BIOTIC COMMUNITY

Fish Communities

Ninety-nine species of fish have been recorded in the Niangua Watershed (Table 24). Diverse aquatic habitats, good water quality, sustained base flows, and stable lake levels support diverse fish communities composed mostly of species associated with the Ozark faunal region (Pflieger, 1989a), but including some riverine species in LOZ. The watershed is well known for the varied fishing opportunities it offers; from stream fishing for smallmouth bass, rock bass, rainbow and brown trout, and suckers, to reservoir fishing for largemouth and spotted bass, crappie, catfish, white bass, paddlefish, and walleye.

Fish populations within the Niangua Watershed have been sampled from four different perspectives including: fish community sampling; snorkeling for Niangua darters; sport fish sampling; and angler surveys. Two fish community samples have been conducted on the LOZ portion of the watershed, and community samples obtained during black bass and crappie sampling. Species lists were completed for many of the Niangua darter samples to obtain faunal index values as described by Pflieger (1978). These were considered limited community samples, because snorkeling in pools were limited by visibility, and the number of individuals was not recorded.

Stream Community Sampling

Fish communities have been sampled at 58 stream sites in the Niangua Watershed (Table 32; Figure 23. The most extensive community sampling of streams throughout the watershed (19 sites) was conducted by Pflieger (MDC) as part of a statewide survey in 1975-1977. Earlier, less comprehensive surveys were conducted by Salyer in the early 1930s and Harry in the 1940s. A thorough survey of the Upper Niangua Subwatershed was conducted by Smale (UMC) for the Upper Niangua Animal Waste Project (UNAWP) between 1991 and 1995. Twenty-three sites were sampled, most, every year for five years. A private contractor, Environmental Science and Engineering (ESE), sampled six sites in the vicinity of Lake Niangua three times in 1989 and 1990 for Tunnel Dam relicensing. All community samples were analyzed to determine species distribution, relative abundance, and occurrence rates. The watershed was partitioned into three subwatersheds of approximately equal area for comparison. The Upper Niangua Subwatershed includes the main stem and tributaries upstream from the mouth of Bennett Spring Branch and the branch itself. The confluence of Bennett Spring Branch was chosen as a dividing point between subwatersheds because it doubles the flow of the NR and creates cold-water conditions for approximately 12 miles downstream. The Lower Niangua Subwatershed includes the main stem and all tributaries downstream from Bennett Spring Branch. The Little Niangua Subwatershed includes the LNR and its tributaries. Stream habitat on the LNR is isolated from that on the NR by LOZ. The lower NR is a sixth order stream for most of the subwatershed. The NR is fifth order in the Upper Niangua Subwatershed and the LNR is fifth order in its subwatershed. Summary data on relative abundance (percent of the total number of individuals) and rates of occurrence (percent of sites) for the subwatersheds and entire watershed are shown in Appendix H. The most abundant fish in the entire watershed was the central stoneroller (22%) with the bleeding shiner a close second (19%). The Ozark minnow, bluntnose minnow, and rainbow darter each comprised about 5% of the community samples. The central stoneroller was most abundant in the Upper Niangua (29%), and much less abundant in the Lower Niangua (2%), and Little Niangua (3%). The bleeding shiner was the most abundant fish in the Little Niangua (23%) and

Figure 23. Fish collection sites on streams within the Niangua River Watershed.

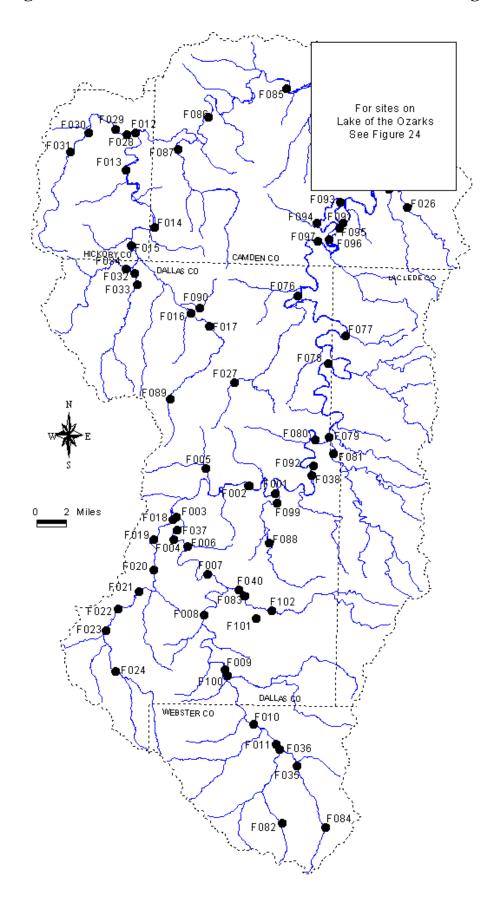


Table 24. Fish species collected within the Niangua Watershed.

	Scientific Name	Common Name	Federal Status	State Staus	State Rank	Global Rank
La	ampreys					
	Chestnut lamprey	Ichthyomyzon castaneus				
	Northern brook lamprey	I. fossor				
St	urgeons					
_	Lake sturgeon	Acipenser fluvescens	E		S1	G3
Pa	<u>addlefishes</u>		1		,	,
	Paddlefish	Polyodon spathula			S3	G4
G	ars		,		,	,
	Longnose gar	Lepisosteus osseus				
	Shortnose gar	L. platostomus				
Н	errings		d 2-	D.	,	7
	Gizzard shad	Dorosoma cepedianum				
	Threadfin shad	D. petenense				
M	ooneyes		,			
	Goldeye	Hiodon alosoides				
	Mooneye	H. tergisus		R	S3?	G5
Tı	couts	1	1			

	Rainbow trout	Oncorhynchus mykiss			
	Brown trout	Salmo trutta			
<u>Pi</u>	kes				
M	uskellunge				
<u>M</u>	Minnows				
	Central stoneroller	Campostoma anomalum			
	Largescale stoneroller	Campostoma oligolepis			
	Goldfish	Carassius auratus ¹			
	Grass carp	Ctenopharygodon idella ¹			
	Red shiner	Cyprinella lutrensis			
	Common carp	Cyprinus carpio ¹			
	Gravel chub	Erimystax x-punctatus			
	Striped shiner	Luxilis chrysocephalus			
	Bleeding shiner	L. zonatus			
	Redfin shiner	Lythrurus umbratilis			
	Hornyhead chub	Nocomis biguttatus			
	Golden shiner	Notemigonus crysoleuca			
	Bighead carp	Hypophthalmicthys nobilis ¹			

	Black carp	Nylopharyngodon piceus			
	Emerald shiner	Notropis atherinoides			
	Wedgespot shiner	N. greenei			
	Blacknose shiner	N. heterolepis	R	S2	G5
	Ozark minnow	N. nubilus			
	Rosyface shiner	N. rubellus			
	Sand shiner	N. stramineus			
	Southern redbelly dace	Phoxinus erythrogaster			
	Bluntnose minnow	Pimephales notatus			
	Fathead minnow	P. promelas			
	Creek chub	Semotilus atromaculatus			
Su	ckers				
	Suckermouth minnow	Phenacobius mirabilis			
	River carpsucker	Carpiodes carpio			
	Quillback	C. cyprinus			
	Highfin carpsucker	C. velifer		S2	G4G5
	White sucker	Catostomus commersoni			
	Northern hog sucker	Hypentelium nigricans			

Smallmouth buffalo	Ictiobus bubalus				
Bigmouth buffalo	I. cyprinellus				
Black buffalo	I. niger				
Silver redhorse	Moxostoma ansurum				
River redhorse	M. carinatum				
Black redhorse	M. duquesnei				
Golden redhorse	M. erythrurum				
Shorthead redhorse	M. macrolepidotum				
Catfishes	Catfishes				
Black bullhead	Ameiurus melas				
Yellow bullhead	A. natalis				
Blue catfish	Ictalurus furcatus				
Channel catfish	I. puctatus				
Slender madtom	Noturus exilis				
Stonecat	N. flavus				
Flathead catfish	Pylodictus olivaris				
Cavefishes					
Southern cavefish	Typhlichthys subterraneus				
Killifishes	,	,			

Northern studfish	Fundulus catenatus				
Blackspotted topminnow	F. olivaceus				
Plains topminnow	F. sciadicus			S3	G3
Blackstriped topminnow	F. notatus				
Livebearers					
Mosquitofish	Gambusia affinis ¹				
Silversides					
Brook silverside	Labidesthes sicculus				
Sculpins	Sculpins				
Mottled sculpin	Cottus bairdi				
Banded sculpin	C. carolinae				
Ozark sculpin	C. hypselurus				
Temperate Basses					
White bass	Morone chrysops				
Striped bass	M. saxatilis ¹				
Striped bass hybrid	M. saxatilis x M. chrysops ¹				
Sunfishes					
Rock bass	Ambloplites rupestris				
Green sunfish	Lepomis cyanellus				

Wa	armouth	L. gulosus				
	angespotted nfish	L. humilis				
Blu	ıegill	L. macrochirus				
Lo	ngear sunfish	L. megalotis				
Re	dear sunfish	L. microlophus				
Sm	allmouth bass	Micropterus dolomieu				
Spe	otted bass	M.punctulatus				
La	rgemouth bass	M. salmoides				
Wi	nite crappie	Pomoxis annularis				
Bla	ick crappie	P. nigromaculatus				
Perche	<u>s</u>					
Gr	eenside darter	Etheostoma blemmioides				
Ra	inbow darter	E. caeruleum				
	iped fantail rter	E. flabellare lineolatum				
Lea	ast darter	E. microperca			S2	G5
Nia	angua darter	E. nianguae	T	E	S2	G2
Jol	nny darter	E. nigrum				
Sti	ppled darter	E. punctulatum				

Northern orangethroat darter	E. spectabile				
Missouri saddled darter	E. tetrazonum				
Banded darter	E. zonale				
Ozark logperch	P.caprodes fulvitaenia				
Bluestripe darter	P. cymatotaenia	*		S2	G2
Slenderhead darter	P. phoxocephala				
Gilt darter	Percina evides				
Walleye	Stizostedion vitreum				
<u>Drums</u>	<u>Drums</u>				
Freshwater drum	Aplodinotus grunniens				

¹ Introduced species

Federal Status

E = Endangered

T = Threatened

C = Candidate for listing

* = Formerly listed as C2 (candidate for listing). This category was dropped in 1996.

E = Endangered

NOTE: All other classifications were dropped in 1998.

State Rank

Numerical rank of relative indangerment for the species within the state based on the number of known occurrences.

- S1 = Critically imperiled in the state because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from the state.
- S2 = Imperiled in the state because of rarity or because some factor(s) making it very vulnerable to extirpation from the state.
 - S3 = Rare or uncommon in the state.
 - S4 = Widespread, abundant, and apparently secure in the state, but of long-term concern.
- S5 = Demonstrably widespread, abundant, and secure in the state, and essentially eradicable under present conditions.

S#S# =Indicates range of uncertainty of the exact numerical ranking for the species.

? = denotes ranking which is uncertain.

Global Rank

Lower Niangua (10%), and the second most abundant in the Upper Niangua (22%).

The communities in the Upper Niangua and the Little Niangua Subwatersheds were very similar (Table 33). The four most abundant fish in the Upper Niangua were also most abundant in the Little Niangua, although in different order. Six species appear in the top

ten for both subwatersheds. The Lower Niangua community was quite different than the other two subwatersheds sharing only three species of the top ten with the Upper Niangua and three with the Little Niangua (Table 25). The fish community is also more diverse in the Lower Niangua. The five most abundant species comprise 35% of the community while the five most abundant in the other subwatersheds comprise over 65% of the communities. Eighty different species were collected in the Lower Niangua, 67 in the upper Niangua, and 58 in the Little Niangua. Relatively high numbers of species (41-50) were collected at the six ESE sites near Lake Niangua. This high diversity could be attributed to a combination of three factors: (1) Exceptionally thorough sampling was conducted including kick and drag seining, electrofishing, trapnetting, and gillnetting; (2) Three samples were grouped for these analyses (August 1989, Sept 1989, and June 1990); (3) The area's downstream position in the watershed (SM 29) and its habitat diversity, including lentic and lotic habitat, are expected to result in greater fish diversity.

Pflieger's (1989a) designations for ecological guilds were evaluated to further describe stream samples in the watershed and subwatersheds (Table 26). Sixty-four percent of the total number of fish collected in stream community samples were nektonic species. The relative abundance of the three guilds were similar in the Upper Niangua and Little Niangua subwatersheds with nektonic species comprising roughly two-thirds of the community. The community was quite different in the Lower Niangua Subwatershed where 55% of the community consisted of large species, 38% nektonic, and only 8% benthic.

Pflieger designated 43 Missouri fish species as "intolerant" meaning they were the first species likely to be affected by stream degradation (Norman, 1994). Nineteen (22%) of the species collected in watershed streams are so designated (Table 26). In the entire watershed, 17% of the total number of fish collected were intolerant species. The relative abundance of intolerant fish collected in the Lower Niangua Subwatershed was high compared to those of the other two subwatersheds (31% vs 13% and 10%). This might be expected in any watershed due to the more stable and diverse habitat normally found in downstream sections with greater streamflow. In addition, the Lower Niangua Subwatershed includes Lake Niangua and LOZ which also provides relatively stable and diverse habitat.

As shown in Table 35, no single intolerant species comprised more than 7.6% of the community in any subwatershed. However, watershedwide, seven species occurred at more than 50% of the sites. The percentage of intolerant species was determined for all community samples (Appendix I). Although no quantitative measure of habitat degradation was available, relatively low percentages of intolerant species at several sites may indicate some correlation with degraded habitat. Most of the samples with values less than 20 percent were located on streams which are generally believed to be degraded, including the East Fork, the West Fork, Dousinbury Creek, and Greasy Creek. These data suggest that the percentage of intolerant species at a given site may be inversely correlated with habitat degradation, such as high temperature, low dissolved oxygen, nutrification, or sedimentation. Further analysis, including statistical methods, is necessary to determine whether this index has potential for monitoring streams.

Table 25. The ten most abundant fish species collected from streams by subwatershed.

Upper Niangua	Subwatershed	Lower Nian Subwatersh		Little Niangua Subwatershed		
Species	Relative Abundance	Species	Relative Abundance	Species	Relative Abundance	
Central stoneroller	29.3	Bleeding shiner	10.0	Bleeding shiner	22.8	
Bleeding shiner	21.8	Black redhorse	7.6	Ozark minnow	15.7	
Ozark minnow	6.3	Golden redhorse	6.7	Rainbow darter	15.0	
Rainbow darter	5.0	Gizzard shad	5.9	Central stoneroller	7.4	
Ozark sculpin	3.9	Bluegill	5.5	N. orangethroat darter	5.9	
N. orangethroat darter	3.4	Longear sunfish	5.4	Striped fantail darter	4.1	
Striped shiner	3.1	Largescale Stoneroller	5.2	Greenside darter	3.8	
Bluntnose minnow	3.1	Rock bass	4.8	Largescale stoneroller	3.4	
Northern studfish	2.7	Green sunfish	4.8	Hornyhead chub	2.1	
Longear sunfish	2.6	Bluntnose minnow	4.6	Bluntnose minnow	1.8	
	81.2		60.5		82.0	

Relative Abundance - Percent of total number of fish collected.

Table 26. Ecological guild, faunal region association, and intolerant species summary for fish community samples from streams within the Niangua River Watershed.

		Upper Niangua Subwatershed			Lower Niangua Subwatershed		Little Niangua Subwatershed		Entire Niangua Watershed			
	Fish	RA*	Species	Fish	RA*	Species	Fish	RA*	Species	Fish	RA*	Species
Ecological Guild:												
Large	10,659	11.2	27	17,921	54.7	39	444	5.4	23	29,024	21.4	39
Nektonic	69,760	73.3	22	12,321	37.6	21	4,947	60.4	19	86,755	63.9	22
Benthic	14,707	15.5	18	2,500	7.6	18	2,799	34.2	15	20,006	14.7	19
Faunal Region:												
Ozark	50,060	52.8	28	15,909	48.6	26	5,751	70.2	20	71,720	52.8	29
River	0	0	0	3	<0.1	1	0	0	0	3	<0.1	1
Prairie	0	0	0	3	<0.1	1	1	<0.1	1	4	<0.1	1
Lowland	0	0	0	0	0	0	0	0	0	0	0	0
Intolerant Species	12,251	12.9	15	10,077	30.8	18	863	10.5	14	23,191	17.1	19

RA* Relative Abundance

LOZ Community Sampling

Most of the fish sampling on the Niangua Arm LOZ has targeted sportfish for management purposes, including black bass, white bass, and crappie. Community samples were obtained by Borges in 1947 and Dent in 1977 using rotenone and gill nets in coves (Table 36). In Borges' samples, numbers of individuals were not recorded and some species were lumped together (i.e. redhorse spp.). Some estimation of the LOZ community has been provided by records of the bycatch obtained during electrofishing surveys for largemouth bass and trapnetting for crappie at the sites listed in Table 37. These data are lumped together for five year periods including 1985-1989 and 1990-1994 (Table 36). The electrofishing surveys were conducted during the spring at sites B101-B109, and the trap netting during the fall at sites C001-C018 (Table 37, Figure 24). Additional data has been obtained from angler surveys conducted from 1970 to date. Several species were not reported in any MDC samples since 1947 (Borges, 1950) including: paddlefish, goldeye, mooneye, emerald shiner, bluntnose minnow, northern studfish, blackstripe topminnow, and orangespotted sunfish. However, paddlefish are commonly caught by anglers, and goldeye and mooneye were reported in angler surveys.

Fish species of the large ecological guild dominated all samples (Table 36). This was probably due largely to the bias of the sampling methods and management objectives. Electrofishing yielded one nektonic species (brook silverside) and one benthic species (Ozark logperch). Borges' methods (rotenone and gill nets) yielded five additional nektonic species (emerald shiner, bluntnose minnow, northern studfish, and blackstripe topminnow), as well as brook silversides. No nektonic species were collected in Dent's rotenone samples, but one benthic species (Ozark logperch) was recorded.

Species characteristic of the four faunal regions in Missouri are indicated in Table 36. Seven species among the collections are characteristic of the Ozark Faunal Region and three of the River Faunal Region. Seven Ozark species were collected in numerous locations throughout the watershed. No species characteristic of the Prairie or Lowland faunal regions were recorded in these LOZ samples.

Ten intolerant species were collected in the LOZ samples (Table 36). Mooneye were only recorded in the 1947 survey, but were still occasionally reported by anglers until the mid 1970s in LOZ angler surveys. Two other intolerant species, paddlefish and walleye are fairly common in the lake, but probably have limited spawning success because Truman Dam blocks their spawning migration. They are both cultured at MDC hatcheries for periodic stocking in LOZ, paddlefish annually and walleye biannually. Brook silverside are very common, and Ozark logperch are fairly common. Smallmouth bass are collected infrequently in LOZ. Golden and shorthead redhorse suckers are common in LOZ, while black, silver, and river redhorse suckers and northern hognose suckers are collected infrequently by electrofishing and trapnetting (Greg Stoner (MDC), pers. comm.). In years with adequate flows, white bass, hybrid striped bass, paddlefish, and walleye make spawning migrations out of LOZ into the NR bypass reach, sometimes as far as Tunnel Dam. MDC Conservation Agents have reported that, historically, large numbers of fish including walleye and white bass congregated below the dam in the spring when discharge from the turbines were discontinued during large portions of the day and flows over the dam were substantial (Ed Webb (MDC retired), pers. comm.). White bass normally spawn in concentrated areas considerably downstream from the dam (Mike Colvin (MDC), pers. comm.), but have been observed spawning within 2.0 miles of the dam (Bob Schulz (MDC), pers. obs.). Tunnel Dam provides a physical barrier to fish and it is unlikely that fish migrating upstream are able to proceed beyond the dam. Although walleye may spawn successfully below the dam in some years, it is unlikely that suitable habitat paddlefish spawning.

Figure 24. Map of fish collection sites on Lake of the Ozarks.

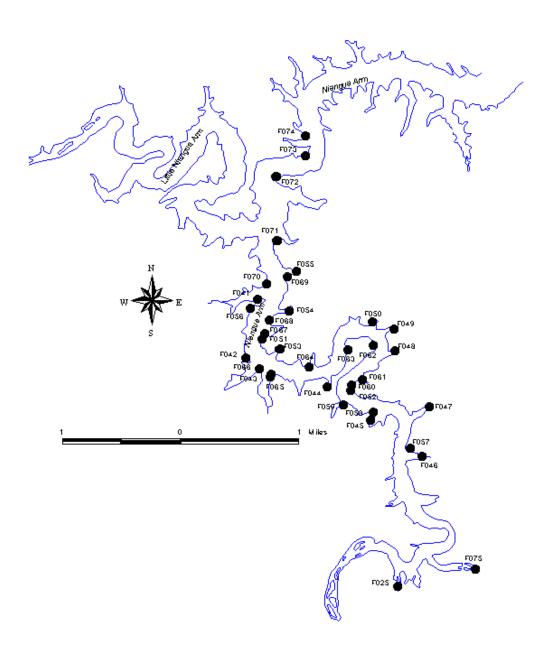
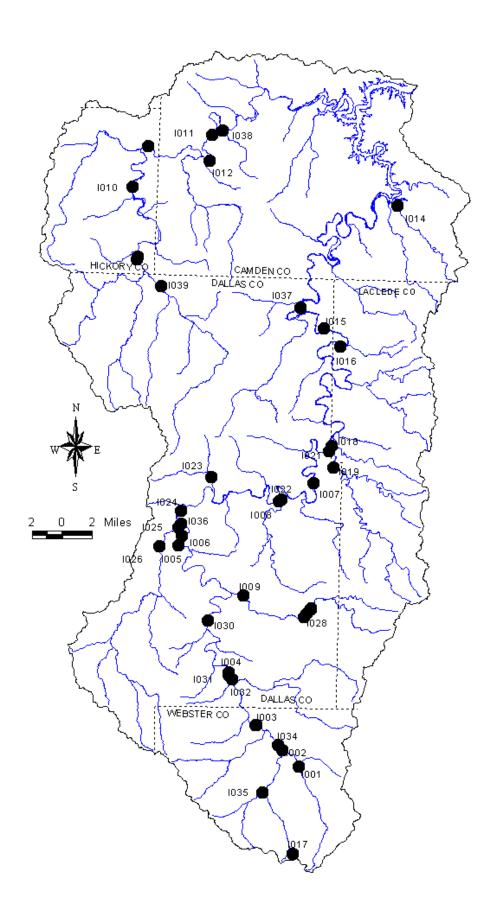


Figure 25. Map of invertebrate collection sites eithin the Niangua River Watershed.fish collection sites on Lake of the Ozarks.



Angler Surveys

Roving angler surveys have been conducted on the Niangua Arm from 1951-1954, in 1956, and every year since 1967. Samples have been conducted from SM 7 to SM 15 on 11-13 days per month between March and November. All species are recorded, and the results have been used to evaluate recreational use including angling effort and catch rates. Some species that have not otherwise been collected in the watershed, were recorded in these surveys. Additional angler surveys have been conducted during April and May between SM 17 and SM 20 on the Niangua Arm. The primary objective of these surveys has been to evaluate white bass catches, but all species were recorded. For further information, consult The Lake of the Ozarks Management Plan (Stoner, 1999).

Sportfish Sampling on the Niangua River

Funk and Fleener (1966) sampled the NR between 1951 and 1962 to evaluate the impact of a closed season for smallmouth bass between December 1 and May 30. The harvest was greater during the closed season trial period (1951-1956). They attributed this to a strong 1952 year-class, and fishing pressure was too light in later years to gauge the full effect of the year-round open season. They reported that growth of smallmouth bass in the NR was near the statewide average for headwater streams.

Cool-water species were sampled in the summer of 1996 at three sites on the NR by electrofishing. At HiCo Ford (SM 106) a high density of small smallmouth bass was observed (catch rate (CR) \$ 7 inches was 23/hr; PSD(12)=3). Only 3 largemouth bass and one spotted bass \$ 8 inches were sampled. A low density rock bass population was observed (CR (\$4")=3.5/hr). Williams Ford CA (SM 93) had a medium-density smallmouth population (CR (\$7")=8/hr). A low-density rock bass population of mostly small fish (5-6") was present. The Lead Mine CA site (SM 42) exhibited a medium-density smallmouth population (CR (\$7")=6.6/hr; PSD(12)=32). The Lead Mine area also supports a medium-density rock bass population (CR (\$4")=18/hr; PSD(7)=47). The Lead Mine results are similar to those obtained by Legler in 1985.

Trout have been sampled by electrofishing on the NR in 1986, 1990, 1993, 1995, and 1996. Data for three samples in 1995 and 1996 are presented in Table 38. Approximately 11 miles of the NR was sampled between Bennett Spring Branch and Prosperine CA. Fall sampling (1996) produced the greatest catch per unit effort (CPUE) for both species. Prior to 1995, brown trout were stocked when available to increase angling diversity in Bennett Spring and occasionally the Niangua River. The first major brown trout stocking of the Niangua River occurred in 1995.

Rare, Threatened, and Endangered Species

Eleven Niangua Watershed fish have been classified as state or federally rare or endangered (Table 28). The most notable of these is the Niangua darter which was so named when it was first discovered at the type locale (NR, SM 118.7) in 1884 (Pflieger, 1978). The Niangua darter is the only federally listed, threatened fish species in the watershed, and two of the eight extant populations are in the watershed (NR and LNR). It was assigned federal protection in 1985 under the Endangered Species Act; the recovery plan was approved in July 1989 (Pflieger, 1989c); and the federal Niangua Darter Recovery Team was appointed in 1991. The species will be considered recovered when two criteria are met:

1) Eight known populations must be made secure by reducing existing and potential threats to the greatest

Table 28. State or federal listed endangered animal species found within the Niangua Watershed.

Common Name	Scientific Name	Federal Status	State Status	State Rank	Global Rank
Lake sturgeon	Acipenser fulvescens		E	S1	G5
Blacknose shiner	Notropis heterolepis			S2	G5
Paddlefish	Polyodon spathula			S3	G4
Mooneye	Hiodon tergisus			S2	G5
Highfin carpsucker	Carpiodes velifer			S2	G4G5
Southern cavefish	Typhlichthys subterraneus			S1S2	G3
Plains topminnow	Fundulus sciadicus			S3	G3
Least darter	Etheostoma microperca			S2	G5
Niangua darter	Etheostoma nianguae	Т	E	S2	G2
Bluestripe darter	Percina cymatotaenia	*		S2	G2
Cooper's hawk	Accipiter cooperii			S3	G5
Great blue heron	Ardea herodias			S5	
Gray bat	Myotis grisescens	E	E	S3	G3
Indiana bat	Myotis sodalis	E	E	S1	G2

Black-tailed jackrabbit	Lepus californicus		E	S1	G5
Eastern hellbender	Cryptobranchus alleganiensis			S4	G4T4
Ringed salamander	Ambystoma anulatum			S3	G4
Four-Toed salamandar	Hemidactylium scutatum			S3	G5
Flat floater	Anodanta suborbiculata			S2	G5
Western fanshell	Cyprogenia alberti	*		S2?	G2
Snuffbox	Epioblasma triquetra			S1	G3
A perlid stonefly	Neoperla carlsoni		,	S3?	G?

¹ Introduced species

Federal Status

E = Endangered

T = Threatened

C = Candidate for listing

* = Formerly listed as C2 (candidate for listing). This category was dropped in 1996.

E = Endangered

NOTE: All other classifications were dropped in 1998.

State Rank

Numerical rank of relative indangerment for the species within the state based on the number of known occurrences.

- S1 = Critically imperiled in the state because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from the state.
- S2 = Imperiled in the state because of rarity or because some factor(s) making it very vulnerable to extirpation from the state.
 - **S3** = Rare or uncommon in the state.
 - S4 = Widespread, abundant, and apparently secure in the state, but of long-term concern.
- S5 = Demonstrably widespread, abundant, and secure in the state, and essentially eradicable under present conditions.

S#S# =Indicates range of uncertainty of the exact numerical ranking for the species.

? = denotes ranking which is uncertain.

Global Rank

extent possible and population size is stable or increasing.

2) Viable populations have been discovered or established in four additional stream drainages (Pflieger, 1989c).

Thirty-one sites within the Niangua Watershed have been sampled specifically for Niangua darters, including many sites established for monitoring Niangua darter distribution and population status. Pflieger sampled 16 of these sites between 1975 and 1976, many more than once. Based on these samples and numerous collections in other watersheds, Pflieger (1978) produced the definitive study on Niangua darter life history and status. Very limited sampling was conducted in the 1980s. Pflieger sampled one site (NR) and Charles Taber (SMSU) sampled one site (NR) on numerous occasions between 1976 and 1989. Regional fisheries personnel have sampled numerous sites within the watershed by snorkeling, including three sites in 1991, 13 in 1992, six in 1993, 11 in 1994, and two each in 1995 and 1996. The main objective of most of these samples was to document presence or absence, or to observe spawning behavior. Pflieger sampled three sites in the Niangua Watershed during a cursory survey of Niangua darter status in April 1992. Hayden Mattingly (UMC) surveyed numerous sites on the LNR between 1994 and 1996 as part of an MDC funded research project to investigate Niangua darter habitat preferences and reproductive behavior. Population densities, microhabitat use, and several physical habitat variables were documented. Limited data for several samples at five sites have been included in analyses for this inventory and assessment.

All of the known Niangua darter range on the NR is included within the Upper Niangua Subwatershed. The Smale survey for the UNAWP (1991-1995) included the entire range of known Niangua darter habitat on the NR. Sampling was completed at 23 sites, many once per year, for a total of 64 samples. No Niangua darters were collected during the five years of sampling, despite the fact that four of the sites had previously yielded darters and several sites were located between sites where Niangua darters were found. The data suggest that the LNR Niangua darter population is probably stable while the NR population may be declining. However, sampling on the NR was limited in 1995 and 1996, and sampling results between 1991 and 1994 were inconclusive. In 1994, observations at two sites extended the known range on Greasy Creek by 6 miles, however, only one darter was observed at each site, and habitat on Greasy Creek is considered poor. There is also reason for concern about the NR population because two previously occupied sites have failed to yield darters in recent years and no darters were found in the Smale survey. The LNR population has probably been one of the largest and stable of the eight extant populations. There is some need for concern though, because the population at the most frequently sampled site declined dramatically after a flood in April 1995 and continued to be depressed in 1996. Pflieger also expressed concern about the LNR population based on cursory sampling in 1992 (William Pflieger (MDC), pers. comm.).

Habitat requirements and distribution for the Niangua darter and the other fish in Table 28 are described by Pflieger (1978). Five fish have Missouri distributions confined to the Ozarks (mottled sculpin, least darter, Niangua darter, and bluestripe darter). Two are only found in Missouri (Niangua darter, bluestripe darter). Six are limited to small or medium sized streams (blacknose shiner, plains topminnow, mottled sculpin, least darter, Niangua darter, and bluestripe darter). This concurs with a study of threatened and endangered fish of the United States that found a high proportion of the species were stream fish and that darters were among the most vulnerable (Williams et al, 1989). Small streams are probably more

susceptible to degradation, and darters, being less mobile than other fish, are probably less likely to escape. In Missouri, the paddlefish is distributed throughout the Missouri and Mississippi rivers, including some major tributaries, and the lower Osage River, including LOZ. Lake sturgeon are also found in the Missouri and Mississippi rivers. They occurred in the Osage River prior to construction of Bagnell Dam, and were recorded in Niangua Arm angler surveys in the early 1970s, but have probably been extirpated. Mooneye range is statewide, and the highfin carpsucker is most common in large Ozark reservoirs.

The current status of most of these listed species in the watershed is precarious. Lake sturgeon were observed in the Niangua Arm shortly after impoundment and several 33- to 55-inch fish were caught by fishermen in the Niangua Arm in the mid 1970s (LOZ Angler Survey). Paddlefish are still fairly common in the Niangua Arm (LOZ) due to MDC stocking (refer to Fish Stocking section). Mooneye were collected in Borges' sampling in 1947 and were reported in angler surveys as recently as 1988. The only recent observation (1989) of the highfin carpsucker was two individuals in Lake Niangua (ESE, 1991). The plains topminnow was apparently extirpated from the watershed by 1971 (Pflieger, 1971) and has not been observed since. Mottled sculpins have been observed at two sites on the NR in recent years by snorkeling. They were fairly common at both sites. Niangua darter populations have been monitored closely, as discussed earlier, and appear to be fairly stable in the LNR and questionable in the NR. The bluestripe darter appears to be declining in the watershed. One was collected on the LNR in the 1950s, but none were detected at the same site in 1977. At one site on the NR, Pflieger collected seven darters in two samples in the 1970s, but Smale collected only one among four samples (1991-1994). At another NR site, Pflieger collected three in 1977, while Smale collected one in four samples (1991-1994). There have only been two snorkeling observations of the least darter in recent years but due to its small size and indistinct appearance, it is probably easily overlooked. Blacknose shiners were collected in Ha Ha Tonka Spring Branch in 1940 and have not been documented since. One southern cavefish was observed in Bennett Spring by Harry in 1940.

Several unlisted species have been rarely observed in the watershed. Borges collected emerald shiners in the mid 1940s in the Niangua Arm. Northern brook lampreys were observed by Pflieger in the 1950s and 1960s at two sites, by ESE in 1990 near Tunnel Dam, and in two unconfirmed snorkeling observations on Starks Creek in 1995 and 1996 (Bob Schulz (MDC), pers. obs.). Solitary blackstripe topminnows have been observed at two sites in the 1990s and suckermouth minnows at two sites in 1991 (Craig Fuller (MDC), pers. comm.).

Introduced and Exotic Species

A draft MDC policy provides guidelines for introducing aquatic species to waters of the state (MDC, 1996). Stocking guidelines are designed to protect native aquatic species and ecosystems from negative impacts through competition, disease introduction, and genetic introgression.

Several exotic species, which are defined as those not native to Missouri, have been introduced to the Niangua Watershed. Rainbow trout were introduced to Mill Creek at the turn of the century and a naturally reproducing population persists. Muskellunge were introduced in 1967 and 1968, and the state record fish was caught in the Niangua Arm in 1981 (41 lbs., 2 oz.). Reports from anglers about catching bighead carp in LOZ have increased in recent years (Greg Stoner (MDC), pers. comm.). Grass carp have also been widely introduced in ponds and lakes for aquatic vegetation control, and probably occasionally escape to other waters. European rudd were found at several bait shops in the LOZ area in the early

1990s, although there have been no reports of their presence in the lake.

Two exotic invertebrates were discovered in Missouri in 1992, the zebra mussel (*Dreissiena polymorpha*) and the spined water flea (*Daphnia lumhotzi*) (Alan Buchanan (MDC), memo, 5/19/92). Zebra mussels have not been found in LOZ but spined water fleas have. Both species present threats to natural communities through unchecked competition. The zebra mussel can encrust and smother native mussels and deplete plankton and other suspended food sources that native mussels and other filter feeders rely on. They can also clog intake pipes for water supplies and cooling systems. The possible impacts of expanding populations of the spined water flea are unknown, but they may alter zooplankton and phytoplankton communities and their predator populations including young fish and filter feeders (John Havel (SMSU), pers. comm.).

Several species have been intentionally introduced in the Niangua River and in LOZ to provide added forage, supplement fish populations with poor reproductive success, and add variety to the number of sport fishes available to anglers. Fish stocking in watershed streams and in LOZ is summarized in Table 29. In 1931, a new fishery began in the watershed when trout fishing first opened in Bennett Springs State Park. As fishing pressure increased with the onset of this new fishery, fish were stocked to help balance the increased harvest and poor reproductive success of trout in these waters. The majority of fish stocked have been rainbow and brown trout. The MDC operates the cold-water fish hatchery in the state park and produces trout for the park and NR stocking. Each year, 11-13 inch rainbow trout (ave. = 12 inch) are stocked in Bennett

Spring Branch, including 436,000 in 1995. Between 1981 and 1996, approximately 10,000 rainbow trout were stocked annually in the NR below the state park as much as 12 miles downstream. Prior to the initiation of the NR brown trout regulation in 1995, 2,090 brown trout were stocked between SM 56 and SM 65. In the spring of 1996, 7,500 brown trout were stocked between SM 54 and SM 62, and in the fall, 2,500.

Several fish species have been occasionally or periodically stocked in LOZ. Striped bass were introduced in 1967 and have been stocked periodically to provide a unique angling experience, and hybrid striped bass have been stocked since 1982. Threadfin shad were introduced in 1975 and were stocked periodically until 1983 to provide additional forage, but apparently have been unable to reproduce successfully. Spotted bass, which are native to the Bootheel and southeastern Ozarks, were probably introduced to the Osage Watershed prior to 1940 (Pflieger, 1975). Rock bass may also have been introduced to the upper Osage Watershed, since they were not collected in early surveys (Pflieger, 1975). Annual paddlefish stocking is necessary because migration to the only known spawning habitat for the LOZ population was blocked by Truman Dam in 1977. Most of the historic walleye spawning habitat was also blocked by Truman Dam, so periodic stocking is necessary. The Lake of the Ozarks Management Plan (Stoner, 1999) describes the following plans for future stocking: Paddlefish - annually; walleye and hybrid striped bass - alternate years; and striped bass every fifth year.

Aquatic Invertebrates

Invertebrates have been sampled at 44 sites within the watershed (Table 41, Figure 25), including 21 in the Upper Niangua, eight in the Lower Niangua, and five in the Little Niangua subwatersheds. The most thorough and extensive surveys were completed by Richard Duchrow (MDC) and Eric Nelson (UMC). Duchrow sampled six sites (Duchrow, 1984) distributed throughout the watershed in 1975 and 1976. Nelson sampled 21 sites in the Upper Niangua Subwatershed for the UNAWP annually between 1991

Table 30. Mussel species collected in the Niangua Watershed.

Scientific Name	Common Name	Federal Status	State Status	State Rank	Global Rank
Actinonaias l. carinata	Mucket				
Alasmidonta marginata	Elk toe	*		S2?	G4
Alasmidonta viridis	Slipper shell				
Amblema plicata	Threeridge				
Anondata grandis	Giant floater	R			
Anondata suborbiculata	Flat floater			S2	G5
Corbicula fluminea	Asian clam ¹				
Cyclonaias tuberculata	Purple wartyback				
Cyprogenia aberti	Western fanshell	*		S2?	G2
Elliptio dilatata	Ladyfinger				
Epioblasma triquetra	Snuffbox	*		S1	G3
Fusconaia flava	Wabash pigtoe				
Lampsilis radiata	Fat mucket				
Lampsilis reeviana	Britts shell				
Lampsilis ventricosa	Pocketbook				
Lasmigona costata	Fluted shell				
Lasmigona complanata	White heelsplitter				
Leptodea fragilis	Fragile papershell				

Ligumia subrostrata	Pond mussel			
Megalonaias nervosa	Washboard			
Obliquaria reflexa	Three horn			
Pleurobema sintoxia	Round pigtoe			
Potamilus alatus	Pink heelsplitter			
Potamilus ohioensis	Pink paper shell			
Ptychobranchus occidentalis	Kidney-shell	*	S2S3	G3G4
Quadrula metanevra	Monkeyface			
Quadrula pustulosa	Pimpleback			
Quadrula quadrula	Mapleleaf			
Strophitus undulatus	Squawfoot			
Toxolasma parvus	Lilliput			
Tritogonia verrucosa	Buckhorn (Pistol-grip)			
Truncilla truncata	Deertoe			
Truncilla donaciformis	Fawns foot			
Venustaconcha ellipsiformis	Ellipse			

 $^{^{1}}$ Introduced species

Federal Status

E = Endangered

T = Threatened

C = **Candidate** for **listing**

E = Endangered

^{*} = Formerly listed as C2 (candidate for listing). This category was dropped in 1996.

NOTE: All other classifications were dropped in 1998.

State Rank

Numerical rank of relative indangerment for the species within the state based on the number of known occurrences.

- S1 = Critically imperiled in the state because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from the state.
- S2 = Imperiled in the state because of rarity or because some factor(s) making it very vulnerable to extirpation from the state.
 - S3 = Rare or uncommon in the state.
 - S4 = Widespread, abundant, and apparently secure in the state, but of long-term concern.
- S5 = Demonstrably widespread, abundant, and secure in the state, and essentially eradicable under present conditions.

S#S# =Indicates range of uncertainty of the exact numerical ranking for the species.

? = denotes ranking which is uncertain.

Global Rank

and 1995. None of the Duchrow sites were sampled during the UNAWP. The taxa collected in these surveys are listed in Appendix J. In addition, Stream Teams have sampled at least twelve sites in the watershed, and two sites in the Upper Niangua were sampled annually from 1993 to 1995 as part of the long-term National Water Quality Assessment Program (NAWQA) by the USGS.

Table 30 lists all the known mussel species collected in the watershed. It includes those listed by Al Buchanan (pers. comm. 2/96) and others from Oesch (1984). Three are listed as rare in the state and two of those had been candidates for federal listing, until the method of listing was changed in 1996. This list portrays a diverse mussel community, however, the current status of mussels in the watershed is unknown due to lack of sampling. Mussels are considered sensitive indicators of water contamination (Cummings and Mayer, 1992). They filter large quantities of water to remove fine suspended sediment that may contain high levels of contaminants. They are also sensitive to streambed erosion and changes in substrate composition.

Pflieger collected three of the five crayfish species listed in Table 31 in the watershed (Pflieger, 1996). The Cambarus and Procambarus species are burrowing crayfish that may be found in flood plain burrows. Pflieger did not collect the burrowing species in his aquatic samples, but was confident they were in the watershed (pers. comm. 2/96). This is a surprising low number of species for a watershed with such a diverse aquatic fauna, however, the entire Osage River Watershed has a low diversity of crayfish (Pflieger, 1996). According to Pflieger, the northern crayfish has a wide distribution throughout Missouri and occurs in other states; the golden crayfish is widely distributed in the Ozarks; and the Salem cave crayfish is limited to the east central Ozarks. The Salem cave crayfish was reported from Ha Ha Tonka Spring, which is typical of its reported habitat (Pflieger, 1996).

Table 31. Crayfish species collected in the Niangua Watershed.

Common Name	Scientific Name	Federal Status	State Status	State Rank	Global Rank
Northern crayfish	Orconectes virilis				
Golden crayfish	Orconectes luteus				
Salem cave crayfish	Cambarus hubrichti			S3	G4
Devil crayfish	Cambarus diogenes				
Grassland crayfish	Procambarus gracilis				

¹ Introduced species

Federal Status

E = Endangered

T = Threatened

C = Candidate for listing

* = Formerly listed as C2 (candidate for listing). This category was dropped in 1996.

E = Endangered

NOTE: All other classifications were dropped in 1998.

State Rank

Numerical rank of relative indangerment for the species within the state based on the number of known occurrences.

- S1 = Critically imperiled in the state because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from the state.
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 - S3 = Rare or uncommon in the state.
 - S4 = Widespread, abundant, and apparently secure in the state, but of long-term concern.
- S5 = Demonstrably widespread, abundant, and secure in the state, and essentially eradicable under present conditions.

S#S# =Indicates range of uncertainty of the exact numerical ranking for the species.

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Global Rank