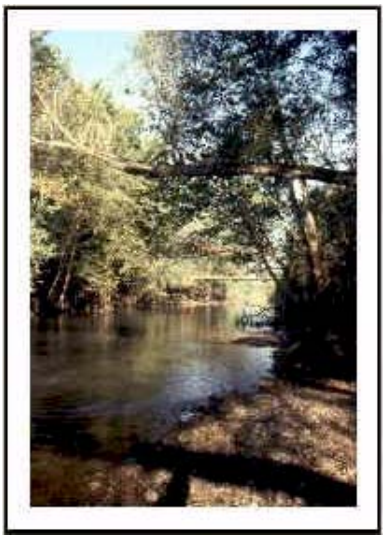
HABITAT CONDITIONS



CHANNEL ALTERATIONS

Channelization

Channelization (shortening the length of a stream) typically increases stream gradient, which often leads to bank instability and stream degradation. The full extent of the channelization activity within the basin is unknown because topographic maps of this subbasin, first printed in 1934, primarily show the flowing water channels. There is no indication of the original channels of smaller streams.

The largest channelization project in the basin involved the Marais des Cygnes River. In the early 1900's, this river was considered the most sinuous in Missouri. (Marais des Cygnes is French for "River of Swans", a reference to the resemblance of the river bends to the curves in a swan's neck (Atkenson 1918).) The lower 44 miles were channelized to create the 23 mile long Bates County Drainage Ditch. The Marais des Cygnes river is one of the most extensively channelized rivers in west-central Missouri.

The channelization project was initiated after a change in Missouri law allowed the formation of county drainage districts. Payment for the $386,000 project was through tax assessment of bonds (Appendix D). This assessment was not popular and a petition was drawn in opposition. However, the issue prevailed and construction began in 1906. The first ditch was dug using floating barges equipped with dredges. In 1907 the channel was four feet deep and 20 feet wide. Major flooding during 1908 and 1909 proved the channel capacity to be inadequate so depth was increased by 10 feet. Also, 4 large bends in the old channel were bypassed. The Ditch was

completed in 1911 (Atkenson 1918). This channelization resulted in the loss of 8.9 and 9.5 miles of 6th and 7th order stream sections, respectively, of the Marais des Cygnes River (35% of total length). Currently, head cutting caused numerous sections to become over 60 feet deep and 200 feet wide (MDC 1990).

In addition to construction of the main channel, 12 miles of tributary streams were subject to "lateral straightening". During this same period, the lower 4.5 miles of Miami Creek were channelized, creating the 5.7 mile Miami Drainage Ditch. This project relocated the stream's confluence with the Marais des Cygnes 9 miles downstream from the original site, increased 6th order stream length by 1.4 miles, and increased overall length by 3.0%. This channelization has increased sedimentation in many portions of the channel.

These channelization projects, in addition to being hydrologically and biologically unsound, were also poorly engineered, as indicated by the many portions of the ditches that did not "take". For example, only 1.9 miles of the 5.7 mile Miami Drainage Ditch are part of that stream's permanent flow channel (Appendix C). In addition, the upper 3.1 miles of the Bates County Drainage Ditch have never become the permanent flow channel of the Marais des Cygnes River. Permanent flow in the Marais des Cygnes River above the confluence of Miami Creek occurs only during flood events. The old river channel is rapidly filling with sediment.

Figure 8. Bates County: Miami Drainage Ditch.

Channelization has caused the Marais des Cygnes River to virtually cut a new river valley. During periods of low flow, the river tends to meander through this wide valley. Head-cutting has reached bedrock in many areas. Therefore, lateral instability will continue and result in additional erosion and sedimentation downstream. Sedimentation is already extensive in the upper reaches of Truman Lake. Erosion and instability will continue until the stream reaches gradient equilibrium by increasing its length by meandering through a wide valley. This process could take centuries.

Some small additional channelization projects have been constructed and are usually associated with road construction. No major channelization has occurred along the Marmaton River. Small sections of the Little Osage River above Highway 71 have been straightened by farmers in their attempts to reduce flooding and increase agricultural land.

Levees

Many streams throughout the basin have been leveed in an attempt to control flood waters. However, perceived short-term benefits are usually off-set by unintended and unforeseen secondary effects which can be long lasting. Increased flooding, upstream head-cutting in the channel, lowering of the water table, and lateral bank erosion and floodplain scour often result. Furthermore, wetland areas isolated from streams by levees are no longer subject to "recharge" by periodic flooding. This exchange of water, nutrients, and biotic organisms is necessary to

maintain the health of the wetland system. Loss of wetland areas reduces biotic diversity by limiting important nesting, rearing, and feeding areas for many aquatic and terrestrial species.

The majority of levees within the basin are privately owned and maintained. Approximately 64 miles of levees are present in the basin, primarily on the Marais des Cygnes River (Table 29). These levees isolate approximately 7,424 acres of floodplain and reduce floodplain capacity by approximately 20%.

Extensive and severe flooding during 1986 and 1993 damaged several miles of levees in the basin. Many landowners who had not built levees are complaining to the COE and are urging landowners with levees to breach them to reduce upstream flooding and erosion of the floodplain and channel. This controversy is becoming volatile; several newspaper articles and one public meeting concerning the Marmaton River have been held in Nevada, MO. At this writing, the Department is planning to reduce/remove 6.2 miles of levees (39% of the 16 miles total present) at Four Rivers C.A., an action that will restore over 3,200 acres of functioning floodplain to the area. This action, in addition to significantly increasing the amount of wetland habitat present, will help to mitigate the effects of future flood events.

Dams

There were three major dams on sixth order and larger streams in the Missouri portion of the basin; at Osceola (since removed), Truman Dam and a low-water dam on the Marmaton River near Nevada (NW 1/4 Sec 31 T36N R31W).

A dam on the Osage River at Osceola was considered as early as 1855. Construction of a hydroelectric dam began in 1927 and the gates closed on Christmas Day 1929. This impeded upstream movement by fish except during extreme flooding. The dam was demolished in 1977 when Truman Dam was completed (St. Clair County Courier 1977, Sprunk and Hendrickson 1980).

Truman Dam is located on the Osage River about 1.5 miles northwest of Warsaw in Benton County. Original purposes of the dam and reservoir were to provide flood control, hydroelectric power, recreational opportunities, and fish and wildlife habitat (COE 1988). Begun in 1964, the dam was closed in 1977 and began operation in November 1979. At normal pool elevation of 706.0 ft. m.s.l., Truman Lake has a surface area of 55,600 acres. At this level, the reservoir inundates approximately 89.0 of the 98.5 mile portion of the Osage River that lies within the basin (90%), and in excess of 36 miles of 8 tributary streams (Table 30). Approximately 193 miles of the 310 mile total length of the Osage River (62%) is inundated by Truman Lake and Lake of the Ozarks. Many other small tributary streams were also inundated but exact mileages have not been determined. In the Wildlife Code of Missouri, Truman Lake is defined as beginning at the dam near Warsaw and ending at normal pool elevation of 706 ft. mean sea level which is near the new Schell City railroad bridge. Maximum pool elevation (739.6 ft. m.s.l.) results in a surface area of 209,300 acres and complete inundation of the Osage River in the basin. Frequent fluctuation

between elevation 706 and 715 ft. m.s.l. kills trees and other riparian vegetation and prevents their re-establishment. Increased flooding of the lower portion of streams by Truman Lake has contributed to increased bank erosion caused by saturated soils, loss of the riparian corridor, and decreased channel capacity caused by increased sedimentation when streams enter backwaters of the lake. Upstream landowners frequently complain of increased flooding due to the backwater effects of Truman Lake during flood periods and the surcharge effect occuring near highways that constrict floodplains.

STREAM HABITAT ASSESSMENT

Stream habitat was evaluated based on condition of streambanks, stream corridors, channel conditions, instream cover, streambed condition, water quality observations and channel alternations. Standardized data sheets were developed with instruction sheets for evaluating the sample sites (Appendix E). Definitions of habitat characteristics and descriptions of ratings for each are included in the data sheets provided in Appendix E.

Stream Habitat Assessment Device (SHAD) sites were selected following Bovee (1992). A total of 84 SHAD sites were evaluated within the basin from 1990-1993. Site locations are listed in Appendix E and indicated on subbasin maps (Appendix C). SHAD data were summarized by subbasin and stream order for specific habitat variables such as streambank erosion, streambank pollution, stream corridor width, vegetative characteristics of corridors, land uses within corridors, and average maximum pool depths (Tables 31-36, respectively). Definitions of habitat characteristics are provided at the bottom of each table. In addition, helicopter flights were conducted to document selected stream corridors via aerial videotaping during 1992-93. The entire length of the Marmaton River has been videotaped using this method. These tapes provide a visual record of corridor condition that can be used for comparative evaluations over time.

Weaubleau Subbasin

Streambank erosion was minor at 16 of 22 sites, moderate or massive erosion occurred at the remaining six sites evaluated (Table 31). No detectable differences in streambank erosion was evident between third and fourth order streams, however small sample sizes made statistical comparisons impractical.

Streambank protection mirrored streambank erosion where the majority of the streambanks fully or adequately protected exhibited little erosion in 16 of 22 corridors evaluated (Table 32).

The majority (17 of 22) sites evaluated had 50% or more of the corridor length at least 100 feet wide (Table 33). Wider corridors along a longer reach of the stream contribute to bank stability and minor erosion. Similar trends were evident for third and fourth order streams.

The majority of stream corridors (17 of 22) evaluated were composed of climax vegetation or immature trees and shrubs (Table 34). This observation coincides with the other characteristics of

relatively undisturbed stream corridors which adequately protect banks and reduces the potential for erosion.

Land uses within the 100 foot stream corridor were predominately pasture or hayland and found at 19 of 22 corridors evaluated (Table 35). The floodplains of third and fourth order streams within Ozark transitional basins are usually too narrow to support extensive rowcropping.

The maximum depth is important to the survival of fish during low flows. All depth is expressed as the average maximum depth throughout this discussion. Average maximum depth of pools for third order streams within the subbasin were generally 1.5 to 3 feet deep or greater, while the majority of the pools evaluated for fourth order streams were generally 3-5 feet average maximum depth (Table 36). Depth is adequate to provide good habitat for most fish throughout the year.

Instream cover in pools and riffles ranged from poor to excellent, but was good overall. Instream cover in pools was mainly rootwads and downed trees; boulders were present in some pools and riffles. Primary cover types in riffle areas were water willow, woody substrate, cobble, and gravel.

Gravel was the dominant substrate at almost all sites, followed by cobble. Some silt was present, primarily at the Weaubleau Creek sites. Water was usually clear and no water quality problems were evident. Channel alterations included inundation of lower stream reaches by Truman Lake; channelization associated with bridges; road crossings; and large trees blocking and altering flow. No large scale channelization was found on topographic maps but many maps are outdated.

Monegaw Subbasin

Streambank erosion was minor at 18 of 26 sites, moderate bank erosion occurred at seven sites and massive erosion occurred at the remaining site (Table 31). No significant differences in streambank erosion was evident between third and fourth order streams, however small sample sizes made statistical comparisons impractical.

Streambank protection mirrored streambank erosion where the majority of the streambanks fully or adequately protected exhibited little erosion in 19 of 26 corridors evaluated (Table 32). The majority of streambanks insufficiently protected by vegetation were found on fourth order and larger streams (5 of 12 corridors).

The majority (17 of 26) sites evaluated had 50% or more of the corridor length at least 100 feet wide (Table 33). The remaining 50% of the corridors were less than 25 feet wide. Wide corridors along more of the stream contribute to bank stability and minor erosion.

The majority of stream corridors (20 of 26) evaluated were composed of climax vegetation or

immature trees and shrubs (Table 34) which coincided with relatively undisturbed stream corridors, adequately protected banks, and minor erosion.

Land uses within the 100 foot stream corridor were divided nearly equally among timber and pasture (Table 35). The floodplains of fourth and fifth order streams of Osage Plains basins are wider and fertile and therefore support rowcropping.

Average maximum depth of pools for third order streams within the subbasin were generally 1.5 to 3 feet deep , while the majority of the pools evaluated for fourth and fifth order streams were generally 3-5 feet deep (Table 36). Depth is marginal to provide good habitat for prairie fish species throughout the year.

Instream cover in pools ranged from poor to excellent, but was mostly poor. Cover in riffles was primarily poor to fair. Dominant cover types in pool areas were boulders and snags or rootwads. Riffles supported some water willow and substrate diversity.

Sand and silt substrates predominated at most sites; gravel, cobble, and boulder occurred at others. The Turkey Creek site was almost entirely bedrock. Significant amounts of cattle manure occurred within the stream at Monegaw Creek, Gallinipper Creek, and Ladies Branch sites. Coal particles from past mining activity were scattered throughout the substrate at the upstream Monegaw Creek site. Water quality was good at some sites, fair at others and seriously degraded where cattle accessed the stream. Channel alterations included inundation of lower stream reaches by Truman Lake, alterations associated with bridge construction, cattle, and log jams. No channelization is indicated on topographic maps but many maps are outdated.

Clear Creek Subbasin

Streambank erosion was minor at 12 of 20 sites evaluated, moderate at five sites and massive at the remaining three sites (Table 31). No significant differences in streambank erosion were evident between third order and larger stream orders, however small sample sizes made statistical comparisons impractical.

Streambank protection mirrored streambank erosion where the majority of the streambanks fully or adequately protected exhibited little erosion in 12 of 20 corridors evaluated (Table 32).

Thirteen of the twenty-two sites evaluated had 50% or more of the corridor length at least 100 feet wide (Table 33). Fifth and sixth order streams tended to have wider corridors. Wider corridors along a longer reach of stream contribute to bank stability.

The majority of stream corridors (15 of 20) evaluated were composed of climax vegetation or immature trees and shrubs (Table 34) which coincided with the characteristics of relatively undisturbed stream corridors, adequately protected banks and minor erosion.

Land uses within the 100 foot stream corridor were predominately timber, pasture or hayland in 19 of 20 corridors (Table 35).

Average maximum depth of pools for the single third order site sampled was 1.5 to 3 feet deep or greater. While the majority of the pools evaluated for fourth and fifth order streams were generally 3-5 feet deep (Table 36). Depth is adequate to provide good habitat for most fish throughout the year.

Instream cover in pools ranged from poor to good. Dominant cover types were logs and root wads. Riffle cover ranged from fair to good and was composed of cobble and root wads.

Silt and sand were dominant substrates at most pool sites, and gravel and cobble at most riffles. Water clarity ranged from clear to muddy. Cattle use at an upstream Clear Creek site caused water to be very turbid and greenish in color. McCarty Creek had an iron-colored mineral deposit on approximately half of the reach length, probably a result of past coal mining activities within the watershed. Channel alterations included inundation of lower stream reaches of Clear and Little Clear creeks by Truman Lake, and a log jam on McCarty Creek. No channelization is indicated on topographic maps, but many maps are outdated.

Marais des Cygnes Subbasin

Streambank erosion was minor at 26 of 40 sites, moderate at 11 sites and massive at the three remaining sites (Table 31). Streambank erosion was more severe in larger streams due to the headcutting effects resulting from channelization of many streams throughout the subbasin.

Streambank protection mirrored streambank erosion where the majority of the streambanks fully or adequately protected exhibited little erosion in 26 of 40 corridors evaluated (Table 32).

Nineteen of the forty sites visited had 50% or more of the corridor length at least 100 feet wide (Table 33). Many of the remaining corridors were less than 25 feet wide. Larger fifth and sixth order streams generally had wider corridors.

Only 28 corridors were evaluated for vegetation, 22 sites were composed of climax vegetation or immature trees and shrubs (Table 34).

Land uses within the 100 foot stream corridor were predominately timber, pasture or hayland in 27 of the 40 corridors evaluated for all orders of streams (Table 35). The larger floodplains of fifth and sixth order streams within Osage Plains basins are larger, more fertile and support rowcropping. Corridor widths along the Marais des Cygnes River and Miami Creek were narrow, rowcropped and in many cases, trees were found very close to the stream.

Average maximum depth of pools for the only third order stream sampled was 1.5 feet deep, while the majority of the eight pools on the fourth order streams were shallow, generally less than

three feet deep (Table 36). Pool depths averaged less than five feet deep for fifth order streams for four of the six sites sampled. Sixth order streams were also shallow where three of the five sites sampled were less than 10 feet deep. Depth is marginal in several streams for providing good habitat for most fish throughout the year.

Instream cover in pools ranged from very poor to good; woody cover types predominated. Riffle cover was poor to fair and was composed of cobble and woody substrate. Many sites sampled were long, shallow pools which lacked well-defined riffles. Many riffles were dry during the evaluation period.

Silt, sand, and bedrock were dominant pool substrates on both the Marais des Cygnes River and Miami Creek. A variety of substrate types were found in the smaller pools. Gravel and cobble dominated riffles. Water was muddy at almost all sites, probably due to heavy silt load caused by channelization. Major channelization and levees occurred on the Marais des Cygnes River and Miami Creek. Other channelizations included those around bridges. Channelization and the associated headcutting has severely degraded the streambed. Now that bedrock is exposed in the bed lateral bank erosion is accelerated causing bank sloughing and has contributed to narrow riparian corridors. A small agricultural drainage ditch was present at a Miami Creek site.

Marmaton Subbasin

Streambank erosion was minor at 17 of 28 sites, moderate at 7 sites and massive at the remaining two sites (Table 31). Erosion was generally more extensive in seventh order streams.

Streambank protection mirrored streambank erosion where the majority of the streambanks fully or adequately protected exhibited little erosion in 22 of the 28 corridors evaluated (Table 32).

The majority of sites evaluated (18 of 28) had 50% or more of the corridor length at least 100 feet wide (Table 33). As with the other basins, generally larger order streams exhibited wider corridors.

The majority of stream corridors evaluated (19 of 28) were composed of climax vegetation or immature trees and shrubs (Table 34), which coincided with relatively undisturbed stream corridors, adequately protected banks and minor erosion.

Land uses within the 100 foot stream corridor were predominately timber (18 corridors) or cropland (9 corridors) (Table 35). The floodplains of Osage Plains subbasins are large and fertile and conducive to rowcropping. The prominence of pecan culture in the floodplain of the Marmaton and Little Osage rivers contributes to the predominance of wider timbered corridors.

No third order streams were sampled in the Marmaton Subbasin. Average maximum depth of pools for fourth order streams within the subbasin were less than 3 feet deep at two sites and between 3-5 feet deep at the other two sites (Table 36). Average depth of fifth, sixth and seventh

order streams were between 5-10 feet deep. Depth is adequate to provide good habitat for most fish throughout the year.

Instream cover in pools was good with woody structure predominating. Woody cover in riffles was fair, but many sites lacked well-defined riffles, which is typical for low gradient prairie streams.

Silt was the dominant substrate type in pools and riffles. Some sand, gravel, cobble, and organic debris also occurred. Water was muddy at almost all sites, possibly due to low water conditions; tributary streams were usually clearer than the two larger rivers in the subbasin. Levees have been constructed at two Marmaton River sites and one Little Osage River site. Levee construction on the Marmaton River is considerably less than rivers of similar size within the entire West Osage Basin. Some channel alterations were associated with bridge construction and there was a low-water dam on the Marmaton River near Nevada. No channelization is indicated on topographic maps but many maps are outdated.

Drywood Subbasin

Streambank erosion was minor at 15 of 32 sites, moderate at 16 sites and massive at one site (Table 31). No significant differences in streambank erosion were evident among any of the sites according to stream order, however small sample sizes made statistical comparisons impractical.

Streambank protection mirrored streambank erosion where the majority of the streambanks fully or adequately protected exhibited little erosion in 15 of 32 corridors evaluated (Table 32).

Half of the sites (16 of 32) evaluated had 50% or more of the corridor length at least 100 feet wide (Table 33). Many of the corridors on the larger fifth and sixth order streams were narrow with seven of the 16 corridors evaluated less than 25 feet wide on these streams.

The majority of stream corridors (27 of 32) evaluated were composed of climax vegetation or immature trees and shrubs (Table 34). Land uses within the 100 foot stream corridor were predominantly timber, pasture or hayland for 19 of 32 corridors evaluated (Table 35). Row cropping was prevalent in floodplains of 3rd, 4th and 5th order streams within the subbasin. Row cropping in these larger floodplains have contributed to the narrower corridors along these larger order streams.

Average maximum depth of pools for third order streams within the subbasin were generally 1.5 to 3 feet deep or greater, while the majority of the pools evaluated for fourth order streams were generally 3-5 feet deep (Table 36). Average pool depths for 5th and 6th order streams were 3-5 feet and 5-10 feet, respectively. Depth is adequate to provide good habitat for prairie fish species throughout the year.

Instream cover in pools and riffles was poor overall. Instream cover in pools was composed of

fallen logs and a few boulders. Cover in riffles was mostly cobble.

Streambeds in the subbasin were mostly silt/sand with gravel in some areas. Bedrock was present on some sites. Water was muddy at the farther downstream sites, but was often clear at the farthest upstream sites. Channels were mostly unaltered. However, levees were present at one site and there were some alterations associated with a highway bridge at another. Bank sloughing associated with snags occurred at two sites. No channelization is indicated on topographic maps, but not all maps are recent. In July 1965, an application was made to USDA-NRCS for installation of a watershed project in the subbasin; at this writing, the application is inactive (USDA-NRCS 1993).

Summary for West Osage River Basin

The quality of streams found within the basin is extremely variable. The Marmaton River is representative of a relatively unaltered and healthy stream. By contrast, the Marais des Cygnes River is an example of a severely degraded stream caused by extensive channelization. Overall, streambank erosion in the basin was observed to be minimal to moderate, but areas of severe erosion did exist. Erosion was caused mostly by inadequate vegetative cover and channelization on the Marais des Cygnes River and Miami Creek. Stream corridors were variable and ranged from none present to wide (>100 feet), wooded corridors. Land use beyond existing corridors was primarily hay fields, pasture, and row crops. Cattle were grazing along or accessing streams at numerous locations but adverse impacts to streambanks were limited to specific sites. A survey of the professional staff of public agencies involved in resource management ranked poor land use and intensive agricultural use as two of the top three problems in the basin; problems associated with poor land use may become severe in the future without education about proper watershed management (MDC 1982). Nonpoint pollution problems and the associated eutrophication of streams has not been sufficiently documented.

Average maximum pool depths on the Marais des Cygnes River averaged 7-15 feet on 6th order sites, 1-5 feet for 5th and 4th order sites, and 1.5-3 feet for a 3rd order site. Average maximum pool depths at the 6th order Ditch site were 3 feet. Average maximum pool depths for other streams in the basin were: 5-10 feet for 7th order sites, 3-7.5 feet for 6th order, 1-7 feet for 5th order, 1.5-5 feet for 4th order, and 1.5-3 feet for 3rd order sites. Instream cover in pools was highly variable but was mostly poor to good and consisted primarily of fallen trees, snags, and rocks or boulders. Riffle instream cover was fair overall and consisted mostly of cobble. Many sites lacked clearly defined riffles.

Sand and silt were the most common substrate types, but gravel, cobble, and bedrock were present in some areas. Water was muddy at many sites and was probably caused by silty soil types, erosion, and cattle usage. Major channelization and levees occurred on the Marais des Cygnes River and Miami Creek. These alterations are currently the source of

many problems, among them head-cutting and siltation. Minor channelizations associated with

bridges and roads were found throughout the basin.

UNIQUE HABITATS

Several unique habitats found within the basin are of biological or economic significance. Many of these communities were once common in Missouri but are now reduced. Several are of particular importance because of their status as High Quality Natural Communities (Table 37). There are many pristine areas throughout the basin that are representative of unique biological communities. Preservation of these unique areas is critical to maintaining maximum biotic diversity and should be given high priority.

Prairies

Prior to European settlement, prairie was abundant in Missouri and covered approximately 15 million acres. Of the less than 80,000 acres remaining statewide, approximately 18,000 acres are protected in the public prairies system as isolated tracts (Toney 1993). Pre-settlement prairie in the three core counties of the basin was extensive (Schroeder 1983). Today, prairies are still important habitat in the basin even though they have been greatly reduced. Approximately 15,000 acres of high-quality prairie in the basin are held in public or private ownership (Table 38; Greg Gremaud, MDC, personal communication). Nineteen public prairie areas totaling over 10,700 acres lie within the basin (Table 39). These prairie areas are unique due largely to the relatively undisturbed state of native vegetation. In turn, these native plant species have protected and maintained stream watershed integrity. Consequently, streams are representative of pre-settlement prairie streams and are important repositories of several unique species. One such area (Taberville Prairie) shelters at least seven species currently listed as state-endangered (three bird, three plant, and one fish) (Toney 1993). Continued protection of these prairie watersheds and streams is critical to maintaining the health of these unique ecosystems. Baker Branch on Taberville Prairie is listed as an Outstanding State Water Resource because of its example as an undisturbed pre-settlement prairie stream (MDNR 1989a). Dry Wood Creek, Little Dry Wood Creek, and Second Nicolson Creek have all been recommended to MDNR for consideration for special protection as "Outstanding Resource Waters"; certification is pending. However, other streams within the basin may be in danger of degradation from strip-mine drainage.

Wetlands

The majority of the basin lies in the Osage Plains physiographic region and relief is not pronounced. As a result, streams occur in relatively broad valleys and exhibit extensive meandering. Consequently, oxbow lakes, sloughs, and marshes are common along the major streams (Pflieger 1989). Many of these features are associated with the Marmaton and Marais des Cygnes rivers. Natural bottomland lakes with adjacent bottomland hardwoods are common. Wetlands contribute to the aquatic habitat by increasing diversity, serving as biological filters for pesticides and herbicides, reducing flooding, maintaining basal flow, and serving as important spawning and nursery areas for fish, invertebrates, birds, and mammals. Several species of fish,

crayfish, and naiades are known to inhabit wetlands during part of their life cycles (MDC 1993b). Thirty-seven of these designated wetland species have been collected in the basin (Table 40).

Wetlands also provide habitat for rare and endangered plants and animals. Some of these areas are listed in Table 41. Oxbow lakes, once part of the original river channel, become isolated from their parent river through the rivers' meandering, a process that usually takes decades. However, increased stream gradient resulting from channelization can increase erosion and speed the isolation process. Many wetlands are protected through public and private ownership (Table 37). Public wetland areas managed by the Department are extensive (Table 42) and wetlands maintained by private "duck clubs" contribute significantly to the total acreage under protection (Table 43). Some private areas are larger than 100 acres in size, and, at this writing, additional areas are planned or under development through the Consolidated Farm Services Administration and Wetland Reserve Program (Jay Bowmaster, MDC, personal communication). Some wetlands in the basin are in jeopardy. Those found along the channelized Marais des Cygnes river are adversely affected by the deeply-incised channel. The deep channel lowers the water table in the basin and increases the "drainability" of wetlands adjacent to the river. Wetlands along channelized rivers (i.e. the Marais des Cygnes) are at greater risk of destruction, both now and in the future, than those along unchannelized rivers (i.e. the Marmaton). However, there are numerous opportunities for protecting the many remaining remnant wetland areas within the basin by acquisition, easement or proper management by private landowners.

Springs

Springs are not common in the Osage Plains region with only ten small springs occurring within the basin; five were inundated by Truman Lake (Table 44; Vineyard and Feder 1982, MDNR 1986a).

Spawning Areas

The Basin supports a large and diverse sportfishery that includes walleye, paddlefish, crappie (black and white), black bass, white and hybrid-striped bass, and blue, flathead, and channel catfish. The region's proximity to the Kansas City area increases it's recreational significance. Several important fish spawning sites have been identified. The Marais des Cygnes River and Bates Co. "Ditch" have spawning riffles which are used by walleye and white bass (Figure 9); walleye and white bass are found in the Marmaton River.

Paddlefish

Paddlefish are big river inhabitants and require specific stream flow, temperature, and substrate characteristics for growth and reproduction (MDC 1992). Historically, Missouri spawning sites for paddlefish were found between Warsaw and the low-water dam at Osceola. Paddlefish migrated out of Lake of the Ozarks during the spring water rises to spawn over clean gravel in the flowing waters of the Osage and Marais des Cygnes rivers (Russell 1986). However,

construction of Harry S. Truman Dam on the Osage River near Warsaw in 1977 inundated many traditional spawning areas and blocked spawning migration runs out of Lake of the Ozarks (MDC 1992).

Currently, good spawning gravel bars are present on the Marais des Cygnes river above the channelized reach (above V Highway Bridge), and it is suspected (but not verified) that these sites are used by paddlefish in some years when conditions are optimum (Kim Graham and Ron Dent, MDC, personal communication). Small (12") paddlefish are sometimes found in the Marais des Cygnes Waterfowl Area in Kansas. In Missouri, small paddlefish were observed in a fish kill at Barber Lake on the Schell-Osage Conservation Area in 1992. These occurrences are evidence that natural spawning may occur in some years. At present, this production is not sufficient to sustain a strong population and fishery (Kim Graham and Ron Dent, MDC, personal communication).

However, potential does exist for paddlefish spawning in the unchannelized portion of the Marais des Cygnes in Missouri, and into Kansas to the low-water bridge at Osawatmie (63.0 RM upstream from the Missouri-Kansas state line). In Kansas, a U.S. Fish and Wildlife Service National Wildlife Refuge associated with the Marais des Cygnes River has been established, in part, because of its importance as paddlefish spawning habitat. Expansion of this refuge to include Missouri segments of the Marais des Cygnes would significantly increase the amount of protected spawning habitat available and would increase the likelihood of naturally-occurring reproduction. Expansion of this refuge into Missouri should be given high priority.

Commercial Nut Production

Commercial pecan production is an important industry in the basin. The three core counties support approximately 250 growers (Bates-80, St.Clair-70, Vernon-100) who manage about 1.2 million trees on almost 55,000 acres of land. The average annual harvest of 2.5 million pounds of nuts has a market value (@ $0.85/lb) in excess of $2.1 million (MaryAnn Byrd, MO Nut Growers Assn., personal communication).

IMPROVEMENT PROJECTS

Various projects and programs have been enacted within the basin to deal with problems associated with streams. Some programs are designed to mitigate the effects of existing problems; others were enacted as preventative measures.

Instream Habitat/Bank Stabilization Projects

Various human activities have adversely impacted bank stability of several streams in the basin. Periodically, landowners contact Department personnel to request assistance in solving these problems. The Department provides stream erosion-abatement information and assistance, on the average, to four or five basin landowners per month (Tom Priesendorf, MDC, personal

communication). Bank erosion, usually associated with inadequate riparian corridors and channelization, is the most common complaint.

Several methods have been developed and used throughout the state to slow or halt erosion, thus enabling natural revegetation to occur. Willow staking, tree revetments, and bank revegetation techniques have all proved effective and have been used successfully in the basin. Department personnel assist property owners in identifying problem areas, recommending appropriate action, obtaining necessary supplies and equipment, installing projects, and evaluating results. In all instances, landowners are encouraged to establish and maintain a 100' wide riparian corridor to prevent future problem from reoccurring.

There are two noteworthy examples of application of the above-mentioned techniques on public lands. In the first, willow staking was successfully used on a 600 foot reach of Weaubleau Creek on Kings Prairie Access. Seven hundred black willow cuttings were installed in three rows at and above the waterline. As a result erosion has been slowed and the bank has begun to backslope naturally and revegetate. The project was completed in March 1987 and, as of this writing, no maintenance has been required (MDC 1993a).

In the second example, a cedar tree revetment was placed, in cooperation with COE personnel, in conjunction with tree planting on a section of Hogles Creek on Truman Lake lands. A 375 foot single-row revetment was installed and a back hoe was used to back-slope the bank to a 3:1 slope. Trees and annuals were planted and secured with netting to speed bank stabilization. As of this writing, some trees have been replaced because of beaver damage, but bank erosion has been slowed and revegetation is progressing (MDC 1993a). Copies of project plans are available from the Department's Fisheries Division.

Department personnel continue to monitor and evaluate all projects in order to refine methods and techniques to improve efficiency of design and implementation.

Stream Stewardship Agreement Program

The Stream Stewardship Agreement (SSA) program was a pilot landowner incentive of the Department's Streams for the Future program. It was designed to provide financial support to landowners exercising good stream stewardship. The management of fish, wildlife, and forest resources associated with streams on private lands is enhanced by providing financial incentives for landowners interested in long-term protection of well-managed stream corridors. This three year pilot program (which expired in March 1995) was offered on three streams in Missouri counties. The Marmaton River in Vernon county was one of the pilot areas.

Stated briefly, this volunteer program pays landowners to restrict activities in good-quality riparian areas. Easements were negotiated for either a period of 30 years or in perpetuity. To be eligible, easement corridors must have been at least 1/4 mile long and have a minimum width (from the edge of the stream channel) of 100'. A maximum of 25 acres per mile (50 acres for both

sides of the stream) of corridor can be eligible provided that sufficient, high-quality vegetation is present and no significant erosion problems exist. Trees were the standard used to evaluate vegetative cover, but other vegetative communities, i.e. wetland and native prairie types (where appropriate), were also acceptable if they contributed to the long-term stability of the stream corridor. Landowners retain ownership, use (subject to mutually-agreed upon restrictions), and control of the land. The SSA program insures that important Missouri streams with healthy and stable corridors will remain as such, even if land ownership changes.

Many streams in the basin have been subjected to channelization and other alterations. However, the Marmaton River's riparian corridor is largely intact. Additionally, there are many associated oxbow lakes and wetlands in the area. Therefore, the Marmaton River was chosen for inclusion in this program because of it's status as one of Missouri's least-altered large prairie streams. A total of 47 miles of this 6th order stream occur within the Basin, therefore 94 miles of stream frontage are potentially available to the program. As of this writing, 14 applications for the program have been received and 2 easement agreements, involving a total of 7.5 miles of stream frontage, have been signed (Table 45). Additional pending applications may increase the streams frontage enrolled in the program to 15% of the riparian corridor along the 47 mile section of river in Missouri.

Table 29. Levee and flood-plain information for selected streams in the West Osage River Basin in west-central Missouri (information obtained from USGS topographic maps).

RIVER	STREAM FRONTAGE (miles)	LEVEES (miles)	FLOOD PLAIN SIZE (acres)	ACRES EXCLUDED (%)
Marais des Cygnes	67.6*	34.1	8,120	4,876 (60)
Marmaton	103.4	14.3	20,888	1,305 (6)
Little Osage	59.8	15.5	8,370	1,243 (15)

*current channel

Table 30. Streams and portions of their lengths inundated by impoundment of the Harry S. Truman Reservoir in the West Osage River Basin in west-central Missouri.

STREAM NAME	LENGTH (mi)	MILES INUNDATED	% OF TOTAL LENGTH
Osage River	98.5	89.0	90.4
Clear Creek	56.9	7.0	12.3
Little Clear Creek	8.9	0.6	6.7
Gallinipper Creek	8.8	4.6	52.3
Hogles Creek	22.4	6.5	29.0
Monegaw Creek	17.4	8.0	46.0
Little Monegaw Creek	9.6	4.5	46.9
Weaubleau Creek	32.1	5.0	15.6
Total	254.6	125.2	49.2

Table 37. Number and size of areas classified by MDNR as High Quality Natural Communities, by category, within the West Osage River Basin in west-central Missouri.

COMMUNITY TYPE	NUMBER	TOTAL AREA (acres)	AVERAGE SIZE (acres)
Prairie (dry)	47	11,193.5	254.4
Prairie (wet)	15	1,275.2	85.0
Forest (dry)	2	210.0	105.0
Forest (bottomland)	1	38.0	38.0
Glade	4	15.6	3.9
Marsh	3	61.0	20.3
Oxbow/Slough	1	1.0	1.0
Swamp	2	113.0	56.5
Wet Savanna	1	4.0	4.0
Total =	76	12,911.3	169.9

Table 38. Prairie acres and percent of total land area for pre- and post-settlement in the three "core" counties of the West Osage River Basin in west-central Missouri (Schroeder 1983; Greg Gremaud, MDC, personal communication).

	PRE-SETTLEMENT		POST-SETTLEMENT	
COUNTY	**AREA (acres)**	**% OF TOTAL**	**AREA (acres)**	**% OF TOTAL**
Bates	417,920	77	998	0.2
St.Clair	190,080	43	4,998	1.1
Vernon	393,600	73	8,998	1.7
Total =	1,001,600	66	14,995	1.0

Table 39. Managed public prairie areas in the West Osage River Basin in west-central Missouri (Toney 1993).

AREA NAME	COUNTY	LOCATION (T-R-S)	SIZE (ACRES)
Ripgut	Bates	39N 31W 33,34	280
Tzi-Sho	Barton	32N 33W 23	160
Hunkah	Barton	32N 33W 27	160
Prairie State Park	Barton	32N 33W 15,16,17,20,21,22	2,678
Bushwacker	Barton	34N 32W 25-28,33,34,35	665
Comstock	Barton	33N 33W 1	320
MO-KO	Cedar	36N 28W 15,23,14	420
Monegaw	Cedar	36N 28W 25,36	270
Taberville	St.Clair	38N 28W 14,15,22,23,26	1,680
Schell-Osage	St.Clair	37N 28W 9,17,18,19 38N 28W 34,35,36	171
Wah-Kon-Tah	St.Clair	36N 28W 10,11, 3, 2	2,332
Gama Grass	Vernon	37N 32W 1	80
Horton Bottoms	Vernon	37N 31W 9,10,15,16	227
Douglas Branch	Vernon	36N 31W 6, 5 37N 31W 32	120
Marmaton Bottoms	Vernon	36N 32W 13 36N 31W 18,19-30	609
Flight Lake	Vernon	36N 32W 26	159
Little Osage	Vernon	35N 31W 34	80
Osage	Vernon	34N 31W 3, 4	1,506
Gay Feather	Vernon	34N 30W 1	116
		Total =	12,033

Table 40. Species of fish, crayfish, and mussels that use wetlands during part of their life cycle (MDC 1993b), and have been collected in the West Osage River Basin in west-central Missouri.

	SPECIES	COMMON NAME
FISH	*Lepisosteus platostomus*	Shortnose gar
	Lepisosteus osseus	Longnose gar
	Amia calva	Bowfin
	Dorosoma cepedianum	Gizzard shad
	Cyprinus carpio	Common carp
	Ctenopharyngodon idella	Grass carp
	Lythrurus u. umbratilis	W Redfin shiner
	Notemigonus crysoleucas	Golden shiner
	Pimephales notatus	Bluntnose minnow
	Pimephales promelas	Fathead minnow
	Carpiodes carpio	River carpsucker
	Ictiobus bubalus	Smallmouth buffalo
	Ictiobus cyprinellus	Bigmouth buffalo
	Ictiobus niger	Black buffalo
	Minytrema melanops	Spotted sucker
	Ameiurus melas	Black bullhead
	Ameiurus natalis	Yellow bullhead
	Noturus gyrinus	Tadpole madtom
	Fundulus notatus	Blackstripe topminnow
	Fundulus olivaceus	Blackspotted topminnow
	Gambusia affinis	Mosquitofish
	Labidesthes sicculus	Brook silverside
	Lepomis cyanellus	Green sunfish
	Lepomis gulosus	Warmouth
	Lepomis humilis	Orangespotted sunfish
	Lepomis macrochirus	Bluegill
	Lepomis microlophus	Redear sunfish
	Micropterus salmoides	Largemouth bass
	Pomoxis annularis	White crappie
	Pomoxis nigromaculatus	Black crappie
	Etheostoma chlorosumum	Bluntnose darter
	Etheostoma gracile	Slough darter
CRAYFISH	*Cambarus diogenes*	Devil crayfish
	Orconectes immunis	Papershell crayfish
	Orconectes virilis	Northern crayfish
MUSSELS	*Ligumia subrostrata*	Pond mussel
	Anodonta grandis grandis	Giant floater mussel
	Anodonta imbecilis	Paper pond shell

Table 41. Selected wetland features associated with major rivers found in the West Osage River Basin in west-central Missouri.

RIVER	FEATURE*	TOPO MAP	T-R-S	SIZE[1]
Marais des Cygnes	BL (unnamed)	Worland	39N 33W 32	8.7
	OL (unnamed)	Worland	39N 33W 33, 5	29.7
	BL (unnamed)	Worland	39N 33W 35	44.0
	BL (unnamed)	Worland	39N 33W 3	20.3
	BL (unnamed)	Worland	39N 33W 3	14.7
	BL (unnamed)	Worland	39N 33W 2	16.8
	BL (unnamed)	New Home	39N 32W 4	6.1
	OL (Big Shoe)	New Home	39N 31W 13,14	17.2
	OL (unnamed)	Rich Hill	39N 31W 34,35	26.5
	BL (Goose Lake)	Rich Hill	38N 30W 17,20	23.2
	OL (Maple Slash)	Rich Hill	38N 30W 7	14.6
	ORC	(above)		(49.4)
Marmaton	BL (unnamed)	Deerfield	36N 33W 34	7.1
	BL (Lively Lake)	Moundville	35N 32W 4	12.5
	BL (unnamed)	Moundville	36N 32W 35	13.5
	BL (Dean Lake)	Metz	36N 31W 18	14.4
	BL (Tucker Lake)	Horton	37N 31W 28,33	20.4
	BL (Cottonwood)	Horton	37N 31W 22	56.9
	BL (Spile Lake)	Horton	37N 31W 21,16	32.7
	BL (Stearns)	Horton	37N 31W 16	27.4
Little Osage	OL (unnamed)	Horton/ Rich Hill	37N 31W 11,14	37.1
	BL (Cresap Lake)	Rich Hill	37N 30W 6	31.2
	BL (Prairie Lake)	Rich Hill/ Papinsville	38N 30W 20,29	21.5

*BL = bottomland lake OL = oxbow lake ORC = original river channel
[1] acres, (length in rivermiles)

Table 42. Name, location (county), and size of public areas managed by the Department of Conservation as wetlands in the West Osage River Basin in west-central Missouri (MDC 1989a).

NAME	COUNTY	TOTAL AREA (ACRES)
Douglas Branch C.A.	Vernon	511
Flight Lake C.A.	Vernon	159
Four Rivers C.A.	Vernon	13,671
Old Town Access	Bates	310
Schell-Osage C.A.	Vernon	8,633

Table 43. Number and size of privately owned wetland areas ("duck clubs") in the three core counties of the West Osage River Basin in west-central Missouri. (Jay Bowmaster & Len Gilmore, MDC, personal communication).

COUNTY	NUMBER	TOTAL AREA (acres)	AVERAGE SIZE
Bates	27	1,500	55.6
St.Clair	9	570	55.6
Vernon	30	1,400	46.7
Total	66	3,470	52.6

Table 44. Springs located in the West Osage River Basin of west-central Missouri (Vineyard and Feder 1982, MDNR 1986a).

SPRING	SUBBASIN	COUNTY	LOCATION	ASSOCIATED STREAM
Berry*	---	St.Clair	SENW 1,39N,24W	Trib Osage River
White Sulphur*	---	St.Clair	SWSW 32,40N,23W	Trib Osage River
Blue Stem	Weaubleau	Hickory	NENE 3,36N,23W	Trib L. Weaubleau
Cave	Weaubleau	Hickory	SESE 19,36N,23W	Trib Weaubleau
Gum	Weaubleau	Hickory	NENE 1,36N,24W	Weaubleau Creek
Black Sulphur*	Monegaw/Gallin.	St.Clair	SWNW 30,38N,26W	L Monegaw/Osage
Magnolia*	Monegaw/Gallin.	St.Clair	SWNW 27,38N,26W	Salt Creek
White Sulphur*	Monegaw/Gallin.	St.Clair	NESW 21,36N,28W	L Monegaw/Osage
Eldorado	Clear	Cedar	SENW 29,36N,28W	Trib Clear Creek
9 Wonders	Clear	Cedar	NESW 21,36N,28W	McCord Branch

*Inundated by Truman Lake

Table 45. Participation in the Stream Stewardship Agreement (SSA) Program in Vernon Co., Missouri* (Tom Priesendorf, MDC, personal communication).

		Stream Frontage Easements		
STATUS	NUMBER OF EASEMENTS	LENGTH (mi)	% OF TOTAL AVAILABLE[1]	ACRES
Application	24	17.0	17.5	895.1
Bid Approved	7	12.1	12.5	772.6
Easement Signed	7	12.1	12.5	772.6

*as of 14 January 1999

[1]Based on 94 miles of available stream frontage.

Figure 8. Bates County: Miami Drainage Ditch.

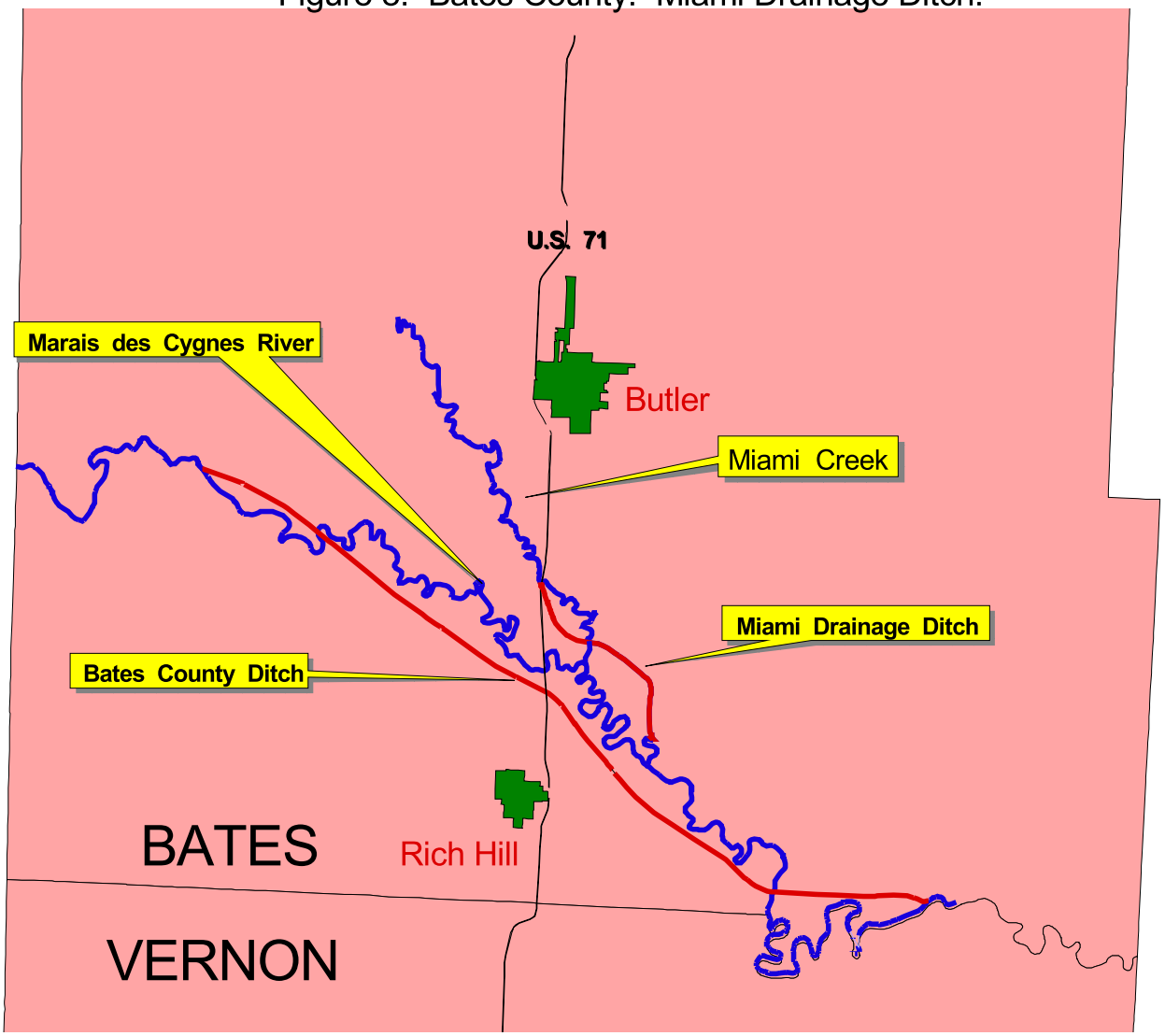


Figure 9. Walleye spawning riffles and paddlefish access creel locations on the Marias des Cygnes River.