Seasonal Hooking Mortality of Flathead Catfish and Blue Catfish

Maurice I. Muoneke, *Texas Parks and Wildlife Department, Heart of the Hills Research Station, HCR-7, Box 62, Ingram, TX 78025*

Abstract: This study was conducted to estimate the summer and winter hooking mortality of flathead catfish (*Pylodictis olivaris*) caught on trotlines in the Colorado River and Kerrville Reservoir, Texas, and blue catfish (*Ictalurus furcatus*) caught on trotlines in Livingston Reservoir, Texas. Water temperatures averaged 12.2 and 13.3 C, respectively, during February and March flathead catfish winter experiments, and 27 C during summer experiments. Water temperatures averaged 12.5 and 24 C, respectively, during winter and summer blue catfish experiments. Flathead catfish (range = 352–675 mm total length (TL)) were caught with sizes 7/0 and 8/0 single hooks baited with live green sunfish (*Lepomis cyanellus*), bluegill (*L. macrochirus*), and goldfish (*Carassius auratus*). Blue catfish (range = 165–655 mm TL) were caught with sizes 4/0 to 6/0 single hooks baited with pieces of shad (*Dorosoma* spp.) and goldfish. Fish were held for 72 hours in 0.61 × 0.76 × 0.91-m metal cages to observe delayed mortality. One of 17 flathead catfish (5.9%; 95% one-tail, upper confidence limit (UCL) = 15.2%) died in the winter and 5 of 35 (14.3%; UCL = 24.0%) died in the summer. Four of 43 blue catfish (9.3%, UCL = 16.6%) died in the summer and none of 35 died in the winter. Overall hooking mortality was 11.5% (UCL = 18.8%) and 5.1% (UCL = 9.2%) for flathead and blue catfish, respectively. There were no significant differences in hooking mortality between seasons for either species ($P >$ 0.05).

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 45:392–398

A major assumption of restrictive fishing regulations is that some fish caught and released survive the effects of hooking, landing, and handling to reproduce or be caught again. Desired outcomes of such regulations include increase in recreational quality, higher catch rates, and availability of more trophy fish. High catch rates (mostly of sublegal length fish) have been associated with highly restrictive length regulations (Luebke 1989). High mortality of released fish, however, could reduce the fishable population, thereby impairing fishing quality (Warner 1976).

Hooking mortality (deaths caused by hooking and related handling) has generally been neglected when calculating fishing mortality rates (Clark 1983). Death from hooking may be immediate (within a few hours) as a result of damage to a vital organ such as the gill. Mortality resulting from stress associated with hyperactivity (Parker et al. 1959), from poor conditions in boat live wells (Plumb et al. 1988), or from holding fish in enclosures for long periods (Carmichael et al. 1984) may be delayed and not immediately apparent. Mortality may also result from bacterial and fungal infections (Welborn and Barkley 1974), fatigue (Bouck and Ball 1966), or increased vulnerability to predation as a result of physiological responses associated with hooking stress (Wydoski et al. 1976). Factors reported to affect hooking mortality include origin of fish (wild vs. hatchery-reared) (Wydoski et al. 1976), fish size (Wydoski 1977, Wertheimer 1988), degree of handling (Childress 1989), anatomical location of hook wound (Warner and Johnson 1978, Wertheimer 1988, Payer et al. 1989), water temperature (Dotson 1982), depth from which fish was caught (Feathers and Knable 1983), hook size (Warner 1978), type of tackle used (Clapp and Clark 1989), type of hook (single vs. treble) (Klein 1965), and whether or not natural baits or artificial lures were used (Wydoski 1977).

Stocks of catfishes (*Ictalurus* spp.) face increasing fishing pressure. Flathead catfish (*Pylodictis olivaris*), along with channel catfish (*I. punctatus*) and blue catfish (*I. furcatus*), provide sport and commercial fisheries in streams and reservoirs throughout Texas. Hooking mortality has been documented only for channel catfish (Rutledge 1975). There is no published information on the hooking mortality of flathead or blue catfish. Texas has adopted a statewide minimum length limit of 229 mm total length (TL) for sport harvest of all catfish with a 356-mm TL minimum length limit for the commercial blue and channel catfish fishery in Livingston Reservoir. The purpose of this study was to determine short-term (72-hour) summer and winter hooking mortality of flathead and blue catfish.

This study was made possible by funds from the Federal Aid in Sport Fish Restoration Act, Project F-31-R of the Texas Parks and Wildlife Department. I am very grateful to Billy Follis, Roy Bamberg, Charles Munger, Robert Cole, David Van Meter, Robert Wienecke, Vernon Hodges, and Joe Hernandez for assisting in fish collection. Steven Gutreuter and William Dolman provided statistical consulting service for which I am very appreciative. I thank the Upper Guadalupe River Authority for permitting the use of gas-powered boats on Kerrville Reservoir. I also thank Mike Knight and Glen Adair of the Trinity River Authority for their cooperation. I am grateful to Gary Garrett, Richard Luebke, William Harvey, and Kendall Warner for reviewing the manuscript.

Methods

Flathead catfish were collected in the Colorado River, Coleman County, Texas, during summer (June 1989), and from Kerrville Reservoir, Kerr County, Texas, during winter (February and March 1990). Kerrville Reservoir is a 42.5-ha impoundment on the Guadalupe River. Water temperatures averaged 12.2 and 13.3 C during the February and March flathead catfish experiments, and 27 C during the summer experiment. Blue catfish were collected in Livingston Reservoir, Polk, San Jacinto, Trinity, and Walker counties, Texas, during summer (August and September

1989) and winter (January 1990). Livingston Reservoir is a 36,423-ha impoundment on the Trinity River. Winter and summer water temperatures averaged 12.5 and 24 C, respectively, during the blue catfish experiments. The 2 seasons were chosen because they represented both extremes of temperature when the effects of post-hooking stress could reasonably be assumed to be pronounced.

Each experiment consisted of catching the catfish using equipment, techniques, and handling procedures typical of catfish fishermen and confining the fish in cages for 72 hours to observe delayed mortality. Trotlines were used because both catfishes are caught by trotlining and trotlines could be used with relative ease to catch large numbers of fish. Flathead catfish were caught using sizes 7/0 and 8/0 single hooks baited with live green sunfish (*Lepomis cyanellus*), bluegill (*L. macrochirus*), and goldfish (*Carassius auratus*). Blue catfish were caught using sizes 4/0 to 6/0 single hooks baited with pieces of shad (*Dorosoma* spp.) and goldfish. Although different-sized hooks were used in this study, hook size was not considered as a mortality-related factor. The lines were baited in the evening and the catch was removed at dawn, noon, and at baiting time. In order to minimize damage to the fish, the trotline stagings were either cut (leaving the hooks in the fish) when fish were hooked deep (i.e., hooks were lodged beyond the buccal cavity (Hulbert and Engstrom-Heg 1980)), or the hooks were removed with normal care using fingers only.

Fish were placed in 200-liter wash tubs immediately upon capture and transferred shortly thereafter to metal cages submerged in water where they were then held for 72 hours. Cages were constructed with 15-mm square mesh material and measured 0.61 × 0.76 × 0.91 m. Each experiment had 2 replicates per season. The flathead catfish winter experiment had 8 and 9 fish per replicate, while the summer experiment had 17 and 18 fish per replicate. The blue catfish winter replicates had 16 and 19 fish, while the summer replicates had 20 and 23 fish.

Upon termination of the holding period, the number of fish alive and dead were counted and the total length (mm TL) of each fish was measured. Flathead catfish used in the winter experiment averaged 526 mm TL (range = 352–675 mm, SD = 82 mm) and for the summer experiment they averaged 507 mm TL (range = 382–636 mm, SD = 61 mm). Blue catfish used in the winter experiment averaged 358 mm TL (range = 230–560 mm, SD = 85 mm) and for the summer experiment they averaged 338 mm TL (range = 165–655 mm, SD = 91 mm).

Because the experimental design did not include control groups, it was assumed that all mortality resulted from hooking or hooking-related sources. Hooking mortality, expressed as the percentage of fish dead at the end of 72 hours, was determined for each season, and collectively for the entire study. Ninety-five percent, one-tail, upper confidence limit for mortality (UCL) was also determined. Since data were binomially distributed, differences in mortality between replicates within seasons were compared using chi-square in all tests. A significance criterion of $P \leq 0.05$ was applied.

Results

Flathead catfish

Hooking mortality rates were not significantly different between replicates within season ($P > 0.05$), thus the data were pooled for each season. Overall hooking mortality for the entire study was 11.5% (UCL = 18.8%) and for the winter and summer experiments it was 5.9% (UCL = 15.2%) and 14.3% (UCL = 24.0%), respectively (Table 1). There was no significant difference in hooking mortality between seasons ($X^2 = 0.78$, $P > 0.05$). Two of the mortalities in the summer were immediate (≤24 hours) and the rest were delayed (>24 hours). Some of the fish released at the termination of the experiments had mouth or lip injuries and most had minor wounds around the fins.

Blue catfish

Because hooking mortality rates were not significantly different between replicates within season ($P > 0.05$), the data were pooled for each season. Overall mortality for the entire study was 5.1% (UCL = 9.2%) and for the winter and summer experiments, it was 0% and 9.3% (UCL = 16.6%), respectively (Table 2). There was no significant difference in mortality between seasons ($X^2 = 0.15$, $P >$

Table 1. Seventy-two hour, seasonal post-hooking mortality of flathead catfish caught on trotlines baited with live green sunfish, bluegill, and goldfish in the Colorado River and Kerrville Reservoir, Texas. Ninety-five percent, one-tail, upper confidence limits of mortality are enclosed in parentheses.

	Hooking mortality		
Variable	Winter	Summer	Overall
N fish caught	17	35	52
N fish dead	1	5	6
% mortality	5.9 (15.2)	14.3 (24.0)	11.5 (18.8)

Table 2. Seventy-two hour, seasonal post-hooking mortality of blue catfish caught on trotlines baited with pieces of shad and goldfish in Livingston Reservoir, Texas. Ninety-five percent, one-tail, upper confidence limits of mortality are enclosed in parentheses.

	Hooking mortality		
Variable	Winter	Summer	Overall
N fish caught	35	43	78
N fish dead	0	4	4
% mortality	0	9.3 (16.6)	5.13 (9.2)

0.05). Although sample size was insufficient for statistical evaluation of the effects of size on mortality, 2 of the 4 fish which died were under the 229-mm minimum length limit for sport harvest and 3 of the 4 were under the 356-mm minimum length limit for commercial harvest of blue catfish. Of the 4 hooking mortalities, 2 were immediate (≤24 hours) and two were delayed (>24 hours). Some of the blue catfish had minor mouth injuries and most had minor wounds around the lips and fins.

Discussion

Overall hooking mortalities of flathead catfish (11.5%) and blue catfish (5.1%) in this study were lower than reported for channel catfish (Rutledge 1975) but within the range of rates reported for other species. Rutledge (1975) conducted experiments during May–October and determined 72-hour hooking mortality of channel catfish caught on artificial lures and held in ponds was 25%. Although natural baits were used in this study, they were not always swallowed deep, since most of the fish were hooked in the lips, mouth, and around the head. Because catfish are caught using mostly natural baits and these are generally swallowed deeper than artificial lures, thus contributing to higher hooking mortality, the rates reported here were expected to be higher than would be observed in the portion of a sport fishery utilizing mostly artificial lures. For example, Weidlein (1989) attributed low smallmouth bass (*Micropterus dolomieu*) hooking mortality to the widespread use of artificial lures.

Fish caught by angling are sometimes played for several minutes and sublegal-length fish are generally released immediately upon landing. Playing times of fish caught by angling, however, are considerably less than the average time hooked fish spend on trotlines. Hooking stress is correlated with water temperature and has been implicated in hyperglycemia and hypochloremia in rainbow trout (*Oncorhynchus mykiss*) (Wydoski et al. 1976) and mortality in rainbow trout and cutthroat trout (*O. clarki*) (Dotson 1982). Both blue and flathead catfish are caught year-round in Texas, but most angling and trotlining occur during the warmer months. Consequently, stress from exhaustion (especially during the warmer months) is expected to be a greater contributor to fish mortality in trotline than in angling fisheries, because fish hooked on trotlines may spend several hours (sometimes a few days) on the line after being hooked. Because additional stressors (hauling, water temperature extremes, extra handling, natural bait, and confinement in cages) were placed on the fish in this study, it is reasonable to expect that catfish would experience lower 72-hour hooking mortality in a sport fishery involving fewer stressors.

The results of this study may have been biased as a result of the use of relatively large hooks for blue catfish and the confinement of fish in cages. Hooks used probably represent the average size used on trotlines set for blue catfish but they were probably larger and more damaging than those used by anglers fishing small baits or artificial lures. Fish held in cages may develop fin damage and other superficial injuries related to confinement (Moring 1982). The skin lesions observed on the fish in this study apparently had little effect on the 72-hour hooking mortality, as 4 of the 6 fish that died were hooked in the esophagus and gills, anatomical areas that, when wounded, are known to result in mortality (Wertheimer 1988, Payer et al. 1989). High water temperatures may also make hooking wounds more susceptible to bacterial and fungal infections. Rutledge (1975) reported the presence of pathogenic organisms on dead fish, but did not attribute mortality to diseases. It is possible that, because tissue damage occurred on some fishes, infections could result in higher long-term (>72 hours) mortality.

High seasonal survival rates (flathead catfish, 85.7%–94.1%; blue catfish, 90.7%–94.3%) suggest hooking mortality from trotlining is not a significant source of mortality in either species. This study has demonstrated that under any management strategy necessitating release of some portion of the catch of blue and flathead catfish, high survival of that portion could be expected.

Literature Cited

Bouck, G.R. and R.C. Ball. 1966. Influence of capture methods on blood characteristics and mortality in the rainbow trout (*Salmo gairdneri*). Trans. Am. Fish. Soc. 95:170–176.

Carmichael, G.J., J.R. Tomasso, B.A. Simco, and K.B. Davis. 1984. Confinement and water quality-induced stress in largemouth bass. Trans. Am. Fish. Soc. 113:767–777.

Childress, W.M. 1989. Catch-and-release mortality of white and black crappie. Pages 175–186 *in* R.A. Barnhart and T.D. Roelofs, eds. Catch-and-release fishing—a decade of experience. Calif. Coop. Fish. Res. Unit, Humboldt State Univ., Arcata, Calif.

Clapp, D.F. and R.D. Clark, Jr. 1989. Hooking mortality of smallmouth bass caught on live minnows and artificial spinners. North Am. J. Fish. Manage. 9:81–85.

Clark, R.D., Jr. 1983. Potential effects of voluntary catch and release of fish on recreational fisheries. North Am. J. Fish. Manage. 3:306–314.

Dotson, T. 1982. Mortalities in trout caused by gear type and angler-induced stress. North Am. J. Fish. Manage. 2:60–65.

Feathers, M.G. and A.E. Knable. 1983. Effects of depressurization upon largemouth bass. North Am. J. Fish. Manage. 3:86–90.

Hulbert, P.J. and R. Engstrom-Heg. 1980. Hooking mortality of worm-caught hatchery brown trout. N.Y. Fish and Game J. 27:1–10.

Klein, W.D. 1965. Mortality of rainbow trout caught on single and treble hooks and released. Prog. Fish-Cult. 27:171–172.

Luebke, R.W. 1989. Preliminary results of a 21-inch largemouth bass minimum length limit on angler catch and harvest in a south Texas urban impoundment. Pages 253–267 *in* R.A. Barnhart and T.D. Roelofs, eds. Catch-and-release fishing—a decade of experience. Calif. Coop. Fish. Res. Unit, Humboldt State Univ., Arcata, Calif.

Moring, J.R. 1982. Fin erosion and culture-related injuries of chinook salmon raised in floating net pens. Prog. Fish-Cult. 44:189–191.

Parker, R.R., E.C. Black, and P.A. Larkin. 1959. Fatigue and mortality in troll-caught Pacific salmon (*Oncorhynchus*). J. Fish. Res. Board Can. 16:429–448.

Payer, R.D., R.B. Pierce, and D.L. Pereira. 1989. Hooking mortality of walleyes caught on live and artificial baits. North Am. J. Fish. Manage. 9:188–192.

Plumb, J.A., J.M. Grizzle, and W.A. Rogers. 1988. Survival of caught and released largemouth bass after containment in live wells. North Am. J. Fish. Manage. 8:325–328.

Rutledge, W.P. 1975. Hooking mortality study. Texas Parks and Wildl. Dep., Final Rep., Fed. Aid Proj. F-31-R-1, Austin. 11pp.

Warner, K. 1976. Hooking mortality of landlocked Atlantic salmon, *Salmo salar,* in a hatchery environment. Trans. Am. Fish. Soc. 105:365–369.

———. 1978. Hooking mortality of lake-dwelling landlocked Atlantic salmon, *Salmo salar*. Trans. Am. Fish. Soc. 107:518–522.

——— and P.R. Johnson. 1978. Mortality of landlocked Atlantic salmon (*Salmo salar*) hooked on flies and worms in a river nursery area. Trans. Am. Fish. Soc. 107:772–775.

Weidlein, W.D. 1989. Mortality of released sublegal-sized smallmouth bass, catch-and-release implications. Pages 217–228 *in* R.A. Barnhart and T. D. Roelofs, eds. Catch-and-release fishing—a decade of experience. Calif. Coop. Fish. Res. Unit, Humboldt State Univ., Arcata, Calif.

Welborn, T.L., Jr. and J.H. Barkley. 1974. Study on the survival of tournament released bass on Ross R. Barnett Reservoir, April 1973. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 27:512–519.

Wertheimer, A. 1988. Hooking mortality of chinook salmon released by commercial trollers. North Am. J. Fish. Manage. 8:346–355.

Wydoski, R.S. 1977. Relation of hooking mortality and sublethal hooking stress to quality fishery management. Pages 43–87 *in* R.A. Barnhart and T.D. Roelofs, eds. Catch-and-release fishing as a management tool. Calif. Coop. Fish. Res. Unit, Humboldt State Univ., Arcata, Calif.

———, G.A. Wedemeyer, and N.C. Nelson. 1976. Physiological response to hooking stress in hatchery and wild rainbow trout (*Salmo gairdneri*). Trans. Am. Fish. Soc. 105:601–606.