HABITAT CONDITIONS

E.

E.1. CHANNEL ALTERATIONS

The Meramec River is the second longest free-flowing river in the state of Missouri. Within the 228 miles total length of the Meramec River, 100% is unaltered (MDNR 1986). The MDNR defines unaltered as segments that man has not channelized or submerged by impoundment. The lower Meramec River has 0.5 miles that are historically navigable as defined by the U.S. Army Corps of Engineers (MDNR 1986).

E.2. UNIQUE HABITAT

E.2.1. Natural Features Inventory

The objective of the MDC statewide Natural Features Inventory was to locate, describe, classify, and rank high quality elements of Missouri's natural habitats. Biologists graded sites for their natural quality, and ranked sites to provide a means of comparing similar features for their preservation value (Ryan 1993). The three rankings were significant, exceptional, and notable.

E.2.2. Potential Natural Feature Sites

Natural history biologists identified 43 sites as potential natural feature sites . Ryan (1993) ranked 10 sites as significant, four sites as exceptional, and 10 sites as notable natural communities in the Crawford, Dent, and Reynolds counties inventory. The remaining 19 areas were identified as special natural areas in the Franklin, Jefferson, St. Louis, and Washington counties inventory by Kurz (1981). A Missouri Natural Features Inventory for Phelps, Pulaski, and Laclede counties was done by Ryan in 1992. Two of the significant natural communities were rare seep fens. The USFS, Salem District, and private interests partially own the Bates Hollow Seep Fen. In addition, Onondaga Cave in Crawford County is a significant feature, as identified by MDC, as well as a National Natural Landmark. The Natural Heritage database lists two types of glades--dolomite and sandstone. The MDC has two dolomite glades in the Indian Trail Conservation Area, and several can be found at Meramec State Park. Also, two of the exceptional communities were endangered deep muck fens. Although not the most abundant community, these wetlands were important high quality communities. Only two of the notable natural communities, the Ver Kamp Glade and the Woodson K. Woods Mesic Bottomland Forest, were identified by Ryan. Natural history biologists identified two dolomite cliffs, Vilander Cliff on the Meramec River (owned by the Missouri DNR) and Red Bluff (owned by the USFS) on Huzzah Creek as significant geologic features. Finally, the Natural Heritage database lists nine types of forests as terrestrial communities within the Meramec River basin.

The Meramec River has the unique honor of being one of the state’s finest free-flowing waters. The upper Meramec River in Dent County was ranked as an exceptional headwater stream, and the Crawford County portions of the Meramec River was identified as a significant aquatic community in the Ryan (1993) survey. Huzzah Creek and the Courtois Creek were also identified as significant aquatic communities in the Ryan (1993) survey.

E.2.3. Rare, Threatened & Endangered Aquatic Fauna

Since 1976, MDC Natural History inventories have documented 106 rare species sites, 72 sites with watch-list species, and 63 endangered species sites within the Meramec Basin (Table 15).

E.3. IMPROVEMENT PROJECTS

MDC fisheries biologists use cedar-tree revetment, corridor reforestation, streambank revegetation, willow staking, and rock blanket (riprap) as stream fish habitat improvement techniques and streambank erosion controls for improved water quality. Since 1987 a total of 13 projects were installed in Crawford, Jefferson, and Washington counties, using these techniques. The intended projects facilitated demonstration of proper stream management techniques and correction of identified MDC land (Fantz et al. 1993).

E.4. STREAM HABITAT ASSESSMENT

E.4.1. SHAD Site Selection

Following Bovee (1982), the methodology for stream habitat evaluation site selection of segments, sub-segments and representative reaches was based on stream order, flow, and stream complexity within the eight watersheds. In Jefferson and St. Louis counties, the St. Louis Region fisheries biologists portion of the lower Meramec River and its tributaries had 55 Stream Habitat Annotation Device (SHAD) sites. St. Louis Region biologists evaluated sites at all existing electrofishing sites and on all streams greater than or equal to order three (Meneau 1991). According to Meneau (1991), his group performed SHADs on every change in order upon a stream, unless a drastic habitat change (unchannelized vs. channelized, intermittent vs. permanent flow) took place. A representative reach consisted of 75-250 feet. Lastly, when possible, SHAD sites corresponded with Pflieger's (MDC Icthyologist) sample sites. In the upper Meramec River portion, East Central Region fisheries personnel evaluated SHAD sites on all streams greater than or equal to order three. Also, in this portion, fewer SHADs were done on higher order stream segments because they were relatively less complex and less prone to change as compared to lower order segments of the systems (Austin, MDC fisheries biologist, personal communication). In addition, according to Austin, the site selection procedure consisted of: (1) constructing gradient plots of potential areas to provide variation in gradient among the sites, (2) consulting a topographic map or aerial photos for surrounding land use and access to the site, (3) viewing video tapes of the watershed areas. Final selection was based on relative difference of the areas, access to the site, and locating and determining representative sections of the area.

E.4.2. HABITAT EVALUATION

E.4.2.1. Deep Loess Hills & Ozark Border Region

E.4.2.1.1. Erosional and Land-use Conditions

Soil types, stream corridor, and land-use conditions ultimately affect the erosional characteristics of a stream. A silty loam bottomland soil type borders the main stem Meramec River from the mouth to the headwaters (Figure 2; subsection A.3. Soils). Its tributaries are contained within two generalized regions: the Deep Loess Hills Region and the Ozark Border Region. Mostly contained within the USGS Lower Meramec River watershed, the Deep Loess Hills Region is predominantly the Menfro-Winfield Association with silt loam underlain by moderately permeable silty clay loam subsoil. The Union-Goss Association within the Ozark Border has a loess and cherty limestone residuum and a fragipan. Soils are silty loams on the surface and degrade to very cherty, silty clay soils. Silty clays, silty clay loams, and

silty loams have an erodibility factor of 0.24, 0.37, and 0.43, respectively, representing moderately to highly erodible soils (Table 1; subsection A.3.1.). In addition, the Deep Loess Hills Region is contained within the urban sprawl of St. Louis. Some areas within the St. Louis vicinity are classified as urban land, having bottomland soils that consist of asphalt, concrete, building, or other impervious surfaces.

Within the third-, fourth-, and seventh-order segments of the Lower Meramec River watershed (USGS Code #07140102-080), forest was the predominant SHAD site land use with development (buildings, roadways, parking lots, generally urban land soils) as a second principal land use. As a result of land use, soil, and stream corridor characteristics, St. Louis Region fisheries biologists found that approximately 43% of the corridors sampled had climax vegetation and 32% of the corridors sampled had immature trees and shrubs. Seventy-two percent of streams were at least adequately protected from streambank erosion; however, roughly 5.5% of the streambanks were unprotected from future erosion. Presently, of all stream orders combined, approximately one-half of the streambanks surveyed in the Lower Meramec River watershed had no unacceptable erosion or bank caving

E.4.2.1.2. Corridor Conditions

Future erosion can be prevented or lessened by maintaining a healthy corridor. Within the Deep Loess Hills Region and the Ozark Border Region, forests are largely oak-hickory, having fewer maple, elm, and black walnut. Also, floodplain areas have the sugar maple and butternut hickory associations (Steyermark 1996). In general, the SHAD survey of the lower Meramec River watershed shows that 44% of the third-order sampled corridors had timbered corridors with 25% of the length greater than 100 feet wide. One hundred feet of timbered corridor is generally agreed upon as the acceptable corridor width. Based on SHAD surveys conducted on the Lower Meramec River watershed, corridors on lower-order streams were poor. Within this watershed, sampled segments of Meramec River’s corridor (seventh order) had 40% of the corridor length as 100 feet or greater in width. All stream orders combined, between 9-15% of the stream corridors sampled had no woody vegetation in 25% of the corridor length (Table 16).

E.4.2.1.3. Channel Conditions

Good bass fishing depends on adequate cover, especially dead trees and crevices, and pool depth development. After the 1993 and 1995 floods, fishery biologists have noted an increase in woody structure that may have influenced the present fish assemblages. Surveys in 1991 of instream cover produced many types of cover that were reduced to nine predominant types. In addition, pool depth was measured to determine available habitat for bass.

The presence and density of woody structure (Table 17)was related to channel size and high flow events. The St. Louis Region fisheries biologists found woody structure as one of the predominant instream cover types on sampled sites (17% woody structure, 33% boulder). Woody structure made up a small portion of the sites sampled on third-order and seventh-order streams. Overall, boulder, rock, asphalt, and concrete were likely to be the predominant cover. Woody structure, however, was the predominant cover on fourth-order streams.

According to Edwards, Gebhart, and Maughan (1983), adult smallmouth bass minimum depth requirements for optimal survival and growth are between 3 to 4 feet. Within the Lower Meramec River, watershed pool depth and cover were from fair to good for the fish community (Table 29). Stormwater input may be contributing to the change in pool depth in some areas. Some main-stem Meramec River

reaches in the Lower Meramec river watershed have been scoured down to bedrock. Roughly 50% of the third-order pools were greater than three feet in depth. Although there are ranges of depths suitable for adult spawning, adult growth, and juvenile growth, optimal depth of all smallmouth bass during mid-summer ranges from 1.5 to 5 feet. Orders five and seven had some pools with depths that were slightly above optimal, such as sites near the mouth of the Mississippi River. These deep pools may explain the presence of bigger bass in the lower Meramec River.

E.4.2.2. Ozark Border Region to Ozark Region

E.4.2.2.1. Erosional and Land-use Conditions

Soil types in the Ozark Region are similar to the Ozark Border Region, having the Clarksville series (SCS 1979). Likewise, water erodibility factors range from 0.10 to 0.43 (see subsection A.3.1.). In the upper basin, selected SHAD sites within four watersheds, Dry Fork, Upper Meramec, Huzzah Creek, and Courtois Creek, had land uses near the SHAD sample site consisting of predominantly timber or forested areas and pasture. Soils in this area are not useful for row-crop farming. Streambanks are generally stable within these areas because of the limited human manipulation of the surrounding land. The levels of streambank erosion protection were indicative of areas that were previously disturbed either by natural events or man. Between 33% (Upper Meramec River) and 73% (Courtois Creek) of the streambanks sampled among the four watersheds were adequately protected from streambank erosion. Often streambank disturbances in this region of the basin were related to cattle grazing within riparian areas (the effects of grazing are discussed in Land Use subsection B.3.3.). Of the four watersheds, Huzzah and Courtois creeks had more streambanks (52% and 73%, respectively, of those sampled within the basin) with climax trees and shrubs, capable of full protection of the streambanks. Soils in these areas are very cherty silty loams on the surface, underlain by very cherty, silty clay loam to sandy loams (SCS 1971). Soils of this nature are highly erodible (water erodibility factor is 0.24).

Streambank protection comes from a combination of soil type and vegetative characteristics of the stream corridor. Sampled sites within the Dry Fork area had forested areas (42.1%) that had climax vegetation capable of erosion protection on 44.7% of the surveyed streambanks. As a result, erosion was minimal to moderate with 44.7% of the 38 streambanks surveyed possessing no significant erosion. Poor streambank protection, poor corridor vegetation, and predominantly pasture land uses were some characteristics that lead to moderate to massive levels of erosion within the Upper Meramec River watershed (Table 16). According to the SHAD survey, climax vegetation comprised 43% and 67% of corridors sampled in Huzzah and Courtois creeks, respectively. Courtois Creek had no erosional problems on 63% of the streambanks sampled, which was slightly higher than Huzzah Creek. Courtois Creek is a good example of a system with a healthy corridor that slows a stream’s natural sinuosity.

The Upper Middle Meramec River watershed RM (river mile) 166-110 (USGS Code #07140102-050), is different in geomorphology, watershed land use, and precipitation patterns from the Dry Fork, Upper Meramec, Huzzah Creek, and Courtois Creek watersheds. Gradient ranges from 6.25 feet/mile at RM 166 to 2.40 feet/mile at RM 110, which is distinctly different from the tributaries that enter this watershed (previously mentioned). For example, gradient in the Courtois Creek watershed ranges from 50-200 feet/mile and 50-300 feet/mile in the Upper Meramec River watershed. Differences in precipitation patterns were notable between the Upper Middle Meramec River watershed, the Lower Middle Meramec River watershed, and the Dry Fork watershed (Figure 7; Subsection C.1). Rolla and Salem both receive more rainfall than Union. Of the 32 sampled sites within the Upper Middle Meramec

watershed, 22% had development as the predominant SHAD site land use. At sampled sites within the Lower Middle Meramec River , landcover was mostly timber (40%), the remaining 60% was pasture, hay meadow, row crop, and other land uses. As within the other basins, land use at SHAD sites was a combination of pasture and timber. Of all the Meramec watersheds, Indian Creek had the most sampled sites with pasture (42.3%).

Thirty percent (Indian Creek), 44% (Upper Middle Meramec River), and 46.9% (Lower Middle Meramec River) of the corridors sampled had climax trees and shrubs, capable of full protection of the streambanks. Vegetation is an important type of hydraulic roughness in a stream system. In addition, root wads are particularly good for stream energy dissipation and act to anchor soils in place. Soils in Upper Middle Meramec River and Indian Creek watersheds are similar to the Dry Fork, Upper Meramec, Huzzah Creek, and Courtois Creek watersheds with very cherty silty loams on the surface and underlain by very cherty, silty clay loam to sandy loams (SCS 1971). In contrast, the Lower Middle Meramec River watershed and part of Indian Creek watershed possess different soil complexes, containing slightly more silty clay loam and less chert.

According to the Franklin County Soil Survey, soils along the Meramec are silty, loamy alluvium to somewhat fine sandy loam subsurface layers. Soils of this nature erode easily. Soil erosion was minimal in the Upper Middle Meramec River ; approximately 56% of sampled corridors had no erosion and 31% had minimal erosion. The Lower Middle Meramec was minimal to moderate in erosion with only 18% of the corridors having moderate amounts. Indian Creek was by far the most disturbed watershed with 19% of the sampled corridors having massive erosion in isolated areas and 11% with moderate throughout the entire sample reach.

E.4.2.2.2. Corridor Conditions

Bottomland trees and riparian vegetation help protect streams against erosion especially in areas having highly erodible soils. Stream reaches with no vegetation have accelerated runoff and increased stream energy. Watershed roughness components are a vital part of the stream erosion protection. Several sites within the Upper Middle Meramec and Indian Creek watersheds have unvegetated corridors that were used for row crops. Greater amounts of vegetated sample corridors were found in the Lower Middle Meramec , although sampled stream corridors often lacked the more important corridor vegetation--trees.

In the SHAD survey, fisheries biologists were interested in determining the amount of the timbered corridor length that was at least 100-foot wide within SHAD sample sites. The five rating categories of the percent corridor length that had at least 100-foot wide corridor were 100%, 75-99%, 50-75%, 25-50%, and less than 25% (Table 16). The best corridor conditions were found in Courtois Creek. Courtois Creek, rated with the least erosional problems, had 47% of corridors with corridor lengths having a 100-foot width and 27% with less than 25% of the corridor length having a 100-foot width. Furthermore, fisheries biologists surveyed fewer stream corridors in Courtois Creek that were completely without woody vegetation and more corridors that had between 75-99% of the corridor length from 51 to 100 feet in width than any other watersheds. Approximately 40% of the Indian Creek corridors sampled had no woody vegetation and one-half had a 100% of the corridor length as 100-foot wide (Table 16). Of moderate corridor condition, Indian Creek watershed also had another 40% with less than 25% of the sampled length having a 100-foot corridor width. Of the 38 sampled corridors within the Dry Fork watershed, 40% had 100% of the sampled corridor length as 100 feet in width and another 40% with less than 25% of the sampled length having a 100-foot corridor width (Table 16).

The two watersheds with the worst corridor rating were the Upper Meramec River and Upper Middle Meramec River watersheds, both having 50% for the less than 25% category. As expected, the Upper Meramec River and the Upper Middle Meramec River watersheds had more sites that were without woody vegetation than most other watersheds. In these two watersheds, a large portion of the sampled fourth-order streams was devoid of vegetation, while a larger portion of the sampled higher-order streams had some vegetation. In the combined Lower Middle and Upper Middle corridors, the main stem Meramec River (seventh order) had six out of 22 corridors with 100-foot or greater width. Likewise in these watersheds, all orders included, between 11-25% of the stream corridors sampled have no woody vegetation in 25% of the corridor length.

E.4.2.2.3. Channel Condition

SHAD surveys from 1991-1996 of instream cover produced many types of cover that were reduced to nine predominant types. Cover types influence the fish assemblage, and system stability is indicated by the certain cover types. In addition, pool depth was measured to determine the available habitat for smallmouth bass.

Indicating the relative stability of the Courtois Creek watershed, the predominant instream cover was water willow (37%) and cobble or roots (Table 17). The lack of downed trees as fish cover suggests that the river sinuosity is stable. In contrast, the remaining watersheds (Huzzah Creek, 35%; Upper Meramec River, 32%; Dry Fork, 37%) had woody structure as the most common cover within riffles and pools. As expected, the Upper Middle and Lower Middle Meramec River watersheds also had 23% and 36% woody structure as cover. Comparatively, cover was poor in the Indian Creek watershed, having no cover in 31% of the sampled riffles and pools.

Recent studies on the Buffalo River, Arkansas, have shown that smallmouth bass macrohabitat use varies on a regional scale (Walters and Wilson 1996). At the macrohabitat level, age-0 and older fish are habitat generalists, using pools and runs. In pools of the Buffalo River, age-0 smallmouth bass utilized shallow water 0.032 to 1.1 feet in combination with cobble substrate, aquatic vegetation, and high light levels. Pool development was adequate (greater than five feet) pool depth for adult smallmouth bass, according to Edwards, Gebhart, and Maughan (1983), in the Dry Fork and Upper Meramec River watersheds. Seventy-five percent of the sites had adequate pool depth for adult smallmouth bass in both watersheds. As would be expected, seventh-order sample segments within the Upper and Lower Middle Meramec watersheds possessed pools that were at least 10 feet in depth. In four out of six fourth-order segments in the Indian Creek watershed pool depth was less than three feet. Within fourth-order streams of the Courtois Creek, 66% of the sites sampled had pool depths that were less than suitable for adult survival and growth, according to Edwards, Gebhart, and Maughan (1983). Sixty % of the fourth-order sites in the Huzzah Creek watershed were less than adequate for adult smallmouth bass.

E.4.2.3. Substrate

Streambed substrate varied somewhat from the headwaters to the mouth of the Meramec River (Figure 14). Gravel was a consistent component of the streambed within all basins. Substrates sampled in Indian Creek, Courtois Creek, and Upper Meramec River watersheds were predominantly gravel. The Regional biologists found cobble substrate in abundance within the Huzzah Creek, Dry Fork, and Upper Middle Meramec River watersheds. Dry Fork had the largest percentage of sand. Only the Lower Meramec River watershed had a high percentage of boulder substrate.

E.4.2.4. Channel Alterations

The Lower Meramec River had no major channel alterations in 11 of the 24 third- order sites, seven of the 10 fourth-order sites, three of the 16 seventh-order sites. The Meramec River had several sites with armoring of some sort to prevent bank erosion. The Meramec River RM (river mile) 15.0 had bank armoring to protect clubhouses. St. Louis Region fisheries biologists noted that downcutting and bank sloughing had happened in the past but appeared to have stabilized at that site. At Meramec River RM 20.0, the channel was downcutting and moving laterally causing bank sloughing, and the channel was paved with rock and broken concrete in many places. At Meramec River RM 48.6 the biologists observed that the channel was migrating vertically and laterally due to armoring of railroad tracks. Downcutting within the channel was most evident on the right bank (approximately five feet during an unknown length of time).

Two third-order, one fourth-order, and one fifth-order SHAD sample segments within the Meramec River basin were channelized. A fifth-order segment of Huzzah Creek RM 25.0 had a channelized loop that was greater than or equal to 1,000 feet long. Bedrock substrate was preventing massive downcutting as evidenced by the exposed bridge. Some widening occurred in the pool below the channelized area. In Pomme Creek, channel alterations were not evident, but channelization occurred 300-400 yards upstream near Highway 55 bridge. In addition, within Fishpot Creek, the stream was actively downcutting (discharge pipes exposed). Within 200 feet upstream of the reach, the channel had been straightened (2000 feet) adjacent to new homes.

No watershed other than the Lower Meramec River watershed had any natural gradient controls within a SHAD site, although many road slab crossings throughout the entire basin act as local gradient controls. On an unnamed tributary of Fishpot Creek RM 0.2, a 5-foot tall concrete grade control structure was 500 feet downstream from the SHAD sample reach. Fisheries biologists observed, "The structure had filled with gravel, making a big plunge pool below the grade control structure." Kiefer Creek RM 2.6 has downcutting due to heavy development in the watershed (high imperviousness) and a gradient control structure directly upstream of the reach. Also, in the SHAD survey, the fisheries biologist observed, "Kiefer Creek Road was not allowing natural meander of the right bank. Despite the gradient control structure, the stream would be downcutting anyway. This is a typical reach of Kiefer Creek."

Within the Dry Fork watershed, no channel alterations were noted by East Central Regional biologists. The regional biologists noted six alterations in the Upper Meramec River watershed, six in the Huzzah Creek watershed, five in the Courtois Creek watershed, five in the Indian Creek watershed, sixteen in the Upper Middle Meramec River watershed and twenty-five in the Lower Middle Meramec River watershed. Gravel reaming has been a problem for sometime within most of these watersheds. For example, within a SHAD site on Crooked Creek RM 8.4, gravel had been pushed up against banks throughout the reach. East Central Region fisheries biologist noted "gravel management techniques" on Courtois Creek RM 25.15, resulting in a shallow and wide channel. Above that SHAD site was a county slab crossing where gravel had been pushed up against each bank. On Cub Creek RM 0.2 of the Courtois Creek watershed, the SHAD site was not disturbed, but 200-300 feet above a slab had been altered with bulldozers that forced materials against the streambank. At Pruett Creek RM 0.05, fisheries biologists in the SHAD survey observed, "Heavy graveling--a mound is pushed up mid-channel and gravel in a 4-foot pile against 30 feet of the left bank. Gravel has been scraped down 2.5 feet from gravel bar height. There is significant gravel working (probably not commercial operation) from bridge down to this site."

Generally, cattle were free to use streams for watering throughout the basin. Their activities can alter the riparian area enough to cause changes in channel morphology and water quality. East Central Region fisheries biologists noted cattle use impacts at the following sites: Fox Creek RM 3.5, Crooked Creek RM 8.4, Benton Creek RM 0.6, Courtois Creek RM 20.9, Hutchins Creek RM 2.3, Hutchins Creek RM 5.7, Dry Branch RM 4.0, Huzzah Creek RM 25.0, and Indian Creek RM 1.0.

ATV and vehicle traffic was relatively moderate in the basin. Gravel bars were most often used by ATVs. Evidence of their use was noted on gravel bars at Courtois Creek RM 25.15, Indian Creek RM 19.6 and RM 18.0, Water Fork Creek RM 1.0, Huzzah Creek RM 32.0, and East Fork Huzzah Creek RM 7.0.

Gravel removal operations were observed on several streams in the basin with some incidents having severe impacts. They were particularly heavy on Indian Creek. At Indian Creek RM 1.0, a gravel removal operation adjacent to the second pool (right bank) was not digging below water line at the time of the sample. This section of stream, however, was dramatically different from 1969 USGS topographic maps, which showed the stream running against the bluff. On Indian Creek RM 5.2, there was a major commercial gravel operation. This SHAD site seemed to have adjusted, although it is probably wider now. A braided area was below downstream pool. Finally, at RM 44.3, the Meramec River channel was wildly laterally migrating due to deposition of gravel and sand. A biologist remarked that the migration was probably directly related to a gravel operation two mi. upstream, which is causing a gradient change and corresponding deposition of bed load. During a 25-year flood event, these sensitive lower Meramec River areas, in particular Eureka and Robertsville (see Table 12--Section C.6.), can receive up to twice the discharge received at Sullivan. As a result of major tributaries such as the Bourbeuse and Big rivers and Indian Creek entering the Meramec main stem, erosion potential and sediment load therefore is much higher.

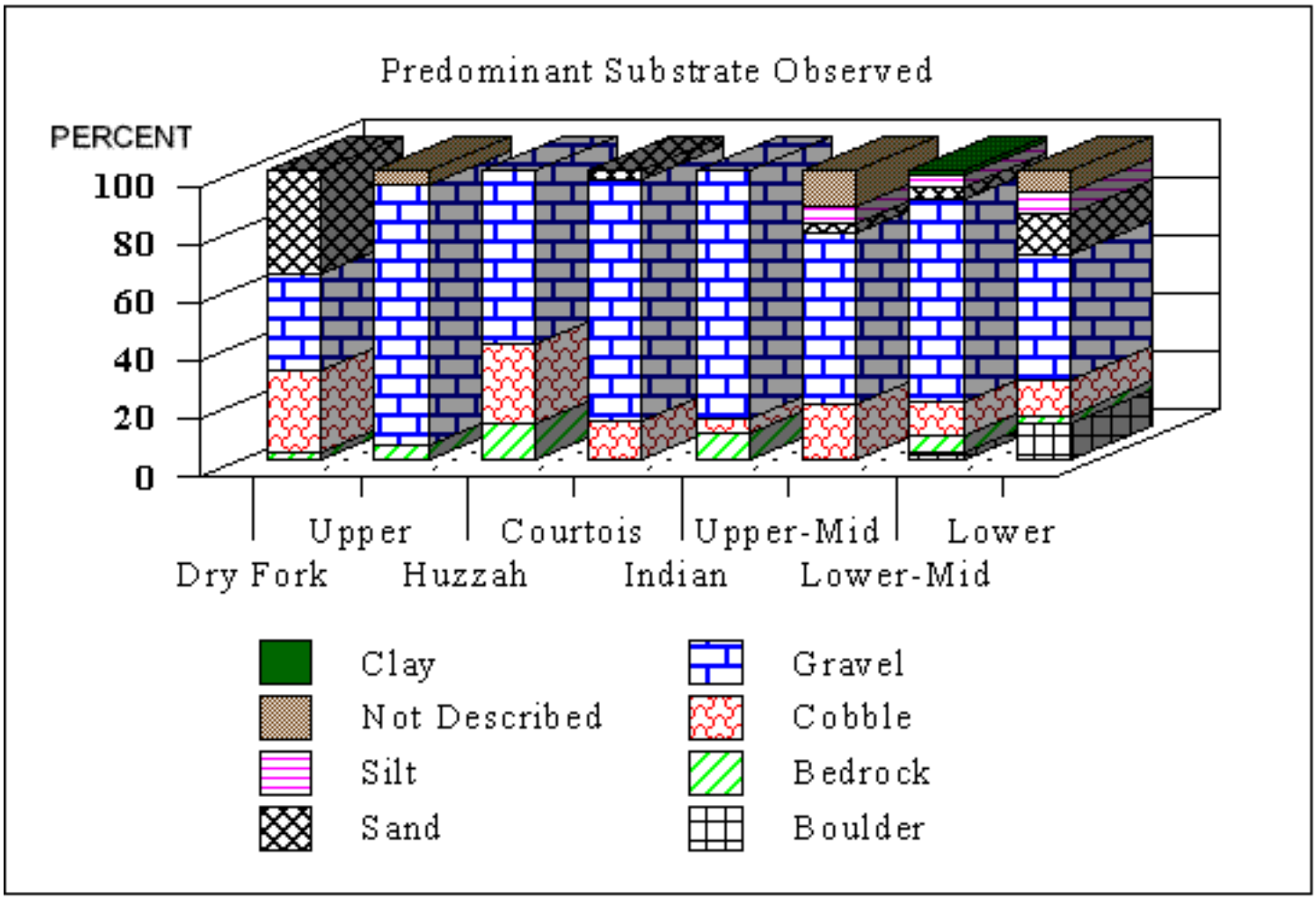

Figure 14. Streambed condition for the Meramec River watershed habitat assessment sites.

Table 15. Sensitive animal species known from the Meramec River basin (printout of Missouri Department of Conservation's Missouri Natural Heritage Database, 1995a).

Sensitive Animal Species	Federal Status[1]	State Status[2]	# of Locations
Amphibians			
Hemidactylium scutatum (Four-toed salamander)		R	2
Rana sylvatica (Wood frog)		R	2
Typhlotriton spelaeus (Grotto salamander)		WL	1
Fish			
Alosa Alabamae (Alabama shad)		R	2
Ameiurus nebulosus (Brown bullhead)		R	1
Crystallaria asprella (Crystal darter)	C2	E	4
Hiodon tergisus (Mooneye)		R	6
Notropis buccatus (Silverjaw minnow)		WL	7
Typhlichthys subterraneus (Southern cavefish)		WL	1
Crustaceans			
Allocrangonyx hubrichti (Central Mo. cave amphipod)	C2	R	2
Cambarus hubrichti (Salem cave crayfish)		WL	1
Styogromus onondagaensis (Onondaga cave amphipod)	3C	WL	4
Mollusks			
Arcidens confragosus (Rock pocketbook)		R	13
Cumberlandia monodonta (Spectacle case)	C2	WL	24
Elliptio crassidens crassidens (Elephant ear)		E	8
Epioblasma triquetra (Snuffbox)	C2	R	7
Fusconaia ebena (Ebony shell)		E	5
Hendersonia occulta (Cherrystone snail)		R	1
Lampsilis abruptus (Pink mucket)	E	E	16

Leptodea leptodon (Scale shell)	C2	R	11
Plethobasus cyphyus (Sheepnose)		R	32
Simpsonaias ambigua (Salamander mussel)	C2	E	2
Vertigo meramecensis (Bluff vertigo)	C2	SU	2
Insects			
Agapetus artesus (Artesien caddisfly)	C2	WL	1
Leucotrichia pictipes (A micro caddisfly)		SU	1
Ophiogomphus westfalli (Arkansas snaketail dragonfly)	C2	R	1
Sinella auita (A springtail)		R	3
Mammals			
Mustela frenata (Long-tailed weasel)		R	1
Myotis grisescens (Gray bat)	E	E	10
Myotis leibii (Eastern small-footed bat)	C2	R	1
Myotis sodalis (Indiana bat)	E	E	9
Birds			
Accipter cooperii (Cooper's hawk)		R	12
Accipiter striatus (Sharp-shinned hawk)		C	2
Ardea herodias (Great blue heron rookery)		C	10
Podilymbus podiceds (Pied-billed grebe)		R	1

1 Federal status: E=Endangered; T=Threatened; C#-Candidate for federal listing; 3C-Former candidate

2 State status: E=Endangered; R=Rare; SU=Status undetermined; WL=Watch listed.

(Recent changes made by the USFWS in Federal listing of candidate species has eliminated 3C and C2 categories.)

Table16. Occurrence of stream corridor lengths where fully timbered corridors are at least 100 feet wide within SHAD sample sites located in the Meramec River basin, Missouri from 1991-96. Calculated values were based on two corridors per sample site.

No. of Corridors	Percentage of Timbered Stream Corridor Length ≥ 100 ft. Wide				
	<25	25-49	50-74	75-99	100
LOWER MERAMEC WATERSHED					
90	44.4	6.7	12.2	8.9	27.8
DRY FORK WATERSHED					
38	39.5	5.3	2.6	13.2	39.5
UPPER MERAMEC WATERSHED					
42	50.0	7.1	4.7	14.3	23.8
HUZZAH CREEK WATERSHED					
44	41.0	11.5	6.8	6.8	34.1
COURTOIS CREEK WATERSHED					
30	26.7	3.3	6.7	16.7	46.7
UPPER MIDDLE MERAMEC WATERSHED					
32	50.0	9.0	4.0	6.0	31.0
INDIAN CREEK WATERSHED					
26	38.5		3.8	7.7	50.0
LOWER MIDDLE MERAMEC WATERSHED					
50	46.0	6.0	12.0	14.0	22.0

Table 17. Predominant instream cover of SHAD sample sites located in the Meramec River basin, Missouri 1991-96. Values represent percentage of predominant cover types for riffles and pools within each sample site. Some areas had no description for riffle or pool.

No. of Riffles and Pools Sampled	Instream Cover for Pools and Riffles									
	B[1]	CB[2]	CO[3]	M/V[4]	WS[5]	NC[6]	R[7]	RK[8]	G[9]	ND[10]
LOWER MERAMEC WATERSHED										
90	33%	1%	9%	3%/2%	17%	6%	3%	12%	3%	10%
DRY FORK WATERSHED										
38	13%	5%	16%	3%/0%	37%		24%	3%		
UPPER MERAMEC WATERSHED										
42	5%	5%		12%/14%	32%	14%	17%			2%
HUZZAH CREEK WATERSHED										
44	20%	10%		8%/15%	35%		5%	5%		3%
COURTOIS CREEK WATERSHED										
30	13%	3%	13%	37%/10%	7%		17%			
UPPER MIDDLE MERAMEC WATERSHED										
32	19%	3%		3%/9%	28%	13%	13%			12%
INDIAN CREEK WATERSHED										
26		8%		4%/15%	27%	31%	12%	4%		
LOWER MIDDLE MERAMEC WATERSHED										
50	10%	6%	8%	4%/4%	36%	12%	8%	10%		

1B = 'BOULDER'
2CB = 'UNDERCUT BANK'
3CO = 'COBBLE\GRAVEL'
4M/V = 'MACROPHYTES (WATER WILLOW, WATER MILFOIL) OVERHANGING VEGITATION
5WS = 'WOODY STRUCTURE (FALLEN)'
6NC = 'NO COVER'
7R = 'ROOTS'
8RK = 'ROCK, BEDROCK, ASPHALT, CONCRETE'
9G = 'GARBAGE - (REFRIGERATOR, CARS, WASHERS)'
10ND = 'NO DESCRIPTION'