HABITAT CONDITIONS

Channel Alterations

Construction of the Diversion Channel and levee system in 1913, which created and then separated the Headwater Diversion Basin from the larger Little River Basin, is the only significant channelization project in the basin. The mouths of major tributary streams entering the Diversion Channel have grade control structures or channel realignments engineered to prevent upstream movement of headcuts. Much of the Diversion Channel Levee (right descending bank of the Diversion Channel) is reveted with riprap and anchored concrete slabs. The left bank of the Diversion Channel is not leveed and is subject to frequent flooding by the Mississippi River. However, the left bank and all channel alignments in the entire 34-mile channelized reach are relatively stable and require little maintenance.

The incidence of channel disturbances caused by private landowners is apparently low and minor. Few specific sites and no stream reached have been identified, through Stream Habitat Assessment Device (SHAD) surveys, as seriously disturbed or altered by private landowner activities such as meander cutoffs, overflow channel blockages, gravel mining, gravel pushing or levee and road construction.

Unique Habitats

The clustered distribution of threatened fish species in two particular stream reaches is significant and suggests a unique and subtle presence of critical habitat components that provide the needs for two diverse fish assemblages. Combined, both reaches account for 78 percent of the sample sites where state listed species have been found and 80 percent of the threatened species identified in the basin (see Threatened and Endangered Species section). Both reaches are about 15 miles long and are located on the mainstem of the Castor River and nearby tributaries between RM 4 and RM 19 in section 11, T28N, R11E to section 18, T29N, R8E and on the mainstem of the Whitewater River and nearby tributaries between RM 16 and RM 32 in section 23, T31N, R11E to section 29, T33N, R11E (Figure 1-B and Table 1-B in Appendix B, contact authors for Appendix B information).

Land use, streambank protection and corridor conditions in both reaches are rated as fairly good, but not necessarily outstanding, and streambank erosion does not appear to be a serious problem. However, both reaches share channel transitions that include abrupt changes in decreased gradient, increased pool/riffle ratios, greater depths, more instream woody structure, finer substrates and promotion to sixth order. Both reaches are also located on the peripheral edges of three overlapping faunal divisions, which contributes to the comparatively higher species richness found at these sites.

The 7,680-acre lake proposed by the Cape Girardeau and Bollinger County Commissions would inundate most of the unique Whitewater River reach. Discharges from the proposed dam would impact the remainder of the reach.

The Castor River Shut-ins Natural Area at RM 56.4 is part of the Amidon Memorial Conservation Area. The rigid boundaries of the extensive pink granite outcrops provide extremely stable and aesthetic stream and overflow channels that are protected and managed under special natural area planning considerations (MDC, 1993b). No state listed fish species have been found near the area.

The Blue Pond Natural Area features the deepest (60 ft) and coldest natural lake (one-acre sinkhole) in the state. The extreme depth and pronounced thermal stratification associated with the clear, steep-sided lake results in low seasonal dissolved oxygen concentrations that may limit the density of fishes (common centrarchids) found in the lake. Several state listed aquatic plants have been collected on the area (endangered Scirpus subetminalis, Potomogetion pusillus; and watch-listed Carex decomposita, Potomogeton pulcher). A small spring entering the lake also supports a blind, white amphipod (Bactrurus brachycaudis) that has limited distribution in the state. The lake is protected and managed under special natural area considerations (MDC, 1992) and drains into an un-named tributary to Pond Creek in the Castor River subbasin.

Improvement Projects

Since 1990, five improvement projects have been installed on three streams in the basin for the purposes of streambank stabilization, streambank revegetation, corridor revegetation or creation of instream fish habitats. Four of the projects are located on public lands owned by the MDC or DNR and one MDC Landowner Cooperative Project (LCP) has been installed on private land. Other MDC landowner stream incentive programs are not being piloted in the basin.

> HAWN ACCESS Cedar Tree Revetment Project: Crooked Creek at RM 40.2 (Figure pa, Land Use Chapter); fourth order; 800 ft vertical eroding streambank; single row tree revetment installed November 1990; tree seedlings, stakes and wattles planted March 1991; tree seedlings and stakes replanted March 1992; stakes replanted March 1993. The revetment successfully stabilized the eroding toe and the willow stakes quickly revegetated the backsloped streambank. But, tree seedling survival in the corridor was poor due to uncontrolled weed competition.
>
> ZOHN KUHLMAN LCP Cedar Tree Revetment Project: Crooked Creek at RM 40.1 (Figure 3-A in Appendix A, contact authors for Appendix A information); fourth order; 450 ft vertical eroding streambank; single row tree revetment installed August 1991; tree seedlings and stakes planted April 1992; stakes replanted March 1993. To date, the young revetment is stabilizing the toe and the willow stakes are beginning to revegetate the backsloping streambank. First-year tree seedling survival in the corridor appears to be poor because of uncontrolled weed competition.
>
> MARQUAND ACCESS Scouring Rack and Rootwad Project: Castor River at RM 40.3 (Figure pa); fifth order; lack of instream habitat diversity; three scouring racks installed and local drift anchored in place September 1992. The scouring racks survived two minor floods and then were completely washed out in a major January 1993 flood (anchors set too shallow).

The anchored drift is still in place, but habitat diversity has not increased.

OLD PLANTATION ACCESS Willow Staking Project: Whitewater River at RM 29.1 (Figure pa); fourth order; willows from different sources and of different sizes were staked November 1990 and March 1991; tree seedlings were planted March 1991. All sizes of willows staked in November suffered higher mortality than willows staked in March. There was no apparent difference in mortality between willow stakes cut on-site and in-basin. MDC nursery stock suffered the highest mortality. The number and length of stems produced is positively correlated to the size of the cutting. Willow leaf beetle infestations did not occur. Tree seedling survival in the corridor was poor due to uncontrolled weed competition.

BOLLINGER MILL STATE PARK Privately Contracted (by DNR, Figure pa) Cedar Tree Revetment Project: Whitewater River at RM 15.9; fifth order; 330 ft vertical eroding streambank; single row tree revetment installed by a St. Louis landscaping firm August 1990; sycamore stakes planted March 1991. the revetment failed to stabilize the site, which has since eroded back another five feet because the DNR did not allow the streambank to revegetate. The sycamore stakes suffered 100 percent mortality, and adequate corridor was never established and the invasion of natural vegetation was not allowed.

Other stream improvement concerns related to adequate corridor widths and healthy streambank vegetation on frontages owned by the MDC are addressed in Area Management Plans for the Amidon Memorial, Castor River and Maintz observation areas. The Castor River and Maintz management plans also contain objectives that specify the establishment of Eastern redcedar plantations as a future source of streambank revetment materials. Cedar trees do not commonly occur in the lower elevations of Whitewater River and Castor River watersheds.

Stream Habitat Assessment:

The MDC Stream Habitat Assessment Device (SHAD, Version II) was used to describe the quality of channel, streambank and corridor habitat conditions in the basin. SHAD is an assessment method that uses objective measurements and subjective ratings to rank particular habitat parameters into categories that allow inter- and intrabasin evaluation and comparison. Ninety-two SHAD sites and nine restricted-access SHAD sites (101 total sites) were selected and sampled or observed in the late summer base flow periods during 1988-1990.

SHAD Site Selection. The selection, distribution and densities of SHAD sample sites were dictated by stream orders in the four major subbasins: Diversion Channel, Castor River, Whitewater River and Crooked Creek. the frequency of SHAD sample sites increased in a downstream direction. It was assumed that the potential for habitat problems to develop would be greater with the increased flood frequencies, discharge volumes (energy) and agricultural activities in the lower watersheds. Therefore, SHAD sample sites were concentrated in the lower reaches of subbasin mainstem streams so that obvious and subtle changes in habitat condition in the more complex segments could be accurately

defined and located. Consequently, over 20 percent of the length of sixth order segments were sampled with close site spacing, whereas only about seven percent of the length of fourth order segments were sampled with wider site spacing (Table 10, contact authors for Table 10 information). An exception was the Diversion Channel where only 4.5 percent of the sixth and seventh order reach was sampled because of the homogenous nature of the habitat parameters associated with the artificial channel. Also, sampling on the lower reaches of Crooked Creek was restricted by poor access. No second order reaches were sampled and most of the third order assessments were conducted on important tributaries to the subbasin mainstem streams.

The lengths and spacing of the SHAD sample stations contained random and uniform sampling elements. For various reasons, a predetermined number of SHAD stations might have been planned for a particular section (usually a one day float). However, the actual selection of a sampling station within a section depended on the ground-truthing of map, channel and photographic information, and then locating and separating truly representative stations within that section. The distance between stations averaged about two miles in the lower watersheds (Table 10). The length of a sampling station was adjusted (usually extended to include more riffle/pool sequences) to enhance the accuracy of station averages if an obvious anomaly was measured. Calculated channel conditions such as pool/riffle ratio, cover density, average width and maximum average depth, do represent the best estimate for the site. SHAD station lengths ranged from 1.3 miles to 0.05 mile and averaged 0.3 mile. About 27.3 miles of stream channels were surveyed (Table 10).

Habitat Evaluation. The 92 SHAD survey sites and the nine restricted-access SHAD sites were assigned identification numbers and located on subbasin maps (Figure hb). Many of the SHAD survey parameters are summarized and tabulated for convenient reference (Table 11, contact authors for Table 11 information). Based on the summarized data, most of the surveyed habitats in the basin are generally in good condition. A subjective habitat assessment using SHAD, Version I scored the mainstem of the Castor River at 0.86 and the mainstem of the Whitewater River at 0.81, which suggests some good to excellent habitat conditions. The few problems that occur in the basin usually minor, scattered and most often associated with streambank instability.

Streambank Conditions:

Analyses of the SHAD, Version II summaries (Table 11) suggest that streambank erosion in the basin is not excessive. Less than three percent of the surveyed streambanks are severely eroding (unstable, vertical and sloughing). An additional three percent of the streambanks are moderately eroding (unstable toes with bank angles exceeding 45 degrees). More than 90 percent of all sampled streambanks are relatively stable (no accelerated erosion). The occurrence and severity of streambank erosion does not appear to correlate well with reach gradient, land use, corridor or vegetation factors. Perhaps substrate composition, in conjunction with the complexities of site-specific disturbances, soil types and channel hydraulics, are responsible for most of the incidences of accelerated streambank erosion that are occurring in the basin.

SHAD frontages exhibiting severe erosion are most frequently associated with loose gravel substrates

that tend to produce migrating point bars. Most of the severely eroding streambanks in the basin are located in the fourth and fifth order reaches of the middle watersheds where clay substrates are infrequent and loose gravel accumulates. The mainstem of Crooked Creek, with perhaps the highest incidence of accelerated erosion in the basin, is a good example. The non-eroding SHAD frontages are most often associated with clay and sometimes bedrock or tightly embedded gravel substrates. Clay can protect the toe of the slope and is probably responsible for the stable streambanks that commonly occur on the larger, low elevation sixth order stream reaches where clay is usually the dominant substrate. Greater stability is also apparent in the smaller, high elevation third order reaches; but, streambank stability in the clayless upper watersheds might be more related to the shorter duration of unit hydrographs. Moderately eroding SHAD frontages seem to occur in all types of substrate materials.

Thirteen percent of the streambank protection on the SHAD frontages is rated as poor (sparsely vegetated and weakly armored). The quality of streambank protection, as measured and described during the SHAD surveys, does not correlate well with the occurrence and severity of streambank erosion. The stable streambanks in the basin are usually associated with high quality vegetative cover. However, incidents of severe erosion occur as often with good cover as poor cover. Moderate rates of streambank erosion actually occur four times more often on well vegetated streambanks as poorly vegetated streambanks.

Erosion of some well-vegetated streambanks is not necessarily cause for concern when considering the low incidence of serious erosion (<3%) and high incidence of timbered corridors (75%) and well-armored streambanks (87%) in the basin. Wandering point bars, moving drift (e.g. 200 woody structures/mile) and the flashy nature of flood flows contribute to normal channel dynamics that may attack any streambank location. Occurrences of naturally healed streambank blowouts and major sloughs are evident throughout the basin.

Corridor Conditions:

The vegetative quality of the wooded portion of the corridors is rated as good (dense stands of trees and understory) throughout most of the basin. Seventy-five percent of the SHAD sites contain corridor conditions that are predominantly well timbered, while only four percent of the SHAD sites have corridors that are dominated by poor vegetative conditions. The widths of the corridors, however, are extremely variable.

Variation in the width of the wooded corridors is dependent on the extent of agricultural activity, which is usually dictated by topographic relief and the width of the subbasin floodplains. The widths of the wooded SHAD corridors, throughout the basin, are most often great enough to promote streambank stability and deter floodplain scour. However, problems that can occur because of inadequate corridor widths are definitely subbasin specific and may therefore offer some focal points for directing management efforts and corrective action (Table 12, contact authors for Table 12 information). For example, the complete absence of some wooded corridors and the high incidence of narrow corridors in the agriculturally important Diversion Channel subbasin may never be adequately addressed because

of serious political, economic, and engineering factors. But, some reaches of narrow wooded corridor in the Whitewater River and Crooked Creek subbasins may eventually be widened and improved through a concentrated effort of landowner education and assistance. The issue of wooded corridor width in the Castor River subbasin does not warrant a high priority concern because of the adequate corridor widths and good land use patterns that are currently present in most of that particular drainage.

The primary land use associated with the corridors in the SHAD surveys are: row crop (39%), timber or woodland (28%), pasture (21%), hay fields (6%) and developments (6%) (Table 11). Changes in land use patterns closely parallel subbasin transitions in geology, soil fertility and topography. Row crops are concentrated in the Whitewater River (61%) and Diversion Channel (100%) subbasins. Woodlands dominate the Castor River (42%) and Crooked Creek (38%) subbasins. Pastures are also most frequently found in the Castor River (38%) and Crooked Creek (31%) subbasins. Streambank instability can occur anywhere in the basin and is not related to any particular type of adjacent land use. Intensive row crop agriculture in or near the corridors will not necessarily increase streambank instability if favorable substrates and streambank protection factors are present. the most frequent incidents of severe streambank erosion are occurring on pastures and hay fields where landowners are, perhaps, trying to get the most utility out of a narrow floodplain. In these instances landowners are reluctant to give up the space for needed corridor development and believe that livestock fencing cannot withstand out-of-channel flood flows.

Channel Conditions:

Pool and riffle habitats are extremely diverse and are distributed in similar patterns in most stream channels throughout the basin (Table 11). Pools are usually more abundant than riffles, regardless of channel size, with pool/riffle ratios most often ranging between 2:1 and 3:1 (Table 13). Pool morphology is highly variable in length, depth, current and substrate, thus providing abundant and essential microhabitats for many forms of aquatic life, particularly fish species and invertebrate forage bases. The lengths, depths and substrates associated with riffle habitats also vary considerable; but fairly shallow, short, high gradient, cobbled riffles appear most frequently.

The average maximum pool depth at most SHAD sites throughout the basin is not particularly good, relative to stream order. Maximum depths at fifth and sixth order SHAD sites average a marginal five to eight feet (Table 13). Third and fourth order sites have poor maximum depths averaging usually less than three feet. Because of the irregularity of channel bottom profiles, the value of the average maximum pool depth is often deflated by the numerous shallow and medium depth pools included in the SHAD site measurements. The approximate maximum depth of the deepest pool measured at any particular SHAD site is about 162 percent of the calculated average maximum depth. Deep water habitats are available; and, when combined with the excellent groundwater supply, provide sufficient water depths in most stream channels to easily maintain aquatic communities during severe drought conditions. Depth diversity is also providing the horizontal and vertical habitat components need to increase niche volume and species richness.

Depth in most of the Diversion Channel is completely dependent upon Mississippi River stages. Normal Mississippi River stages will back water up to the Blockhole grade control structure at RM 21 and provide minimum depths of 5 to 25 feet in much of the channel during most of the year. However,

drastic dewatering (depth less than one foot) of the wide, lower reaches occurs when the Mississippi River falls to a stage below the evapotranspiration and drought. The most severe dewatering occurred during the hot August drought of 1988 when the Mississippi River fell to 4.6 feet on the Cape Girardeau gage. Less sever dewatering has occurred at lower gage heights that happened to have coincided with cool winter temperatures and normal tributary base flows.

Instream cover is definitely abundant in the mainstem channels throughout the basin, including the artificial Diversion Channel. The density of woody cover is apparently related to channel size and flood flows. Particularly high densities of woody cover tend to accumulate in the lower reaches of the Castor and Whitewater Rivers, where 100 to 200 woody structures per mile were recorded at most SHAD sites (Table 11). The upper mainstem reaches and smaller tributaries have considerably lower, but generally adequate, concentrations of woody cover (Table 13). Only nine percent of the SHAD sites on the mainstem channels of the four subbasins contain low densities (<20/mile) of woody cover; whereas about 40 percent of the SHAD sites on the smaller tributary channels have low densities of woody cover. Little Whitewater Creek and Little Crooked Creek are the only tributary streams with limited amounts of instream cover and marginally significant recreational fisheries that might benefit from efforts to increase woody habitats.

Woody structure most often occurs in the form of entire trees, with rootwads attached, that are well anchored (partially buried) in the channel bottoms. Attrition eventually breaks the trees into smaller parts that are either redistributed and anchored or formed into numerous drift piles and log jams of various shapes and sizes. Intricate current patterns and subtle scour holes develop around the woody structures that provide additional channel diversity and microhabitats. Other types of instream cover structures, which appear less frequently than the woody elements, are large boulders in the upper watersheds, undercut banks in the lower watersheds and scattered stands of water willow throughout the basin. The instream cover component is, perhaps, the habitat forte of the basin.

Streambed Conditions:

Substrate composition provides another significant dimension of diversity for channel habitats. Each of seven types of substrate material, ranging in size from clay to boulders, was the dominant substrate present at a SHAD site somewhere in the basin (Table 11). And, a mixture of all substrate materials, except bedrock and boulders, was usually observed, if not measured, at most SHAD sites. The distribution and composition of the diverse substrate materials, however, is dependent on watershed and subbasin locations.

Coarse sediments are absent in the Diversion Channel substrates, which are dominated by sand, silt and clay. Coarse sediments are also scarce in Diversion Channel subbasin tributaries. The upper watersheds of Castor and Whitewater Rivers are dominated by large amounts of clean gravel and cobble, which eventually cede some importance to clay and bedrock in the lower reaches of the watersheds. The entire mainstem of Crooked Creek is dominated by clean gravel. Outside of the Diversion Channel subbasin, silt is fairly rare and only occasionally dominates the substrate. The substrates in all tributaries to the Castor River, Crooked Creek and Whitewater River contain huge

amounts of gravel, cobble and sand which supply the three mainstems with large bedloads.

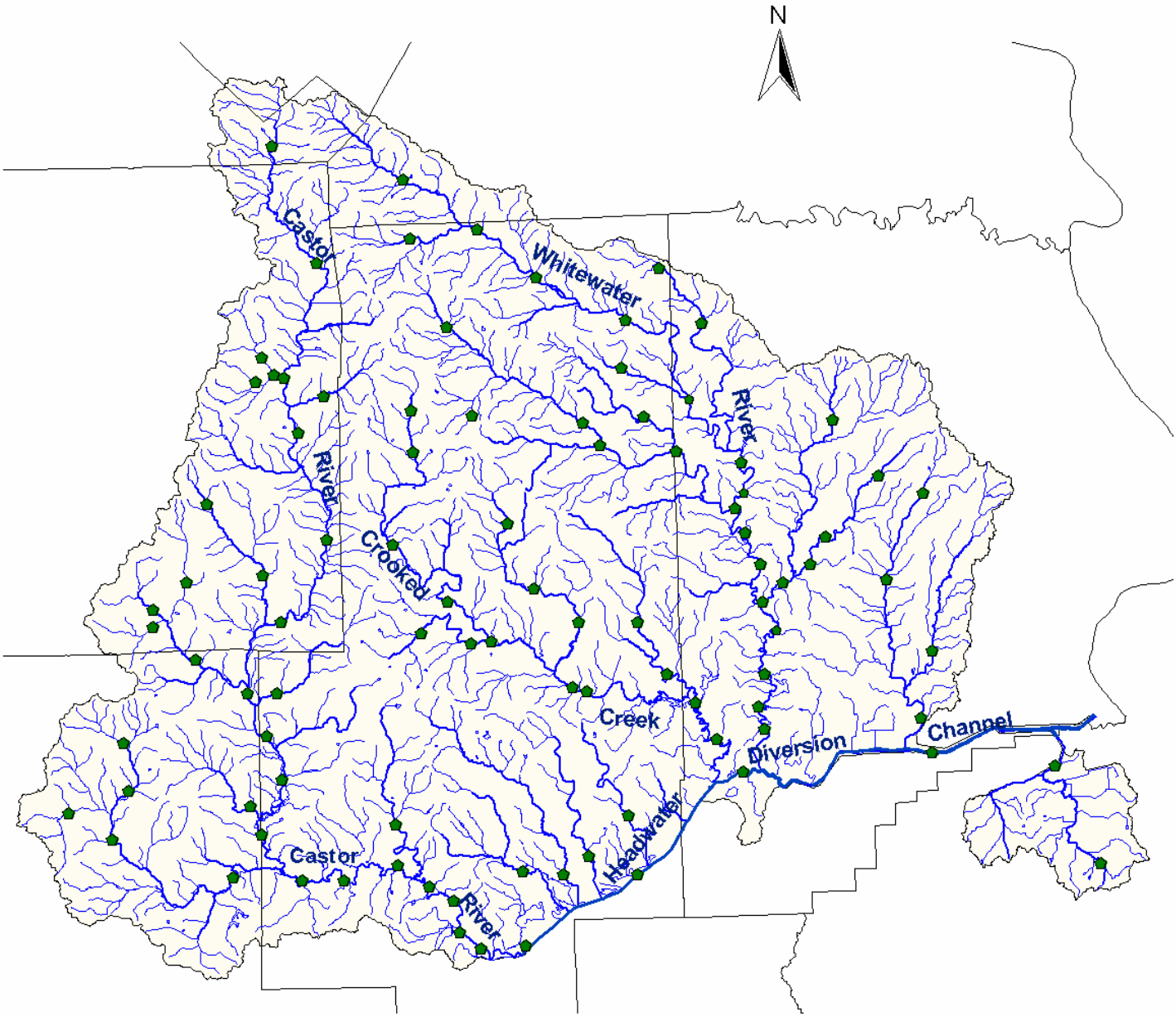
The transport of coarse sediments is responsible for most of the channel dynamics that occur in the upper mainstem reaches of Castor River and Crooked Creek and to a lesser extent in the Whitewater River. Excessive bedloads of gravel can smother riffles, fill pools and upset channel hydraulics at some locations. Channel stability generally improves downstream, but thalweg displacement can cause local site specific incidents of accelerated erosion anywhere in the basin. Channel disturbances involving gravel deposition are currently present in all stages of development and stabilization, ranging from deeply-embedded, well-armored, willow-covered islands to soft and soggy point bars on inside bends. With time, old deposits will stabilize and fresh deposits will accumulate, which actually contributes to the dynamic nature and diversity of instream habitat development in the basin.

Water Quality:

No water quality problems were evident at any SHAD site. Water clarity ranges from clear in the upper watersheds to a slightly green color in the lower elevations. Little inorganic turbidity was noted anywhere outside of the Diversion Channel subbasin. Algae concentrations are usually restricted to backwater areas. Partial shade is abundant throughout the basin and many reaches have closed tree canopies.

Channel Alterations:

Major channel alterations are rare outside of the Diversion Channel subbasin. No channelized cutoffs have been identified and only scattered incidents of clearing, snagging or gravel pushing have been observed. The Regulatory Office of the USCOE has issued two Cease and Desist orders to landowners conducting channel disturbances: Shetley Creek at RM 0.6 in 1992 and Bear Creek at RM 11.5 in 1993. Non-permitted gravel mining activities (personal/private/County) are numerous and widespread throughout the basin, and have the potential to cause local problems.



Legend

- Habitat Samples
- Streams
- Headwater River
- Major Rivers
- Counties
- Headwater Basin

5 0 5 10 15 Miles

Figure hb. Habitat sample sites in the Headwater Diversion Basin, in Missouri.