

Summary of Technical Report prepared by WSB entitled: Population Monitoring, Movement, and Removal of Common Carp in Lake Mattamuskeet, NC

PROJECT DESCRIPTION

This project was conducted as part of ongoing efforts to evaluate baseline carp population dynamics, further assess the effectiveness of carp removal as a tool for ecosystem restoration and wildlife conservation, and remove as many carp as possible from Lake Mattamuskeet.

Objective 1 - Remove large numbers and weight of invasive common carp from Lake Mattamuskeet.

Objective 2 - Establish an array of bait traps and or pound nets to remove carp at strategic locations on a semi-regular basis so that the density of carp in the lake can be monitored by catch rates.

Objective 3 - Conduct analyses to estimate baseline population dynamics parameters (i.e., age, growth, mortality, and biomass) to inform future modeling efforts aimed at better understanding carp population control over the long term.” Page 2

METHODS

Why was radio telemetry used? “At the start of the project, we had planned to use radio tagged carp to identify when and where large aggregations formed and target those for large scale removal as in other similar projects, but radio tagged carp never formed an aggregation where more than 2 or 3 radio tags were found. This may be due to the homogeneity of the habitat across the lake.” Page 14

Anticipating a high population of carp from the initial 2018 estimate, WSB initially intended to use seine nets as the primary means of removal. Following discovery of significantly fewer carp than anticipated, other gear types such as hoop nets, trap (fyke) nets, mini trap (min fyke) nets, electrofishing, box nets, and gill nets were utilized.

Abundance [population size] was recalculated as similarly as possible to the 2018 study in the enclosed bay north of Rose Bay canal following struggles to locate the expected number of carp.

RESULTS

Telemetry

The anticipated aggregations never appeared. “Of the 39 implanted radio tags, 28 unique frequencies were heard during field telemetry surveys.” Page 13

Size Structure

“Of the 1,065 carp measured, average length was 21.9” with a range of 6” – 34”. Less than 14% of these individuals were below 18” TL [total length] with the majority being 20 to 25”. Average weight of these fish was 4.52 lbs. Average length of the carp removed from the impoundment was 19.3”, with lengths ranging from 15”–27”. On average, impoundment carp weighed 3.63 lbs. Weights ranged from 1.63 lbs. to 9.48lbs.” Page 18

Abundance

“In updating the Lake Mattamuskeet carp abundance [population] estimate, two methods were used: an area swept calculation using catch data from the seine hauls and a mark-recapture survey in an enclosed bay, similar to the 2018 effort (Lamb 2020).

Density (carp/ac) was estimated to be 1.73 (SE, 0.44) by the area-swept method. This value multiplied by total lake acreage (40,312 ac) produced an abundance estimate of 69,554 carp (SE, 17,716). Biomass (lbs/ac) was estimated to be 8.51 (SE, 1.97). This value multiplied by total lake acreage yields a total biomass estimate 343,258 (SE, 79,475).

From the mark-recapture survey, density was estimated to be 0.88 carp/ac. This value multiplied by total lake acreage yielded a total lake abundance estimate of 35,474 carp. Biomass (lbs/ac) was 4.52 lbs/ac. In this case, total lake biomass would be 182,210 lbs. We were unable to calculate standard errors for these values as it was a simple mark-recapture survey, thus analyzed as one event.” Page 25.

Note that these studies were conducted in drastically different habitat: the area swept calculation was from surveys done next to the causeway, whereas the mark-recapture calculation was from a study in Rose Bay.

Removal

“Across all gear types, 3,780 individual carp were removed from Lake Mattamuskeet. This accounts for an approximate 17,916 pounds of carp biomass removed from the system. The majority (1,239 carp; 6,141 lbs.) were removed using box nets followed by seines (1,124 carp; 5,247 lbs.), gill nets (787 carp; 3,712 lbs.), electrofishing (336 carp; 1,473 lbs.), hoop nets (260 carp; 1,217 lbs.), beach seine (30 carp; 109 lbs.), and trap nets (4 carp; 17 lbs.). Dependent upon the abundance/biomass estimate method applied, this represents 5.4% and 5.2% of the abundance and biomass removed, respectively, according to the area swept calculation and 10.6% of the abundance and 9.8% of the biomass removed according to the mark-recapture estimate.” Page 26

Age Structure and Population Dynamics

Understanding the ages of the carp in Lake Mattamuskeet is a vital piece of information in determining the population dynamics. “From the 217 otoliths [fish ear bones that contain age rings] processed from the main lake, average age was 15 years old and ranged from 1 – 33 years old. 79% of the individuals aged were between 10 and 18 years old and 96% were 10 years old or greater. 4% of the aged individuals were less than 10 years old (Figure 15; Figure 16). 5 of these individuals were age-1 fish and were captured via electrofishing near the Lake Landing Canal tide gate. USFWS staff had raised the gate slightly for a study focused on carp use of the canal under varying flow conditions [and it is possible these young fish entered from outside of the lake system or from a refuge impoundment].

In general, recruitment [successful reproduction] over the last 10 years seems to be low and the Lake Mattamuskeet carp population largely comprised of older adults.

Many of the gravid females’ ovaries observed in the main lake over two spawning seasons showed signs of egg resorption. Given the energetic demands of reproduction, spawning success is highly dependent on physiological health of individuals (Horvath 1986). Carp may forgo spawning when underweight, highly stressed, or in poor health. This is another potential limiting factor of successful recruitment in Lake Mattamuskeet.

Of the 28 carp aged from the impoundment, ages ranged from 2 – 33 years old with an average age of 9 years old. 57% of these fish were less than 3 years old and 68% less than 6 years old. The remaining 9 carp were all over 15 years old. Although the ageing data from the impoundment was limited, there does appear to be recent recruitment and possibly fairly steady recruitment unlike the main lake population over the last 10 years.” Page 26-27

“These estimates indicate relatively high annual survival of fully recruited age classes, with approximately 77% of individuals surviving from one year to the next. Such survival rates suggest that adult carp persist in the population for many years, contributing to a stable age structure dominated by older individuals. Under these conditions, population reduction through natural mortality alone is likely to occur slowly. However, at least in recent years, recruitment seems to be minimal, so, presently, there may be few young carp to replace the older stock in the future.” Page 31

“A large proportion of the main lake fish were severely thin, less so for the impoundment.” Page 33

DISCUSSION

“Common carp abundance in Lake Mattamuskeet appears to be substantially lower than previously thought. Multiple findings from the current project indicate that the current population is likely characterized by limited recruitment, poor individual condition, and an

annual mortality rate in range of that normally associated with carp, resulting in a population structure primarily comprised of old individuals.

The apparent absence of successful recruitment may be a key factor explaining low observed abundance. This suggests that, at least currently, in the lake's unvegetated state, spawning either fails to produce viable offspring or that early life stages experience high mortality. It's possible that the routine bluegill stocking conducted by North Carolina Wildlife Resources Commission and Edenton National Fish Hatchery is also further promoting this recruitment bottleneck.

While not exceptionally high, the estimated annual mortality rate of 22.8%, in the absence of compensatory recruitment, is sufficient to drive the population decline (Table 4). Poor relative weights and poor individual health, according to USFWS fish health analysis, provide additional support for this. This seems to be due to a lack of food availability, rather than density dependence as CPUE [Catch Per Unit Effort] across all gear types was low.

Implementing carp barriers may have also contributed to the reduction in abundance by interrupting important aspects of Lake Mattamuskeet carp life history. In the absence of suitable spawning habitat within the lake due to the decline in submerged aquatic vegetation, carp may have used habitat toward Pamlico Sound and other areas adjacent to the main lake for spawning and foraging. The barriers may have restricted access to these traditionally used habitats and disrupted seasonal movements that were critical for successful reproduction and health. Over time, these structures could prove to be one of the most viable, in terms of efficiency and cost effectiveness, in managing and suppressing carp abundance in the lake.” Page 41

A truncated version of Table 4 is shown below and lists the “Number of individuals remaining in 2025, assuming an annual mortality rate of 22.8% and no successful recruitment since 2018 population estimate.”

<u>Year</u>	<u>Number of Individuals</u>
2018	971,220
2019	749,781
-	-
2025	158,722

Looking forward... “Given the apparent low recruitment and poor condition of carp in Lake Mattamuskeet, management actions should focus on promoting native fish communities, continued suppression of carp recruitment, SAV recovery trials and research, carp population monitoring, and sustained removals at whatever level deemed feasible.” Page 42