer surface temperatures rise regularly into the mid 80's with a record high of 89F, these temperatures do not adversely affect the fish population; (2) due to low dissolved oxygen concentrations, 40 percent of the potential habitat has been of little value to the fish during the summer, and winterkill was a danger in several years; and (3) the impoundment has a high productivity level for plants as well as fish -- phytoplankton scums appear periodically on the surface and dense aquatic vegetation extends from the shore out to a depth of 8-10 ft.

In general, there has been a sizeable decline in fishing pressure, and the recreational quality of the impoundment has greatly diminished. New management techniques are needed to rectify conditions in Cox Hollow Lake and to prevent similar deterioration of other impoundments.

1300-11

ACKNOWLEDGMENTS

It would be impossible to name everyone who has contributed to this study. Those who have exerted an especially great effort in collecting and tabulating information are Clifford Brynildson, John Truog, and Gerald Lowry. In addition, Thomas Wirth has given much helpful advice in preparation of the manuscript.

The author is a fishery biologist with the Bureau of Research, Madison.
Edited by Joyce A. Jais and Susan Hickey.

CONTENTS

The Cox Hollow Lake basin before construction of the dike which is shown by the dotted line. When flooded, the North arm of the lake will extend to the left and the South arm will extend to the lower right. The impoundment will be drained by a spillway into the downstream channel which extends above the dike in the center of the picture.

Cox Hollow Lake approximately one-half full, with a portion of the dike in the lower left, the South arm extending into the upper left and the North arm of the lake extending across to the right.

INTRODUCTION

Multi-purpose impoundments have become an extremely important consideration in regard to our water resources management program. The popularity of impoundments has been especially evident in southwestern Wisconsin. The region has only a few natural lakes, and impoundments have provided recreation for a multitude of people. Although the fertility of the region causes these impoundments to become highly eutrophic with management problems in water quality and fish production, public support for additional impoundments has been overwhelming and the number of impoundments in the region has been rapidly increasing.

The recreational value of these impoundments has definitely needed improvement. In 1958, a project was begun to study the development of the fishery in a new impoundment, Cox Hollow Lake. The emphasis was on fish growth, population size, and angler success; however, much information was collected concerning water quality.

Following completion of this project, research was begun to test potential methods of improving the water quality and fish population. Continuous artificial circulation began on July 1, 1966. This report will describe the physical, chemical, and biological conditions in Cox Hollow Lake prior to the artificial circulation project.

DESCRIPTION OF THE STUDY AREA

Cox Hollow Lake is located in Governor Dodge State Park, Iowa County, Wisconsin. An earthen dike was built at the junction of two valleys so the impoundment is horseshoe shaped. The basin began filling in early 1958 and was completely flooded by the spring of 1959. The impoundment has a surface of 96 acres and a maximum depth of 29 ft. The basin holds nearly 1,200 acre-feet of water. The impoundment was created primarily for recreation, but flood control has been an important benefit. Most of the surrounding land is forested and is used for picnicking, hiking, and camping. The impoundment itself is heavily used for fishing, swimming, and boating; outboard motors are not permitted.

The impoundment has a drainage area of 6.19 square miles. All of the geologic formations in this area contain water. Galena dolomite, Platteville limestone, and St. Peter sandstone all yield relatively small amounts of hard water with a high mineral content (Klingelhoets, 1962). The impoundment receives water from 6 streams. During low discharge periods the total flow amounts to only about 1 cfs, but flash flooding is a common occurrence.

The soil fertility is very high in the drainage area. The upper reaches are not in the park and the rich silt loam is heavily used for pasture and the growing of grain crops, particularly corn. Within the park land immediately surrounding the streams, as well as almost the entire impoundment basin, is composed of silt loam and loamy alluvial soils. These soils have a moderate to high fertility and a high organic content. Steep, rocky land with a 25 to 60 percent slope surrounds the impoundment and most of the land adjacent to the streams (Klingelhoets, 1962). The average rainfall for this region is 32 inches per year and runoff is very rapid; siltation, flooding, and severe erosion are serious problems within the entire drainage area (Iowa County Soil Conservation District, 1961).

Two means of water discharge were provided for when the dike was constructed. A surface spillway allows continuous discharge of water into the downstream channel; however, there is also a bottom drain which could be used to empty the impoundment. The discharge eventually enters the Wisconsin River via Mill Creek at Tower Hill State Park.

The earthen dike and the concrete spillway. The arrow indicates the rectangular notch which allows for the continuous discharge of water.

FISH PRODUCTION AND HARVEST

Methods

In 1958 Cox Hollow Lake was stocked with 22 pairs of adult northern pike and 16 pairs of adult largemouth bass. Although not initially stocked, white suckers, black bullheads, and bluegills are now also present. The lake was opened to fishing on June 1, 1960 and harvest information was collected from that date through the end of the study in 1966.

Using fyke nets and electrofishing gear, population estimates were made every spring since 1959 by the mark and recapture method. The estimates were computed with the modified Peterson (M(C+1)/R+1) and the modified Schnabel ($E(C_tM_t)/R+1$) formulae as described by Ricker (1958). Unfortunately the smaller fish for each species could not be caught in sufficient numbers to be included in the estimates.

The average length for each age group was determined in several years for the three primary fish species. Scale samples were collected by fyke netting (northern pike), electrofishing (largemouth bass and bluegills), and angling (all three species). The annuli were counted with the use of a scale projector and a dissecting microscope. The average length of a particular age group was calculated by averaging the lengths of all fish determined to belong to that age group.

Harvest information was compiled by means of a mandatory free-fishing permit system. Self-registration was required of all fishermen at the beginning and end of every fishing day. A clerk was on duty at a checking station at irregular intervals. The data were tabulated on the basis of an April through March fishing season.

Production

The development of the fish population in Cox Hollow Lake can be separated into two periods. As shown in Table 1, the population of each species expanded greatly in the first few years after introduction. Reproductive success was tremendous. Unfortunately the expansion period was followed by several years of steady population decline.

The number of northern pike has dropped continually since 1961. With the last year class being produced in 1962, the species may be expected to disappear from the impoundment in the future. Adult fish do mature in the impoundment, so assuming that spawning does occur, a mortality must take place after the eggs are emitted from the female. It is improbable that a near total mortality could result from egg and fry predation by bluegills or by any other fish species. The only obvious change in the spawning area has been a large-scale increase in aquatic vegetation dominated by Ceratophyllum demersum; however, there is no proof of any connection between this increase in vegetation and the lack of young fish.

The largemouth bass population, despite annual reproduction, has also been decreasing, although a slight increase did occur in 1966. Part of the decline in numbers has been due to the continued growth of the older bass in the population. As these fish increase in size, their food requirements become greater. Assuming that the food supply in the impoundment has not changed significantly and that one 20-inch bass (6 lb.) exerts the same pressure on the food supply as 300 4-inch bass (0.02 lb. each), population numbers should have decreased simply on the basis of increased size of older fish. However, the magnitude of the decrease indicates that some other, unknown factor has been involved. Although much reduced, the population should eventually become relatively stable as a result of the continued annual reproduction and recruitment.

TABLE 1

Fish Population Estimates, Cox Hollow Lake*

Year	Species: Northern Pike	Bluegill	Largemouth Bass
1960	3,015 (22)	--	779 (39)
1961	4,040 (10)	--	6,724 (53)
1962	1,361 (7)	--**	20,103 (72)
1963	895 (48)	104,562 (45)	12,975 (4)
1964	511 (180)	129,833 (355)	3,805 (24)
1965	278 (66)	519,990 (7)	3,332 (15)
1966	156 (122)	279,142 (113)	4,210 (23)

* The modified Schnabel formula was used for computing the northern pike estimates. The modified Peterson formula was used for the largemouth bass and bluegill estimates. The number in parenthesis equals the number of recaptures.

** Although a spring estimate was not made, an estimate in July showed the presence of 214,558 bluegills, ages 0 and 1.

The slight increase in 1966 indicates that the population may have approached this state of balance.

The bluegill was a late introduction into the impoundment. Age determinations made in July, 1962 indicated that bluegills were planted in 1961 before the spawning period.* Despite large populations of northern pike and largemouth bass, and assumed heavy predation, the bluegill population expanded rapidly until 1965. Based on the 1966 estimate it appears that the population has begun to decrease. Reproduction and recruitment has continued and future bluegill population dynamics are expected to be similar to that of the largemouth bass population.

According to Bennett (1962), "Fish often grow rapidly and reach exceptionally large sizes when first introduced into new waters. This

* Fifteen adult bluegills were also caught by anglers during the summer of 1961.

superior growth is largely due to an abundance of food, space and possibly an absence of parasites and other biological forces which may slow down the rate of growth in waters where these fish have been present for some years." Apparently this is what has occurred in Cox Hollow Lake. Initially high growth has been followed by poor growth in all fish species (Table 2,3 and 4). Assuming a constant level of food supply for each species in the impoundment, high initial growth would occur due to low populations. As the population increases, growth should decrease; this also has occurred in Cox Hollow Lake. However, increased growth should then accompany any decrease in population, and

TABLE 2

Average Size in Inches of Northern Pike, Cox Hollow Lake*

	Year				
Age Group	1960	1961	1962	1964	1966
Age I					
Fyke Netting**	--	--	--	--	--
Angler Caught	17.9 (27)	15.6 (587)	15.8 (164)	--	--
Age II					
Fyke Netting	--	--	--	18.4 (12)	17.6 (1)
Angler Caught	24.3 (28)	17.5 (43)	18.6 (79)	--	--
Age III					
Fyke Netting		--	--	20.3 (22)	--
Angler Caught		22.1 (5)	20.4 (7)	--	--
Age IV					
Fyke Netting				24.9 (7)	22.0 (33)
Angler Caught				--	--
Age V					
Fyke Netting				25.8 (3)	23.2 (80)
Angler Caught				--	--
Age VI					
Fyke Netting					24.7 (10)
Angler Caught					--

* The data are comparable only between years using the same techniques, not between techniques. Each technique introduces a certain bias to the data and was used only during a particular time period.

** The fyke net samples were taken in April; the angler-caught samples include April through June. The number of fish included in each average length is enclosed in parenthesis.

TABLE 3

Average Size in Inches of Largemouth Bass, Cox Hollow Lake*

Age Group	1961	1962	1964	1966
	Year			
Age II				
Electrofishing**	--	--	4.3 (11)	6.1 (22)
Angler Caught	12.0 (184)	8.2 (15)	6.7 (11)	--
Age III				
Electrofishing	--	--	7.0 (24)	7.2 (14)
Angler Caught	15.4 (13)	14.4 (40)	8.5 (58)	--
Age IV				
Electrofishing		--	14.1 (7)	8.3 (40)
Angler Caught		17.5 (1)	12.9 (36)	--
Age V				
Electrofishing			14.7 (5)	12.5 (79)
Angler Caught			16.7 (6)	--
Age VI				
Electrofishing			14.5 (1)	15.0 (59)
Angler Caught			--	--
Age VII				
Electrofishing				18.3 (7)
Angler Caught				--
Age VIII				
Electrofishing				20.2 (1)
Angler Caught				--

* The date are comparable only between years using the same techniques, not between techniques. Each technique introduces a certain bias to the data and was used only during a particular time period.

** The electrofishing samples were taken in April and May; the angler-caught samples include April through June. The number of fish included in each average length is enclosed in parenthesis.

this has not occurred for any of the fish species in the impoundment. A slight increase in growth of the young largemouth bass was recorded, but this increase materialized only after several years of decrease in both growth and size of the population.

TABLE 4

Average Size in Inches of Bluegills, Cox Hollow Lake*

Age Group	Year 1964	Year 1966
Age II		
Electrofishing**	5.2 (40)	3.7 (28)
Angler Caught	5.3 (63)	5.0 (15)
Age III		
Electrofishing	5.8 (36)	5.1 (98)
Angler Caught	6.1 (10)	5.2 (148)
Age IV		
Electrofishing		6.1 (35)
Angler Caught		6.1 (43)

* The data are comparable only between years using the same techniques, not between techniques. Each technique introduces a certain bias to the data and was used only during a particular time period.

** The electrofishing samples were taken in April and May; the angler-caught samples include April through June. The number of fish included in each average length is enclosed in parenthesis.

Harvest

The quality of the fishery in Cox Hollow Lake has been rapidly deteriorating. Table 5 shows a great reduction in both fishing pressure and yield.* One-half as many anglers now fish one-third as many hours to catch one-hundredth as many northern pike and one-tenth as many largemouth bass as were caught in peak years. The percentage of anglers who catch and register their fish has remained near 25 percent, but bluegills now dominate the catch. The yield of bluegills increased from 15 in 1961-62 to 19,590 in 1963-64. Approximately 96 percent of the fish caught since the 1962-63 season have been bluegills.

Unfortunately the bluegills have been very small. The percentage of bluegills taken which were less than 6.0 inches long has been increasing

* The northern pike yield in the first 2 years was higher than the population estimates for those years, because the anglers were removing a large number of small fish which were not catchable with the gear used for the estimates.

since the 1963-64 season, reaching almost 90 percent during the 1965-66 season. In addition bluegills above 5.0 inches in May, 1966 had an average Index of Condition of only 6.6; Bennett (1962) comments that an Index of 7.0 or less for a bluegill of 5.0 to 8.0 inches denotes poor condition. The majority of the Cox Hollow Lake anglers now catch many small, thin bluegills (Table 6).

TABLE 5

Trends in the Sport Fishery, Cox Hollow Lake*

				Yield			
Fishing Season	No. Angler Trips	Hours per Acre	Percent Angler Trips Successful	No. of Northern Pike	No. of Large-mouth Bass	No. of Blue-gills	Pounds/ Acre of Total Fish
1960-61	9,372	291.7	18.2	3,518	892	0	49.3
1961-62	9,874	348.3	31.0	4,353	3,985	15	52.1
1962-63	10,673	310.0	26.4	1,910	3,669	3,377	44.4
1963-64	9,264	221.1	25.0	196	796	19,590	39.1
1964-65	6,251	153.0	20.8	104	360	11,771	18.8
1965-66	4,922	120.0	22.0	39	343	9,152	15.9

* A 22.0 inch size limit was placed on northern pike at the beginning of the 1963-64 fishing season.

WATER QUALITY

Methods

The water quality was determined through measurements of temperature, dissolved oxygen, transparency, and chemistry. Because of their importance to fish production, these parameters were selected in order to characterize the impoundment. The sampling techniques were as follows:

TABLE 6

Percentage of Bluegills by Size Class Caught by Anglers from 1961-66, Cox Hollow Lake

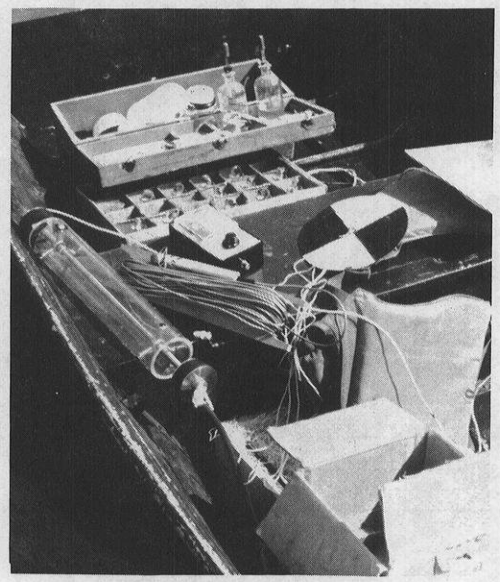
Size Range (inches)	Fishing Season				
	1961-62	1962-63	1963-64	1964-65	1965-66
2.0 - 2.9	0.0	0.0	0.0	0.0	0.4
3.0 - 3.9	0.0	1.1	0.1	2.8	3.6
4.0 - 4.9	33.3	37.8	10.5	18.1	40.6
5.0 - 5.9	0.0	51.2	45.9	58.3	44.0
6.0 - 6.9	0.0	9.5	42.2	20.5	11.4
7.0 - 7.9	33.3	0.1	1.4	0.3	0.1
8.0 - 8.9	0.0	0.2	0.0	0.0	0.0
9.0 - 9.9	0.0	0.1	0.0	0.0	0.0
10.0-10.9	33.3	0.0	0.0	0.0	0.0
No. bluegills measured	3	2,227	6,065	8,527	2,756
No. bluegills caught	15	3,377	19,590	11,771	9,152

1) Water temperatures were measured with a hydrographic thermistor thermometer. Measurements were made by lowering the probe to the desired depth and recording the temperature from the readout scale on the meter.

2) Dissolved oxygen concentrations were determined by a modified Winkler method. A water sample was taken from the desired depth with a 1,200 cc Kemmerer-type water sampler. The standard Winkler method was modified by substituting powdered sulfamic acid for sulfuric acid and thyodene for starch solution.

3) Water transparency readings were made by the traditional Secchi disk method. The disk was lowered until it just disappeared and this depth was recorded.

Fish population data were collected through the use of fyke nets (above) and electrofishing gear (upper right). Standard equipment for gathering water quality data included a dissolved oxygen kit, a hydrographic thermistor thermometer, a Secchi disk and a 1200 cc Kemmerer-type water sampler (right).



4) Water samples were removed for chemical analyses with a 1,200 cc Kemmerer-type water sampler. The analyses were conducted at the laboratory according to established methods. Determinations were made for 13 parameters.

The sampling site was located near the dike in the central area of the impoundment, although supplemental readings were often made near the midpoint in each arm of the impoundment.

Temperature

The annual temperature cycle in the impoundment is typical of lakes in this part of the country. There are four distinct periods during the year: vernal turnover, summer stratification, autumnal turnover, and winter stagnation. Thermal stratification normally becomes definite by mid-May and lasts until late October. The stagnation period (ice cover) occurs from December until late March.

The impoundment is protected from the wind on all sides except the east. The thermocline is therefore sustained at a shallow depth throughout the summer stratification period. According to Ruttner (1953), the depth of mixing is determined primarily by the energy the wind exerts on the lake surface. In Cox Hollow Lake the epilimnion normally extends to a depth of 5-7 ft; however, on a hot, calm day large temperature differences will also temporarily occur within the epilimnion.

The water temperatures are very high for short periods during the summer months. Temperatures in the mid 80's were noted in several years. On June 30, 1966 a surface temperature of 89F was measured; this was the highest temperature ever recorded. Brett (1956) has shown that warmwater fishes, largemouth bass and bluegill in particular, which have been acclimatized to 86F will survive in temperatures over 90F. So the summer temperatures in Cox Hollow Lake do not reach lethal levels.

Although food requirements increase as the water temperature increases, due to the increase in metabolic rate, high summer temperatures do not appear to directly suppress fish growth. Optimum temperature ranges for good growth have been determined for brown trout (Brown, 1957) but not for any of the warmwater species found in Cox Hollow Lake. Ferguson (1958) has, however, summarized some of the work done on preferred temperatures of fish. Young largemouth bass and bluegills have preferred temperatures of 86-89F and 86-90.1F, respectively. Thus high summer temperatures do not appear to be the cause of poor fish growth in the impoundment.

Winter temperatures are also suitable to the fish population. Temperatures are relatively stable from ice cover in December until the spring breakup. The temperature increases rapidly from 32F adjacent to the ice to 37F at a depth of 3 ft, then gradually to 39F at 25 ft. These temperatures do inhibit growth but are not a threat to survival and are typical winter temperatures for lakes in southern Wisconsin.

Dissolved Oxygen

The dissolved oxygen concentrations are greatly affected by the degree of water circulation within the impoundment. During the periods of turnover (vernal and autumnal), desirable oxygen concentrations are maintained throughout the impoundment. Unfortunately, any thermal stratification results in oxygen depletion near the bottom. Unsatisfactory oxygen levels occur during both the winter stagnation and summer stratification periods.

After formation of the thermocline in spring, dissolved oxygen is rapidly depleted near the bottom. In less than 4 weeks there is an oxygen deficit in part of the hypolimnion; this deficit often exists even before the beginning of June. During most of the summer the dissolved oxygen concentration in the impoundment is less than 5.0 ppm below 8 ft and 0.5 ppm below 13 ft. Laboratory tests conducted by Moss and Scott (1961) have indicated that the minimum oxygen requirements for largemouth bass and bluegills are between 0.5 and 1.0 ppm at summer temperatures in the absence of concentrations of carbon dioxide and other metabolic waste products. Due to the presence of these materials in Cox Hollow Lake, the minimum oxygen requirements for the fish in the impoundment are somewhat higher. Thus, a minimum of one-fourth of the impoundment's volume is unsuitable for fish survival throughout much of the summer. Bouck and Ball (1965) have also found that adverse changes in largemouth bass and bluegill blood serum occur in oxygen concentrations near 3.0 ppm. In addition, Stewart et al. (1967) determined that with a temperature of 78.8F, optimum growth of juvenile largemouth bass occurred only if the oxygen concentrations were at least 5-6 ppm. Assuming that levels in excess of 5.0 ppm are necessary for good habitat, an additional 15 percent of the impoundment's volume is of little value during the summer.

Low dissolved oxygen concentrations also occur in winter. Conditions are normally most critical in March; however, in some years the oxygen levels were already unsatisfactory by late January. The worst dissolved oxygen profile in recent years occurred in 1965. On March 22 there was 2.5 ppm at 2.5 ft; 0.4 ppm at 10 ft; and 0.0 ppm at 19 ft. Fish mortalities have never been observed, but this was probably the result of preventive techniques which were employed in several winters. Carbon dusting, strip plowing, and bottom water release have all been tried with some success (Brynildson and Truog, 1960). In a few winters snow did not cover the ice and although the oxygen concentrations became low near the bottom of the impoundment, there was no danger of winterkill.

Transparency

Water transparency is a crude index of phytoplankton density. Measurements were taken sporadically in Cox Hollow Lake but the information presented in Table 7 at least indicates that summer densities have been steadily increasing since 1961. In addition, the June average was 16.2 ft in 1961 and 4.9 ft in 1966, although the readings were again few in number. In recent years unsightly green scums of phytoplankton have appeared at the surface during calm weather. As a result, the impoundment has lost some of its recreational value for certain segments of the public.

Chemistry

The results of the chemical analyses are shown in Table 8. The impoundment can be classified as having a high productivity for fish and plants. Moyle (1949) found that the most productive natural lakes in Minnesota had a methyl orange alkalinity of 91 ppm or more and a sulfate concentration of between 0 and 50 ppm. Cox Hollow Lake definitely falls in this category; the methyl orange alkalinity is normally 150-230 ppm and the sulfate concentration, 15-25 ppm.

Major changes occurred in the concentrations of several chemicals in the epilimnion between 1960 and 1966; however, there again was infre-

TABLE 7

Measurements of Transparency, Cox Hollow Lake*

Month	1960	1961	1962	1963	1965
July:					
Number	3	1	1	1	--
Range	10.0-11.2	--	--	--	--
Average	10.7	15.5	4.9	2.6	--
August:					
Number	3	3	1	1	2
Range	5.8-11.0	11.8-13.5	--	--	3.7-5.0
Average	8.7	12.4	6.8	5.6	4.4

* Measurements were normally made at three locations. The average transparency was determined for each date and these were averaged on a monthly basis. Measurements are in ft.

quent sampling. The apparent shift in nitrogen compounds was particularly significant. The nitrate-nitrogen and ammonia-nitrogen concentrations were much lower at the end of the study while the organic nitrogen was higher. Pearsall (1932) found that blue-green phytoplankton species are normally associated with high concentrations of organic nitrogen. As previously mentioned nuisance algae blooms occur in the impoundment.

High concentrations of several chemicals have been revealed in the anaerobic hypolimnion. Although specific analyses have not been conducted, the odor of hydrogen sulfide is also obvious, thus indicating a tremendous oxygen demand in the hypolimnion. It is conceivable that dissolved oxygen could be severely depleted in the entire impoundment if the water was rapidly mixed without an additional oxygen input.

TABLE 8

Water Chemistry Analyses, Cox Hollow Lake*

Location	pH	MOA	PO_4(D)	PO_4(T)	NO_3-N	NH_4-N	K-N	Ca++	Mg++	Na+	K+	Fe(T)	Cl-
Epilimnion													
July 12, 1960	7.7	230	0.03	0.17	0.40	0.24	0.57	24.0	24.3	3.38	2.33	> 0.02	4.35
Aug. 26, 1965	8.5	147	0.10	0.17	0.02	0.03	0.90	22.5	22.5	1.95	2.32	0.12	1.90
June 16, 1966	7.9	185	0.03	0.16	0.01	0.01	0.90	18.6	17.3	2.15	1.76	0.47	4.50
Hypolimnion													
Aug. 26, 1965	6.9	239	> 2.00	16.2(3.05)**	0.00	4.12	0.80	44.3	22.5	2.70	2.02	2.18	3.05
June 16, 1966	7.7	208	0.73	0.77	0.01	0.83	0.11	25.2	18.9	2.05	2.16	2.35	4.00

* The values are reported in parts per million.

** A second sample was taken on September 14, 1965 to verify the unusually high concentration found in the previous sample. A high concentration was again found, although not as extreme as the first one.

SUMMARY AND SIGNIFICANCE

Initially the fish in Cox Hollow Lake exhibited a rapid population expansion and superior growth. Since that time there has been a tremendous reduction in both the population size and the growth for each species. In the case of the northern pike population there has not been a year class since 1962 and this species may soon disappear from the impoundment. Parasitism, disease, reduced food supply, or some other environmental stress are possible causes for the decline; more research in this area is definitely needed.

Originally the impoundment yielded only northern pike and largemouth bass. Bluegills began appearing in 1961 and have dominated the catch since the 1962-63 season; relatively few game fish were being caught at the end of the study. Unfortunately almost 90 percent of the bluegills taken from the impoundment during the 1965-66 season were less than 6.0 inches long. Although one-fourth of the anglers continued to be successful, a significant drop in fishing pressure emphasized the dwindling quality of the fishery.

Water temperature readings revealed that the impoundment has an annual temperature cycle typical for lakes in this section of the country. Measurements have also shown that the surface temperatures approach 90F, although these temperatures are neither high enough nor of sufficient duration to adversely affect either the survival or the growth of the fish.

Dissolved oxygen determinations have disclosed that concentrations drop very rapidly during any period of thermal stratification. During most of the summer, 25 percent of the impoundment's volume has oxygen levels of less than 0.5 ppm and another 15 percent has less than 5.0 ppm. This loss of 40 percent of the otherwise available habitat causes a compressing of the fish population each summer and naturally has a detrimental effect on the population. Oxygen has also been a winter problem. Winterkill has been imminent in several years and preventive measures were often necessary.

Chemical anlyses have demonstrated that the impoundment has a high productivity level for both fish and plants. Nutrient concentrations are adequate, and the presence of hydrogen sulfide in the hypolimnion denotes intense biological productivity. Conditions favor an overabundance of blue-green algae. The impoundment has lost much esthetic value in recent years due to periodic surface scums of phytoplankton.

Although the density of aquatic vegetation has not been closely studied, it is a factor that must be considered when assessing the recreational value of an impoundment. In 1966 aquatic vegetation occurred around the entire shoreline to a depth of 8-10 ft. This condition resulted in a certain amount of interference to swimming, boating, fishing, and general esthetic enjoyment.

The recreational value of Cox Hollow Lake has been greatly diminished as a result of these circumstances. Unfortunately there also are a large and growing number of other impoundments in a similar condition. Future research must concentrate on the development of new management techniques, by which impoundments can be better maintained.

LITERATURE CITED

Bennett
1962. Management of artificial lakes and ponds. Reinhold Publishing Corp., New York. 283 p.

Bouck, G.R. and R.C. Ball
1965. Influence of a diurnal oxygen pulse on fish serum proteins. Trans. Amer. Fish. Soc. 94(4):363-370.

Brett, J.R.
1956. Some principles in the thermal requirements of fishes. Quart. Rev. of Biol. 31(2):75-87.

Brown, M.E.
1957. Experimental studies on growth. In: The physiology of fishes. Vol. 1, Metabolism. Acad. Press, New York. 447 p.

Brynildson, Clifford and John Truog
1960. The methods adopted to prevent winterkill of fish in Cox Hollow Lake, Iowa County, during the winter of 1960. Southern Area Investigational Memo., No. 254. Fish Manage. Div., Wis. Conserv. Dept., Madison. 7 p.

Ferguson, R.G.
1958. The preferred temperature of fish and their mid-summer distribution in temperate lakes and streams. Jour. Fish. Res. Bd. Can. 15(4):607-624.

Iowa County Soil Conservation District
1961. Watershed work plan, Twin Parks watershed, Iowa County, Wisconsin. 52 p.

Klingelhoets, A.J.
1962. Soil survey of Iowa County, Wisconsin. Soil Conserv. Service Ser. 1958, No. 22. 101 p.

Moss, D.D. and D.C. Scott
1961. Dissolved oxygen requirements of the three species of fish. Trans. Amer. Fish. Soc. 90(4):377-393.

Moyle, J.B.
1949. Some indices of lake productivity. Trans. Amer. Fish. Soc. 76:322-334.

Pearsall, W.H.
1932. Phytoplankton in the English Lakes II. The composition of the phytoplankton in relation to dissolved substances. Jour. Ecol. 20:241-262.

Ricker, W.E.
1958. Handbook of computations for biological statistics of fish populations. Fish. Res. Bd. Can. Bull. No. 119, Ottawa. 300 p.

Ruttner, Franz
1953. Fundamentals of limnology. Univ. of Toronto Press. 242 p.

Stewart, N.E., D.L. Shumway, and P. Doudoroff
1967. Influence of oxygen concentration on the growth of juvenile largemouth bass. Jour. Fish. Res. Bd. Can. 24(3):475-494.