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Species Profile: Hybrid Crappie

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Black crappie (*Pomoxis nigromaculatus*) and white crappie (*P. annularis*) have a number of common names throughout the United States, including papermouths, speckled perch, calico bass, and sac-a-lait. Crappie belong to the Centrarchidae family, which includes largemouth bass and bluegill. They are some of the most popular sport fish in North America. Crappie culture was first documented in 1897. Black and white crappie have been produced by many state, federal, and private fish hatcheries, primarily for supplemental stocking programs in recreational water bodies. These fish have also been evaluated as candidates for commercial aquaculture because they a) are the only sunfish that is caught in the wild more for consumption than for sport, b) have a faster growth rate than other sunfish under optimal conditions, c) can be trained to eat prepared diets, and d) are relatively easy to spawn in captivity. Unfortunately, one of the major obstacles to successful culture and stocking of crappie is that they have an extremely high reproduction rate, which can lead to overcrowding and stunting in commercial aquaculture ponds and in small ponds used for recreational fishing. To overcome this problem in small fishing ponds, hybrid crappie, a cross between the female black crappie and the male white crappie, has been produced and tested. This cross does reproduce but less frequently than the white or black crappie. This hybrid shows promise for aquaculture because it grows faster than the parental species through the first two growing seasons.

Description/ taxonomy

There are morphological differences between the two crappie species. White crappie have five or six dorsal spines and black vertical bars on the sides of the body, whereas black crappie have seven or eight dorsal spines and small mottled black spots on the sides of the body (Fig. 1). Hybrid crappie do occur naturally and are often difficult to distinguish from black crappie (Fig. 1). In most cases, genetic analysis is the only way to positively identify a hybrid.

Natural history

White crappie live in pools with sand or mud bottoms, in backwaters of creeks, and in small to large rivers, lakes, and ponds. White crappie are more commonly found

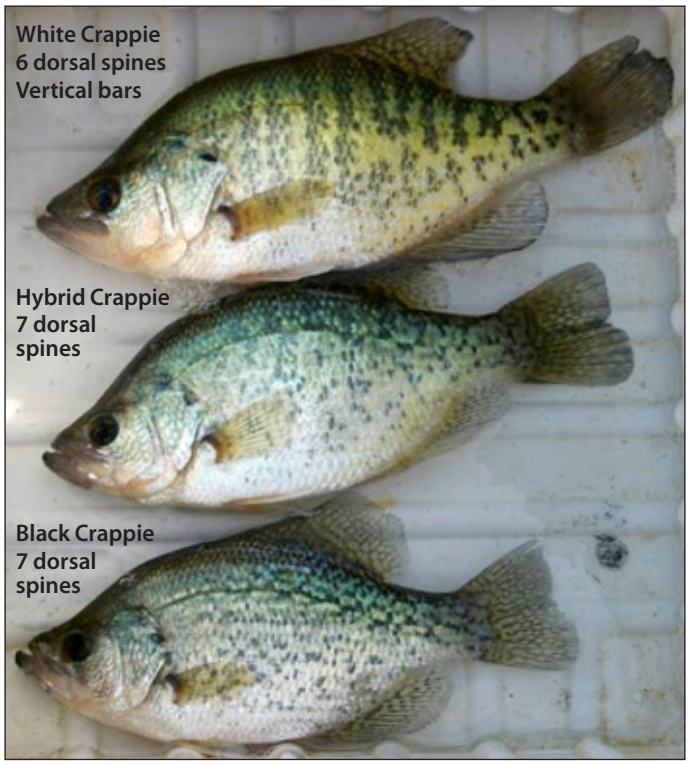

Figure 1. This picture of a white crappie (top), hybrid crappie (middle), and black crappie illustrates the differences in the color patterns between the two species and the hybrid. White crappies have vertical bars, whereas black and hybrid crappies have black spots. (Photo courtesy of Tennessee Wildlife Resource Agency, 2007).

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in turbid water. Black crappie inhabit ponds, lakes, and backwater sloughs in streams and rivers. They prefer clear water with low turbidity. Both species are most commonly found near aquatic vegetation over mud and sand bottoms.

The historic range for white crappie includes the east central portion of the U.S. as far north as the Great Lakes, Hudson Bay, and the Mississippi River basins, west to Minnesota and South Dakota, and south to the Gulf drainages from Mobile Bay, Georgia, and Alabama, to the Nueces River in Texas. The native range of black crappie is difficult to ascertain, because it is widely distributed throughout the U.S., including the northeastern and western states.

Adult white crappie range in size from 6.5 to 21 inches (41.9 to 53.3 cm) in total length, whereas black crappie range from 5 to 19 inches (12.7 to 48.3 cm). Typical recreational fishing catches of either species range from 8 to 12 inches (20.3 to 30.5 cm). Crappie can weigh up to 3 or 4 pounds (1.36 or 1.8 kg), but they typically reach a weight of 0.25 to 0.50 pound (0.11 to 0.23 kg). The life expectancy is 13 years for black crappie and 9 years for white crappie.

Zooplankton and insects are the preferred foods of young-of-the-year black and white crappie. On this diet, they can grow up to 4 inches during the first 12 months. When they reach 6 to 8 inches (15.2 to 20.3 cm), diets of young crappie change to mostly smaller fish and minnows. Adult crappie prefer forage fish, particularly threadfin and gizzard shad, found in the open water areas of reservoirs. Although black crappie grow more slowly than white crappie, they are much heavier than white crappie of similar length. The growth rate for both species is dependent on habitat, food availability, and crappie population size for a given body of water. When crappie populations are large and food availability is limited, the result is slow growth or stunting. The tremendous reproductive capability of the two crappie species often results in stunting, particularly in small ponds.

Both white and black crappie reach sexual maturity at 2 to 3 years of age. Spawning begins in late March, April, or early May depending on geographical location. Black crappie spawn when water temperatures warm to 60 to 64 °F (15.6 to 17.8 °C), while white crappie spawn when water temperatures reach 65 to 70 °F (18.3 to 21.1 °C). Males select the nest sites and clear circular beds 8 to 15 inches (20.3 to 38.1 cm) in diameter. The beds are often located in water that is 3 to 8 feet (0.9 to 2.4 m) deep. Black crappie nests are frequently found in gravel or in soft, muddy river or lake bottoms. White crappie nests are often located near structures such as brush piles, stumps, or rock outcrops. Each spawning black crappie female produces 20,000 to 140,000 eggs, or an average of 46,400 eggs per 0.25 pound (113 g) or 12,700 eggs per inch (2.54 cm) of total length. Each white crappie female produces 56,750 eggs per 0.25 pound. The number of eggs produced depends on the size and condition of the female. Males guard the eggs, which hatch within 3 to 5 days. After hatching, males continue to guard the fry for a few days until the young leave the nest.

Hybridization

Hybridization between crappie species occurs naturally in the wild. Environmental factors that enable hybridization to occur are turbid water, increased amounts of vegetation, limited spawning habitat, overlapping spawning seasons, and water level fluctuations. The female black crappie × male white crappie hybrid has shown higher survival, growth, and reproduction rates than the female white crappie × male black crappie.

Hybrid culture techniques

It is illegal in some states to culture game fish. Before you attempt to culture crappie or crappie hybrids, check with the local state regulatory agency to determine whether crappie are defined as game fish. If so, make sure it is legal to culture them in your state.

Many of the culture techniques used for hybrid crappie are similar to those used for largemouth bass. Two- to 3-year-old broodstock are obtained from a hatchery or from the wild. Since hybrid production is the goal, males and females are usually kept separate from one another, which means that males and females must be properly identified by gender. Male and female crappie look similar and are more easily distinguished from one another during the spawning season. A four-step process has been developed for identifying fish gender. First, note the coloration of the fish. Males will be darker than females, particularly around the head, opercula, and under the jaw. Step two is to try to gently hand strip a few eggs from fish that do not display the dark coloration. If eggs are present the fish is female. If no eggs are obtained, the third step is to examine the urogenital opening of the fish. If the scaleless area around the opening is round or oval, the fish is considered male. If the scaleless area is shaped like a teardrop or a pear and the posterior genital opening is swollen like a donut, the fish is female (Fig. 2). The final step is to check the abdomen for distention. A firm abdomen dorsal to the urogential opening indicates the ovaries of a female, whereas firmness anterior to the opening indicates food had been ingested. To avoid mistaking food in the digestive tract for ovaries, fish are not fed for a couple of days before they are examined. If no distention is observed, then the fish are either males or immature females.

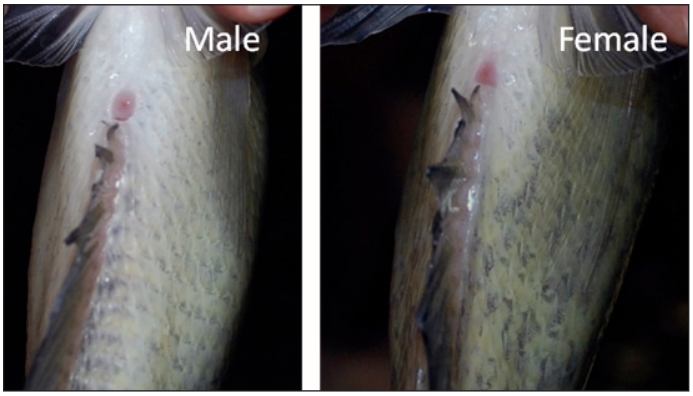

Figure 2. The scaleless region around the male and female urogenital openings aids in determining the gender. The scaleless region in a male is oval or round and in a female is teardrop shaped.

Hybrid crappie can be produced by in-pond spawning or by manually stripping the gametes and crossing the two species in the hatchery. For in-pond spawning, usually the female black crappie is crossed with the male white crappie, as the reciprocal cross is very inconsistent with regard to offspring production. Males of one species are stocked with females of the other species into prepared, fertilized ponds, approximately 1 acre (0.4 ha) in size, at a rate of 50 to 100 brood fish per acre (0.4 ha) and at a sex ratio of 1:1. Stocking more than 100 brooders per acre (0.4 ha) has been shown to decrease fry production. Brood fish between 1 and 1.25 pounds (0.45 to 0.57 kg) are the size preferred by producers. Fathead minnows should not be added as forage for brood fish because they compete with crappie fry and fingerlings for zooplankton. Once fry swim up, brood fish should be removed from the pond using a 1-inch (2.54-cm) mesh seine to reduce fingerling losses from cannibalism.

Artificial spawning (hormone treatments)

The other method of producing hybrid crappie is to manually cross the two crappie species in the hatchery. When water temperatures reach 58 °F (14.4 °C) fish are brought into the hatchery, separated by sex, and placed into holding vats. Fish are injected with Chorulon® (human chorionic gonadotropin, HCG) or leutenizing hormone-releasing hormone analog (LHRHa). Chorulon has been approved by the U.S. Food and Drug Administration (FDA) for use as a spawning aid in fish, but LHRHa has not been approved. This hormone can be used only if you have an Investigational New Animal Drug permit for LHRHa from the FDA or if you get an extra label use prescription from a veterinarian.

Males are injected with either LHRHa at 50 µg/kg or HCG at 1000 IU/kg body weight. Females are given two injections, 12 hours apart, with a total dose of 100 µg/kg of LHRHa or 1000 IU/kg body weight of HCG. The first injection is 10 percent of the total dose and the second 90 percent of the total dose. Females are examined after 30 hours to determine whether ovulation has occurred. If the fish has ovulated, light pressure on the abdomen will cause the eggs to be released. The eggs are stripped into a bowl, using caution to prevent water from contacting the eggs. Males do not release their sperm when stripped by hand, so the male is euthanized, the testes are removed and chopped or macerated, and then the testicular material is mixed with the eggs. Water is added and the sperm and eggs are mixed. Eggs are adhesive and must be placed in a container where they can be spread out in a single layer. Water must be exchanged at least four times a day. Fry usually hatch within 48 hours and swim up 5 to 7 days later, depending on the water temperature. Please see SRAC Publication Nos. 421 to 427 for more information on induced spawning in fish.

Larval rearing

Once crappie fry swim up they can be stocked into ponds or into a mobile nursery system (Fig. 3). Larval fish are stocked into ponds at rates of 100,000 to 250,000 fry per acre (0.4 ha). Ponds are fertilized approximately 7 to 10 days before stocking to ensure that the zooplankton population is adequate but predacious insects are not yet

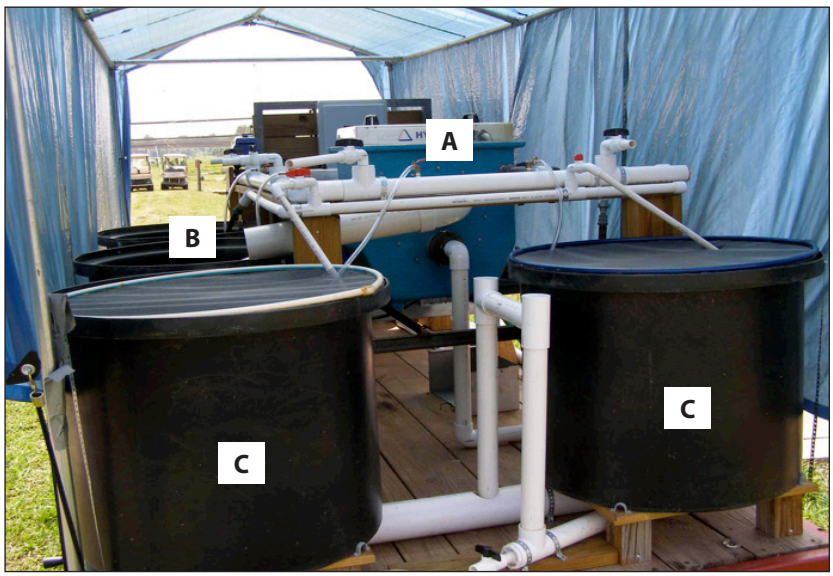

Figure 3. The mobile nursery system was developed at the University of Arkansas at Pine Bluff. Pond water is filtered through two drum filters (A). Plankton too large to pass through the screen on the drum filters is drained to two tanks (B) and returned to the pond. Plankton that is able to pass through the screen is diverted to fry tanks (C).

established. Zooplankton populations should be verified by sampling the water and observing zooplankton under a microscope. A fertilization schedule similar to that used in hybrid striped bass culture works well (see SRAC Publication No. 302, *Hybrid Striped Bass: Fingerling Production in Ponds*). The use of rice bran alone also has produced good survival rates in fish. The rice bran fertilization regime is as follows: add 100 pounds (45.4 kg) of rice bran per acre (0.4 ha) as the pond is being filled and again 3 days later. For the next 2 weeks add 25 pounds (11.3 kg) of rice bran to the ponds twice a week. Additional fertilizer is added only when Secchi depths are more than 18 inches (0.46 m).

Alternatively, larval hybrid crappie can be stocked into a mobile nursery system (Fig. 3). The mobile nursery system was developed at the University of Arkansas at Pine Bluff. The system draws water from a fertilized pond and then runs it through two different sized screens attached to two rotating drum filters. These screens filter the water and concentrate the zooplankton, which is then delivered to the fry-holding tanks. The screens can be changed to enable larger zooplankton to pass as the fish get larger. Hybrid crappie fry can be kept in this system for only 7 to 10 days and then must be stocked into ponds because they outgrow the size of the zooplankton provided by the mobile nursery system. The advantage of the mobile nursery system is that the high concentration of food increases growth and survival rates. Also, the mobile nursery system can be moved from pond to pond to ensure ample forage is available in the system.

Another version of this mobile nursery is the use of a parabolic screen filter rather than the rotating drum filters (Fig. 4). The screen size on the parabolic filter also enables the right size zooplankton to be delivered to the fish. This has also been used to increase growth and survival rates of hybrid crappie before they are stocked into ponds.

Figure 4. A parabolic screen filter can be used to filter out small plankton for feeding hybrid crappie fry.

Hybrid crappie fingerling yields from ponds are highly variable and can range from 0 to 180,000 fingerlings per acre (0.4 ha). The reasons for this variability are not well understood, but should be considered when estimating production numbers.

Feed training

When harvesting fingerlings for feed training, it is best to handle them at the coolest time of day and during low light. Hybrid crappie have been shown to handle stress well when harvested at night and when water temperatures are below 59 °F (15 °C).

Fry feed on natural foods in ponds until they reach 1.5 inches (3.8 cm) in length. Then they are seined out of ponds and placed into raceways for "feed training" or habituation to commercial fish feeds. The fish are stocked into raceways at 200 to 300 fish per cubic foot (0.03 cubic m) to prevent access to natural foods. The water flow rate through the tanks should completely replace the tank water volume four times a day. Fish must be fed several times a day. The use of automated feeders will reduce the amount of labor required. Belt feeders can provide feed continuously throughout the day. Hand feeding fish four to six times a day enables the producer to observe whether the fish are eating. Hybrid crappie fingerlings are fed either common carp eggs or freeze-dried shrimp the first day. The freeze-dried shrimp is commercially available, whereas the carp eggs will need to be obtained from broodstock. On subsequent days, the carp eggs or shrimp is mixed with increasing amounts of a semi-moist pellet. On day seven the fish should be consuming only the semi-moist pellets. Hybrid crappie that are "feed trained" will be thicker in the body than fish not eating the commercial feed. Feed-trained fish can be separated from non-feed-trained fish by grading. Feed-trained fish should be offered the feed for an additional 7 days before stocking. The non-feed-trained fish can be crowded and the feed training sequence repeated.

It is important to note that when hybrid crappie are stocked into ponds after successful feed training they can easily revert to natural foods. Hybrid crappie will not feed on floating pellets, which makes it difficult to observe them feeding in ponds. A slow-sinking feed can be used to keep hybrid crappie "on feed" once restocked into commercial ponds, but even with slow-sinking feeds it is difficult to observe crappie feeding on commercial diets.

Water quality requirements for hybrid crappie are similar to those for largemouth bass. Crappie are not tolerant of prolonged low dissolved oxygen levels. Dissolved oxygen concentrations above 4 mg/L reduce stress and loss of fish.

Because hybrid crappie eat small fish, the diets used are similar to those for largemouth bass. Diets containing 40 percent protein usually are used to raise crappie. However, no research has been published examining optimal protein or amino acid percentages.

Diseases

Hybrid crappie are susceptible to many of the diseases that afflict other freshwater species. They are highly susceptible to stress and often experience an outbreak of *Flexibacter columnaris* shortly after handling. Additional research focused on improved husbandry methods is warranted to reduce mortality rates in crappie after handling.

Economics and marketing

To date, no economic analysis of hybrid crappie production has been published. Most hybrid crappie are sold to the sportfish market for stocking ponds, lakes, and reservoirs. The market for food-size hybrid crappie has primarily been through on-line sales of fillets. Current market prices for hybrid crappie fillets are $13 to $15 per pound (0.5 kg).

There is also potential in live fish markets. This market has not been exploited yet because the demand is much higher than current producers can supply as hybrid crappie do not tolerate handling and hauling stress very well. Research is needed on improved handling methods to increase survival and enable hybrid crappie markets to expand.

Conclusion

Fingerling production of hybrid crappie is sufficient to meet the sportfish demand for stocking ponds, lakes, and reservoirs. Hybrid crappie show great potential as a food fish, but their low tolerance to handling and hauling stress may limit the number of fish produced for the food fish market.

Suggested readings

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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.

USDA United States Department of Agriculture National Institute of Food and Agriculture

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