Fisheries Session

Three Decades of Managing Largemouth Bass, Smallmouth Bass, and Walleye in Meredith Reservoir, Texas

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Abstract: Management of largemouth bass *(Micropterus salmoides)*, smallmouth bass *(M. dolomieu)*, and walleye *(Stizostedion vitreum)* fisheries in Meredith Reservoir has a long history of challenges addressed by fisheries managers including dramatic water level changes and habitat loss, changes in sampling gear and sampling protocols, changing angler concerns, and limited information. Management philosophy changed from a period of liberal harvest regulations designed to promote maximum harvest to one of more restrictive regulations designed to optimize both fish populations and angler success. As data and analytical tools improved and new information was obtained, regulations gradually became more stringent resulting in improvements in density and size structure of the fish populations and increased opportunities for anglers. Research of basic life history information, species behavioral characteristics, and assessments of length limits have led to improvements in stocking strategies, harvest regulations, and interactions with anglers. Fish populations have improved in Meredith Reservoir through analysis of species-specific long-term data sets, application and evaluation of new management and sampling techniques, sound scientific investigations, and cooperative efforts of anglers.

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Fisheries management in reservoirs is a continuously evolving process, and biologists are challenged with balancing the development and maintenance of quality sport fisheries with other uses of the reservoirs, varying inflows and productivity, and changing desires of anglers. Assessing management techniques such as stocking and enacting regulations requires long periods of time. Annual variance in estimates of fish abundance, growth, condition, and population structure may represent normal fluctuation around long-term trends. To identify problems with fish populations, develop management plans, and assess success of applied management, biologists compile long-term databases using a variety of sampling regimes and analyze the data. Biologists must take into account environmental variables when assessing long-term databases as well as when designing, implementing, and evaluating fisheries management practices. Literature dealing with similar reservoirs and environmental conditions that can provide precise direction for fisheries managers are rare because water quality characteristics and fish habitat vary among drainages and reservoirs and even within the same reservoir year-to-year.

This manuscript recounts results of species-specific fisheries management efforts conducted at Meredith Reservoir in the Texas Panhandle since the late 1960s and presents sampling data and research that led to management decisions. The fishery consists of white bass *(Morone chrysops),* channel catfish *(Ictalurus punctatus),* flathead catfish *(Pylodictus olivaris),* bluegill *(Lepomis macrochirus),* smallmouth bass *(Micropterus dolomieu),* largemouth bass *(M. salmoides),* white crappie *(Pomoxis annularis),* and walleye *(Stizostedion vitreum).* This paper will focus on management of largemouth bass, smallmouth bass, and walleye. These species were selected because they provide examples of the use of long-term data sets and research investigations to manage sport fish. In this paper we review the sampling history, stocking, regulation changes, and research investigations over the past 30 years and present data sets that led to management decisions. Our purpose is to demonstrate the dynamic nature of fisheries management and the use of sound data to help deal with the changing nature of fisheries management in one reservoir. Funding for this project was provided by the Federal Aid in Sport Fish Restoration Act Project F-30-R of the Texas Parks and Wildlife Department.

Methods

During the 1960s and 1970s in West Texas, many reservoirs were impounded in semiarid regions on intermittently flowing rivers. These impoundments today present a formidable challenge for providing quality sport fishing. The climate in West Texas is harsh, with extremes in temperatures occurring in both summer and winter. Droughts are frequent and may persist for 7 to 10 years.

Meredith Reservoir is located 72 km north of Amarillo, Texas, on the Canadian River. The reservoir was built in 1965 by the Bureau of Reclamation, like most West Texas impoundments, for municipal water supply and flood control. The Canadian River Municipal Water Authority operates the reservoir for supplying water to 13 member cities. The National Park Service manages the surrounding Lake Meredith National Recreation Area and the Texas Parks and Wildlife Department (TPWD) manages the fish and wildlife resources. At conservation pool, 882.3 m above mean sea level, surface area is 6,480 ha and maximum depth is 39 m. Since impoundment, reservoir surface area has ranged from 2,794 to 4,860 ha (Fig. 1). There have been no downstream releases of water from the reservoir since impoundment. Steep canyon walls with rock and boulder shorelines characterize most of the basin with the exception of the upper reaches of the reservoir and a few, relatively shallow, large embayments. Secchi disk transparency ranges from 61 to 244 cm.

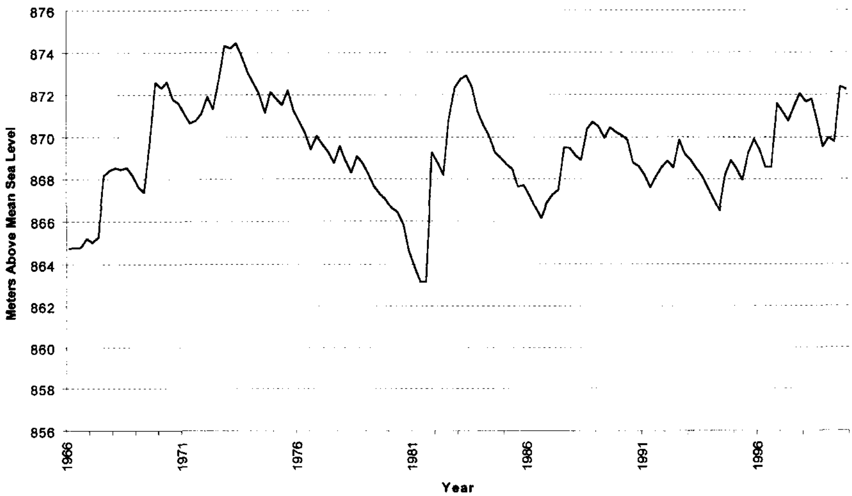

Figure 1. Quarterly water Level history of Meredith Reservoir, Texas. Conservation pool is 882.3 m above mean sea level.

Prior to 1975, TPWD had no standard survey protocol for assessing fish populations in reservoirs. Typical sampling consisted of gill netting, seining, and water quality and vegetation assessment. Additional survey techniques included trap netting, electrofishing and cove rotenone sampling. Standardized fish sampling protocols were established in 1975 and were presented in a management techniques manual with specific guidelines for each targeted species and gear type. These included when, where, how, and how many samples were to be collected. This manual was revised in 1976, 1978, 1986, 1993, and 1998 (TPWD 1998) in an effort to continue strengthening protocols and update sampling methods. Sampling protocol was changed in 1998 from fixed stations to randomly selected stations, which changed with each sample.

Gill-net samples for walleye population assessment were collected in spring each year. From 1969 through 1987, gill nets were 60 m long and consisted of 8 multifilament panels with mesh sizes increasing from 12.7 to 101.6 mm bar mesh by 12.7-mm increments. Gill nets were constructed of monofilament webbing in 1988. In 1995, gill nets were modified by removing the 12.7-, 88.9-, and 101.6-mm panels thereby consisting of 5, 7.5m monofilament panels with bar mesh sizes from 25.4 to 76.2 mm by 12.7-mm increments. Detailed gill netting methodology was described by Munger and Kraai (1997).

Electrofishing in Meredith Reservoir was initiated in 1985 to annually sample largemouth and smallmouth bass populations. Sampling was conducted annually during September or October. From 1986 to 1991, sampling was conducted with AC current but was changed to pulsed DC current in 1992. Detailed electrofishing methodology has been described by Kraai (1993*a*).

Cove rotenone sampling was used annually from 1969 to 1989 to estimate standing crop within the reservoir. Two or three, 0.2-ha to 0.5-ha coves were sampled each

August with 5% rotenone. Fish were collected for 2 days following treatment. Weights and lengths were recorded on the first day of collection, but only lengths were recorded on the second day. Detailed cove rotenone sampling methodology has been described by Kraai (1990).

A non-uniform, random creel survey was conducted annually from 1984 to 1999 to estimate fishing pressure and angler catch and harvest. The roving survey was conducted on 5 weekend days and 4 week days each quarter. Four quarters were sampled each year. Two angler counts were conducted during each creel day to estimate fishing pressure. Detailed creel survey methodology was described by Munger and Kraai (1997).

Results and Discussion

Trophic relationships and rapid aging of new reservoirs have been described in detail by Kimmel and Groeger (1986). Meredith Reservoir reflects the initial new reservoir trophic disequilibrium of "trophic upsurge" (high biological productivity) followed by "trophic depression" (low biological productivity). From 1966 to 1973—the trophic upsurge stage—reservoir water levels rose, organic detritus and nutrient input was high, and much terrestrial vegetation was inundated providing habitat for fish and benthic organisms. The trophic depression stage at Meredith Reservoir was accelerated when water levels consistently declined from 1973 to 1981. Nutrients and organic detritus inflow was negligible and most inundated terrestrial vegetation was either dewatered or had decayed. The fishery necessarily followed the "upsurge" and "depression" process, an initial "boom" followed by a resounding "bust." The bust was further accentuated by liberal length and bag limits associated with the maximum sustained yield philosophy of the times. Anglers, particularly organized black bass anglers and walleye anglers, demanded that the TPWD stock more fish. The following text details the challenges faced and recommendations made by TPWD personnel in establishing management practices over the years for largemouth bass, smallmouth bass, and walleye.

Largemouth Bass

Fishing success for largemouth bass declined in the early 1970s based on angler reports and complaints and public demands that TPWD initiate a stocking program. Efforts to educate anglers of the futility of stocking into a reservoir that contained an established population and little suitable habitat (Durocher et al. 1984) were unsuccessful, and pressure to stock increased. The TPWD agreed to stock under the conditions that all fish be marked and assessments of stockings be documented. Fluorescent-dye-marked fingerling (25–78 mm) bass (61,000 fish) and freeze-branded 254-mm bass (27,000 fish) were stocked in 1973 (Kraai 1977). Local bass clubs provided boats and labor for the stocking. Sampling over the next year (22 electrofishing stations, 378 trap nets, 16 gill nets, 30 30-m seine drags, and 3 bass tournaments) resulted in the collection of no dye-marked fish and 8 freeze-branded fish. Subsequent demands to stock largemouth bass declined.

Meredith Reservoir was 1 of 30 Texas reservoirs studied from 1976 to 1978 to determine relationships between largemouth bass abundance and submerged vegetation (Durocher et al. 1984). A significant positive relationship ($P<0.01$) was found between percent submerged vegetation and standing crop of largemouth bass ($r=0.79$) and numbers being recruited to harvestable size ($r=0.69$) based on cove rotenone samples. Meredith Reservoir had the lowest percent coverage of submerged aquatic vegetation (<1%), lowest standing crop (1.46 kg/ha) and the lowest number of >254-mm bass (2.47/ha) of all the reservoirs studied.

Cove rotenone sampling was employed to assess the dynamics of the largemouth bass population during the period 1976–1986 when the reservoir was experiencing severe water level fluctuations with water levels declining 10.5 m over 7 years and then rising 9.9 m in 2 years. Correlation of age-0, juvenile, and recruited largemouth bass with water level data revealed age-0 densities were independent of net annual water level change ($r=0.36$; $P=0.38$), densities of juvenile fish were strongly related with net changes from the previous year ($r=0.73$; $P=0.04$), and densities of fully recruited fish were strongly related with net changes from 2 years prior ($r=0.90$; $P=0.002$) (Kraai 1990). The population density at the conclusion of the study (<2.5 adult bass/ha) was similar to that prior to the water level rise in 1982. Even with the best habitat since impoundment, approximately 2,020 ha of flooded, dense terrestrial vegetation (Kraai 1985), broodfish abundance was too low to produce a strong year class. Reynolds and Babb (1978) found most bass populations they studied which had <24.7 adult largemouth bass/ha experienced year class failure.

Corrective management recommended following this study included more restrictive length limits to build and protect broodstock and stocking fingerling largemouth bass. Florida largemouth bass *(M.s. floridanus)* were stocked to improve genetic potential for producing large fish and northern largemouth bass *(M. S. salmoides)* were supplementally stocked during years with rising waters, abundant habitat, and low densities of adult fish. Largemouth bass were managed with no minimum length (MLL) and a 15-fish daily bag limit from impoundment to 1971. In 1971, a statewide 254-mm MLL, 10-fish daily bag limit, was implemented. This regulation apparently was inadequate for protecting and building the fishery and promoted rapid harvest of fish as soon as they reached legal size. The MLL for Meredith Reservoir was increased from 254 mm to 305 mm in 1986 and subsequently to the statewide 356 mm length limit in 1988. The statewide daily bag limit was reduced in 1986 from 10 fish/day to 5 fish/day.

Stocking to introduce Florida largemouth bass genes into the population and of northern largemouth bass to coincide with water level increases for supplementing natural recruitment were conducted in the late 1980s and the early to mid-1990s (Table 1). Stocking pure Florida largemouth bass was not successful as they did not persist in the system (Fig. 2) similar to what was reported for Oklahoma waters of the same latitude (Gilliland 1992). Stocking Kemp's bass, an F1 hybrid between northern and Florida largemouth bass with a distinct genetic marker, was successful as they comprised a substantial percentage of the 1988 and 1990 year classes and the genetic marker persisted in subsequent year classes (Terre et al. 1993). Anglers

Table 1. Stocking history of smallmouth bass, largemouth bass, and walleye for Meredith Reservoir, Texas. Total length (TL) categories are: FRY = <26mm; FGL =26–77 mm; and ADL = adults (sexually mature fish).

Species	Year	*N*	TL category
Smallmouth bass	1974	11,100	FGL
	1975	28,000	FGL
	1976	66,000	FGL
	1977	322,700	FGL
Total		427,800	
Largemouth bass	1965	480,000	FGL
	1966	462,000	FGL
	1973	61,000	FGL
	1973	27,000	ADL
	1994	286,400	FGL
	1995	586,663	FGL
	1997	177,000	FGL
Total		2,050,063	
Florida largemouth bass	1986	631	ADL
	1990	401,749	FGL
	1993	100,000	FGL
Total		502,380	
Kemp's[a] largemouth bass	1988	412,727	FGL
	1990	189	ADL
Total		412,916	
Mixed largemouth bass[b]	1983	553	ADL
	1989[c]	197	ADL
	1990[c]	40	ADL
Total		790	
Walleye	1965	500,000	FRY
	1966	2,000,000	FRY
	1998	5,096,000	FRY
	2000	290,196	FGL
Total		7,886,196	

a An F1 hybrid between northern largemouth bass *(Micropterus salmoides salmoides)* and Florida largemouth bass *(M. s. floridanus)* with a distinct genetic marker. b Largemoth bass of unknown genetics
c Surplus hatchery broodfish 0.68 to 1.82 kg.

helped document a consistent trend of increasingly large fish caught from the reservoir since the introduction of Florida largemouth bass hybrids: in 1989, the certified water body record for largemouth bass caught from Meredith Reservoir was 2.63 kg. In 1990 the record increased to 3.69 kg, in 1996 it was 3.97 kg, then 4.09 kg in 1998, and in 1999 the record increased to 4.28 kg. In 2000 a new record of 5.27 kg was set, a fish identified by electrophoresis to be a Florida largemouth bass F1 hybrid. Creel survey statistics from 1985 through 1998 showed high variability in pressure, catch, and harvest for largemouth bass without definable trends. Creel statistics did reflect an increasing trend in the numbers and percentages of legal-size largemouth bass caught and released by anglers since 1992 (Table 2). The combination of more restrictive regulations and catch and release may be contributing substantially to the

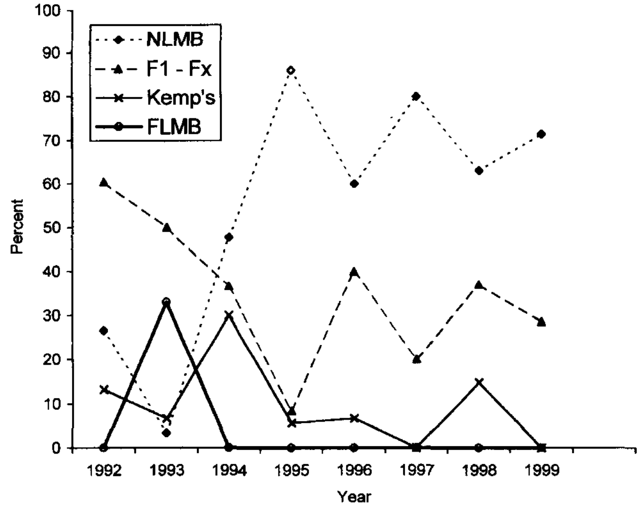

Figure 2. Percent genetic composition of largemouth bass samples, Meredith Reservoir, Texas. Thirty young-of-the-year largemouth bass were collected by electrofishing each fall 1992 to 1999. Legend abbreviations are FLMB for Florida largemouth bass, NLMB for northern largemouth bass, Kemp's for a genetically marked Florida largemouth bass × northern largemouth bass hybrid, and F1-Fx for naturally produced intergrades.

Table 2. Number of legal-size largemouth bass documented during creel surveys and percent released, Meredith Reservoir, Texas, 1985–1998. Largemouth bass were managed with a 254-mm minimum length limit 10-fish daily bag limit in 1985. The minimum length limit was increased to 305 mm and bag limit reduced to 5 fish/day in 1986. The minimum length limit was further increased to 356 mm in 1988 and the bag limit remained at 5 fish/day.

Year	Total caught	% released
1985	13	0
1986	6	0
1987	5	0
1988	33	36
1989	11	32
1990	14	14
1991	5	20
1992	5	0
1993	18	78
1994	61	70
1995	11	54
1996	58	77
1997	22	59
1998	64	76
Total number	326	132

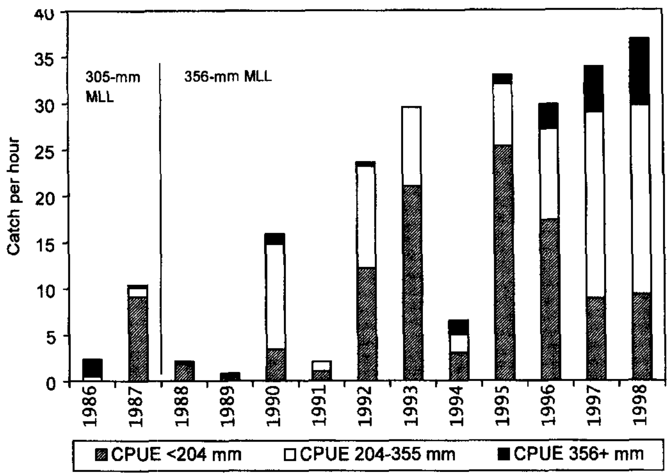

Figure 3. Electrofishing catch rate (*N*/hour) of largemouth bass from Meredith Reservoir, Texas. Total length categories are sub-stock length (<204 mm), 204–355 mm, and ≥356 mm. Largemouth bass were managed with a 305-mm minimum length limit (MLL) and 5-fish daily bag limit in 1986 and 1987. The length limit increased to 356 mm in 1988 and the bag limit remained the same.

increase in CPUE ≥356 mm fish seen in electrofishing samples and to the opportunity for anglers to catch trophy-size fish. Northern largemouth bass were stocked in 1994, 1995, and 1997 following water level rises in 1994 through 1996. Density estimates and stock structure have improved markedly for this population since 1994 (Fig. 3). This would suggest that, under the condition of extremely low broodfish density and an abundance of quality nursery habitat, supplemental stocking might have increased recruitment. This concept diverges from present-day beliefs of many fisheries biologists and additional research is needed. Additionally, stocking northern largemouth bass appears to have effected a substantial change in population genetics (Fig. 2). When genetic testing was first initiated in 1992 and 1993, Florida bass genetic influence dominated in the electrophoresis samples while pure northern largemouth bass comprised <30%. Following stockings, pure northern largemouth bass presence increased to 60%–80% of the samples.

Smallmouth Bass

Biologists investigated alternative species for filling the burgeoning demand for tournament bass fishing opportunities following the decline of the largemouth bass fishery in the early 1970s. Smallmouth bass appeared better suited to environmental conditions in Meredith Reservoir than largemouth bass. The TPWD stocked smallmouth bass fingerlings from 1974 through 1978 (Table 1) and the population expanded and became self-sustaining by the late 1970s. Unlike largemouth bass, water level fluctuations had little influence on this population (Kraai 1990).

Movement and distributional patterns of adult smallmouth bass in Meredith Reservoir were studied using ultrasonic telemetry from 1985 through 1987 (Kraai et al. 1991). They occupied discrete home range areas ranging from 1.32 to 43.23 ha from July through February, but moved up to 6.5 km during spring months. Minor inshore movements occurred during spring and fall, and minor offshore movements in summer and winter. Preferred habitat was rocky shorelines and submerged humps in water ≤5 m deep. Such movement and habitat preferences may have resulted in adult smallmouth bass being highly susceptible to anglers. Length frequency trend information from electrofishing samples appeared to support the likelihood of excessive harvest of legal-sized fish. (Fig. 4).

As with largemouth bass, the MLL was increased from 254 mm to 305 mm in 1986 and again to 356 mm in 1988 in an attempt to increase smallmouth bass abundance and the availability of quality-size fish. The daily bag limit was reduced in 1986 from 10 fish/day to 5 fish/day. Electrofishing samples following these changes showed a significant increase in population density ($P = 0.006$), primarily of 178- to 280-mm fish characterized by slow growth and poor condition, and a fishery characterized by high catch rates of small fish (Kraai 1993*a*).

A 305- to 380-mm slot limit (SLL) 3 fish bag limit for smallmouth bass only was enacted in 1992 to reduce the density of 178- to 280-mm fish, increase the density of ≥281-mm fish, and improved growth and condition. Post-regulation assessments

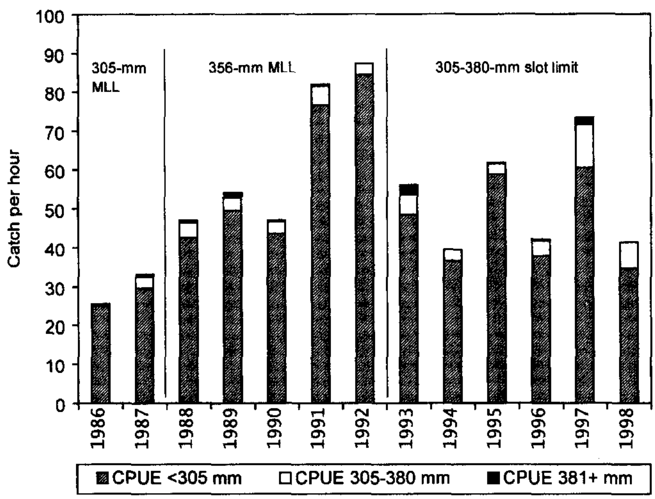

Figure 4. Electrofishing catch rate (*N*/hour) of smallmouth bass from Meredith Reservoir, Texas. Total length categories are <305 mm, 305–380 mm, and ≥381 mm. Smallmouth bass were managed with a 305-mm minimum length limit (MLL) and 5-fish daily bag limit in 1986 and 1987. The length limit increased to 356 mm in 1988 and the bag limit remained the same. A 305- to 380-mm slot length limit was implemented in 1992 with a 3-fish daily bag limit.

indicate some decrease in densities of 178- to 280-mm fish and a minor increase in the densities of ≥281-mm fish (Fig. 4); however, a longer term evaluation will be needed. Munger (2000) found a high percentage (56%–78%) of fish harvested from 1996 to 1999 were below slot size, harvest which is essential for the regulation to work as it was designed. Growth rates improved since implementation of the SLL. Smallmouth bass reached 305 mm in 5 years prior to the SLL; by 1999, they reached 305 mm in 3 years (Munger 2000). Condition indices have remained variable despite improved growth (Munger 2000). As with largemouth bass, anglers have helped document a trend of increasingly larger fish being caught since the inception of more restrictive length limits. Starting in 1989 the certified lake record smallmouth bass weight increased from 2.55 kg to 2.81 kg, then to 2.86 kg and in 1993 it further increased to 2.94 kg. The current state record for smallmouth bass (3.60 kg) was caught in 1998 in Meredith Reservoir. Both the 281- and 356-mm MLL regulations proved inappropriate for this population. The SLL had improved smallmouth bass growth and appears to be improving population density and size structure, which should provide anglers with better quality fishing opportunities.

Walleye

Relatively small numbers of walleye fry were stocked in Meredith Reservoir in 1965 and 1966 (163–410/ha) to provide an open-water predator and new angling opportunities (Table 1). A self-sustaining fishery developed within 3 years after stocking (Kraai and Prentice 1974) and walleye quickly became a popular sport fish for area anglers. This was the first successful establishment of walleye in Texas. With this introduction, TPWD identified the need for information on walleye in Texas and a life history study was initiated. Growth of walleye in Meredith Reservoir was compared to more northern lakes, and it was learned that age-1 Meredith Reservoir walleye grew more rapidly than northern fish, followed by a sharp decline in growth (Kraai and Prentice 1974). Walleye growth rates in northern lakes declined at a slower rate resulting in larger fish at older ages than in Meredith Reservoir. Walleye in Meredith Reservoir matured at age 2 for males and age 3 for females. Spawning occurred from mid-March to mid-April when water temperatures were between 4.4 and 13.3 C. The peak spawning activity occurred between 5.6 and 10.0 C. Virtually the entire shoreline of Meredith Reservoir was found to contain suitable spawning habitat for walleye but only 2 distinct spawning sites were documented. Rip-rap along the dam was the primary site. Introduction of walleye was expanded to other reservoirs in Texas following the success of the fishery in Meredith Reservoir.

An assessment of cost-to-benefit considerations for stocking walleye in Texas revealed Meredith Reservoir achieved a cost-to-benefit ratio of 1:89 for developing this fishery. Cost to establish the fishery included expenses for equipment and labor to procure and hatch eggs, to rear fry, and to stock the reservoir. Value of the walleye fishery was determined by multiplying the monetary value of a man-hour of recreational fishing ($28 per day in Texas or $7 per man-hour, U.S. Dep. Int. 1980). Economic benefit of walleye fishing was evaluated for a 3-month period in 1981. The total recreational benefit during that time was $479,626. The initial cost of establishing the fishery from 1965–1967 was $5,358 (Kraai et al. 1983).

Parks and Kraai (1991*a*) conducted an ultra-sonic telemetry study from April 1986 to May 1988 to determine specific behavioral characteristics of adult walleye in Texas. Individual walleye established home ranges that varied in size from 141 to 2,519 ha. Fish were located most frequently in water ≤8.1 m deep within 90 m of shore and associated with brush or rocky shorelines. A 3-stage spawning pattern was identified: pre-staging, movement to within 5.6 km of the dam; staging, movement to within 2.2 km of the dam; then spawning on the rip-rap of the dam. Fish redistributed throughout the reservoir immediately after spawning. As with smallmouth bass, such movement and habitat preferences may have resulted in adult walleye being highly susceptible to anglers.

Regulations have been enacted to protect and enhance the walleye population. Complete protection was afforded by prohibiting harvest from 1965 to May 1968. The population was then determined to be self-sustaining and anglers were allowed to harvest 5 fish/day with no MLL. In 1980 the bag limit was further liberalized to 10 fish/day. Declining density estimates were observed from 1984 to 1986 (Fig. 5) leading to establishment of a 407-mm MLL in 1987. Parks and Kraai (1991*b*) conducted a hooking mortality study during spring 1988 to address angler concerns about possible high mortality of hooked-and-released walleye under 407-mm. They found

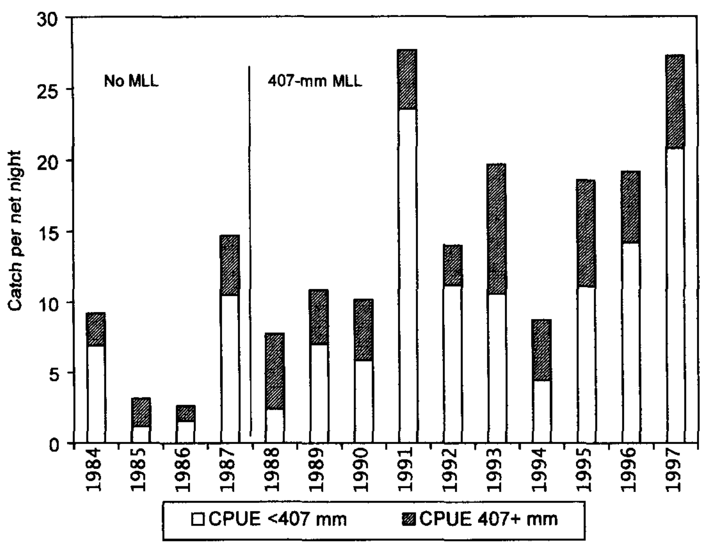

Figure 5. Spring gill net catch rate (*N*/net night) of walleye from Meredith Reservoir, Texas. Total length categories are <407 mm and ≥407 mm. Walleye were managed with no length limit and 10 fish daily bag limit from September 1980 to September 1987. A 407-mm minimum length limit (MLL) was implemented in September 1987. The bag limit was reduced to 5 fish per day in 1988.

>88% of total annual harvest of walleye occurred during spring months at Meredith Reservoir. No hooking mortality was observed when fish were held from 72.0 to 103.5 hours after being caught. The authors concluded that hooking mortality associated with the more restrictive MLL would be negligible. The bag limit was reduced to 5 fish/day in 1988 to address angler concerns of overharvest. Subsequent creel surveys indicated that the reduction in the daily bag limit had no significant impact on the average number of walleye harvested by angler parties (Munger and Kraai 1997). Gill net and creel surveys indicated that the change in MLL increased the total abundance of walleye ($P=0.037$), and angler catch rate ($P=0.011$). However, harvest rates were not significantly higher. The largest increase in walleye abundance was for 331- to 407-mm fish. Increased abundance resulted in a slight decline in growth and led to a decline in relative weight (Munger and Kraai 1997). The regulation was changed in 1999 to a 5-fish daily bag limit with no more than 2 fish <407 mm to address the increase in 331- to 407-mm walleye and decline in growth and condition without losing the benefits of the MLL. This regulation was designed to allow some harvest of fish <407 mm long and improve growth and condition of all size classes.

Forage availability may have impacted growth and condition of walleye. Gizzard shad *(Dorosoma cepedianum)* are the primary forage for walleye in Meredith Reservoir. Gizzard shad in this reservoir appear to follow a natural cycle of relatively high abundance for several years followed by a 1–2 years of relatively low abundance. The mechanism that drives this cycle is unknown and TPWD has made attempts to diversify the forage population to address this issue. Following a severe decline in gizzard shad numbers in 1968 (Crabtree 1968), inland silversides *Menidia beryllina)* were stocked and became established by 1970. An initial food habit study conducted by Kraai and Prentice (1974) failed to document any use of inland silversides as prey by walleye. In another study conducted by Kraai (1977), inland silversides were documented as a food item for walleye following a decline in gizzard shad. Between 1980 and 1984, yellow perch *(Perca flavescens)* were stocked into Meredith Reservoir to further diversify the prey base (Kraai 1993*b*). Yellow perch were established in the reservoir but the population has never become large enough to provide a significant amount of forage (Kraai 1993*b*). Neither inland silversides nor yellow perch provided significant increased forage availability and subsequent attempts to address growth and condition problems of sport fish have been conducted through appropriate harvest regulations.

While the walleye fishery in Meredith Reservoir has improved, the reservoir has produced few walleye over 4.54 kg (Munger 1999). (The current Texas state record, however, is 5.39 kg, caught from the reservoir in 1990.) Low production of large fish could either be a result of high harvest of larger walleye or a genetic growth differential. Creel survey information does not indicate excessive harvest of large walleye. Because the population was established with relatively few fish from 1 hatchery, the paucity of large fish may be due to a genetic difference in growth potential. Female walleye used as a brood source for Colorado hatcheries are frequently larger than 5.4 kg and the state record is over 8.2 kg. Walleye fry were obtained from Colorado in 1998 and 2000 and stocked in Meredith Reservoir to introduce new genetics into the population. Preliminary genetic evaluation of Meredith and Colorado walleye showed a significant difference in frequency of 3 loci, MDH3, IDHP, and general protein. The most diagnostic loci was MDH3 and success of the stocking program will be determined by monitoring for a shift in frequency of this allele within the population and for size of fish in angler creels.

Conclusions

Improving the quality of fishing is a primary goal of the Inland Fisheries Division of the TPWD. Largemouth bass, smallmouth bass, and walleye population structure and density estimates have shown continued improvement since the mid-1980s. Anglers now enjoy improved opportunities to catch more and larger fish. A review of the history of fisheries management at Meredith Reservoir has shown common threads of management that have led toward our goal. Management philosophy for these 3 species changed from maximum to optimum sustained yield. Regulations evolved from statewide, liberal, harvest-oriented limits to customized, situation-specific, catch-oriented limits designed to address specific management needs. Development and maintenance of long-term databases was essential for evaluating management of each species. Research methods and results were peer reviewed and significant findings published and used to improve fisheries management statewide. Appropriate stockings improved the genetic diversity of the populations and increased the potential of producing trophy-size fish for anglers. Angler cooperation with regulations and voluntary catch and release of legal-size fish magnified the effectiveness of management. Information anglers volunteered from their trophy catches provided valuable supplementary documentation of management successes in Meredith Reservoir.

A review of Meredith Reservoir history also reveals some significant lessons that we have been able to apply to current management. Despite system dynamics we could not control such as fluctuating water levels, declining productivity, and variable forage production, appropriate stockings and regulations could be used to maintain and improve existing fisheries. We learned long-term data sets were requisite for fully evaluating management actions. When actions were evaluated over the short-term, effects were often masked by variability of sampling data and could be impacted by unusual environmental conditions. Research investigations targeting specific problems often substantially supplemented and complemented standardized fish sampling procedures and provided a quality of information that otherwise would have been unavailable. We also found that knowledge of species behavioral characteristics and habitat preferences were useful for complimenting population statistics and could be used to refine sampling techniques. It was thought that Florida largemouth bass would not survive in Meredith Reservoir. While pure Florida largemouth bass did not persist, we have found that Florida largemouth bass × northern largemouth bass intergrades survived and grew to trophy proportions in this cool water reservoir.

Hindsight revealed missed opportunities that could have prevented problems or may have accelerated the recovery of fisheries. Looking back, restrictive harvest regulations should have been in place in 1966 to take advantage of early trophic conditions to build adult sport fish numbers and extend the initial period of high angler satisfaction. In 1981 following an increase in water level that flooded about 2,000 ha of terrestrial vegetation, we also missed an opportunity to improve the largemouth bass population by enacting a much more restrictive MLL. During this period with an abundance of quality nursery habitat and an adult largemouth bass population of $<$2.5/ha, we also missed the opportunity to supplementally stock Florida largemouth bass $\times$ northern largemouth bass fingerlings to more rapidly build the population. Smallmouth bass population structure would have improved sooner with increased numbers of quality-size fish had we changed directly from the 305-mm MLL to the slot length limit in 1988 instead of enacting the 356-mm MLL. Finally, additional stocking of walleye from other sources during the development stage of the population may have increased genetic diversity within the population and may have maintained a trophy fishery aspect for this reservoir. Continued adherence to sound management and research will be essential as environmental conditions and angler's expectations continue to change. Lessons learned from the past 30 years should help guide us in dealing with such new issues as the doubling of the Texas population, changing demographics, user conflicts, and increasing demands for water.

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