

COMMERCIAL CARP REMOVAL AT LAKE MATTAMUSKEET, NORTH CAROLINA

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Lake Mattamuskeet is famous as a National Wildlife Refuge for a wintering concentration of swans, Canada geese and ducks. The 50,000-acre lake is located in Hyde County, North Carolina, seven miles north of Pamlico Sound. Prior to 1915 the lake was an open body of water with no obstructions to mar the surface. The marsh was limited to a narrow band of low flats on the south shore. There was only one small outlet canal draining this vast area.

In 1915 the lake was purchased by a stock company and the largest pumping plant in the world, at that time, was installed. The lake was drained and approximately 20,000 acres were reclaimed for farm lands. Except for short periods, these lands were cultivated until the fall of 1932, when the lake refilled after financial failure of the drainage project.

On October 30, 1934 the Federal Government purchased the lake as a wintering ground for migratory waterfowl. After the refuge was established improvements were begun to manage the area for the purpose desired. More canals were constructed to secure drainage by gravity, not only for the purpose of influencing plant life in the marsh, but also to assist crop production on

adjacent private farm lands. An earthen causeway, with five bridges, constructed in 1941-42, more or less divides the lake in halves.

At present, levels are controlled by gates on six canals draining into Pamlico Sound. The lake receives no creek or river drainage, being fed by runoff and agricultural drainage from the surrounding watershed. The open water consists of approximately 30,000 acres, bordered by 20,000 acres of marsh and upland. It is the practice to lower the lake water level during the growing season to expose shorelines as early in the spring as possible for proper growth of native emergent waterfowl food-plants. The number of waterfowl utilizing the area has increased substantially as a result of this drawdown.

Until 1949 the lake water was so turbid that submerged aquatic plants could not exist. Secchi disc visibility in the lake proper was approximately six inches in waters that averaged three feet deep. The salt content of the open lake for the past five years averaged 875 p.p.m. chlorides, or 2.5% sea strength. After the first agricultural drainage the fish population naturally was reduced to a minimum; but, subsequent to the 1932 water rise, there developed a tremendous population of largemouth bass, crappie and white perch, which provided excellent sport-fishing. Since 1937 the lake fishery

¹ Appreciation is expressed to W. P. Baldwin, U. S. Fish and Wildlife Service, for assistance in the preparation of this article.

changed from a predominantly large-mouth bass and crappie population to one in which perch and finally carp were dominant. Sport-fishing declined accordingly. Data supporting this trend were collected by the writer and interpreted by Holloway (1948).

THE ROLE OF THE CARP

Since Mattamuskeet is a wintering ground for thousands of waterfowl, a large quantity of natural waterfowl food-plants is needed to carry the birds through the winter. However, the 30,000 acres of open water supported practically no submerged aquatics. A constant six-inch Secchi disc visibility precluded the development of such aquatics. It was thought feeding carp were responsible for the turbid condition.

Observations during the past six years indicated that the carp also were destroying large quantities of marginal marsh vegetation submerged after summer rains. To reduce such depredation and to increase water clarity, a stepped-up program of carp removal was encouraged. Attempts were made to locate a market that would be profitable to local commercial fishermen. One interested person built several ponds near Winston Salem, N. C., during 1948, securing carp from Lake Mattamuskeet for stocking purposes. He then sold permits to local sport-fishermen. It is known that this project yielded a good income to the owner. Construction of carp ponds at other points in the state increased—all with good success. At present (1952) it is estimated there are in North Carolina 150 ponds which frequently restock rough-fish from Mattamuskeet through 20 to 25 in-

dividually-owned tank-trucks.

THE REMOVAL OF CARP

The problem of carp reduction in such a vast lake was approached with some trepidation. Local misguided opposition, state restrictions against seining lake waters, and a degree of administrative apathy had to be overcome before fishing could be started. The first attempts with fyke-nets in the canals, starting in 1940, did not yield outstanding results. The problem was complex, in that it was desired (1) to stop the annual migration of adult carp into the lake without halting the spring run of white perch, (2) to reduce the present adult rough fish population in the lake, and (3) to reduce young carp that would continually develop from lake spawning.

STOPPING THE ANNUAL MIGRATION INTO THE LAKE

Lake Mattamuskeet drains into tidal Pamlico Sound through six water-control structures. Principal spring migration of carp and white perch occurs through three of these canals. The peak of the perch migration is in April; that of carp in May. This period coincides with maximum discharge of lake waters to favor waterfowl marsh management and local agriculture. Both species easily entered the lake while the structures were open for drainage. The problem was to modify the structures to permit water passage and white perch entrance but to halt adult carp. Screening of wire failed because of rapid clogging by debris and silt. The water quality also makes metal barriers short-lived. An obvious answer was a weir of wooden construction. On the

"Headquarters-Canal" a successful barricade was developed which passes perch but stops adult carp. It also serves as a trap for lake carp moving through the canals from one section of the lake to another. The weir consists of one continuous slat barricade, with a slat funnel-trap attached, to impound the carp within a two-mile section of a 90-foot-wide canal.

The weir is built of cypress in the following manner. Pilings, 4" x 6", are jettied into firm bottom of the canal to support the structure. Then, 2" x 6" timbers are notched to allow 1" x 4" slats to pass through slots on a two-inch spacing. To keep the slats on the proper spacing and in line, two notched timbers are required, one about two feet above the water line and one near the bottom of the canal, or approximately six feet apart, depending on the water depth. The timbers are bolted to the piling, and the slats are fitted in the top slot, driven through the lower slot into the canal bottom about four feet (or down to solid soil). The portion of the structure where the ends connect with the shore should be riplapped to keep the carp from boring under the structure. The slats are nailed to the top timber only, to permit easy removal of broken slats, and 2" x 6" braces are driven into the bottom and bolted to both sides of the barricade. A two-foot wide walkway is attached to one side, furnishing easy access for cleaning debris from the structure. The width of the weir opening is about twelve inches or smaller, according to the size of the impoundment desired and the size of the fish being trapped. A deflector board is attached in the throat of the weir to guide the fish into the impound-

ment. The structure was constructed by the Fish and Wildlife Service with the North Carolina Wildlife Resources Commission cooperating.

Three periods of fyke netting inside the weirs since 1951 has indicated that they are stopping large carp, gar, catfish and bowfins but passing most game fish. To perfect this phase of management it is desired to construct weirs on the other five outlet canals.

REMOVING THE CARP POPULATION

Adult carp removal was started during 1940, in a small way, by the use of pound or fyke nets located only in the canals. This practice was continued until 1949, with no apparent reduction in the carp population. During the fall of 1949 fishermen were encouraged to convert to drag seines, under strict supervision of refuge personnel. Seining sites free of snags were located and permits assigned to groups of commercial fishermen. It was pointed out to them that baiting of seining sites with grain would improve their catch of carp and catfish. To stimulate this practice the refuge supplied surplus corn for trial seining. This method proved so successful that the fishermen began purchasing their own bait. We have continued to furnish some surplus corn and beans each spring to encourage the removal of as many carp as possible before the onset of the spawning season. Catches at this time are usually small and would not otherwise be economically feasible without this subsidization. Bait for carp and catfish also included soybeans, cottonseed cake, and chicken scratchfeed which attracted as well as corn. Baited spots do not seem to attract game fish. In operating, a lapse

of approximately five to ten hours is allowed after the site is baited to permit carp to congregate. A drag net then is laid out by boat around the baited area and the net pulled in to shore. When this method was first used from one to seven tons of carp were captured in single hauls of a three-hundred-yard seine. The best netting periods have been February to April and September to October. No netting is permitted during the December - January waterfowl hunting season. Daytime seining during cold weather has been successful, but in the summer seining is limited mostly to late afternoons and early mornings.

The carp are kept in good condition while in holding nets with 1" bar, twenty to thirty feet in diameter and approximately eight feet deep. This type of pound was found to be far more efficient than a holding pen built of wood palings, since the fish did not bruise themselves in their attempts to escape. Transportation by tank-truck for several hundred miles was found feasible during cold weather by the use of aerated tanks similar to those employed by fish-hatcheries. For hot-weather shipment successful transportation was possible by loading the tanks in later afternoon, adding another pump (and sometimes ice), and traveling at night.

REDUCTION OF YOUNG CARP

The seines have been catching sizable quantities of fingerling carp, presumably recently lake-hatched. These are too small for the holding pounds but are often placed directly into the tank trucks. It is felt that additional control of small carp will result from extensive

recent stocking of predatory game fish.

EFFECTS OF CARP REMOVAL

The Mattamuskeet carp fishing has improved local economics, physical conditions in the lake affecting the flora, and possibly the sport fishing within the period of the described activity. Over 1,600,000 pounds of carp and 95,000 pounds of catfish have been removed from Lake Mattamuskeet principally for live-sale to North Carolina upland fish ponds.

Below is the catch by years, tabulated from the most reliable figures available:

Year	Carp (pounds)	Catfish (pounds)	Value*
1945	26,341	1,897	\$ 2,405.33
1946	6,320	255	543.10
1947	25,753	2,233	2,089.51
1948	54,054	3,459	4,843.17
1949	110,086	13,278	10,798.58
1950	360,012	12,800	30,720.96
1951	745,870	43,831	66,244.25
1952**	367,166	17,658	32,021.98
TOTALS	1,695,602	95,411	\$149,666.88

* Gross sale value to commercial fishermen

** Total only to July 31, 1952

In addition to the "commercial" value received by the seiners of Hyde and Dare Counties, North Carolina, this industry has proven remunerative to the truckers and pond owners. The average sport fishing fee for these rough fish is \$1.50 for half-day fishing, with a catch limited to ten pounds.

While the economic effect has been locally worthwhile, the effect on the lake management has been even better than anticipated. Secchi disc visibility of lake water was only six inches up to 1948. Coincidental with the last four years cumulative removal of over 1,500,000 pounds of carp, a gradual improve-

ment in water clarity has been obvious, and visibility in much of the shallow lake has increased to three and four feet in depth (1952). It is the opinion of Service biologists familiar with local ecology (unpublished F.W.S. reports by W. P. Baldwin, *et al*) that carp removal is responsible for this improvement.²

The immediate result of increased water clarity has been the volunteering of at least 7,500 acres of muskgrass (*Characeae*) in 1951, and an additional 7,500 acres in 1952, making a 15,000-acre increase in the two-year period. This past summer bushy pondweed (*Najas*) and other desirable pondweeds have appeared, and additional species are being introduced. Damage to shoreline emergents also has decreased. It is assumed that these desirable waterfowl food plants will increase as long as a carp removal program continues, with a consequent marked effect on the size and composition of future waterfowl populations at Mattamuskeet National Wildlife Refuge.

In comparing these results with those in other parts of the country there might be reasonable doubt that this degree of carp reduction could accomplish what is claimed. Perhaps Mattamuskeet results are better understood

² Editor's note: On the basis of experience reported elsewhere, it is doubtful that the removal of less than 25 pounds of carp per acre in any year can be assumed, without more data, to have reduced a carp population sufficient to change the environment. The reduced turbidity and increased plant growth may have been the result of some other unrecorded factors or may be the result of the carp removal. The changes and operations merit recording and it will be interesting to observe further results of the program.—K. D. CARLANDER.

when one considers the following factors: (1) Earliest and most extensive plant invasion appeared east of the dividing causeway, where the first and greatest carp removal occurred. (2) The new outlet weirs permitted lake removal of carp from populations not replenished by migration from Pamlico Sound. (3) Maximum summer drawdown during 1949-51 resulted in minimum water acreage of 20,000 acres. On the basis of this minimal acreage, the 1,215,968 pounds of carp removed in 1949-51 (the "critical" period leading to wholesale invasion by submerged plants) was about 60 pounds per acre, or 37 pounds for the peak year of 1951.

Possibly the total removal of 1,791,013 pounds of rough fish has permitted a better spawning increase of game fish. According to data collected by Ancil D. Holloway, Service fishery biologist, (unpublished Service report) the 1951 condition factors of game fish showed an improvement and reproduction of bass was found for the first time in many years. A vigorous stocking program also has been instituted. During 1949 - 1952 a total of 1,244,500 largemouth bass fry, 680,000 rock-fish fry, and 160,000 bluegill bream have been stocked.

Based on nearly 100 percent creel census, it has been determined (since the carp removal and the restocking of game fish programs began) that the take of game fish by sport fishermen has gradually increased by 1952 to a figure 75 per cent over previous years. Due to the clarity of the lake waters there are large areas suitable for game fish spawning and should the reproduction of these species reach the point expected, the restocking program will cease.

SUMMARY

1. Lake Mattamuskeet, N. C., embraces some 30,000 acres of open water and 20,000 acres of marsh and administrative upland, all serving as a National Wildlife Refuge, principally for waterfowl.

2. Between 1915 and 1932 the lake was drained for agricultural use, terminating in economic failure. Upon refilling, the lake developed a tremendous game-fish population. Species domination gradually passed from largemouth bass to carp, and sport-fishing declined.

3. Feeding action by carp was believed to be a major cause of the high turbidity in the lake proper, which prevented the existence of desired submerged waterfowl food-plants. Carp feeding was observed to be the cause of widespread destruction to marginal marsh plants.

4. To improve waterfowl habitat a program of carp removal was commenced. A wooden canal weir is described that was successful in passing white perch but stopping adult carp migrating into the lake.

5. An even more successful system of hauling-seining on baited spots in the lake is described.

6. An estimated 150 inland North

Carolina fish ponds have been constructed or renovated primarily to use the Mattamuskeet source of rough fish, supplied through a transportation service of about two dozen independent tank-trucks.

7. The removal of over 1,600,000 pounds of carp and 95,000 pounds of catfish from the lake, has resulted in the Secchi-disc visibility gradually increasing from six inches (1948) to three and four feet (1952).

8. Desirable submerged waterfowl food-plants have invaded 15,000 acres of the formerly barren lake bottom, and the spread continues. Carp-destruction of shoreline emergents has been reduced. This new and large supply of waterfowl food undoubtedly will influence future populations and movements of waterfowl in eastern North Carolina.

9. Sport-fishing, which is secondary to waterfowl food production, already has improved, and has been implemented by a restocking program.

LITERATURE CITED

- HOLLOWAY, A. D. 1948. Twelve years of fishing records from Lake Mattamuskeet. *Trans. N. A. Wildl. Conf.*, 13: 474-480.

Accepted for publication October 17, 1952.