Catch and Release Mortality of Striped Bass Caught with Artificial Lures and Baits

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Abstract: Mortality of striped bass <20 inches total length (50.8 cm) captured by hook and line was investigated. Both artificial lures and baits were used with single and treble hooks. A control group of fish was captured by electrofishing and handled in a similar fashion. Fish (N = 683) were caught from a freshwater river and a small reservoir during 4 different months of the year (October, February, June, and August). After capture, test fish were transported to holding ponds and held 2 weeks to evaluate total (pre- and post-release) mortality. No fish died prior to release in the holding facilities. There were no significant differences in mortality between any of the groups comparing month and method of capture. Likewise, there were no significant monthly differences between treatments. There were significant differences within treatments for different months when compared separately. Highest mortality occurred during June and August samples respectively for all groups including controls. Mortality associated with catch and release of striped bass <20 inches (50.8 cm) total length may be more a function of combined stress of temperature and hooking/handling stress than hooking stress alone.

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As with any game fish, management strategies often require timely changes of the regulations regarding harvest and legal size limits of the species in question, and striped bass (*Morone saxatilis*) are no exception. A question that often arises when considering the effectiveness of size limits is what are the mortalities associated with release of sublegal size fish that have been caught.

Previous studies on stress or physical damage associated with catch and release have been concerned with trout or salmon (*Salmo*) (Mason and Hunt 1967, Hunsaker et al. 1970, Marnell and Hunsaker 1970, Warner 1976, Hulbert and Engstrom-Heg 1980), or largemouth bass (*Micropterus salmoides*) (May 1972; Rawstron and Hashagen 1972; Welborn and Barkley 1973; Archer and Loyacano 1974; Plumb et al. 1974; Pelzman 1978; Schramm et al. 1985, 1987). Holbrook (1975) estimated total mortality of largemouth bass to range from 16% to 76%.

The major concern associated with hooking mortality is whether it will, in actuality, defeat the intended purpose of size limits, which is to increase the number of large fish in a population. Both minimum and maximum length limits are commonly used to manage striped bass, but the effect of catch and release has not been investigated for this species. Therefore, it was the objective of this study to evaluate the magnitude of mortality associated with the release of sublegal size striped bass that have been captured by hook and line.

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Methods

This study was designed to examine mortality associated with the catch and release of striped bass of a size that would be released under most state regulations of both inland and coastal states. The range of size limits was obtained from a regulation synopsis provided to the Striped Bass Committee, Southern Division, American Fisheries Society. Therefore, a maximum size of 20 inches (50.8 cm) was chosen as the size cut-off for this study.

Striped bass were captured during October, February, June, and August from either the Santee River, South Carolina, or from a reservoir in Kent County, Maryland. Fish were captured by anglers using both artificial lures and baits. Artificial lures consisted of plugs with at least 2 treble hooks and single hook lead head lures, such as bucktails. Baits included cut blueback herring (*Alosa aestivalis*) and live minnows (*Notemigonus crysoleucas*). A control group of fish were captured each season with electrofishing with a 230V AC generator which had an average output of 6 Amps.

A minimum of 50 fish were caught each sample month by each of the 2 fishing devices (artificial lures and baits) and at least 25 fish were caught during the same test interval by electrofishing (Table 1). Hooked fish were played in a usual fashion using medium action rods and 20-pound test line before they were landed. No special handling or care was offered either in the playing, landing, or transport of the captured fish. Fish that were gut or hooked in the esophagus had the line cut as close to the hook as possible as recommended by Mason and Hunt (1967) and Hulbert and Engstrom-Heg (1980) to prevent further damage from attempting to remove the hook.

Once captured, all fish, both hooked and control, were placed on a transport truck with a rectangular hauling tank (average density of 0.2 kg/liter) containing

Table 1. Number and median size (cm) of striped bass caught by season and device during a study to determine hook and release mortality.

Month	Artificial lures N (cm)	Baits N (cm)	Control N (cm)
October	50 (43.2)	50 (45.7)	30 (44.5)
February	50 (41.9)	50 (40.6)	30 (43.2)
June	133 (44.5)	125 (43.2)	40 (44.5)
August	50 (40.6)	50 (43.2)	25 (41.9)
Total	283	275	125

freshwater from the same source as capture. Additional oxygen was provided by a diffuser tube connected to bottled oxygen. No salt or anesthetic was added to the water. After transport, fish were held in either a 0.25-ha pond in South Carolina or in 3 14-m^3 (2.5 m × 2.5 m × 2.3 m) net-pens at a density of 4.6 kg m^{-3} (≈1.2 fish/m^3) in Maryland. Fish were held for 2 weeks to allow for determination of post-release mortality. Then either the ponds were drained or net-pens removed and survival, general health, and external bacterial or fungal infections were noted.

Results and Discussion

None of the fish collected died prior to release in the holding facilities; therefore, mortality is expressed as total mortality. A total of 107 (15.7%) of the 683 fish captured died by the end of the 2-week holding period (Table 2). In each treatment, mortality was highest in June and August. Mortality was <6% during October and February (Table 2).

Statistical Chi square analysis using Yates' correction for continuity (Zar 1974) revealed no significant difference in mortality between overall comparisons of artificial lures, baits, or control survivals (Table 2). Likewise, there were no significant monthly differences between the treatments. However, differences within a given treatment for different times of year were significant. In particular, there were significant differences ($P \leq 0.05$) between June and August, August and October, and August and February for every treatment; June and February for both artificial lures and baits; and June and October for the artificial lures. Most mortality (85 out of the 107, 79.4%) occurred within 72 hours of capture and the remaining mortality was spread over the 2-week holding period.

A total of 13 fish were considered deeply hooked (Hulbert and Engstrom-Heg 1980) and all were captured with baits. Three (23%) of the 13 died during the 2-week holding period. The 10 surviving fish appeared to be in similar health to those fish that were hooked in the mouth.

Survival decreased with increasing water temperatures. During both June and August, a total of 12 fish developed fungal and bacterial (*Flexibacter columnaris*) infections. Most of the infections appeared to be with what was thought to be those fish that were accidentally dropped on the ground or rocks before being placed in the hauling truck. Unfortunately, none of the fish "mishandled" were identified.

Table 2. Percent mortality of striped bass associated capture and release. Capture techniques included hook and line (treatment) and electrofishing (control) during four separate times of the year.

	Artificial lures		Baits		Control	
Month	Number of fish	Percent mortality	Number of fish	Percent mortality	Number of fish	Percent mortality
October	48	4.0	47	6.0	29	3.4
February	49	2.0	50	0.0	29	3.4
June	105	21.0	103	17.6	37	7.5
August	32	36.0	30	40.0	17	32.0
Total	234	17.3	230	16.4	112	10.4

Thus, positive correlations could not be determined. Those fish caught during October and February had a good appearance and no major signs of fungal or bacterial infections.

It is important to note that there was no significant difference between survival of control fish and hooked fish during the times of poorest survival (Table 2). This indicates that hooking is not the sole source of mortality, especially in August. Although mortality is probably influenced by stress associated by hooking, playing, and handling, it is not the only factor that must be considered.

Previous studies associated with confinement- and hauling-induced stress with both largemouth bass and hybrid striped bass have indicated short term exposure to poor water quality, netting, and/or hauling can significantly influence blood chemistry levels, in particular, corticosteroid and glucose levels (Tomasso et al. 1980; Carmichael et al. 1984*a,b*). These chemicals are commonly used as stress indicators in fish. Similarly, it has long been recognized stress can induce osmoregulatory dysfunctions in fishes (Lewis 1971, Wedemeyer 1972). Coutant (1985) stated that striped bass can be stressed to the point of mortality at high temperatures (>25°C) in reservoirs and it is possible this interaction of osmoregulatory dysfunction, temperature, and hooking/handling stress, combined to cause the high mortality in treatments and controls during the warmer months. The ponds in both South Carolina and Maryland often exceeded 25°C for the length of the holding period for both the June and August samples. If Coutant's (1985) hypothesis is correct, there was no thermal refuge for the fish to retreat to in the ponds as there may be in some reservoirs or coastal rivers. Temperature stress may have further exacerbated the stress levels and may have been the critical factor that contributed to mortality. Thus, if a released fish in the wild could find a thermal refuge it may have a better chance of survival than these results indicate, because the fish would not be subjected to the additional continued stress of high temperature as our treatment fish were.

In addition to both handling (each sample) and temperature stress (during June and August), treatment fish were subjected to a worst case situation that would not normally be found as when under actual fishing conditions sublegal size fish are caught and immediately released. The normal procedure for this study involved hooking, playing, hook removal, placement in the transport truck, hauling, removal from transport truck, and placement into the holding facilities. Thus, fish for this study went through at least 1 extra handling in off-loading from the transport truck (the control fish had 2 extra handlings; once from the boat to the truck and once from the truck to the pond or pen). Also, on occasion, fish were held in excess of 3 hours on the transport truck while enough fish were being captured to meet the minimal treatment sample size. It has already been mentioned what the effect of handling and confinement can do to the physiology of fish. Yet, throughout the study, there was no pre-release mortality.

Although total mortality (15.7%) was within ranges commonly associated with "catch and release" tournaments sponsored by Bass Anglers Sportsman's Society (B.A.S.S.) (see reviews in Holbrook 1975; Schramm et al. 1985, 1987), the higher mortality levels found during June and August may be unacceptable to many fisheries managers. As stated, there was evidence of synergistic effects between temperature and capture related stress during the 2 warmest sample periods of June and August.

These results may lead managers to consider closed seasons or allowances, especially during the warmer months, in which sub-legal sized fish could be kept. A seasonal management consideration would be prompted by the higher mortalities found during the warmer months (40% as was the case in August fish captured with bait). This higher mortality brings up the question of would a seasonal strategy be self-defeating if a high percentage of incidental catches die? Fish in this study were subjected to extremes with regard to stress that would not normally be found in an actual fishing situation and even then 60% of captured fish survived in the worst situation. Since there were additional stressors placed on fish, is it reasonable to assume in an actual catch and release situation, mortality would be less than that exhibited in this study? I feel it is, and therefore, believe seasonal regulations may be an answer. However, each system will have to be evaluated individually. Coastal systems will have an advantage over inland systems because the salinity levels will help ameliorate potential osmoregulatory dysfunction and electrolyte imbalance situations which result from stress. Likewise, many inland reservoirs offer thermal refuges for stressed fish. The answer may simply be in the education of striper fisherman in the proper releasing techniques of sublegal size fish, the proper sizing of live wells and/or the use of salt. B.A.S.S. anglers have progressed a long way in improving survival rates of released bass and it may be the time for striper fishermen to consider adopting similar techniques especially during tournaments.

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