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Common Carp Affect Turbidity and Angler Catch Rates of Largemouth Bass in Ponds

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Abstract.—We examined effects of common carp *Cyprinus carpio* on angler catch rates of largemouth bass *Micropterus salmoides* in experimental ponds. Catch rates were significantly lower and turbidity was significantly greater in ponds with common carp. Maximum angler catch rates were negatively correlated with turbidity. Densities of catchable-sized largemouth bass (>200 mm total length) in ponds with and without common carp were not significantly different.

Largemouth bass *Micropterus salmoides* is one of the most popular warmwater sport fishes in the United States, and understanding and regulating factors that control harvest of sport fishes such as largemouth bass is a major management issue facing state fisheries agencies (Hendricks et al. 1995; Mather et al. 1995). This study focused on the effects of common carp *Cyprinus carpio* on angler catch rates for largemouth bass. Common carp is native to Eurasia and the species was introduced during the 1800s into U.S. waters, where it has become a dominant species in reservoir fish communities (Lee et al. 1980; Miranda 1983). Although common carp can be a sport species (Sheddan 1987), it usually is considered a pest species that has adverse impacts on lake systems (Rach et al. 1994; Verrill and Berry 1995). Common carp destroy vegetation, increase water turbidity, and promote eutrophication of ponds and lakes (Crivelli 1983; Meijer et al. 1990; Roberts et al. 1995), but the effects of common carp on angling for largemouth bass have not been explored. In this paper we show that turbidity enhancement by high biomass of common carp reduces angler catch rates for largemouth bass.

Methods

The study was conducted at Eagle Mountain Fish Hatchery, Fort Worth, Texas, in 23 ponds filled and maintained with water from eutrophic Eagle Mountain Lake. The experimental design consisted of 11 ponds with common carp and 12 ponds without. Average pond sizes were 0.38 ha (SD = 0.18) with common carp and 0.37 ha (SD = 0.16) without common carp.

Ponds were stocked with fish from October 1991 through February 1992. Eleven of the 23 ponds were stocked with 1,200 fingerling common carp (5.7 g) per hectare. All ponds were stocked with fingerling largemouth bass (120/ha), bluegills *Lepomis macrochirus* (1,200/ha), and sterile triploid grass carp *Ctenopharyngodon idella* (25/ha).

Ponds were closed to public fishing and personnel living on the hatchery prevented poaching. Experimental angling occured on 18 of the ponds one or two times from May through October 1993 and on 17 of the ponds one or two times from May through June 1995. Each fishing event consisted of a pair of anglers fishing along the entire shoreline of a pond for 10–30 min during daylight hours. Ten anglers participated in the study and were allowed to fish with the lures of their choice. Captured largemouth bass were measured (total length, TL) and returned to the ponds.

We tested two hypotheses that could account for the impact of common carp on largemouth bass catch rates: (1) common carp increase turbidity and reduce the catchability of largemouth bass; and (2) common carp reduce densities of largemouth bass, which causes reduced angler catch rates.

To test the first hypothesis, we collected water samples in 1993 and 1995 from the top 0.5 m of each pond using an integrated tube sampler and analyzed turbidity using a Hach turbidimeter. Because common carp may increase turbidity by reducing aquatic plants that dampen wind-induced resuspension of sediments (James and Barko 1994), we sampled aquatic macrophyte biomass during draining of six ponds with and seven ponds without common carp. Ten vegetation samples

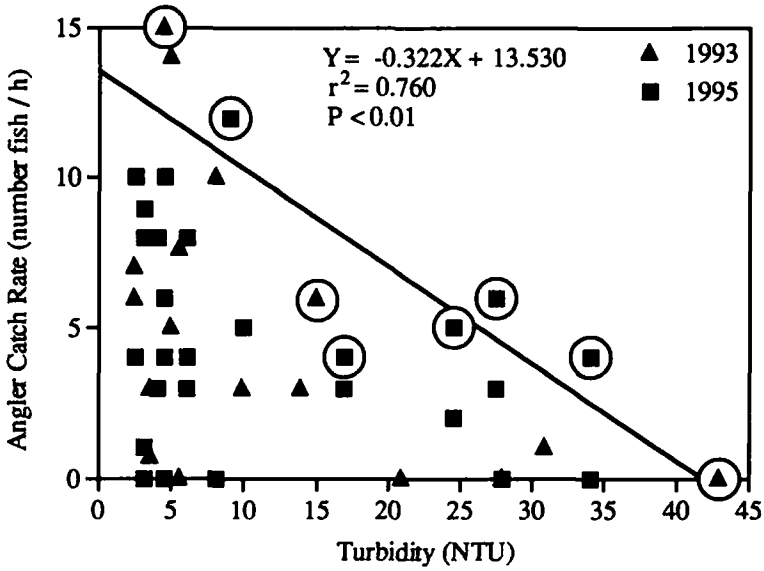

FIGURE 1.—Relationship between number of largemouth bass caught by anglers (Y) and turbidity of ponds (X) in 1993 and 1995. The regression equation for maximum angler catch rates was calculated for circled symbols, which represent the maximum catch rates for each 5-NTU increment (NTU = nephelometric turbidity unit).

were taken per pond along a line transect from near the water inflow area to the opposite side of the pond. One sample was taken 0.5 m offshore at both ends of the transect and eight other samples were taken at randomly selected distances along the transect. At each sample site, all vegetation above the sediment surface was removed from a 0.5 × 0.5-m area. Vegetation samples were placed in nylon mesh bags and stored in water until sorted by species. Plant specimens were blotted with paper towels, sun dried, and weighed to the nearest gram.

To test the second hypothesis, we examined the density of largemouth bass in six ponds with common carp and seven ponds without common carp. To examine population densities of largemouth bass, we drained the ponds from May to July 1995 by slowly lowering the water level of each pond over a 12–24-h period. All largemouth bass greater than 200 mm TL and all common carp were collected and measured.

Data were analyzed by ANOVA and linear regression by using SYSTAT version 5.2.1 (Wilkinson 1992). An alpha level of 0.05 was chosen.

Results

Angler catch rates of largemouth bass were significantly lower in the ponds with common carp both in 1993 ($P < 0.01$) and 1995 ($P = 0.02$). In 1993 the mean catch rate was 1.4 fish/h in ponds with common carp and 6.3 fish/h in ponds without common carp. Similarly, in 1995 the mean was 3.0 fish/h in ponds with common carp and 6.2 fish/h in ponds without common carp. The mean length of largemouth bass caught by anglers in 1995 was 319.4 mm (SD = 52.3) in ponds with common carp and 332.3 mm (SD = 59.6) in ponds without common carp.

Turbidity levels were significantly greater in the ponds with common carp in 1993 ($P < 0.01$) and 1995 ($P < 0.01$). In 1993 the mean turbidity was 17.9 nephelometric turbidity units (NTU) in ponds with common carp and 3.7 NTU in ponds without common carp. Similarly, in 1995 the mean was 16.5 NTU in ponds with common carp and 4.5 NTU in ponds without. Turbidity was a good predictor of maximum catch rates of anglers (Figure 1), with anglers catching more than 12 largemouth bass/h from ponds with turbidity less than 10 NTU and less than 5 largemouth bass/h from ponds with turbidity greater than 30 NTU. Clear water did not guarantee fishing success, and some anglers were unable to catch largemouth bass in ponds with low turbidity.

Aquatic plant communities in the 13 drained ponds were variable. Dry plant biomass ranged from 0.0 to 336.3 g/m^2. Abundant plant taxa were bushy pondweed *Najas* spp., Eurasian water milfoil *Myriophyllum spicatum*, common pondweed

Potamogeton spp., American lotus *Nelumbo lutea*, muskgrass *Chara* spp., coontail *Ceratophyllum demersum*, grasses (Graminae), and filamentous algae. Total vegetation biomass was not significantly different between ponds with and without common carp ($P = 0.322$). The mean dry biomass of bushy pondweed was 0.0 in ponds with common carp and 74.4 g/m^2 in ponds without common carp, which was marginally significant ($P = 0.06$).

Common carp, which were stocked at 6.8 kg/ha, had grown to a mean biomass of 566.2 kg/ha (SD = 170.9) when the ponds were drained. Population densities of largemouth bass greater than 200 mm TL were not significantly different ($P = 0.28$) between ponds with (mean of 140.3 fish/ha) and without common carp (mean of 183.3 fish/ha).

Discussion

Angler catch rates for largemouth bass were significantly lower in the ponds containing common carp. We postulate that common carp reduced angler catch rates by increasing turbidity and reducing the ability of largemouth bass to locate lures. We found turbidity was a good predictor of maximum angler catch rates of largemouth bass. Laboratory experiments have shown that high turbidity and low light decrease reactive distance between visually feeding centrarchids and their prey (Vinyard and O'Brien 1976; Howick and O'Brien 1983).

The angler catch rates in our study were higher than for anglers fishing public lakes (range = 0.08–1.3 fish/h) (Buck 1956; Schramm et al. 1987; Champeau and Denson 1988; Parks and Seidensticker 1994; Storey and Ott 1994). Largemouth bass in our ponds had not been exposed to angling. Anderson and Heman (1969) found that largemouth bass from unfished populations were more vulnerable to capture by anglers than fish from lakes that had been previously fished.

Common carp can increase turbidity via several mechanisms, including resuspension of sediments during bottom feeding (Roberts et al. 1995), nutrient excretion and consequent enhancement of phytoplankton biomass (Lamarra 1975; Brabrand et al. 1990), and by destruction of vegetation (Crivelli 1983) that could result in increased wind resuspension of sediments (James and Barko 1994). We observed common carp expelling turbidity plumes from their opercular cavities as they fed in shallow water, and when we drained the ponds we found that the bottoms of ponds containing common carp were covered with depressions caused by common carp feeding.

This study demonstrates that an increase in turbidity caused by common carp reduces angler catch rates of largemouth bass. Angler catch rates for largemouth bass may be increased in ponds by reducing or eliminating common carp populations.

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