Evaluation of *Morone* Hybrids in a Small, Shallow, Warmwater Impoundment

Danny J. Ebert, *U.S. Department of Agriculture Forest Service, 605 W. Main St., Russellville, AR 72801*

Kenneth E. Shirley, *Arkansas Game and Fish Commission, P.O. Box 541, Brinkley, AR 72021*

Jeffery J. Farwick, *Arkansas Game and Fish Commission, P.O. Box 541, Brinkley, AR 72021*

Abstract: Fingerling *Morone* hybrids were stocked into Storm Creek Lake, Phillips County, Arkansas, to control a nuisance gizzard shad (*Dorosoma cepedianum*) population and diversify the sport fishery. The lake, a 169.7-ha shallow, warmwater impoundment, was stocked with 31,000 hybrids during a 4-year period (1982, 1984, 1985, and 1987). Growth during their first 3 years was rapid (age I—325 mm; age II—428 mm; age III—591 mm). Number of age IV fish (602 mm) declined over time. Due to high water temperatures, low dissolved oxygen levels, and shallow nature of the lake, hybrid populations were not concentrated in deep, aerated areas, but were dispersed in shallow coves over the entire lake during summer and fall. Observation of hybrid stomach contents indicated use of shad (*Dorosoma spp.*) ranging in size from 178 to 229 mm. Population levels of young of the year and adult largemouth bass (*Micropterus salmoides*) were not affected by the introduction of *Morone* hybrids. The introduction of hybrids into Storm Creek Lake has diversified the fishery, supplied local anglers with a large, fast-growing species, and demonstrated that hybrids can be successfully stocked in a small impoundment if a shad forage base is available.

Proc. Annu. Conf. Southeast Assoc. Fish and Wildl. Agencies 41:55–62

The striped bass hybrid (*Morone saxatilis* × *Morone chrysops*) has been introduced into many impoundments in the southeastern United States since its original development (R. E. Stevens, unpubl. rep., S.C. Wildl. Resour. Dep. 1965). It has been well documented that hybrids have a better survival rate and grow faster in their early life history than striped bass (*M. saxatilis*) and have the potential for control of rough fish populations such as shad (*Dorosoma sp.*) (Logan 1967, Williams 1970, Ware 1970), or at least utilize shad as a principal forage base (Bor-

kowski and Snyder 1982, Germann 1982, Moss and Lawson 1982, German and Bunch 1983, Morello 1984, Yeager 1985). Hybrid fisheries have been established in many southeastern states. Alabama (Bryce and Shelton 1982, Moss and Lawson 1982), Arkansas (Crawford et al. 1984), Florida (Ware 1974, Borkowski and Snyder 1982, Champeau 1984, Morello 1984, Young 1984, Yeager 1985), Georgia (Germann 1982, Germann and Bunch 1983), South Carolina (Williams 1970), Tennessee (Bishop 1967, Saul and Wilson 1981), and Texas (Crandall 1978) are states where age, growth, food habits, survival, and management of hybrid populations have been investigated.

Since Logan (1967) reported higher survival rates for hybrids as compared to striped bass in hatchery ponds, and Ware (1974) stated that growth of hybrids in reservoirs was greater than striped bass during the first 2 years of life, hybrids have been supplementally stocked in large reservoirs and river systems. Moss and Lawson (1982) found that in small, shallow (18 to 74 ha) Alabama public fishing lakes, condition factors (Kn) for hybrid striped bass were very low for age classes I to III compared to those of hybrids in West Point Reservoir. This was thought in part to be based on the abundance of threadfin shad (*D. petenese*) in West Point Reservoir and the primarily bluegill based forage populations and heavy predator populations in Alabama public fishing lakes. The authors stated that creel return for hybrids in Alabama public fishing lakes was $<3\%$ of stocked fish. Growth, condition, and survival of these stocked fish was low to moderate.

The Arkansas Game and Fish Commission has stocked *Morone* hybrids in fishing lakes throughout the state of Arkansas for shad control and sportfishing diversification. Many of the lakes that have been stocked are large and deep. The objectives of this study were to determine if hybrids stocked in a small, shallow, warmwater U.S. Forest Service impoundment could reduce the resident gizzard shad population, survive, grow, and provide area fishermen with a viable sport fishery.

Methods

Study Site

Storm Creek Lake, Phillips County, Arkansas, is a shallow, warmwater 169.7-ha Forest Service impoundment managed for recreational fishing. The lake lies in the Crowley's Ridge geographic division of northeast Arkansas and drains an area of approximately 1,854 ha. Crowley's Ridge is unique because it traverses the Gulf Coastal Plain in a general north-south arc passing through portions of 8 counties. In Phillips County, it rises approximately 122 m above sea level with its width varying between 1.6 and 19.3 km. The ridge area is completely surrounded by agricultural and pasture Mississippi Delta land. The major soil type of the Ridge is the Lorine Grenada Association (Fulmer and Harp 1977). These soils are deep, medium textured, and moderately to slowly permeable. Major soil types to the east and west of the Ridge are bottomlands and terraces and loessial plains (Soil Conserv. Serv. 1967). Eastward flowing streams drain into the St. Francis River water-

shed. Storm Creek, the major drainage into Storm Creek Lake, is shallow and narrow, with a silt, sand, and hardpacked clay bottom. Oak-hickory and pine forest surround the stream and lake.

Case History

Storm Creek's history typifies "rough" fish impacts. A 1961 management plan submitted by the Arkansas Game and Fish Commission to the U.S. Forest Service noted that for many years the lake was one of the better sport fishing lakes in Arkansas. But, unlike Bear Creek Lake, a similar lake in the Crowley's Ridge area, Storm Creek Lake contained gizzard and threadfin shad, carp, and other rough species. Presence of these species was attributed to "salvaged" fish placed in the lake during years past. Management activities were designed to control the gizzard shad, favor the threadfin shad, and establish a fishable population of channel catfish. As part of the management practices, substantial fall and winter drawdowns, selective shad treatments, and supplemental stocking of threadfin shad and channel catfish were recommended. Sportfish present in the lake in 1961 included largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), green sunfish (*L. cyanellus*), white crappie (*Pomoxis annularis*), black crappie (*P. nigromaculatus*), blue catfish (*Ictalurus furcatus*), and channel catfish (*I. punctatus*). By 1978, no threadfin shad remained in the lake.

In 1979, a selective shad treatment was conducted. This resulted in good spawns for several fish species. Both white and black crappie fishing and sample returns were good in 1980 and 1981. Intermediate size (200–305 mm) largemouth bass and crappie were abundant in a 1981 summer cove rotenone; however, gizzard shad (>178 mm) accounted for 40.0% of the sample by weight. In May 1982, the Arkansas Game and Fish Commission, as part of a statewide program of hybrid striped bass (*M. saxatilis* × *M. chrysops*) stockings, introduced 10,000 fingerlings into Storm Creek Lake. A 1982 summer cove rotenone showed gizzard shad (>178 mm) accounted for 41.8% of the sample by weight. No threadfin shad were collected in the sample and no schools of small shad were observed in the lake as in past years. From 1983 to 1986 gizzard shad accounted for more than 45% by weight of summer cove rotenone samples. Hybrid striped bass fingerlings were supplementally stocked in 1984 (10,000), 1985 (7,700), and 1987 (3,300). Cage culture of channel catfish and supplemental stocking of channel catfish and blue catfish shad were implemented on an infrequent basis from 1982 to 1987. In the spring of 1986, 110 triploid grass carp were supplementally stocked into the lake for vegetation control.

Sampling Procedures

During the 1981–82 period, the fish population was sampled on a yearly or semi-yearly basis using various techniques. Monofilament gill nets (38, 50, 63.5, and 88 mm mesh × 24.4 to 91.5 m in length) and trammel nets (75 to 88 mm mesh × 91.5 m in length) were set for 12 to 24 hours at preselected sites each year. Sample periods usually were in November and/or February. In each case, the nets

were set perpendicular to the shoreline; minimum depths were 0.5 to 2.0 m. In 1985 and 1986, day and/or night electrofishing transects were run using a boat mounted 5,000-watt generator (220 V), pulsed DC current (Coffelt VVP-2E) and boat-mounted boom electrodes. Transects were approximately 2,600 seconds of continuous electroshocking parallel to the shoreline (0.5–2.0 m deep). When feasible, all stunned fish were collected on each run, measured (TL mm), weighed (g), identified, and returned to the water. Three to 5 transects (minimum 100 largemouth bass total) were conducted in the spring and/or fall. Proportional stock density (PSD), length frequency, and catch per unit effort (CPUE) were calculated for each trip. Late spring shoreline seine hauls were also made in a selected lake area using a 6.1- or 9.2-m small mesh seine. Young-of-the-year (YOY) bass and sunfish production was checked in 5 seine hauls. All YOY and intermediate bass and sunfish were measured and counted. A representative sample was preserved in 10% formalin in the field and later analyzed in the laboratory. Annual cove rotenone samples were conducted in the same 0.4-ha cove each year. The cove was treated with a 7% powdered rotenone formulation. Fish were collected for 2 days, separated by size groups and species, then weighed, counted, and categorized as percent by weight in species group and total sample.

Dissolved oxygen, visibility, pH, temperature, and alkalinity were measured during numerous sample trips. In the summer of 1986, sonar fish finders (Lowrance 1510-C and X-15B) were used to locate large pelagic fish presumed to be hybrid striped bass in relation to the lake's thermocline and bottom contours.

Results and Discussion

Morone hybrids stocked in 1982, 1984, and 1985 grew very well. Growth rates of Storm Creek hybrids compared favorably to growth rates documented by Florida hybrids (Ware 1974). Mean total length of 363 mm for age I Florida hybrids was higher than Borkowski and Snyder (1982) recorded for Alabama hybrids (age I—292 mm). Hybrids from Storm Creek Lake averaged 325 mm at age I; at age II, they averaged 428 mm, which compared favorably with both previous studies. Crandall (1978) reported rapid growth in hybrids from Lake Bastrop, a heated Texas reservoir. Fish from the study's primary stocking averaged 351 mm and 429 mm at the first and second annulus, respectively. While hybrids in Borkowski and Snyder's (1982) study exhibited slower growth in their first year, the mean total length of 23-month old fish equalled that of Crandall's (1978) hybrids. Age III hybrids in Storm Creek lake averaged 591 mm, while age IV hybrids averaged 602 mm. This represented a slowing in growth at later life stages which is typically associated with growth patterns found in older fish (Fig. 1). Hybrids stocked in all 3 years grew rapidly and attained average weights of 0.77 to 1.80 kg after 2 years. These weights are lower than those reported in previous investigations. The largest hybrid caught in gill nets was an age IV fish weighing 4.67 kg; this weight appears typical for similar-aged fish in southeastern states (Ware 1974).

Cove rotenone samples from 1981 to 1987 indicated that standing crops of

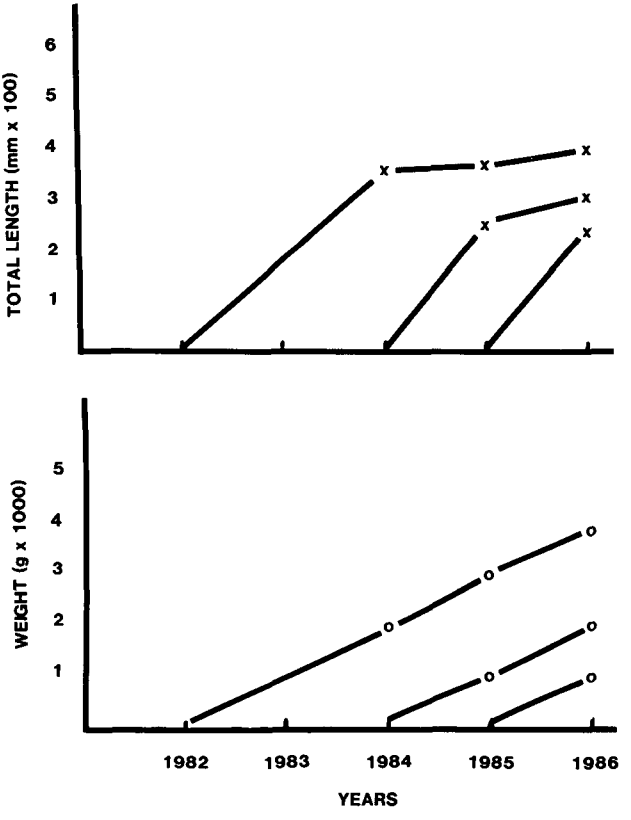

Figure 1. Growth rates of *Morone* hybrids in Storm Creek Lake, Phillips County, Arkansas (1981–1985).

most fishes varied little from year to year (Table 1). Gizzard shad populations remained stable after 1981 (41.8%–48.3%). The majority of the fish in this group ranged from 178 to 229 mm. While hybrids were feeding almost exclusively on gizzard shad, their population numbers were not noticeably diminished. Morello (1984) found that clupeid fishes were the most common forage for reciprocal hybrids in Lake Osborne, Florida; however, the hybrids did not alter shad populations during from 1975 to 1983. Crandall (1978), Williams (1970), and Ware (1974) have also identified clupeids as a primary forage base for hybrids. The absence of hybrids from rotenone samples (except 1985) indicated that this technique was ineffective for collecting schooling pelagic fishes.

Storm Creek Lake has supported a large population of gizzard shad prior to and after hybrid introductions (Table 1). Observation of hybrid stomachs revealed gizzard shad to be the major if not sole food items when stomachs were not empty. Although sunfishes and white crappie were abundant in summer cove rotenone samples (Table 1), apparently they were not a preferred food item when shad were available. Bishop (1967), Crandall (1978), and Williams (1970) identified clupeids as preferred items by hybrids.

Table 1. Summer cove rotenone analyses, Storm Creek Lake, Phillips County, Arkansas (1976–1987) (*=hybrid stocking; total standing crop=kg/ha) (LMB=Largemouth Bass; BG=Bluegill; CR=Crappie; GS=Gizzard Shad).

Year	% total weight/group					Total standing crop
	LMB	BG	Total sunfish	CR	GS	
1987*	7.1	20.0	27.1	0.6	45.3	200.2
1985*	4.1	8.9	18.8	3.2	46.1	92.2
1984*	7.1	12.7	18.5	2.3	48.3	196.8
1983	9.9	10.9	29.1	0.7	44.4	263.7
1982*	7.7	23.8	29.3	0.7	41.8	214.0
1981	2.7	6.8	9.3	35.6	36.0	175.5
1980	3.8	15.7	17.4	8.7	23.8	47.7
*Shad treatment						
1979	4.3	10.7	14.4	5.5	59.6	517.7
1977	7.2	15.3	24.5	1.0	52.4	198.5
1976	3.2	4.8	6.2	4.8	66.8	155.0
Before hybrids	4.2	10.7	14.4	11.1	47.7	218.8
After hybrids	7.1	15.3	24.6	1.5	45.2	193.5

The high successive stocking rates of hybrids in Storm Creek Lake (45.4–58.9/ha) apparently did not result in an overabundance of hybrid predators and a dramatic decrease in shad. Hybrid growth rates and condition in all age classes were excellent. There was no evidence of natural reproduction by hybrids; consequently, control of the population may be managed through angler harvest, stocking rates, and natural mortality. It was evident that 1984 age IV hybrid numbers were not as abundant in 1986–87 gill netting samples as they were at younger age classes. This suggests that larger hybrids (>2.8 kg) may have trouble coping with high summer temperatures and low dissolved oxygen levels in Storm Creek lake (mean depth 5 m), high natural mortality, or are being caught in higher numbers than we have thought. Few studies have specifically addressed the effects of thermal stress on survival of striped bass or hybrids in small, shallow, warmwater impoundments. Coutant and Carroll (1980) noted ontogenetic changes in temperature preference in which the mean temperature selected by adult striped bass in Cherokee Reservoir, Tennessee, was near 20.5°C. Two-year-old fish, in their study, sought a temperature of about 22°C and juveniles preferred 25°C. This resulted in young striped bass with an elevated temperature tolerance thriving, while older individuals requiring cooler waters were limited to unoxygenated or very warm areas in late summer. Consequently, adults suffered a high mortality (Coutant and Schaich 1980). Bryce and Shelton (1982) suggested that, based on scale annuli analysis, *Morone* hybrids observed from the tailwaters to 15 km downstream in the Tallapoosa River, Alabama, were not thermally stressed like striped bass. An abundance of age I and II hybrids were observed by the authors in shallow coves during summer months based on cove electroshocking, sonar recordings, and angler catch response.

During summer 1986, an attempt was made to locate hybrid populations based on temperature preference and dissolved oxygen levels. The lake at that time was

thermally stratified. Schools of age I–II hybrids were observed in shallow coves during early morning, moving into deeper areas in midmorning, and returning to shallow areas during early evening. This was verified using an electroshocker boat and sonar recordings. Fish schools were located on sonar, electroshocked, visually inspected, and graph recordings identified according to species obtained (i.e., sunfish, shad, hybrids, and crappie).

The sport fishery in Storm Creek Lake since the early 1960s has been dominated by the largemouth bass. YOY bass collected from spring shoreline seine samples from 1983 to 1987 have indicated good reproduction. YOY bass were supplementally stocked in 1984 (20,400) and 1985 (10,000) to strengthen and increase populations. Summer cove rotenone samples from 1982 to 1985 have indicated bass levels to be stable (Table 1). The introduction of hybrids has not appeared to affect reproduction of bass or population structure. Angler response during fall 1986 and spring 1987 has indicated increased harvest of intermediate (200–305 mm) and large bass (>305 mm). Electrofishing results from spring 1986 collections indicated that of 131 bass collected, 103 were stock size (>200 mm) and 30 were larger than 300 mm. Length frequency data revealed the majority of bass were in the range of 225 to 300 mm, with some bass attaining 575 mm.

Summary

Growth of *Morone* hybrids in Storm Creek Lake did not adversely impact resident largemouth bass populations. Hybrid growth rates of ages I–IV fish are similar to rates documented by previous studies in southeastern states where forage (shad) was abundant. Hybrids fed extensively on 178 to 229 mm gizzard shad and did not alter forage populations. This investigation documents the successful supplemental stocking of hybrids in a small, shallow, warmwater impoundment for fishery diversification.

Literature Cited

Bishop, R. D. 1967. Evaluation of the striped bass (*Roccus saxatilis*) and white bass (*R. chrysops*) hybrids after two years. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 21:245–253.

Borkowski, W. K. and L. E. Snyder. 1982. Evaluation of white bass × striped bass hybrids in a hypereutrophic Florida lake. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 36:74–82.

Bryce, T. D. and W. L. Shelton. 1982. Dimorphic growth patterns on scales of striped bass and *Morone* hybrids from a central Alabama River. Proc. Annu. Conf. Southeast Assoc. Fish and Wildl. Agencies 36:42–47.

Champeau, T. R. 1984. Survival of hybrid striped bass in central Florida. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 38:446–449.

Coutant, C. C. and D. S. Carroll. 1980. Temperatures occupied by ten ultrasonic-tagged striped bass in freshwater lakes. Trans. Am. Fish. Soc. 109:195–202.

——— and B. A. Schaich. 1980. A biotelemetry study of spring and summer habitat selection by striped bass in Cherokee Reservoir, Tennessee, 1978. ORNTL/TM-7127. Oak Ridge Natl. Lab., Oak Ridge, Tenn. 65pp.

Crandall, P. S. 1978. Evaluation of striped bass × white bass hybrids in a heated Texas reservoir. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 32: 588–598.

Crawford, T., M. Freeze, R. Fourt, S. Henderson, G. O'Bryan, and D. Philipp. 1984. Suspected natural hybridization of striped bass and white bass in two Arkansas reservoirs. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 38:455–469.

Fulmer, R. F. and G. L. Harp. 1977. The fishes of Crowley's Ridge in Arkansas. Proc. Ark. Acad. Sci. 31:42–45.

Germann, J. F. 1982. Food Habits of *Morone* hybrid bass in Clarks Hill Reservoir, Georgia. Proc. Annu. Conf. Southeast. Assoc. Fish. and Wildl. Agencies 36:53–61.

——— and Z. E. Bunch. 1983. Age, growth, and survival of *Morone* hybrids in Clarks Hill Reservoir, Georgia. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 37:267–275.

Logan, H. J. 1967. Comparison of growth and survival rates of striped bass and striped bass × white bass hybrids under controlled environments. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 21:260–263.

Morello, F. A. 1984. Development and management of an urban fishery with hybrid striped bass. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 38:436–445.

Moss, J. L. and C. S. Lawson. 1982. Evaluation of striped bass and hybrid striped bass stockings in eight Alabama fishing lakes. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 36:33–41.

Saul, B. M. and J. L. Wilson. 1982. Food habits and growth of young-of-year white bass × striped bass hybrids in Cherokee Reservoir, Tennessee. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 35:311–316.

Soil Conservation Service. 1967. Soil association map, state of Arkansas. U.S. Dep. Agric., Little Rock, Ark.

Ware, F. J. 1974. Progress with *Morone* hybrids in freshwater. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 28:48–54.

Williams, H. M. 1970. Preliminary studies of certain aspects of the life history of the hybrid (striped bass × white bass) in two South Carolina reservoirs. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 24:424–430.

Yeager, D. M. 1985. Creation of a hybrid striped bass fishery in the Escambia River, Florida. North Am. J. Fish. Manage. 5:389–392.

Young, N. 1984. Establishment of a hybrid *Morone* fishery in the Apalachicola River, Florida. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 38:450–454.