Effect Of Catch-And-Release Angling On The Survival Of Black Sea Bass

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Effect of Catch-and-Release Angling on the Survival of Black Sea Bass

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Abstract.—We tested the hypothesis that black sea bass *Centropristis striata* captured and released by anglers experience zero mortality. Black sea bass captured by hook and line in Nantucket Sound, Massachusetts, were tagged and held in wire cages on site for 48 h. Hook location and physical condition were recorded for each fish. Concurrently, black sea bass used as controls were collected from commercial fish pots, tagged, and held under similar conditions. A preliminary experiment established that neither tagging nor densities up to 12 fish per cage caused mortality. During the 48-h posthooking period, 3 of the 64 fish tested died, resulting in an estimated hooking mortality of 4.7%. The three fatalities were among five fish hooked in the esophagus. We concluded that survival is high among small caught-and-released black sea bass (<27 cm standard length) and that release of hooked fish has little effect on total fishing mortality.

Recreational catches of black sea bass *Centropristis striata* in the middle Atlantic and New England states constitute an important component of total landings for the species. In 1988, the Marine Recreational Fishery Statistics Survey (MRFSS) estimated recreational landings at 1,600 tonnes, or 48.5% of the total black sea bass landings north of Cape Hatteras (USDOC 1989). Thirty percent of the harvest occurred within bays and estuaries, 22% in open water within 4.8 km (3 mi) of shore, and 48% beyond 4.8 km (NMFS 1991).

Recreational catches are reported in three categories: fish that are caught and landed whole (type A), fish that are caught and filleted or discarded dead (type B1), and fish that are caught and released alive (type B2). Since 1979, the estimated number of black sea bass in the B2 category has averaged 35% of the total number caught (range, 8–58%). Final estimate of harvested fish currently includes only types A and B1; it is assumed that all released (B2) fish survive.

An assumption of 100% survival of B2 fish may underestimate the fishing mortality attributable to the recreational fishery. Estimates of hooking-mortality rates for other species, primarily salmonids, have been as high as 50% (Wydoski 1977). Hooking mortality may be as high as 27% for black sea bass (Rogers et al. 1986). Furthermore, the relationship between hooking mortality and fish size has important management implications when minimum-size restrictions or bag limits are imposed on recreational fisheries. The minimum-size limits for black sea bass in Massachusetts—30 cm total length (TL) and 27 cm standard length (SL)—have been in effect since 1985. To develop an estimate of hooking mortality for black sea bass in the Massachusetts recreational fishery, we experimentally determined the immediate mortality of caught and released fish of both sublegal (<27 cm SL) and legal size (≥27 cm SL).

In a preliminary study we determined the appropriate fish density per experimental cage and the mortality attributable to tagging. We then experimentally tested the null hypothesis that fish hooked and released experience zero hooking mortality. The experiment was conducted in Nantucket Sound, Massachusetts, during the spring of 1988 and 1989 (Figure 1). Originally, we also intended to examine the secondary effects of air and water temperatures on mortality during summer and fall, but experimental animals were unavailable then. The sampling was conducted at depths of 6–12 m, where water temperatures ranged from 13.3 to 13.6°C.

In the preliminary study of density and tagging effects, 48 black sea bass under 27 cm SL were obtained from commercial fish pots. Fish were transported about 1 km in a tank with flowing seawater at ambient temperature to the experiment site. There, 4, 8, or 12 untagged fish were placed in one of three vinyl-coated wire cages (1 m × 0.6 m × 0.5 m), and 4, 8, or 12 fish tagged with a Floy T-tag below the posterior dorsal fin were placed in similar cages. The weighted cages

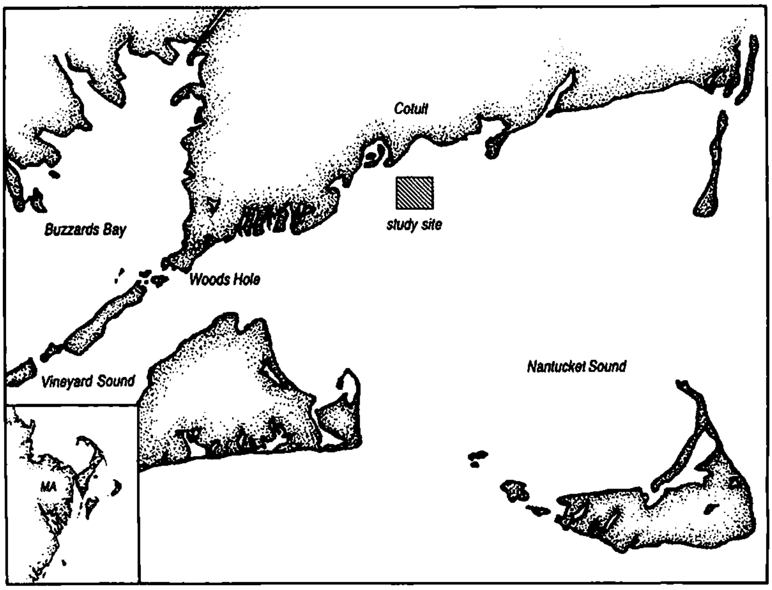

FIGURE 1.—Map of Nantucket Sound, Massachusetts, showing study site offshore from the town of Cotuit.

were placed randomly on the bottom (rock–gravel substrate) in 6 m of water. After 48 h the cages were retrieved; no mortality was observed among tagged or untagged fish at any of the densities. Therefore, densities of 12 or fewer fish per cage and the tagging operation were considered to have no adverse effect on short-term survival.

The hooking-mortality experiments were conducted with the same cage arrangements used in the preliminary study, but control as well as experimental fish were tagged. The cage arrangements were determined by the number of fish caught by hook and line each day. No more than 12 hooked or control fish were placed in a cage, and all cages were submerged at the same experimental site.

Hooked fish were caught with double #2 hooks baited with surf clams or squid and drifted along the bottom. A 15-m research vessel, the *F.C. Wilbour,* served as the fishing platform, and the 24 anglers were laboratory personnel with various levels of fishing expertise. After the fish were unhooked by the anglers, we tagged the fish and recorded hook location. Fish were held in a 568-L tank with flowing seawater until the end of the day, when they were placed in cages at the experiment site. Equal numbers of black sea bass were obtained from commercial pot fishermen, tagged, and placed in wire cages. After 48 h the condition of hooked fish and controls was recorded and the standard and total lengths (cm) were measured.

Four fishing trips during the spring of 1988 and 1989 resulted in the capture of 44 black sea bass under and 20 over the legal size of 27 cm SL. Size frequency of the hooked fish is shown in Figure 2A. Three of the hooked fish died within 5 h of capture and before being caged. None of the hooked or control fish held in the cages died. Overall, mortality from the experiment (95% confidence interval, CI) was estimated at 4.7% (1.0–12.9%) (Snedecor and Cochran 1967). By size-category, mortality was 2.3% for sublegal fish and 10% for legal fish (Table 1).

Only black sea bass hooked in the esophagus died. A higher percentage of larger fish swallowed the hook, but two smaller fish did so as well (Table 2). The rate of hook ingestion among all fish was 7.8% (95% CI, 2.6–17.0%). Of the five fish that swallowed the hook, two were released by cutting the line, and the other three had the hook forcibly

TABLE 1.—Sample size and hooking-mortality estimates for black sea bass. Parenthetic values are 95% confidence intervals.

	Standard length	
Sample statistic	≤27 cm	>27 cm
Number caught	44	20
Number dead	1	2
Percent dead	2.3% (0.06–12.1%)	10% (1.2–31.7%)

TABLE 2.—Relationship between mortality, fish standard length, and hook location in black sea bass. Parenthetic values are 95% confidence intervals.

Length category	Jaw-hooked fish: Number hooked	Jaw-hooked fish: %	Jaw-hooked fish: Number dead	Esophagus-hooked fish: Number hooked	Esophagus-hooked fish: %	Esophagus-hooked fish: Number dead
≤27 cm	42	95.5 (89.2–100)	0	2	4.5 (0.1–15.6)	1
>27 cm	17	85.0 (69.0–100)	0	3	15.0 (3.4–37.9)	2

removed. Only the two fish with the hook left intact survived.

Black sea bass released after 48 h in the cages showed no signs of physical damage from hooking. Gas bladders were slightly distended when fish were brought to the surface, most notably in larger fish. Fish had no difficulty swimming toward the bottom when released.

In the New England recreational fishery for black sea bass, 58% of recent landings have come from bays and estuaries (NMFS 1991). Therefore, we believe the conditions of our experiment are representative of the Massachusetts recreational fishery. The size of the fish we used corresponded to the black sea bass length distribution in the 1988 MRFSS (Figure 2). The wide range of fishing expertise among anglers participating in the experiment helped minimize any bias in hooking or hook-removal techniques associated with experience level. The use of nonhooked control fish enabled us to separate the effects of hooking from captivity-related mortality. For these reasons we conclude that a reliable estimate of hooking mortality among black sea bass in Massachusetts waters is within the range determined by our study.

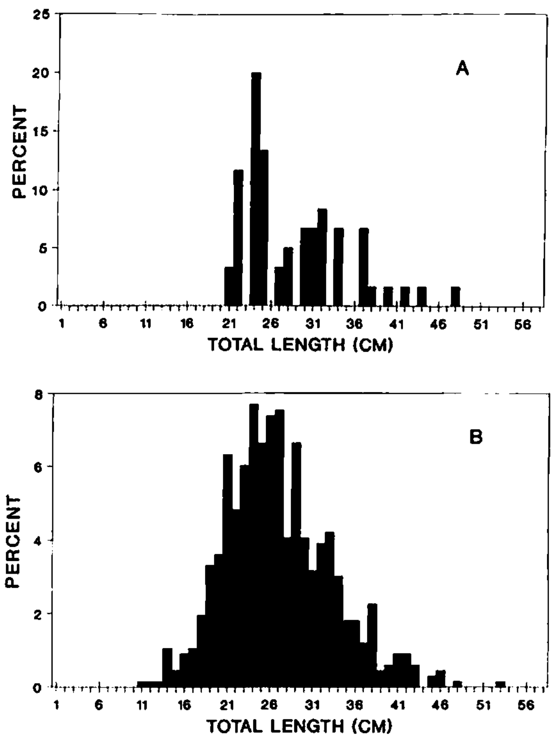

FIGURE 2.—Length-frequency distributions of (A) of black sea bass captured in the hooking mortality study and of (B) black sea bass north of Cape Hatteras, North Carolina, sampled in the 1988 MRFSS.

Survival of hooked and released black sea bass may be related to their feeding behavior and anatomical characteristics. Only fish that ingested the bait and were consequently hooked in the esophagus died during our experiment. Smaller fish with smaller mouths may be less able to swallow a baited hook than larger fish. Sublegal fish in our study had a lower frequency of hook swallowing than legal fish, and a relatively high survival rate. Aquarium observations of feeding black sea bass (H. Jensen, National Marine Fisheries Service, personal communication) indicate that larger fish are the more aggressive feeders; hence, they may be more likely to swallow a baited hook and to die from resulting injuries.

Hook ingestion may increase mortality (1) by trauma associated with physical damage from the hooking process, and (2) by trauma associated with the increased handling time necessary for hook removal. In this study two fish hooked in the esophagus retained the hook after the line was cut; both fish survived, and hooks were not present in either fish following the 48-h holding period. All jaw-hooked fish survived handling. Apparently, the physical damage caused by removal of a swallowed hook was the primary cause of death. If all black sea bass that swallowed the hook were potential fatalities, total hooking mortality could be as high as 7.8%.

Depth of capture may also determine physical damage. Rogers et al. (1986) indicated that black sea bass caught in deep water (37 m) were severely traumatized by displacement of the swim bladder through the cloaca or mouth. This type of trauma is relatively minor in the Massachusetts inshore hook-and-line fishery, which general takes place at depths less than 20 m. Black sea bass used in this study were captured at depths of 6–12 m, and although some of the larger fish exhibited slight extension of the abdomen, their ability to recover after release was not impaired. There was no reason to believe that fish released in healthy condition would be subjected to predation beyond a normal level. Retrieval of fish from deeper water increases the likelihood of distended bladders, which in turn could hinder swimming skills and descent. Consequently, released black sea bass with distended bladders are subject to greater predation by piscivorous fish and birds. The degree of such predation should be examined in future experiments.

Waters and Huntsman (1986) suggested that the minimum-size limit necessary to maximize yield per recruit for a population will be reduced as mortality of released fish increases. They found that a reduction in percent survival of released fish from 100 to 60% may reduce the optimal minimum size by 36%. As the mortality of undersized fish increases, the utility of minimum-size restrictions becomes doubtful. The high survival rate among sublegal black sea bass in Massachusetts indicates that a minimum-size restriction in the recreational fishery is an appropriate option for maximizing yield and reducing fishing mortality.

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