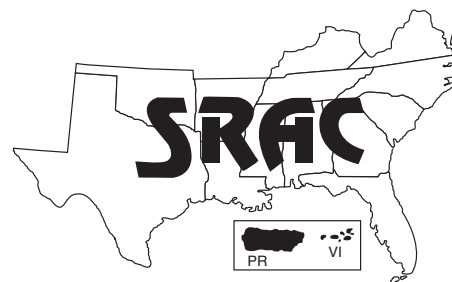


Southern Regional Aquaculture Center



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Hybrid Striped Bass: Hatchery Phase

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Hybrid striped bass (white bass, *Morone chrysops*, × striped bass, *M. saxatilis*) support the fourth largest fish farming sector in the United States. Next to salmon, they are the main marine finfish product marketed by U.S. aquaculture producers. The farming of hybrid striped bass in the U.S. grew by more than 600 percent from 1988 to 1993, but annual production is now level at about 14 million pounds because of high production costs and concern about consistent fingerling supply. Hybrid striped bass are either palmetto bass (female striped bass × male white bass) or sunshine bass (female white bass × male striped bass). Commercial hatcheries mostly produce sunshine bass because white bass females are more easily acquired and spawned than striped bass females.

This discussion of hatchery techniques emphasizes sunshine bass. Since methods used to procure, transport, hold and spawn broodstock are very specific, readers interested in more detail should visit existing facilities.

Broodstock acquisition and handling

Hatcheries rely on the use of either wild-caught or domesticated broodstock or both (Fig. 1). To our knowl-

edge, North Carolina State University is the sole provider of domesticated white bass and striped bass to private industry at this time. Methods of holding domesticated broodfish are very site specific, and are just being initiated by private industry.



Figure 1. Mature white bass.

White bass

White bass are restricted to freshwater. Adults make spawning migrations from lakes and reservoirs to inflowing streams. They generally spawn in rocky areas where water flow is turbulent. Peak spawning season is from late March to late May depending on location. Male white bass usually arrive at the spawning grounds before the females. Peak spawning activity occurs when water temperatures are 16 or 18 °C. There is usually more than one spawning period for a specific population.

Until 2007, most private hatcheries obtained white bass broodstock from

catch fisheries (seine nets) in Lake Erie. The recent outbreak of viral hemorrhagic septicemia (VHS) in the Great Lakes region led to a moratorium on the transport of live fish outside the region.

Wild white bass are now being caught by hook and line in lakes and reservoirs in the Mississippi River and Tennessee River drainages, usually with the assistance of local fishermen. Hook and line collections work well for white bass males and females because these relatively small fish are easy to catch in spring as schools of fish migrate towards spawning grounds. It is important to know about catch limits, the legality of using wild fish as broodstock, and regulations regarding the transport of live fish within and between states. Most private hatcheries annually collect 100 to 300 female white bass weighing 1.5 to 3 pounds per fish. More experienced hatchery operators may also keep 10 to 20 male white bass (0.5 to 2 pounds per fish) on hand during the spawning season in case promising female striped bass become available for producing palmetto bass.

Male white bass will begin producing sperm in the winter and may be identified by gently squeezing the abdomen. The presence of sperm positively identifies males, while the absence of sperm makes it probable the fish is

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a female. Females selected should be robust and in good health. A swollen abdomen indicates well-developed ovaries or a recent meal. It is better to mistake a few males as females than to apply too much pressure to the abdomen during inspection and damage the ovaries of females.

Broodstock, especially females, should be handled carefully with as little stress as possible. Frequent handling of broodstock or unnecessary roughness may inhibit ovulation or increase mortality. Boats for collecting white bass need live-haul boxes that can maintain good quality water saturated with oxygen. Some fishermen use floating net cages about 4 feet in diameter and 4 feet deep to stockpile fish during collections. Once the desired number are collected, fish are loaded on live-haul trucks and transported to the hatchery. Fish should be transported in oxygen-saturated water with 3 to 10 g/L of salt (NaCl) added to reduce osmoregulatory stress. Some haulers also use anesthetics, ammonia removers and defoamers from aquaculture suppliers. Ice can be added to minimize changes in temperature. If the hauling water is less than 20 to 30 mg/L in hardness, hardness should be increased to 100 mg/L using calcium chloride (CaCl₂).

White bass broodstock, NCSU-WB1, have been domesticated over seven generations in captivity at the Pamlico Aquaculture Field Laboratory, North Carolina State University. The NCSU-WB1 are the product of an original founder stock established in 1990 by crossing white bass from Lake Erie with fish collected from tributaries of the Mississippi River in an attempt to enhance genetic variability. Domesticated white bass broodstock are now being transferred from research institutions to commercial hatcheries. In 2007, private hatcheries began rearing the NCSU-WB1 domesticated line of white bass. Female NCSU-WB1 should be ready for spawning at private hatcheries in the spring of 2010.

Striped bass

Most commercial hatcheries in North Carolina and South Carolina use domesticated male striped bass. If wild-caught males are used, they are collected from late winter to early spring when the water temperature is less than 18 °C. Spawning runs for striped bass occur from late March to late May, depending on location. Male striped bass are collected by pound nets located in estuaries or by hook and line in estuaries, lakes and reservoirs. Most private hatcheries keep 10 to 30 male striped bass. For ease of handling, the preferred size of males is 2 to 5 pounds. Private hatcheries usually work with commercial fishermen (e.g., pound netters) to acquire additional males and especially promising females. For special needs or in emergencies, freshly collected and chilled striped bass sperm may be used within 30 hours to produce sunshine bass. As private hatcheries gain trust in the use of domesticated male striped bass, they are abandoning the use of wild-caught fish. While male striped bass may be collected by hook and line without affecting gamete quality, that is not the case for female striped bass broodstock. Gravid females often die from stress after capture by hook and line. In general, female striped bass are rarely spawned by private hatcheries and the few that are come from pound nets.

Broodfish handling in the hatchery

After capture and transport, broodfish should be acclimated by slowly adding hatchery water to the hauling tank. Fish are then transferred to hatchery tanks. Fish should be treated for ectoparasites with formalin in either the hauling tank or hatchery tank. Concentration and duration of treatment vary widely and are dependent on hatchery design and water availability for flushing or dilution. *Ichthyophthirius multifiliis*, which causes Ich disease, is the most problematic parasite of white bass because of its virulence, complex life cycle, and the difficulty of treating

it. Keeping salinity between 3 and 10 g/L NaCl is the simplest and most effective method of treating Ich.

Female striped bass are usually spawned soon after collection. White bass and male striped bass broodstock are generally collected several weeks before they are spawned in the hatchery. It is usually necessary to have facilities for holding broodfish so that fish health and gamete quality can be optimized, and the time of spawning coordinated with pond temperatures for fry rearing. In producing hybrid striped bass, it is best to follow the natural spawning cycle of striped bass or white bass in your region to facilitate spawning and larval rearing.

Cold-banking

The optimal time for spawning is when pond water temperatures are 18 or 19 °C. Commercial hatcheries typically have a system for holding broodstock at cool temperatures (cold-banking) to extend gamete quality over 2 to 4 weeks and sometimes even longer. Male striped bass need to be held at temperatures below 15 °C before they are used for spawning to extend the time over which they produce viable sperm. Female white bass should be held at temperatures below 13 °C before used for spawning and to extend the time over which they produce viable eggs.

Cold-bank systems may be simple or sophisticated in design. Design is dictated primarily by the duration of cold-banking and the number of broodstock to be held. If less than a month is required, then insulated fish tanks to which ice (without chlorine) is added periodically may be sufficient. If longer periods of cold-banking are required, commercial fluid heat pumps or chillers are used to hold broodstock at the desired temperature. If possible, the salinity of cold-bank system water should be maintained at 3 to 10 ppt.

Domesticated white bass females and striped bass males held in cold-bank can produce viable gametes for 4 to 6 months past their natural time of

spawning. Fish held in cold-bank for an extended period should be fed. Wild-caught white bass and male striped bass will not accept pelleted feeds and will have to be fed live forage fish. The choice of forage depends on availability and cost. Most hatcheries use various bait minnows. Slightly more live minnows should be added to tanks than the broodfish will eat. Domesticated white bass and striped bass will eat pelleted feeds, which eliminates the inconvenience, expense and disease risk of using live forage. Live forage should be treated with formalin to eliminate or reduce parasites before they are fed to white bass or striped bass.

Time of spawning

The time chosen for spawning broodfish is based on when fry can be reared successfully. In early spring, determining when to spawn is inexact and depends primarily on when water temperatures in fry-rearing ponds will average 18 to 19 °C. Paying close attention to weather forecasts is important. It is usually warm enough in early spring to stimulate dense populations of zooplankton needed as food for fry, yet cool enough that fry-eating insects will not jeopardize fry survival. Later in spring or early in summer, when pond water temperatures exceed 20 °C, specialized methods of minimizing predaceous aquatic insects while maintaining dense zooplankton populations must be used.

If cold-banking is used, a controlled warm-up cycle needs to be followed before spawning. For white bass females and striped bass males, the recommended cycle is a 1 °C increase in temperature per day to 16 °C, followed by a 2 °C rise to 18 °C in one day. Once temperature reaches 18 °C, fish are injected with hormones to induce spawning.

Hormone injections

Because so few private hatcheries produce palmetto bass, and because female striped bass require more expertise to spawn, this discussion is

limited to the production of sunshine bass. Human chorionic gonadotropin (HCG) hormone is used to induce final maturation and ovulation of eggs of white bass, and to enhance sperm production of striped bass. Females and males should be anesthetized with MS-222, quinaldine or clove oil to reduce stress whenever they are handled. The hormone is injected intramuscularly below the dorsal fin and above the lateral line (Fig. 2).



Figure 2. Injecting white bass with human chorionic gonadotropin (HCG) before spawning.

White bass females are injected with 660 International Units (IU) HCG per kilogram (300 IU/lb) of body weight to induce ovulation. Sexually mature female white bass will usually ovulate within 25 to 50 hours after injection, depending on water temperature. Time to ovulation also depends on the difference in time between when spawning would naturally occur and when the fish are actually spawned. For example, if natural spawning occurs in mid-April, expect fish injected in April to ovulate in 36 to 48 hours, whereas expect fish injected in late May to ovulate in 18 to 24 hours.

Unlike striped bass, egg samples are generally not taken from white bass for microscopic examination. White bass are small and relatively easy to handle, and ovulation is less likely to be affected by handling stress. To minimize handling, females are sorted into groups starting about 18 to 20

hours after injection based on rough estimates of when final ovulation will occur. The stage of ovulation is checked by holding the fish belly-up in one hand and applying slight pressure to the abdomen with the other hand. When fish are further from complete ovulation, slightly more pressure must be applied closer to the vent to express ovarian fluid or eggs. As the fish approach ovulation, less pressure more anterior of the vent is required to express eggs.

The "art" of determining when complete ovulation has occurred is best learned from experienced workers. Upon squeezing the abdomen, typical stages observed are no flow (re-check in 4 hours), flow of ovarian fluid (re-check in 2 hours), slight flow of clumped eggs (re-check in 1 hour), and easy flow of eggs (time to spawn). If eggs flow down the sides of the fish in a monolayer when applying only slight pressure just posterior of the pelvic fins, then that fish is ready to be spawned. If unsure that the eggs are flowing readily, it is better to wait another hour than to strip the eggs prematurely. A series of tanks or divided raceways may be used to hold fish at similar stages.

Spawning

The production of sunshine bass must be accomplished by manually stripping the eggs and sperm from ripe fish into a container. Expect to produce about 50,000 fry per pound of female successfully spawned. During the spawning process be sure that water containing anesthetics does not come into contact with the eggs and sperm. Generally the fish are quickly immersed in clean water and wiped dry with a towel before they are held over the spawning container. Sperm from two or more striped bass males is used to fertilize eggs from one or more white bass females to ensure fertilization of the eggs.

The fertilization of white bass eggs is accomplished using the dry method of spawning. This involves manually stripping the eggs from the female into a dry, clean container (Fig. 3).



Figure 3. Manually stripping eggs from white bass into a Teflon-coated pan.

Teflon-coated pans are often used as spawning containers so eggs will not stick to the container. Eggs from several females may be stripped into the same pan before adding sperm. Water should be kept out of the container until after sperm has been added. Sperm from several males (Fig. 4) is mixed thoroughly with the eggs by stirring with a finger or feather. Water is then added to mobilize sperm. Eggs, water and sperm are gently mixed and fertilization is completed within 2 minutes.

White bass eggs are adhesive and unless they are treated with a tannic acid solution successful incubation is



Figure 4. Manually stripping sperm from striped bass.

difficult. Typically, fertilized eggs are washed from the spawning container into a modified, 6-liter McDonald hatching jar half filled with water. Once eggs are added, the volume in the hatching jar is usually 4 to 5 liters. Tannic acid solution (150 to 300 mg tannic acid/L water) is then added. An airstone is immediately placed inside the hatching jar to provide agitation for 7 to 12 minutes; this helps remove the adhesive coating on the eggs. The actual amount of time eggs must be kept in tannic acid depends upon the alkalinity and hardness of the water. A second tannic acid treatment is sometimes necessary.

Incubation of eggs and larvae

Fertilized eggs are incubated in a modified hatching jar (Fig. 5). The jar is a tube-within-a-tube designed to allow circulating water to keep eggs in motion and air bubbles to escape without lifting eggs out of the jar. One jar holds 100,000 to 200,000 eggs. The optimum flow rate is 0.1 to 0.4 gallons per minute, but varies according to fluctuations in egg buoyancy during the incubation period. Egg buoyancy increases with water hardening during the first 2 hours of incubation. Water flow must be monitored closely to avoid flushing eggs from the jar. Newly hatched fry are carried by water out of the jars and into aquaria.

The water temperature for egg incubation should be similar to that in the broodstock holding tanks, ranging from 16 to 20 °C. Aerated well water is preferred because temperature variation is minimal. Water for egg incubation should be supplied from a head tank to minimize fluctuations in flow. The incubation period varies inversely with water temperature. At 16 to 18 °C the incubation period is 40 to 48 hours.

Fry are held in aquaria (30- to 75-gallon capacity) before pond stocking. Aquaria should have a 1-inch stand-pipe surrounded by a 300-micrometer mesh screen mounted on 6-inch pipe.



Figure 5. Incubating fertilized eggs in a hatching jar.

The base of the 6-inch pipe should be encircled by bubble tubing. Bubble tubing is available from aquarium supply houses or can be made from standard air tubing. A hot needle is used to poke holes in the air tubing. A steady stream of air bubbles from the tubing surrounding the screened pipe acts as a bubble curtain to prevent fry from becoming impinged on the screen. Water should be exchanged continuously in the aquaria. Newly hatched hybrids have no mouth opening, an enlarged yolk sac, and a large oil globule projecting beyond the head. At 4 to 8 days post-hatch, the yolk sac and oil globule are assimilated, the mouthparts developed, and fry begin to feed.

Fry can be transported when they are 1 to 2 days of age post-hatch. Mortality is less at this age than if the fry are transported at 4 to 5 days of age. The numbers of fry per aquarium are estimated by counting the number of fry in several well-mixed subsamples of known volume. The average number of fry per sample is then used to calculate the total number of fry in the aquarium. Just before transport, larvae are concentrated in the aquarium and then dipped from the aquarium

um into plastic bags containing approximately 2 gallons of water. Bags are placed in styrofoam containers. All air is expelled from the bags and oxygen is added to fill the bags. Larvae can survive well in these containers for 48 hours. Containers should be kept out of direct sunlight and water temperature maintained at 16 to 18 °C. Ice can be added to the containers to help maintain acceptable temperatures.

Fry are stocked into fertilized ponds at 2 to 6 days post-hatch, depending on the culturist's preference and experience. Fry are stocked between dusk

and dawn because exposure to ultraviolet light may kill them. If there is a choice of fertilized ponds, select ones with an abundance of zooplankton and the correct pH. An abundance of rotifers, at least 300 organisms per liter, is desirable. The pH of ponds should not vary more than a half unit from that of the hatchery water. Fluctuations of pH in newly filled ponds are of less concern in the early spring than in later spring or early summer. Bags of fry should be floated in the pond for about 30 minutes to allow the temperature to equilibrate. After the bags have been opened, small

amounts of pond water should be added periodically for the next hour to help the fry adjust to any differences in water quality. More information on rearing hybrid striped bass fry to fingerlings in ponds can be found in SRAC Publication No. 302.

References

Ludwig, G. M. 2004. Hybrid striped bass: fingerling production in ponds. Southern Regional Aquaculture Center Publication No. 302.

SRAC fact sheets are reviewed annually by the Publications, Videos and Computer Software Steering Committee. Fact sheets are revised as new knowledge becomes available. Fact sheets that have not been revised are considered to reflect the current state of knowledge.



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