# Natural and Induced Production of Striped Bass Hybrids in Tanks[1]

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*Abstract:* Natural and induced production of striped bass hybrids was examined under controlled tank conditions. Four culture female $F_1$ hybrid bass (striped bass, *Morone saxatalis* × white bass, *M. chrysops*) received human chorionic gonadotropin (HCG) and ovulated, but only 2 spawned eggs. These eggs, deposited in fresh water, were fertilized by HCG-treated cultured male $F_1$ hybrids. One untreated (no HCG) female $F_1$ hybrid which was paired with 2 untreated male $F_1$ hybrids and held in brackish water (13 ppt salinity) also tank spawned and fertilized eggs were produced. This is the first documented case of a non-induced "natural" tank spawn among these striped bass hybrids. Hatch rates for the $F_1 \times F_1$ hybrid cross were low. One attempt to induce a tank spawn between a HCG treated female white bass and 2 similarly treated male striped bass was not successful.

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Striped bass were first hybridized with white bass in the early 1960s through the use of hormones (Stevens 1965). Since then, other striped bass hybrids have been produced, but the original cross (female striped bass × male white bass) and the reciprocal cross (female white bass × male striped bass) have proven to be the most popular. These hybrids have a number of desirable characteristics which include rapid early growth, high survival rates, general hardiness, and adaptability to a wide range of environments (Bishop 1968; Bayless 1968, 1972; Kerby 1972; Ware 1975; Kerby and Joseph 1979; Smith and Jenkins 1985 *a,b*). As a result, striped

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bass hybrids have been stocked in numerous reservoirs as well as inland streams and estuaries in the United States (Stevens 1984).

Striped bass/white bass hybrids are generally stocked as a management tool to help control forage fish populations in reservoirs and to provide enhanced fishing opportunities. Research has demonstrated that these hybrids will mature and that $F_2$ hybrids ($F_1$ hybrid × $F_1$ hybrid) and backcrosses ($F_1$ hybrid × parent species) can be artificially produced in the laboratory (Bayless 1972). There has been substantial discussion concerning the ability of $F_1$ hybrids to spawn "naturally" in the wild. No conclusive evidence of natural hybridization between striped bass and white bass has been demonstrated but apparent spawning behavior in natural habitats has been observed (Williams 1972).

Recent research demonstrated that $F_1$ hybrids (female striped bass × male white bass) will tank spawn when both parents are injected with hormones (Harrell 1984, Smith and Jenkins 1984); however, $F_1$ hybrids have not been shown to tank spawn without hormonal stimulation.

Objectives of this research were: 1) to determine if striped bass, white bass, and $F_1$ striped bass hybrids (original cross) could be matured in recirculating water systems; 2) to test if $F_1$ striped bass × white bass hybrids would naturally hybridize; and 3) to test if HCG-injected female white bass would tank spawn with similarly injected striped bass males.

## Methods

All fish used in the study were held in recirculating water systems at the Marine Resources Research Institute in Charleston, S.C. Wild-caught whit bass and 3-year-old cultured $F_1$ hybrid bass were held and reared in 6.1-m × 1.5-m deep cylindrical outdoor tanks. Three-year-old cultured striped bass were reared and matured in 3.7-m diameter × 0.9-m deep indoor tanks and subjected to controlled temperature and photoperiod (Smith and Jenkins 1984, 1985*b*). The striped bass and $F_1$ hybrids were cultured in recirculating brackish water systems (15 ppt salinity) while the white bass were held in fresh water. All fish were fed a variety of foods which included (in order of importance) commercial trout rations, chopped squid, and live killifish (*Fundulus* spp). In treatments in which HCG was employed, the hormone was administered intramuscularly at a dosage of 330 I.U./kg body weight.

The attainment of the objective of study I—to demonstrate maturation of striped bass, white bass, and $F_1$ striped bass/white bass hybrids in captivity—was required before spawning trials could be initiated. Gonadal development was monitored during the conditioning phase of the experiment. Female maturity was assessed by measuring egg diameter from egg samples obtained by inserting a 3-mm o.d. glass catheter through the genital opening (Bayless 1972). A minimum of 10 eggs from each female were measured using a dissecting microscope and an ocular micrometer. Male gonadal development was qualitatively determined by abdominal compression and inspection for presence of milt. Cultured animals were considered

**Table 1.** Data from tank spawning trials with $F_1$ striped bass hybrids, striped bass, and white bass. Treatment 1 = HCG $F_1$ × HCG $F_1$; Treatment 2 = no HCG $F_1$ × no HCG $F_1$; Treatment 3 = HCG white bass × HCG striped bass.

| | Females | | | Number of Eggs | | Males |
|---|---|---|---|---|---|---|
| | | Length | | | | |
| | Weight (kg) | F.L. (mm) | T.L. (mm) | Spawned | Hatched | *N*/tank |
| Treatment 1: | | | | | | |
| Rep. 1 | 1.5 | 422 | 452 | 0 | 0 | 2 |
| Rep. 2 | 1.4 | 415 | 445 | 327,026 | 100[a] | 1 |
| Rep. 3 | 1.9 | 457 | 486 | 353,100 | 3,000 | 2 |
| Rep. 4 | 1.2 | 408 | 428 | 0 | 0 | 1 |
| Treatment 2: | | | | | | |
| Rep. 1 | 1.2 | 411 | 435 | 265,000 | 50 | 2 |
| Treatment 3: | | | | | | |
| Rep. 1 | 0.5 | 325 | 350 | 0 | 0 | 2 |

[a]Hatchery system malfunction; eggs in McDonald jars died. Eggs in petri dishes hatched.

mature when mean egg diameter was greater than 750μ and milt could be readily expressed from males.

The objective of study II was to test the natural and induced production of striped bass hybrids under controlled conditions. To accomplish this objective, 3 treatments were run. In the first treatment, 4 hormone-injected female $F_1$ striped bass × white bass hybrids, ranging in size from 1.2–1.9 kg and with egg diameters ranging from 755–853μ were stocked in separate tanks with 1 or 2 hormone-injected hybrid males (Table 1). These tanks were supplied with recirculated fresh water. In the second treatment, 1 uninjected female $F_1$ striped bass × white bass hybrid (with a mean egg diameter of 1.30 mm) was stocked with 2 uninjected male $F_1$ hybrids in recirculating brackish (13 ppt) water (Table 1). In the third treatment, 2 hormone-injected striped bass males were stocked in a spawning tank with 1 hormone-injected white bass female. Fish in the third treatment were stocked in a flow-through fresh water system. The fiberglass tanks, 1.8-m diameter × 0.9-m deep, used during these spawning experiments were similar to those described for tank spawning of striped bass (Bishop 1975). Rooms containing the spawning tanks were kept dark during the experiment to avoid stressing the fish. After stocking, the spawning tanks were checked regularly for the presence of spawning behavior and or eggs.

## Results

Striped bass hybrids and white bass held in the outdoor tanks were in spawning condition by April. In the indoor controlled system, the male striped bass came into spawning condition in January and remained this way through April. In the first treatment of study II (injected $F_1$ × $F_1$), 2 females spawned in 24 hours and each released over 300,000 eggs (Table 1). These eggs were transferred to McDonald hatching jars for incubation. A small sample of eggs from each female was also placed in petri dishes to observe egg development. A subsequent hatchery system malfunction resulted in the loss of all eggs from 1 female; however, 1% of the second female's eggs hatched (Table 1). A small percentage of the 2 batches of eggs in the petri dishes also hatched. The other 2 females in this treatment ovulated but no eggs were discharged.

In the second treatment (uninjected $F_1 \times F_1$) the $F_1$ hybrids spawned less than 5 hours after being transferred from the outdoor holding tank. One hundred and sixty-five thousand eggs were transferred to the hatchery for incubation and 100,000 eggs were left to incubate in the brackish water (13 ppt) spawning tank. No eggs left in the spawning tank hatched and only 50 sac-fry were produced in the hatchery.

Fish in the third treatment (injected white bass female × injected striped bass males) did not tank spawn. When the white bass female was examined 48 hours after injection, eggs had been ovulated but were overripe.

## Discussion

This work showed that cultured male striped bass and $F_1$ striped bass × white bass hybrids can be grown and matured in captivity (Smith and Jenkins 1984, 1985*b*). Additionally, it was demonstrated that wild caught white bass can be matured in recirculating water systems. Results of treatment I of study II confirmed that $F_1$ striped bass × white bass hybrids can be induced to tank spawn using hormones (Harrell 1984, Smith and Jenkins 1984). The reason that 2 females in the treatment did not discharge their ovulated eggs may be the result of oviduct damage caused by the catheter used to remove an egg sample before the fish were injected. The females used in the studies were much smaller than those used in most hatcheries, thus the chance for oviduct injury was increased. Hatcheries which routinely use tank spawning techniques do not sample eggs prior to injection to avoid this problem (D. Bishop Tenn. Wildl. Resour. Agency, pers. comm. 1985).

The "natural" tank spawning of cultured $F_1$ striped bass hybrids (female striped bass × male white bass) has not been previously reported. In treatment 2, the only pair of $F_1$ hybrids tested did successfully spawn without hormone inducement and this occurred in brackish water. Hatch rates were low for both the natural and induced spawning treatments. In treatment 1 (hormone induced $F_1 \times F_1$) this was due to hatchery system malfunction and a high incidence of fungal growth on incubating eggs. In treatment 2 (no hormones $F_1 \times F_1$) poor hatch rate was probably due in part to exposure to the 13 ppt recirculated water for 1–2 hours before collection. Previous work resulted in hatch rates of 10% for these $F_2$ hybrids (Smith and Jenkins 1984*a*). In the present study, we suspect that the use of domesticated fish contributed substantially to the "natural" tank spawning of the $F_1$ hybrids. Unlike wild brood stock, cultured fish have been selected for and adjusted to captive conditions.

The attempt to induce a female white bass to spawn with 2 male striped bass was unsuccessful. However, as only 1 test was conducted such results can not be considered conclusive.

This research demonstrated that cultured striped bass × white bass hybrids are capable of spawning naturally under controlled conditions. $F_2$ hybrids ($F_1 \times F_1$) exhibit a high incidence of morphological deformities, low survival rates, and widely divergent individual growth rates (Smith et al. 1985). Also, in culture most male $F_2$ hybrid bass matured at $\leq 1$ year of age while females had well developed ovaries at a similar age (Smith and Jenkins, unpubl. data).

Our data suggest that fishery managers should be aware of the possibility of natural hybridization by the hybrids and/or of backcrosses to parental species in planning stocking programs. Further experimentation should be conducted to provide additional information on the reproductive responses of the $F_1$ hybrids (striped bass × white bass) in nature.

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