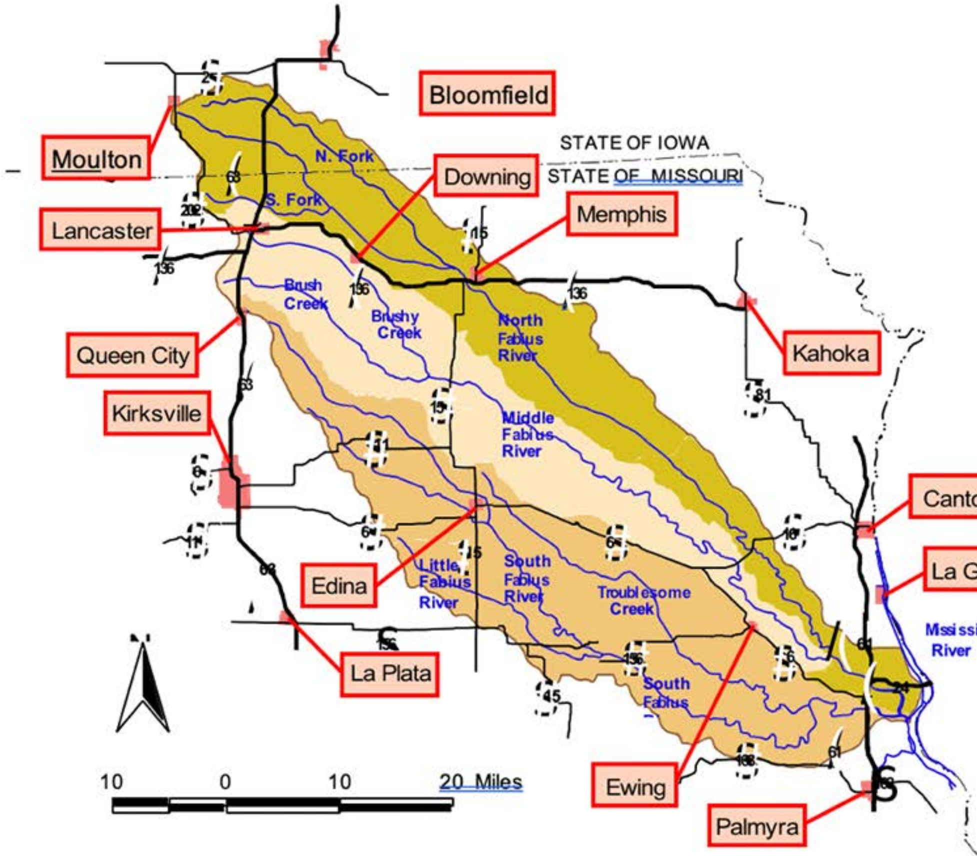

Fabius River

Watershed and Inventory Assessment

Prepared by

H. Ross Dames and David J. Neuswanger

Missouri Department of Conservation, 2500 South Haliburton, Kirksville, MO 63501

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Preface

The Missouri Department of Conservation (MDC) is responsible for managing the forests, fish, and wildlife of the State of Missouri. The water, fish, and other animals inhabiting our streams are a public resource, but the quality of stream fishing and overall stream health is almost entirely dependent upon land management decisions made by private citizens who own more than 97% of the State, including the corridors and beds of our streams.

Since the mid 1980s, MDC biologists have provided on-site stream habitat evaluation and planning services to landowners, usually in response to geographically random streambank erosion problems. Local attempts at spot-treatment, while instructive, have done little to address the watershed-wide problems that affect our streams. Clearly, any substantial progress toward improving our stream fisheries will occur only if a significant number of people from all walks of life acquire an understanding of the physical, chemical and biological character of these resources and their values to society. Only from such a common understanding may there arise a shared vision and science-based plan for watershed conservation that incorporates the perspectives and reflects the needs of all potential beneficiaries.

The main objectives of this report are:

1) to summarize the widely scattered physical, chemical, and biological information most relevant to the stream fishery of the Fabius River watershed; and
2) to identify opportunities for conserving (wisely managing) Fabius River basin streams on a watershed scale. In addition to providing guidance for MDC operations, we hope this document will facilitate citizen-led initiatives to manage the watershed in a way that will benefit our fisheries, our rural economy in general, and future generations who will inherit our legacy.

David J. Neuswanger

Fisheries Regional Supervisor

April, 1999

Location

Watershed Geography

The Fabius River basin is easily divided into three main sub-basins (Figure wm). The North Fabius sub-basin originates in Davis County, Iowa. The Middle Fabius and South Fabius sub-basins originate in Schuyler County, Missouri. Approximately 6% of the watershed is in Iowa. The three principal streams flow in parallel relation southeasterly across northeastern Missouri, draining portions of eight counties (Schuyler, Scotland, Clark, Adair, Knox, Lewis, Shelby, and Marion). The Middle Fabius River joins the North Fabius in southeastern Lewis County. The North Fabius flows another 8.9 miles before merging with the South Fabius in northeastern Marion County to form the Fabius River. The Fabius River then flows only 3.5 miles before reaching its confluence with the Mississippi River in the Fabius Chute near River Mile 323. All three mainstem streams have upper tributaries named North Fork and South Fork. Bear

Creek is the only other major tributary of the North Fabius River (besides the Middle Fabius River). Durgens Creek, once a North Fabius tributary, has been diverted and now drains directly into the Mississippi River. Bridge Creek is a major tributary of the Middle Fabius River, and the Little Fabius River and Troublesome Creek are major tributaries of the South Fabius River. The Fabius watershed is bounded by the Salt River basin to the west, the Wyaconda River basin to the northeast, and the North River basin to the south.

Watershed Area

The Fabius watershed drains 1,543 square miles (988,900 acres) of land. The basin is about 80 miles long and up to 25 miles wide. The North Fabius, Middle Fabius, and South Fabius sub-basins compose 32%, 27%, and 40% of the Fabius basin, respectively (SCS 1992a, SCS unpublished). The only other fifth-order streams in the basin are the South Fork of the South Fabius River and the South Fork of the Middle Fabius River which drain about 53.5 square miles (34,311 acres) and 94.0 square miles (60,323 acres), respectively.

Stream Orders

Streams were identified on USGS 7.5-minute topographic maps and ordered according to Strahler (1957). There are 57 third-order and larger streams in the basin (Appendix A). The North Fabius River is the longest (105 miles) and largest (sixth order). The Middle Fabius River (75 miles long) and South Fabius River (81 miles long) are fifth-order streams, as are their respective South Forks. All other streams in the basin are fourth-order or smaller.

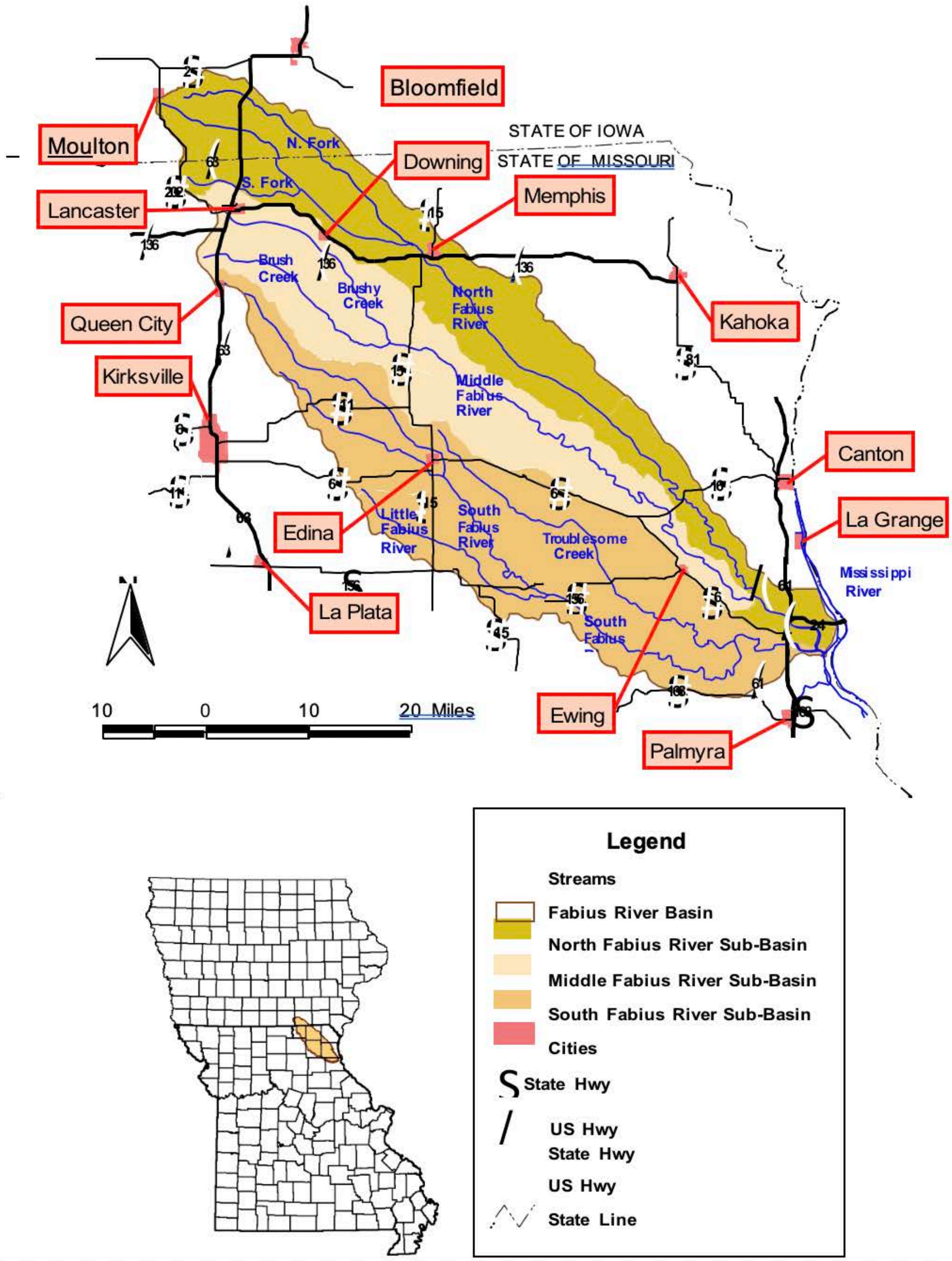

Figure wm. Location of Fabius River watershed.

Appendix A. Third-order and larger streams in the Fabius River basin. S T R indicates section, township, and range at the mouth. An asterisk (*) indicates a stream length too short to measure gradient.

STREAM NAME	LOCATION S T R	TOTAL LENGTH (MILES)	PERCENT CHANNELIZED	STREAM ORDER AT MOUTH	GRADIENT BY STREAM ORDER (FEET/MILE)			
					6	5	4	3
Fabius River	21 59n 8w	3.5	100	6	2			
North Fabius	24 59n 6w	104.9	59	6	2.8	3.3	6.7	10.3
Unnamed trib.	22 61n 7w	1.1	0	3				*
Unnamed trib.	8 61n 7w	1.8	0	3				*
Forsee Branch	5 62n 8w	3.6	0	3				18.2
Cooper Branch	6 62n 8w	9.9	0	3				6.6
Bear Creek	23 63n 9w	26.2	0	4			5.5	6.2
Long Branch	33 64n 10w	12.5	0	3				13.3
Indian Creek	12 64n 11w	12.4	0	3				10
Gunns Branch	34 65n 11w	13.2	0	3				9.7
Unamed trib.	12 65n 12w	4.7	0	3				19.5
N. Fk. N. Fabius	2 65n 12w	19.9	69	4			3.9	6.5
Unnamed trib.	3 65n 12w	3	0	3				11.4
S. Fk. N. Fabius	1 66n 14w	15.1	0	4			10.1	9.1
Unnamed trib.	1 66n 14w	3.7	0	3				13.1
Batten Branch	15 67n 14w	3.7	0	3				22.2

STREAM NAME	LOCATION S T R	TOTAL LENGTH (MILES)	PERCENT CHANNELIZED	STREAM ORDER AT MOUTH	GRADIENT BY STREAM ORDER (FEET/MILE)			
					6	5	4	3
Carter Creek	27 76n 13w	24.5	37	3				6.9
Unnamed trib.	33 68n 15w	3.5	0	3				15.2
Unnamed trib.	5 67n 14w	8.1	23	3				12.8
Middle Fabius	29 60n 6w	74.5	0	5		2.6		
Unnamed trib.	5 60n 7w	2	0	3				30.7
Unnamed trib.	30 61n 7w	5.2	0	3				23.3
Reddish Branch	31 62n 8w	11.8	0	3				15.1
Bridge Creek	6 62n 9w	30.2	0	4			6	5.2
L. Bridge Creek	10 62n 10w	9.7	0	3				12.3
Tobin Creek	30 64n 11w	14.5	0	3				7
N. Fk. Middle Fabius	27 64n 12w	35	0	4			6.3	6.1
Bridge Creek	36 65n 13w	16.3	0	3				8
S. Fk. Middle Fabius	27 64n 12w	30.3	0	5		5	8	13.7
N. Bridge Creek	23 64n 13w	7.2	0	4			11.5	14.6
Bee Branch	22 64n 13w	4.2	0	3				16.2
Brushy Creek	9 64n 13w	9.4	0	4			9.3	14.1

STREAM NAME	LOCATION S T R	TOTAL LENGTH (MILES)	PERCENT CHANNELIZED	STREAM ORDER AT MOUTH	GRADIENT BY STREAM ORDER (FEET/MILE)			
					6	5	4	3
Tipp Creek	8 65n 14w	6.1	0	3				12.5
South Fabius	24 59n 6w	81	10	5		2.9		
Troublesome Creek	13 59n 7w	60.1	16	4			4	5
Grassy Creek	18 59n 6w	27.8	0	3				5.4
Brower Branch	28 59n 8w	5.4	0	3				18.8
Unnamed trib.	17 59n 8w	2.7	0	3				30
Unnamed trib.	2 59n 9w	7.6	19	3				4.2
Allen Branch	29 60n 8w	6.1	0	3				15.9
Hawkins Branch	17 61n 9w	10.5	18	3				6.5
Seebers Branch	32 60n 9w	8.1	0	3				8.9
Spees Branch	29 60n 9w	11.9	0	3				8.8
Cottey Creek	31 62n 10w	3.2	0	3				14.3
L. Fabius River	23 60n 10w	40.5	0	4			5.1	6.7
Unnamed trib.	26 60n 10w	4.2	0	3				23.1
Long Branch	14 60n 11w	4.8	0	3				16.1
Unnamed trib.	17 61n 12w	3.7	0	3				9.4
Unnamed trib.	36 61n 11w	2.7	0	3				7.1

STREAM NAME	LOCATION S T R	TOTAL LENGTH (MILES)	PERCENT CHANNELIZED	STREAM ORDER AT MOUTH	GRADIENT BY STREAM ORDER (FEET/MILE)			
					6	5	4	3
Coon Creek	15 61n 11w	10.6	0	3				9.4
N. Fk. S. Fabius	29 62n 11w	42.4	0	4			4.6	7.1
S. Fk. S. Fabius	29 62n 11w	32.8	0	5		5	4.6	7.1
Rock Creek	30 62n 11w	11.1	0	4			10.8	7.1
Unnamed trib.	34 62n 12w	2.3	0	3				20.8
Long Branch	6 62n 12w	7.4	0	3				10.7
Nick Branch	2 62n 13w	6.2	0	3				10.8
Unnamed trib.	4 63n 13w	2.8	0	3				18.1
Tauaninny Creek	15 64n 14w	5.6	0	3				10.4

Geology

Physiographic Region/Geology/Soils

The Fabius River basin lies in the eastern section of the Glaciated Plains Division of Missouri (Thom and Wilson 1980), also known as the Dissected Till Plains (Figure nd). The Till Plains were formed by glaciers that deposited drift composed mostly of clay with some rock, gravel and sand lenses (MDNR unpublished). Geologically, the basin changes significantly from northwest to southeast. Glacial till up to 200 feet thick on ridgetops is found in the upper portions of the basin, mainly the upper North and Middle Fabius sub-basins. It thins only slightly on gentle slopes and in broad valleys. Four to eight feet of wind-deposited loess overlies this till. Beneath it is a thin layer of sand and gravel and then a layer up to 400 feet thick of alternating deposits of Pennsylvanian age sandstone, siltstone, shale, limestone, and coal.

In the middle and lower portions of the basin the topography grades from broad plains to steep, abrupt valleys with high relief. Till shallows quickly on the lower slopes to expose Mississippian age limestone in the valley walls and streambeds (Figure ge). Loess deposits are usually less than four feet deep in lower North and Middle Fabius sub-basins and in the South Fabius drainage. This region of thin glacial soils and exposed limestone is roughly defined as the area downstream of Route E in Lewis County in the North Fabius sub-basin, downstream of the Scotland-Knox county line in the Middle Fabius drainage, and downstream of Edina, Missouri in the South Fabius sub-basin. The basin flattens as it enters the Mississippi River floodplain, and the substratum turns to fine alluvium.

The majority of the basin is located in the Central Claypan region (Allgood and Persinger 1980). Soils of this region are formed in glacial till or loess parent material or both (SCS 1992b, 1984, 1979, 1975). They generally have a silt loam surface of moderate to high erosion potential overlying a silty clay subsoil of low permeability. Once home to native prairie grasses, most of this fertile region is now considered excellent farmland. Deep loess soils occur in the upper North and Middle Fabius drainages, and soils of the Central Mississippi Valley Wooded Slopes are found on steep hills and some ridgetops primarily in the lower part of the basin. Silty loam alluvial soils are limited to stream floodplains. Due to the clay content of the till and the underlying shales and limestone, vertical movement of water from the surface to groundwater is minimal throughout the basin (MDNR unpublished). No significant springs exist so stream flow is largely dependent on surface runoff.

Stream Channel Gradients

Channel gradients (slopes) were determined for all third-order and larger streams by using USGS 7.5-minute topographic maps and digitizing software (Appendix A). Gradient is very low in the lowermost reaches of the Fabius and North Fabius rivers (2.0-2.8 feet/mile). Gradients in fifth-order reaches of basin streams range from 2.6 feet/mile in the Middle Fabius River to 5.0 feet/mile in the south forks of both the Middle Fabius and South Fabius rivers. Because of their higher gradients, the latter two streams exhibit better riffle/pool development than many lower-gradient prairie streams of similar size. Gradients in fourth-order reaches of basin streams range from 3.9 to 11.5 feet/mile.

While third-order reaches of basin streams have wide-ranging gradients (Appendix A), the slopes of some short, third-order streams are strikingly high. For instance, gradient exceeds 90 feet/mile in an unnamed tributary in the lower portion of the North Fabius River sub-basin. This and other high-gradient streams are generally located in the middle and lower portions of the basin as the watershed enters the region of steep, narrow valleys with shallow till and exposed limestone.

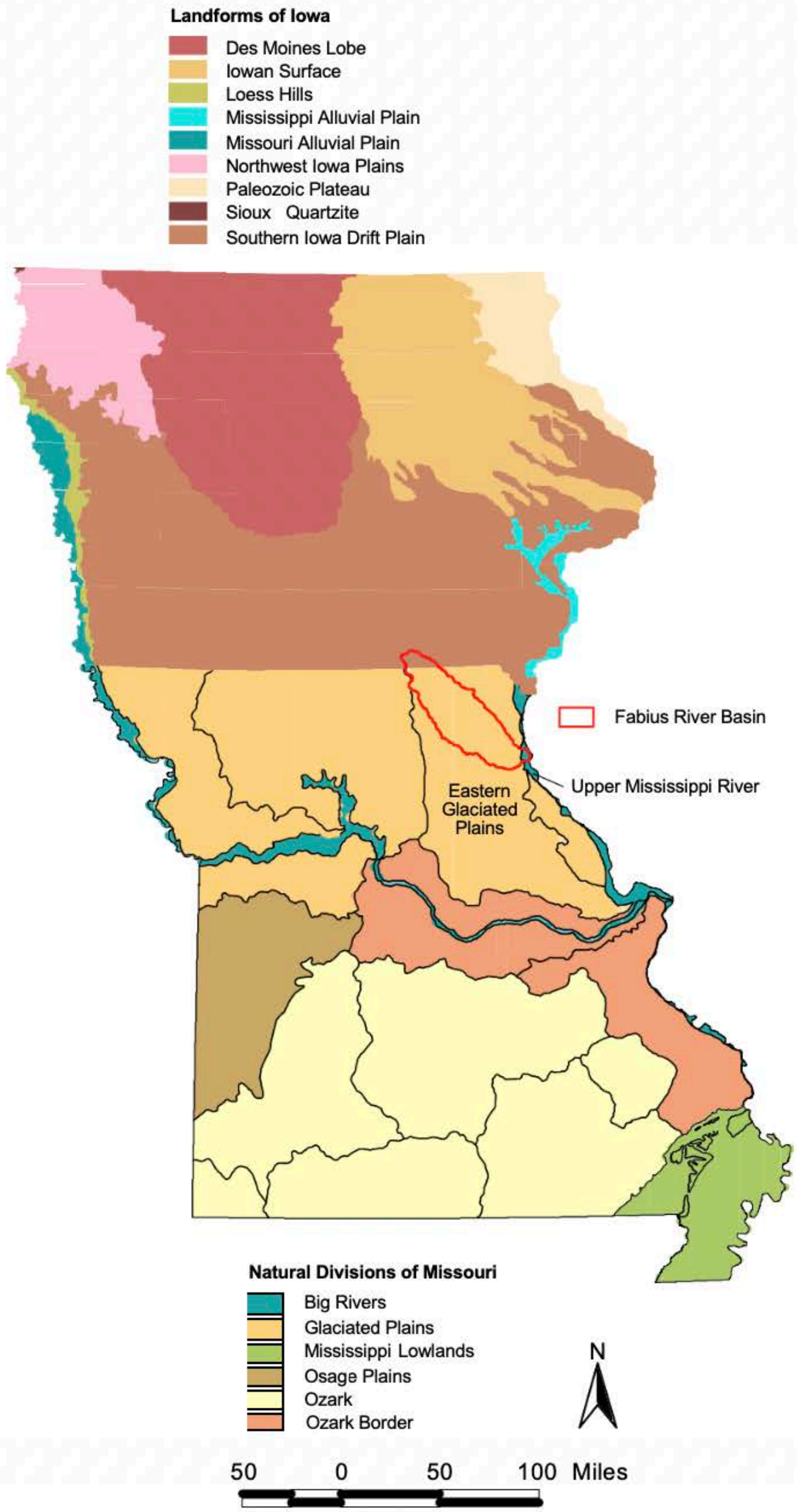

Figure nd. Location of the Fabius River watershed in the natural divisions of Missouri and the landforms of Iowa.

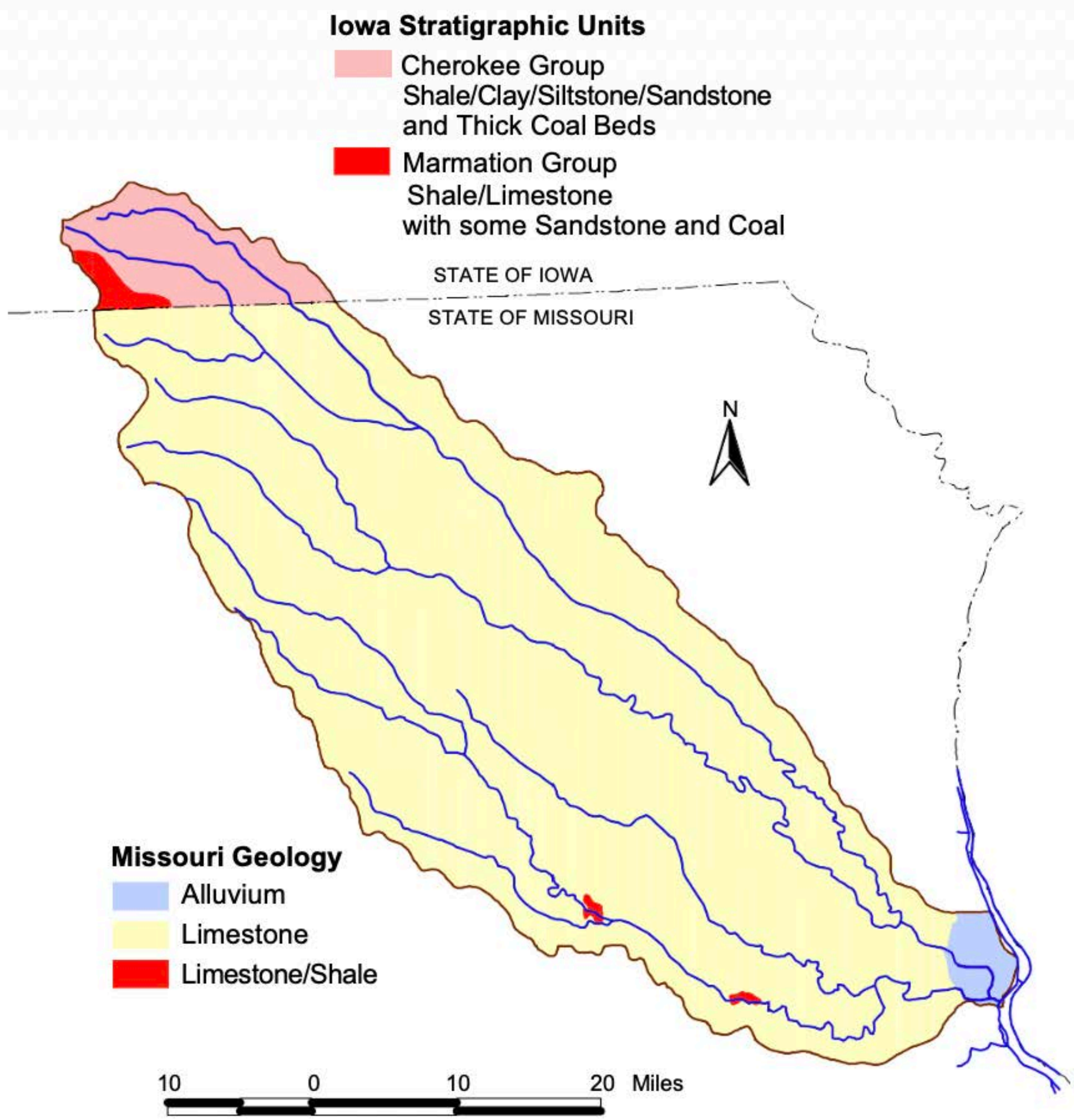

Figure ge. Geology in the Fabius River watershed in Missouri and Iowa.

Appendix A. Third-order and larger streams in the Fabius River basin. S T R indicates section, township, and range at the mouth. An asterisk (*) indicates a stream length too short to measure gradient.

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Unnamed trib.	5 67n 14w	8.1	23	3				12.8
Middle Fabius	29 60n 6w	74.5	0	5		2.6		
Unnamed trib.	5 60n 7w	2	0	3				30.7
Unnamed trib.	30 61n 7w	5.2	0	3				23.3
Reddish Branch	31 62n 8w	11.8	0	3				15.1
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Long Branch	6 62n 12w	7.4	0	3				10.7
Nick Branch	2 62n 13w	6.2	0	3				10.8
Unnamed trib.	4 63n 13w	2.8	0	3				18.1
Tauaninny Creek	15 64n 14w	5.6	0	3				10.4

Hydrology

Precipitation

Average annual precipitation ranges between 34 and 36 inches (MDNR 1986).

USGS Gaging Stations

There are three active gaging stations in the basin (USGS 1995; Table 1). Water quality is monitored at the South Fabius River station.

Permanence of Flow and Average Annual Discharge

Average annual discharge at the three stations ranges between 278 and 413 cfs (Table 1). All streams are subject to periods of no discharge. Nevertheless, five basin streams denoted by solid blue lines along their entire length on USGS maps are considered to be permanently flowing streams (Fabius, North Fabius, Middle Fabius, South Fabius, N. Fork of North Fabius). Most other fourth and fifth-order streams have only short reaches considered intermittent. Many third- order streams are intermittent their entire length.

Base Flow and Low-Flow Frequencies

Base flows throughout the basin are not sustained by groundwater inflow during dry weather due to the low conductivity of the underlying clays and rock. Seven-day periods of no flow occur every 5 to 10 years (Skelton 1976; Table 2). Also, stream discharge can fall below 1.5 cfs for 30 days or longer every five years.

Flow Duration

Flow duration statistics reflect the stream discharge that is exceeded for a specified proportion of time. Median discharge (flow exceeded 50% of the time) for the North, Middle, and South Fabius rivers is 41, 47, and 62 cfs, respectively. The ratio of the flow that is exceeded 90% of the time to the flow exceeded 10% of the time (90:10 ratio) is indicative of the flashiness or variability of stream flow. The 90:10 ratios calculated for the Fabius River basin indicate that stream flows are highly variable (Table 1). Small precipitation events cause rapid increases in stream flow; most water runs off quickly due to the low permeability of underlying strata.

Flood Frequency

Alexander and Wilson (1995) determined through multiple regression techniques that drainage area and main-channel slope can be used to estimate flood frequency flows for unregulated streams in Missouri (Table 3). The generalized least squares regression equations are as follows:

- $Q_2=69.4A^{0.703} S^{0.373}$
- $Q_5=123A^{0.690} S^{0.383}$
- $Q_{10}=170A^{0.680} S^{0.378}$
- $Q_{25}=243A^{0.668} S^{0.366}$
- $Q_{50}=305A^{0.660} S^{0.356}$
- $Q_{100}=376A^{0.652} S^{0.346}$
- $Q_{500}=569A^{0.636} S^{0.321}$

Where,

- Q_t=estimated discharge in cubic feet per second per time interval (t=years)
- A=drainage area in square miles

- S=main channel slope in feet per mile

Discharges in excess of 5,000 cfs occur every two years in the major streams of the basin.

Dam and Hydropower Influences

There are no major dam or hydropower influences at this time, except that the regulation of Pool 22 of the Upper Mississippi River by the Corps of Engineers can affect water level and flow in the lower two miles of the Fabius River.

Major Water Users

Seven public water supply facilities in the basin withdraw surface water from 13 small reservoirs (Vandike 1995). Two water supply lakes (LaBelle City Lake and Lewistown Lake) have water quality problems related to the herbicide Atrazine (MDNR 1994). Little water is used for irrigation in the basin (MDNR 1986a). Fewer than 1,000 acres are irrigated in Marion County and fewer than 50 acres are irrigated in each of the remaining counties. There are no major industrial water users in the basin.

Table 1. Stream discharge (cfs) for the period of record at gage locations within the Fabius River watershed (from USGS 1995).

Location	Instantaneous Peak Flow	Instantaneous Low Flow	Mean	Exceeds 10%	Exceeds 50%	Exceeds 90%	90:10 Ratio
North Fabius Monticello 1922-1995	20,700	0	296	572	46	4	1:143
Middle Fabius Monticello 1946-1995	17,700	0	278	587	40	2.6	1:226
South Fabius Taylor 1935-1995	19,700	0	413	995	62	4.1	1:243

Table 2. Seven-day and 30-day low-flow discharges (cfs) at 2, 5,10, and 20 year recurrence intervals for streams in the Fabius River watershed (from Skelton 1976).

Stream	Drainage Area (mi2)	Period (d)	Recurrence Interval (years)			
			2	5	10	20
North Fabius Memphis	-	7	0.8	-	0	0
North Fabius Monticello	452	7	2.1	0.1	0	0
		30	4.3	0.5	0	0
Middle Fabius Baring	185	7	0.1	0	0	0
		30	0.2	0	0	0
Middle Fabius Monticello	393	7	1.3	0.2	0	0
		30	2.6	0.6	0.2	0
North Fabius Taylor	930	7	3.3	0.5	0.1	0
		30	7.8	1.2	0.3	0.1
South Fabius Taylor	620	7	1.9	0.2	0	0
		30	4	0.8	0.1	0

Table 3. Flood discharges for 2 to 500 year intervals at stream flow gaging stations in the Fabius River basin (from Alexander and Wilson 1995).

Stream/ Location	Period of Record	Drainage Area (mi2)	Main Channel Gradient (ft/mi)	Flood Discharge (cfs) for Indicated Recurrence Interval in Years						
				2	5	10	25	50	100	500
North Fabius Monticello, MO	1922-93	452	4.8	8080	11800	14200	17000	18900	20800	24900
North Fabius Taylor, MO	1929, 1931-42	930	4	10600	18700	24400	31900	37400	42900	55500
Middle Fabius Baring, MO	1931-61, 1963-76, 1978-86	185	6.8	5050	7970	9900	12300	14000	15700	19500
Middle Fabius Monticello, MO	1946-93	393	4.1	5860	9080	11200	13900	15800	17600	21800
Bridge Creek Br. Baring, MO	1955-79	2.4	43.2	363	585	755	996	1190	1410	1980
South Fabius Taylor, MO	1933, 1935-93	620	3.4	7990	12000	14600	17900	20200	22500	27600

Land Use

Historical Land Use

Original inhabitants of the area were Native Americans of the Missouri, Osage, Fox, and Sac tribes who depended upon the abundant wildlife resources (SCS 1992b, 1975). The first white settlers of Missouri, the French, laid claim to much of the area in 1712. The United States took ownership in 1803 as part of the Louisiana Purchase. The Fabius River was named around 1800 by a Spanish surveyor, Don Antonio Soulard. Treaties signed with native tribes in 1804 and 1816 designated the area north of the Fabius River and 30 miles west of the mouth of the river as Indian territory. The last treaty in 1824 permanently turned the region over to the United States. The natives were taken to reservations around 1840. White settlers from Kentucky, Indiana, Ohio, Tennessee, Pennsylvania, and Virginia were already arriving by that time and quickly established farming as the region's economic base.

Lewis County was founded in 1833 and originally included Clark, Knox, and Scotland counties. Present boundaries for the counties in the basin were established between 1825 and 1845. Human population in the region grew rapidly from 1840 to 1920, then declined. For example, the population of Lewis County increased from 6,578 in 1850 to 16,724 in 1900. By 1980 it had dropped to 10,901 (SCS 1992b). Other basin counties exhibited similar demographic trends, except Marion County, where the population has been relatively stable since 1900.

Much of the presettlement landscape of the basin was prairie (Schroeder 1982). The proportion of prairie land in Lewis, Knox, Scotland, and Schuyler counties ranged between 30% and 55%. Prairies of the basin were usually long and narrow since they were located on the narrow uplands or ridges along the three main, parallel-flowing streams. Wet, bottomland prairies occurred on nearly all floodplains. Wooded areas were found across the steeper rolling hills and adjacent to streams.

Modern Land Use

Characterization of modern land use was based upon the 1992 National Resources Inventory conducted by the U.S. Soil Conservation Service, currently the Natural Resources Conservation Service (Table 4; SCS 1992a) (Figure lu). Nearly 70% of the land in the watershed is used for agricultural purposes. Approximately 387,600 acres are cultivated for crops, and another 234,400 are in pasture. Only about 14% of the basin is forested (including grazed forest land). County crop production reports indicate that soybeans are the most important field crop in terms of acres planted and harvested (Sallee et al. 1996). Corn and wheat rank second and third. Annual livestock production in the counties of the basin ranges from 25,000 to 28,700 cattle and 8,000 to 32,500 hogs.

Soil Conservation Projects

Under the authority of the Watershed Protection and Flood Prevention Act (PL 83-566), the Natural Resources Conservation Service (NRCS) administers three soil conservation projects in the basin (Table 5). The Bear Creek project, completed in 1981, included 66 land treatment structures, 7 flood retardation structures, and 3 grade stabilization structures. Troublesome Creek and Grassy Creek projects are ongoing. In the mid 1970s, a watershed project for the Upper and Lower Middle Fabius drainage was proposed and investigated. Project planning was terminated in 1982 due to lack of support by local landowners; however, resource inventories and assessments were prepared (SCS 1977, 1978). In addition to these projects, NRCS administers three EARTH and four SALT (Special Area Land Treatment) projects in the basin that may impact a total area of 77,910 acres (Table 5).

Public Areas

There are 12 public areas totaling 13,053 acres within the Fabius River basin (Table 6). All areas except

Ella Ewing Lake and Henry Sever Conservation Area provide access to basin streams. Deer Ridge Conservation Area, the largest publicly owned tract in the basin (6,921 acres), offers access to both the North Fabius and Middle Fabius rivers. Although many of the areas have developed parking lots adjacent to the streams, Soulard Access on the Fabius River provides the only concrete boat ramp. Five rock barbs (jetties) have been constructed at this site to decrease streambank erosion, improve stream habitat, and provide bank fishing access. Several accesses are located within a few miles of each other and provide excellent drop-off and pick-up points for one-day fishing/float trips (e.g. Dunn Ford to Blackhawk; Sunrise to Soulard). The Missouri Department of Conservation also manages the fisheries of nine small public impoundments in the basin with a combined total of 700 surface acres.

Table 4. Land use/cover estimates for the Fabius River watershed (from SCS 1992a).

Type	North-Middle Fabius (Acres)	South Fabius (Acres)	Percent of Total
Cropland	218300	169300	39.2
Hayland	53700	19400	7
Forest Land	79400	55900	13.7
Pasture Land	151100	83300	23.7
Misc/CRP	66700	55200	12.3
Other	20200	16400	3.7
Total	589400	399500	100

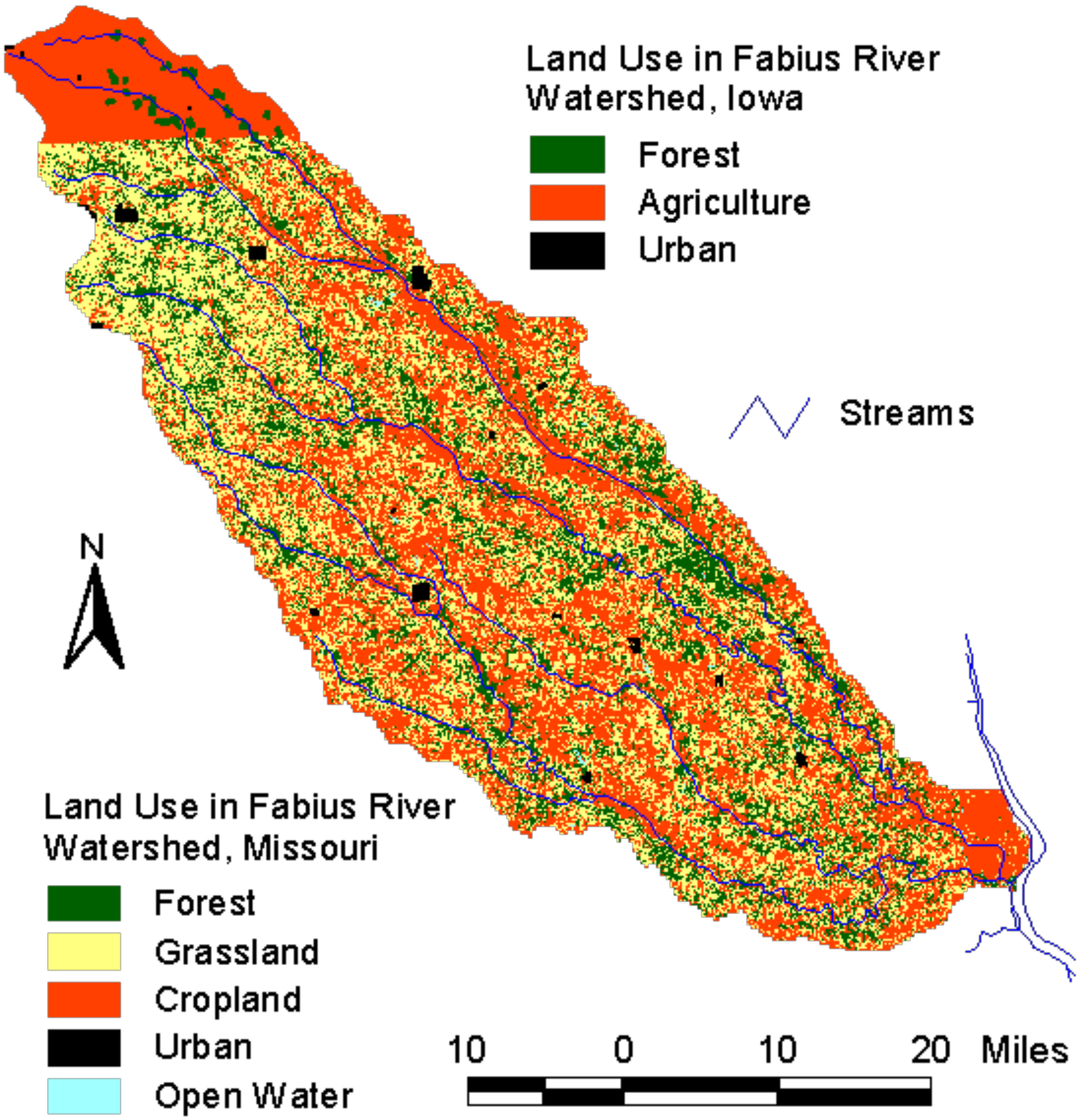

Figure 4. Land Use in the Fabius River watershed in Missouri and Iowa.

Table 5. Soil conservation projects in the Fabius River watershed as of 1999. Numbers in parenthesis represent the project area in acres.

County	PL-566	SALT	EARTH
Scotland, Schuyler, Knox, Lewis	Middle Fabius* (269,320 A)		
Clark, Scotland	Bear Creek (33,172 A)		
Knox, Lewis, Marion	Troublesome Creek (89,300 A)		
Lewis, Marion	Grassy Creek (35,600 A)		
Scotland			Bear Creek (22,094 A)
Lewis			Monticello Basin
			N. Fabius(15,500 A)
Knox		Hawkins Branch (5,744 A)	Troublesome Creek (28,600 A)
Knox		Little Troublesome (2,322 A)	
Marion		Franklin School Br. (2,450 A)	
Schuyler		Downing Lake (1,200 A)	

*Project planning terminated

Table 6. MDC-owned conservation areas (CA) and stream accesses (AC) located in the Fabius River watershed as of 1999.

Area Name	County	Acres	Development*
Indian Hills CA	Scotland	3691	P, PC
Ella Ewing Lake CA	Scotland	60	P, R, BR, PC
Clark CA	Clark	268	P, PC
Deer Ridge Lake CA	Lewis	6921	P, R, BR, PC
Henry Sever Lake CA	Knox	1115	P, R, BR, PC
Tolona AC	Lewis	176	P
White Oak Bend AC	Knox	160	P, PC
McPike AC	Marion	79	P
Sunrise AC	Marion	40	
Black Hawk AC	Marion	137	P, BR, PC
Dunn Ford AC	Marion	136	P
Soulard AC	Marion	270	P, R, BR, PC

*P = Parking Lot, BR = Boat Ramp, R = Restroom, PC = Primitive Camping

Water Quality and Use

Designated Beneficial Uses

At the recommendation of the Department of Natural Resources, the Missouri Clean Water Commission determines the quality of water necessary to attain designated "beneficial uses" on Missouri streams. Eighty-three miles of the North Fabius, 64 miles of the Middle Fabius, and 67 miles of the South Fabius rivers and the lower 3.5 miles of Troublesome Creek are designated for public drinking water supply (MDNR 1986a). All basin streams are designated for livestock and wildlife watering and protection of aquatic life. No streams in the basin are classified for whole- body contact recreation.

The primary deterrents to recreational use in the basin are high turbidity and siltation, which are direct results of poor soil management (MDNR 1986b). Excessive turbidity and siltation have not only decreased the abundance and diversity of aquatic life and habitat (Missouri Department of Conservation 1978), but have also made boating and canoeing more difficult due to locally heavy sedimentation. Stream channelization, which has also drastically reduced the amount and quality of aquatic habitat in parts of the basin, especially in the North Fabius River (Turner 1978), has affected recreational use by creating high banks and steep-sided channels where access is difficult. The lack of public access in parts of the basin also limits recreational use.

Chemical Quality of Stream Flow

Water quality data have been collected intermittently since 1972 at the South Fabius River gage station (USGS 1986, 1993; Table 7). A typical water year (1986) and a flood year (1993) were chosen for comparison. Both iron and manganese sometimes exceed secondary drinking water standards in the South Fabius River. Groundwater quality is considered poor throughout the basin due to high concentrations of dissolved solids and iron (MDNR 1986a, 1986b).

Water quality surveys were conducted in the Middle Fabius River, Troublesome Creek, and Grassy Creek by the Soil Conservation Service during 1975-1976 (Tables 8 and 9). Elevated levels of dissolved solids, ammonia, coliform, nutrients, and pesticides were recorded in these streams during 1975-1976. Total iron concentrations sometimes exceeded maximum drinking water quality standards for dissolved iron by a factor of ten or more. Presumably, much of the iron measured during these periods was attached to soil particles as insoluble ferric (Fe^{+3}) ions (Soil Conservation Service 1977). High levels of bacteria, suspended solids, and nutrients were usually associated with periods of high flow. Department of Conservation personnel collected water quality information from three sites in Troublesome Creek during 1988-1992 (Table 9).

Non-Point Source Pollution

Sedimentation and turbidity are the basin's most severe water quality problems. Intensive crop farming and livestock grazing have caused severe soil erosion throughout the watershed.

Anderson (1980) reported 18-24 tons/acre/year of sheet and rill erosion from tilled land in the basin. Erosion from permanent pasture land averaged 5-9 tons/acre/year. Gully erosion in the drainage was among the most severe in the state, averaging 500-750 tons/square mile annually. As a consequence, the watershed delivered about 3.7 tons/acre of sediment to streams annually and was ranked the fifth worst of 45 basins in the state. Streambank erosion is also a problem in the basin. In the upper and lower Middle Fabius sub-basins, streambank erosion was estimated at 380 tons/square mile/year and 160 tons/square mile/year, respectively (SCS 1978).

Agricultural run-off, which includes fertilizer, pesticides, herbicides, and animal waste, also poses a significant threat to water quality in the basin. Excessive aquatic plant growth (mostly algae) has been observed periodically in several basin streams (MDC 1978). Although fish kills in the basin are uncommon, they usually can be attributed to low dissolved oxygen concentrations or high levels of ammonia entering the stream from animal feedlots or sewage lagoons.

Point-Source Pollution

Point-source pollution is low in the basin (Table 10). There are nine small communities that operate wastewater treatment facilities. Only three (Edina, Lancaster, and Memphis) discharge more than 0.06 MGD (million gallons daily) of sewage into receiving streams.

Numerous small privately owned point-source discharges (mobile home parks, schools etc.) occur in the basin. Stormwater run-off from eight mining quarries and one petroleum storage facility are also potential point sources of pollution, but none have been linked to pollution events significant enough to cause a fish kill.

Concentrated Animal Feeding Operations

CAFOs are expanding in the basin, especially in the Troublesome Creek watershed, where they may have significant negative impacts on water quality. Currently, the only significant CAFO in the basin is a large dairy operation located in the Troublesome Creek watershed, Lewis County (s4 T60n R9w). Chronic releases of lagoon effluent from this facility directly into Troublesome Creek during the late 1990s may have caused significant damage to aquatic life.

Table 7. Select water quality data for the South Fabius River near Taylor, Missouri in 1986 and 1993 (from USGS 1986, 1993)

Parameter	STATE STANDARDS	WATER YEAR
	I III VI VII	1986, 1993
Temperature (EF)	90E max	32-82, 33-80
Specific Conductance (Fmhos/cm)		140-47, 1 130-382
pH	6.5-9.0	6.9-8.3, 7.0-8.4
Coliform, fecal (cols/100ml)	200 non- storm runoff	4K-9,400, 150-3,400K
Hardness, Total (mg/L as CaCo3)		100-210, 54-180
Alkalinity, Total (mg/L as CaCo3)		50-184 40-154
Nitrogen, Ammonia (mg/L as N)	Depends on pH and temp	0.03-0.30, 0.01-0.28
Phosphorus, Total (mg/L as P)		0.05-0.30, 0.08-0.27
Manganese, Dissolved (Fg/L as Mn)	50, 50	6-250, 47-56
Iron, Dissolved (Fg/L as Fe)	1,000 300 300	<3-370, 17-3602010
Solids, Residue Suspended (mg/L at 221EF)		9-700 <1-2010
Oxygen, Dissolved (mg/L)	5	6.4-13.5 8.6-14.6

I: Protection of aquatic life

III: Drinking water supply

VI: Whole-body contact recreation

VII: Groundwater

K: Non-ideal count of colonies

Table 8. A summary of water quality data collected in the lower Middle Fabius River and Grassy Creek during 1975 and 1976 (from SCS 1977).

Parameter	Middle Fabius (Range)	Grassy Creek (Range)
Temperature (EF)	52 - 81	48 - 77
Dissolved Oxygen (mg/L 02)	4.4 - 13.2	0.3 - 14.0
pH	6.8 - 7.7	6.5 - 8.0
Specific Conductance (Fmhos/cm)	24 - 870	295 - 825
Turbidity (JTU)	34455	5 - 150
Total Alkalinity (mg/L CaCO3)	112 - 226	72 - 355
Hardness (mg/L CaCO3)	129 - 350	130 - 430
Total Solids (mg/L)	173 - 1120	209 - 726
Dissolved Solids (mg/L)	2 - 414	185 - 585
Suspended Solids (mg/L)	5 - 870	1 - 277
Total Coliform (No./100 ml)	50 - 2100	150 - 88,000
Fecal Coliform (No./100 ml)	0 - 3400	0 - 8,700
Fecal Strep. (No./100 ml)	130 - 3600	90 - 20,000
FC/FS	0.00 - 5.00	0.00 - 8.60
Total Phosphate (mg/L PO4-P)	0.09 - 1.60	0.00 - 9.70
Total Nitrogen (mg/L N)	<0.21 - 4.70	0.50 - 34.00
Ammonia (mg/L NH3-N)	0.05 - 0.24	0.02 - 0.130
Nitrate (mg/L NO3-N)	0.00 - 2.07	0.05 - 1.33
Nitrite (mg/L NO2-N)	<0.002 - 0.130	0.005 - 0.130
Kjeldahl Nitrogen (mg/L N)	0.16 - 2.50	0.31 - 2.60
Total Iron (Fg/L Fe)	180 - 3,640	500 - 7,300
Aldrin (ng/L)	<0.5 - 11.5	<0.5 - <2.2
Dieldrin (ng/L)	0.94 - 126	0.94 - 95
Endrin (ng/L)	<0.25 - <10	<0.25 - <10
a-BHC (ng/L)	0.29 - 38.8	0.31 - 25.2
B-BHC (ng/L)	<0.78 - <3.0	<0.78 - <3.0
Lindane, Y-BHC	<0.5 - 48.4	<0.51 - 29
Total BHC Fraction (ng/L)	<1.60 - 72.8	1.60 - 30.91

Table 9. A summary of water quality data collected in the Troublesome Creek watershed during 1975-1976 (from SCS 1977) and 1988-1992 (MDC).

Parameter	1975-1976 (Range)	1988-1992 (Range)
Temperature (EF)	54 - 90.5	35 - 88
Dissolved Oxygen (mg/L 02)	1.4 - 12.4	43542
pH	6.3 - 8.4	7.0 - 9.8
Specific Conductance (Fmhos/cm)	160 - 700	118 - 678
Turbidity (JTU)	3 - 150	<5 - 930
Total Alkalinity (mg/L CaCO3)	54 - 284	34 - 289
Hardness (mg/L CaCO3)	90 - 269	68 - 374
Total Solids (mg/L)	225 - 628	
Dissolved Solids (mg/L)	2 - 626	
Suspended Solids (mg/L)	2 - 439	
Secchi (inches)		13181
Total Coliform (No./100 ml)	50 - 4700	
Fecal Coliform (No./100 ml)	10 - 15000	
Fecal Strep. (No./100 ml)	75 - 12000	
FC/FS	0.04 - 16.20	
Total Phosphate (mg/L PO4-P)	0.01	
Total Nitrogen (mg/L N)	0.20 - 5.35	
Ammonia (mg/L NH3-N)	<0.05 - 1.40	0 - 2.5
Nitrate (mg/L NO3-N)	0.05 - 2.47	
Nitrite (mg/L NO2-N)	<0.005 - 0.590	
Kjeldahl Nitrogen (mg/L N)	0.17 - 2.71	
Total Iron (Fg/L Fe)	200 - 6,500	
Aldrin (ng/L)	<0.5 - 4.55	
Dieldrin (ng/L)	0.9 - 140	
Endrin (ng/L)	<0.25 - <10	
a-BHC (ng/L)	<0.31 - 108	
B-BHC (ng/L)	<0.78 - <3.0	
Lindane, Y-BHC	<0.50 - 20.0	
Total BHC Fraction (ng/L)	<1.60 - 112	

Table 10. Potential point-source pollution sites in the Fabius River basin as of 1999 (MDNR, unpublished). WWTF = Waste Water Treatment Facility.

Source	County	Location (S-T-R)	Receiving Stream
Baring N WWTF	Knox	s23 63n 12w	Trib. Bridge Cr.
Baring S WWTF	Knox	s26 63n 12w	Trib. Bridge Cr.
Downing WWTF	Schuyler	s28 66n 13w	Trib. N. Fabius
Edina WWTF	Knox	s18 62n 11w	N. Fk. S. Fabius
Knox City WWTF	Knox	s27 62n 10w	L. Troublesome Cr.
LaBelle WWTF	Lewis	s32 62n 9w	Trib. Reddish Br.
Lancaster WWTF	Schuyler	s19 66 14w	N. Fk. Middle Fabius
Memphis WWTF	Scotland	s17 65 11w	Gunn's Br.
Lewistown WWTF	Lewis	s17 61 8w	Trib. Middle Fabius
Sand/Gravel Quarry	Marion	s2 59n 6w	N. Fabius
Sand/Gravel Quarry	Marion	s24 59n 6w	Trib. S. Fabius
Sand/Gravel Quarry	Marion	s24 59n 6w	S. Fabius
Sand/Gravel Quarry	Lewis	s7 61n 7w	Trib. N. Fabius
Sand/Gravel Quarry	Lewis	s17 60n 7w	Trib. Middle Fabius
Sand/Gravel Quarry	Knox	s25 62n 12w	Rock Cr
Sand/Gravel Quarry	Knox	s23 60n 10w	Little Fabius
Sand/Gravel Quarry	Scotland	s22 64n 12w	Middle Fabius
Petroleum Storage	Marion	s26 59n 6w	Trib. S. Fabius

Habitat Conditions

Channel Alterations and Habitat Problems

Channelization not only includes straightening the stream, but also bank clearing, and widening of the channel. This results in a loss of total stream area and usable habitat, increased streambank and streambed erosion, and a homogenous habitat that supports far less aquatic life.

While most of the North Fabius River has been channelized, the Middle and South Fabius rivers remain largely unaltered. The North Fabius River has been completely channelized upstream of Monticello, Missouri, resulting in ongoing, severe headcutting in upper reaches of the watershed. The South Fabius River has an 8.5-mile channelized reach downstream from Newark, Missouri. The Middle Fabius River has no extensive channelized reaches. Each of these streams has several very short channelized sections usually associated with bridge crossings. Small sections of several tributary streams have been altered also, usually by private landowners and local governments. Durgens Creek was once a tributary of the North Fabius River, but it was diverted and now drains directly into the Mississippi River.

Even on reaches of stream not impacted by channelization, accelerated streambank erosion occurs where protective forested corridors have been removed. In such cases, vertical banks up to 15 feet high have developed. Maintaining diversity of water depth is difficult, if not impossible, in areas where streambanks are unstable. Stream fish habitat in many small tributaries has been severely degraded by grazing livestock that trample streambanks and streambeds, increasing turbidity and erosion and destroying instream cover. Problems stemming from instream sand and gravel removal are locally significant but minor compared with problems resulting from stream channelization and watershed erosion.

Turner (1978) summarized morphological information collected at 57 sites throughout the North, Middle, and South Fabius rivers. These data include river width, channel width, water depth, and substrate composition and are available from the Missouri Department of Conservation, Columbia, Missouri.

Unique Riparian Habitats

Even though all streams in the basin have been degraded by agricultural encroachment, some still provide excellent aquatic habitat. The Middle and South Fabius rivers are two of only a few northern Missouri streams that have not been channelized extensively. These streams offer a wide variety of habitat types since they both flow through two distinct regions—one of glacial till with sand and silt substrates and another of rock outcroppings with gravel, cobble, and bedrock substrates. Compared to most other northern Missouri streams, the banks of the Middle Fabius River are relatively low, and the streambed is stable.

Due to the diversity of available habitats, the basin is home to 58 species of fish. Because of its species-rich fish fauna, Pflieger (1997) classified the Fabius River system as Ozark border—a transition zone where the Ozark and Prairie faunal regions overlap. Parts of the Middle Fabius River, South Fabius River, Troublesome Creek, and the Little Fabius River were named as Significant Aquatic Areas in the Missouri Natural Features Inventory (Anderson 1983).

There are other notable habitats located in the basin. Among these are the numerous limestone bluffs that border the lower reaches of several streams. Several of these were listed in Anderson's Natural Features Inventory. The basin also provides seasonally important habitat for the Indiana bat *(Myotis sodalis),* a federally endangered species. During the breeding season Indiana bats roost beneath the loose bark of old, large decaying hardwood trees. They are especially attracted to shagbark hickory trees (R. Clawson, MDC, personal communication).

Habitat Conservation Projects

Five rock barbs (dikes) were spaced along 600 feet of eroding bank at the Soulard Access on the Fabius River in 1992. Each dike was angled slightly upstream to divert the energy of the water toward mid channel and away from the eroding bank and concrete boat ramp. These structures have significantly reduced bank erosion at the site. Sediment accretion is occurring between the dikes, and what was a steep, 12-foot-high streambank eroding at a rate of 10-15 feet per year, is becoming a more naturally sloping bank with established vegetation. Deep scour holes (7-10 feet) are developing off the tips of the dikes, adding depth diversity to the formerly uniform channel bed. However, no detectable changes in the fish community were observed immediately following completion of the project.

A cedar tree revetment was installed in 1997 along approximately 450 feet of eroding bank at the McPike Access on Troublesome Creek. Due to previous removal of the forested riparian corridor, this site was likely to erode rapidly during high flows. After establishing a 2:1 bank slope, a single-row revetment was installed using 20-foot tall cedar trees. Bottomland tree species were planted along the reach to reestablish a 100-foot wide forested corridor. This project is expected to stabilize the streambank, increase habitat diversity for fish and invertebrates, and improve stream access.

The Missouri Department of Conservation has permanent easements called "Stream Stewardship Agreements" with four private landowners in the basin. All are located along the South Fabius River in Marion County. Combined, these contracts permanently conserve 88 acres of high-quality forested riparian corridor along 2.4 river miles. Landowners retain the right to control trespass and manage their easement zones to produce forest products, but activities destructive to the streams or riparian corridors are restricted. Existing easements are located at sw22 T59n R8w, se21 T59n R8w, e25 T59n R8w, and 20 T59n R8w.

Corps of Engineers 404 Jurisdiction

The Fabius River basin is under the jurisdiction of the Rock Island District of the U.S. Army, Corps of Engineers (COE). Most activities involving the deposition or stockpiling of material in stream channels require a Section 404 Permit from COE. As of January 1, 1999, applications for 404 permits should be sent to: Clock Tower Building, P.O. Box 2004, Rock Island, IL 61204-2004, attention NCROD-S. Phone (309) 794-4200.

Biotic Community

Fish Communities

Fish community data were collected by Missouri Department of Conservation (MDC) staff from 42 sites throughout the basin during 1988-1989 (Table 11). Fish were collected using a seine 15 or 25 feet long with 1/8" mesh. Kick seine methods were used to sample riffles. A boat-mounted electrofishing unit was used where possible to sample deep pools. Large fish were identified on site and returned to the water. Small fish were preserved and later identified in the lab. Data collected prior to 1988 were obtained from the MDC database (Pflieger, unpublished).

A total of 63 fish species from 13 families has been collected in the Fabius River basin (Table 12). Fifty-eight species and several *Lepomis* hybrids were found in recent surveys. From a basin-wide perspective, the community includes fishes representative of the Prairie, Lowland, Ozark, and Big River faunal regions. According to Pflieger (1971), one-third are wide-ranging, 17% are Big River species, 27% are Prairie species, 27% are Ozark species, and 9% are representative of the Lowlands. Several species are associated with more than one faunal region, so the sum of these percentages exceeds 100%. Six species associated with both Prairie and Ozark streams accounted for 6.5% of the total number of fish collected in 1988-1989.

The dominant fish families were the minnows (*Cyprinidae*, 20 species), perches (*Percidae*, 9 species), sunfishes (*Centrarchidae*, 7 species), suckers (*Catostomidae*, 7 species), and catfishes (*Ictaluridae*, 7 species). The most common and abundant species collected in recent surveys was the red shiner *(Cyprinella lutrensis),* which comprised 31 to 38% of the total sample in each sub- basin and occurred at 95% of all sites. The bluntnose minnow *(Pimephales notatus)* was the second most abundant species, comprising 11 to 20% of the total sample in each sub-basin and occurring at 86% of all sites.

Other commonly occurring species (found in at least 60% of all sites) included quillback *(Carpiodes cyprinus),* creek chub *(Semotilus atromaculatus),* bigmouth shiner *(Notropis dorsalis),* sand shiner *(Notropis stramineus),* central stoneroller *(Campostoma anomalum),* johnny darter *(Etheostoma nigrum),* green sunfish *(Lepomis cyanellus),* and orangespotted sunfish *(Lepomis humilis).*

Sport fish (16 species that provide angling opportunity) comprised 10% of all fish collected in basin streams. Due to their large size, these fishes were under-represented numerically because they were not fully vulnerable to our sampling gear. Green sunfish were the most abundant species in this group and were found at nearly all sample sites. Channel catfish *(Ictalurus punctatus),* the most popular game species in the basin, were found at 38% of the sites, but accounted for fewer than 1% of the total fish collected. Smallmouth bass *(Micropterus dolomieu)* were also collected at 38% of the sample sites and were more than twice as abundant as largemouth bass *(M. salmoides).* Bullheads *(Ameiurus spp.),* bluegill *(Lepomis macrochirus),* carp *(Cyprinus carpio),* and white crappie *(Pomoxis annularis)* were abundant in parts of the basin as well. Limited age and growth data for bluegill, white crappie, smallmouth bass, largemouth bass, channel catfish, and flathead catfish *(Pylodictis olivaris)* are available from the Missouri Department of Conservation, Hannibal, Missouri.

Five species found in the basin prior to 1988 and not found in recent surveys include the striped shiner *(Luxilus chrysocephalus),* last collected in 1941; Mississippi silvery minnow *(Hybognathus nuchalis),* last collected in 1941; American eel *(Anguilla rostrata),* last collected in 1975; blackstripe topminnow *(Fundulus notatus),* last collected in 1941; and logperch *(Percina caprodes),* last collected in 1979. Striped shiners and Mississippi silvery minnows have been extirpated from the basin. Similar declines of these two species have occurred in other northeastern Missouri streams, including the Mississippi River (Pflieger 1975, Hrabik 1992).

Reasons for the declines are not well understood; however, these species prefer clear water and seem intolerant of high turbidity (Pflieger 1997). Logperch also avoid continuously turbid or silty streams.

Species collected in 1988-1989 that were not found by previous investigators include the goldeye *(Hiodon alsoides),* speckled chub *(Extrarius aestivalis),* channel shiner *(Notropis wickliffi),* spotfin shiner *(Cyprinella spiloptera),* mosquitofish *(Gambusia affinis),* and the western sand darter *(Ammocrypta clara).* With the exception of the western sand darter, these species are tolerant of high turbidity. One western sand darter was collected from a site in the Middle Fabius River.

The South Fabius sub-basin yielded the most species (49), followed by the Middle Fabius (43), and North Fabius (40). Thirty-five species were collected from a single site on the Fabius River. The proportions of species associated with each faunal region were similar for the three main sub-basins. The most apparent difference between the sub-basins was that Ozark species were generally more abundant and widely-distributed in the Middle and South Fabius drainages than in the North Fabius sub-basin. Less of the North Fabius sub-basin lies in the region of thin till and exposed rock than the other two sub-basins, and it has been more severely degraded.

Fish Contamination Levels and Health Advisories

Fish from the basin have not been tested for contaminants and no health advisories have been issued specifically for the basin. However, the Fabius River basin is included in the limited consumption advisory (one pound per week) for fatty fish (e.g. catfish, carp, buffalo, drum, suckers, paddlefish) for all of Missouri outside of the Ozark region.

Aquatic Invertebrate Communities

Limited mussel surveys have been conducted in the basin. Buchanan (1992) surveyed the North, Middle, and South Fabius rivers in 1991 while determining the status of the endangered winged mapleleaf *(Quadrula hagosa).* He reported 24 mussel species from the basin (Table 13). In limited crayfish surveys, only two species have been recorded (golden crayfish, *Orconectes luteus* and northern crayfish, *Orconectes virilis;* Missouri Department of Conservation records, S. Bruenderman, personal communication). Other species are likely to occur in basin streams.

The Missouri Department of Natural Resources initiated a quantitative study of aquatic insects in reference streams throughout the state in 1992. The Middle Fabius River was surveyed in 1993 (C. Rabeni, Missouri Cooperative Fish and Wildlife Research Unit, personal communication). Seventy genera representing seven orders were collected (Table 14).

Table 11. Fish sampling site locations in the Fabius River watershed, 1988-1989.

North Fabius Fish Sampling Sites		Middle Fabius Fish Sampling Sites		South Fabius Fish Sampling Sites	
Station Number	**Legal Description**	**Station Number**	**Legal Description**	**Station Number**	**Legal Description**
10	nw¼35 66n13w	26	ne¼23 65n13w	42	ne¼06 61n10w
9	sw¼06 66n13w	25	n½08 64n12w	41	n½13 60n09w
8	sw¼05 66n14w	24	se¼04 64n13w	40	ne¼23 59n07w
7	e½05 66n12w	23	s½09 65n14w	39	se¼14 62n12w
6	se¼31 66n12w	22	ne¼28 64n12w	38	nw¼18 63n12w
5	ne¼27 65n11w	21	ne¼12 64n12w	37	nw¼03 62n12w
4	ne¼19 64n10w	20	se¼13 63n12w	36	ne¼16 60n10w
3	se¼16 61n07w	19	ne¼02 62n11w	35	ne¼08 60n10w
2	e½1960n06w	18	se¼04 62n10w	34	ne¼36 61n11w
Fabius River at>	<Soulard Access	17	e½10 62n10w	33	ne¼11 59n09w
1	se¼19 59n05w	16	se¼01 62n10w	32	sw¼03 58n07w
		15	n½14 63n11w	31	sw¼21 59n08w
		14	s½09 62n09w	30	nw¼21 59n06w
		13	se¼03 61n08w	29	se¼16 61n12w
		12	s½24 60n07w	28	nw¼33 61n11w
		11	nw¼05 60n07w	27	ne¼29 60n10w

Table 12. Fish species occurrence and status as of 1989 in the Fabius River basin. C = Common; E=Extirpated; LA = Locally Abundant; R = Rare; U = Uncommon.

Species	Collected Prior to 1988	Collected Recently	Current Status
Shortnose gar ***Lepisosteus platostomus***	X	X	LA
Longnose gar ***Lepisosteus osseus***	X	X	LA
Goldeye ***Hiodon alosoides***		X	U
Gizzard shad ***Dorosoma cepedianum***	X	X	LA
Bigmouth buffalo ***Ictiobus cyprinellus***	X	X	LA
Smallmouth buffalo ***Ictiobus bubalus***	X	X	LA
Quillback ***Carpiodes cyprinus***	X	X	C
River carpsucker ***Carpiodes carpio***	X	X	C
White sucker ***Catostomus commersoni***	X	X	LA
Golden redhorse ***Moxostoma erythrurum***	X	X	C
Shorthead redhorse ***Moxostoma macrolepidotum***	X	X	C
Common carp ***Cyprinus carpio***	X	X	C
Hornyhead chub ***Nocomis biguttatus***	X	X	R
Speckled chub ***Extrarius aestivalis***		X	U
Silver chub ***Macrhybopsis storeriana***	X	X	R

Species	Collected Prior to 1988	Collected Recently	Current Status
Creek chub ***Semotilus atromaculatus***	X	X	C
Bigmouth shiner ***Notropis dorsalis***	X	X	C
Channel shiner ***Notropis wickliffi***		X	R
Emerald shiner ***Notropis atherinoides***		X	LA
Ghost shiner ***Notropis buchanani***	X	X	R
Golden shiner ***Notemigonus crysoleucas***	X	X	C
Red shiner ***Cyprinella lutrensis***	X	X	C
Redfin shiner ***Lythrurus umbratilis***	X	X	C
River shiner ***Notropis blennius***	X	X	R
Sand shiner ***Notropis stramineus***	X	X	C
Spotfin shiner ***Cyprinella spiloptera***		X	R
Striped shiner ***Luxilus chrysocephalus***	X		E
Bluntnose minnow ***Pimephales notatus***	X	X	C
Bullhead minnow ***Pimephales vigilax***	X	X	C
Mississippi silvery minnow ***Hybognathus nuchalis***	X		E
Fathead minnow ***Pimephales promelas***	X	X	C

Species	Collected Prior to 1988	Collected Recently	Current Status
Suckermouth minnow ***Phenacobius mirabilis***	X	X	C
Central stoneroller ***Campostoma anomalum***	X	X	C
Channel catfish ***Ictalurus punctatus***	X	X	C
Black bullhead ***Ameiurus melas***	X	X	LA
Yellow bullhead ***Ameiurus natalis***	X	X	LA
Flathead catfish ***Pylodictis olivaris***	X	X	LA
Stonecat ***Noturus flavus***	X	X	R
Tadpole madtom ***Noturus gyrinus***	X	X	U
Slender madtom ***Noturus exilis***	X	X	U
American eel ***Anguilla rostrata***	X		R
Blackstripe topminnow ***Fundulus notatus***	X		R
Mosquitofish ***Gambusia affinis***		X	U
White bass ***Morone chrysops***	X	X	LA
Sauger ***Stizostedion canadense***	X	X	LA
Walleye ***Stizostedion vitreum***	X	X	LA
Slenderhead darter ***Percina phoxocephala***	X	X	C

Species	Collected Prior to 1988	Collected Recently	Current Status
Logperch ***Percina caprodes***	X		R
Western sand darter ***Ammocrypta clara***		X	R
Johnny darter ***Etheostoma nigrum***	X	X	C
Bluntnose darter ***Etheostoma chlorosomum***	X	X	R
Orangethroat darter ***Etheostoma spectabile***	X	X	U
Fantail darter ***Etheostoma flabellare***	X	X	U
Slough darter ***Etheostoma gracile***	X	X	R
Smallmouth bass ***Micropterus dolomieu***	X	X	LA
Largemouth bass ***Micropterus salmoides***	X	X	LA
Green sunfish ***Lepomis cyanellus***	X	X	C
Orangespotted sunfish ***Lepomis humilis***	X	X	C
Bluegill ***Lepomis macrochirus***	X	X	LA
Black crappie ***Pomoxis nigromaculatus***	X	X	U
White crappie ***Pomoxis annularis***	X	X	C
Brook silverside ***Labidesthes sicculus***	X	X	U
Freshwater drum ***Aplodinotus grunniens***	X	X	LA

Species	Collected Prior to 1988	Collected Recently	Current Status
Hybrid sunfish ***Lepomis spp.***		X	

Table 13. Mussel species occurrence in the Fabius River basin (from Buchanan 1992).

Species	North Fabius	Middle Fabius	South Fabius
Paper floater ***(Anodonta imbecilis)***			X
Flat floater ***(Anodonta suborbiculata)***			X
Giant floater ***(Anodonta grandis grandis)***		X	X
Stout floater ***(Anodonta g. corpulenta)***	X		
Squaw foot ***(Strophitus undulatus undulatus)***	X	X	X
White heelsplitter ***(Lasmigona complanata)***		X	X
Washboard ***(Megalonaias nervosa)***	X	X	
Buckhorn – Pistolgrip ***(Tritogonia verrucosa)***	X	X	X
Mapleleaf ***(Quadrula quadrula)***	X	X	X
Wartyback ***(Quadrula nodulata)***	X	X	
Pimpleback ***(Quadrula pustulosa)***			X
Three-ridge ***(Amblema plicata)***	X	X	X
Pigtoe ***(Fusconaia flava)***			X
Threehorn wartyback ***(Obliquaria reflexa)***	X	X	X
Mucket ***(Actinonaias ligamentina carinata)***			X
Deertoe ***(Truncilla truncata)***	X	X	

Species	North Fabius	Middle Fabius	South Fabius
Fawnfoot ***(Truncilla donaciformis)***	X	X	X
Fragile papershell ***(Leptodea fragilis)***	X	X	X
Pink heelsplitter ***(Potamilus alatus)***	X	X	X
Pink papershell ***(Potamilus ohienis)***	X	X	X
Lilliput shell ***(Toxolasma parvus)***	X	X	
Slough sandshell ***(Lampsilis teres teres)***	X	X	X
Fat mucket ***(Lampsilis radiata luteola)***		X	X
Pocketbook ***(Lampsilis ventricosa)***	X	X	X
Total Species	17	19	19

Table 14. Aquatic insect occurrence in the Middle Fabius River, 1993. (from C. Rabeni, pers. comm.). Number collected in parentheses.

Middle Fabius River Insect Occurrences
Order Plecoptera (stoneflies):
Hydroperla (5)
Taeniopteryx (2)
Allocapnia (1)
Order Ephemeroptera (mayflies):
Stenonema (150)
Baetisca (20)
Tricorythodes (99)
Caenis (174)
Leptophlebia (5)
Baetis (6)
Hexagenia (2)
Isonychia (11)
Brachycercus (7)
Paraleptophlebia (3)
Stenocron (18)
Order Trichoptera (caddisflies)
Cheumatopsyche (86)
Ptilostomis (1)
Nectopsyche (88)
Hydroptila (1)
Oecetis (1)
Pynopsyche (4)
Order Odonata (damselflies and dragonflies)
Enallagma (7)
Progomphus (12)
Calopteryx (3)
Hydaticus (1)

Middle Fabius River Insect Occurrences
Hetaerina (4)
Boyeria (1)
Macromia (1)
Argia (2)
Gomphus (1)
Order Coleoptera (beetles)
Helichus (4)
Stenelmis (26)
Hydroporus (7)
Dubiraphia (9)
Macronychus (1)
Salpinidae, genus unknown (1)
Order Diptera (true flies):
Simulium (17)
Cnephia (9)
Chrysops (1)
Ceratopogonidae, genus unknown (24)
Hemerodromia (1)
Hydrobeanus (14)
Cricotopus (7)
Polypedilum (88)
Lipiniella (23)
Glypotendipes (1)
Paratendipes (1)
Hyporhygma (1)
Paraphaenocladius(1)
Cryptochironomus (1)
Orthocladius (1)
Oliveridia (1)

Middle Fabius River Insect Occurrences
Rheocrirotopus (1)
Thienemanniella (1)
Paratanytarsus (4)
Thienemannimyia (15)
Larsia (2)
Stictochironomus (34)
Dicrotendipes (3)
Chironomus (1)
Robakia (1)
Tribelos (1)
Nanocladius (5)
Ablabesmyia (13)
Labrundinia (4)
Cladotanytarus (8)
Rheotanytarus (62)
Micropsectra (3)
Order Hemiptera (true bugs)
Trichocorixa (72)
Belastoma (1)
Rheumatobates (1)

Management Problems and Opportunities

Opportunities for stream fishery conservation in the Fabius River watershed.

The following perspectives on problems and opportunities for watershed management will guide MDC management priorities and activities for the foreseeable future. We realize we are only one of many partners whose joint efforts will be needed to protect and restore stream ecosystem integrity in the Fabius River watershed.

Managing Riparian Ownership

Stream Access Acquisition

MDC has purchased small tracts of land along streams in order to provide public access for recreation and to establish an ownership stake which may strengthen our position in resisting system-wide threats to riparian habitat integrity. In the past, statewide planners have assumed that a desirable spacing was approximately ten stream miles between access areas. Experience suggests that it takes much longer to float and/or fish a typical reach of prairie stream than an equivalent length of Ozark stream. Because of slower currents and more frequent channel obstructions in the prairie region, we should seek to shorten the distance between access areas to 5-7 miles on floatable, unchannelized prairie streams with high public use potential.

In order to provide a stream access system with optimal one-day trip distances, MDC should acquire at least two additional access sites in the Fabius River watershed—one located on the South Fabius River between Black Hawk and Sunrise accesses (preferably at T59N, R6W, S31), and another located on the Middle Fabius River between Deer Ridge and Tolona accesses (preferably at T61N, R8W, S12).

Stream Access Development

Because of fiscal constraints, planned developments have not been completed on all existing stream access areas. Developments must be completed so citizens can experience the quality recreational opportunities that will build their individual commitment to helping preserve and restore streams in this watershed. As a matter of strategic priority, MDC will complete planned developments on existing areas before acquiring many additional areas.

Development of Soulard Access on the Fabius River mainstem is largely complete (parking lot, privy, and concrete boat ramp). In addition, angler-accessible rock barbs (short jetties) have been installed on this Stream Demonstration Area in order to correct a streambank erosion problem and improve instream habitat. One of these rock barbs could be fitted with a concrete pad and sidewalk to accommodate disabled anglers. This would provide the only stream fishing site accessible to disabled anglers in the Northeast Region. Other stream access development needs in the Fabius River watershed are listed in Table 15.

Site-Specific Stream Habitat Restoration

Although stream ecosystem health is almost entirely dependent upon processes occurring upstream and downstream of any given ownership, Department of Conservation riparian areas should serve as models of good stream stewardship. In the Fabius River watershed, streambank erosion and forested corridor deficiencies have been corrected at stream access areas like Soulard and McPike. However, extensive bank erosion problems remain at Sunrise Access on the South Fabius River and Tolona Access on the Middle Fabius River. At such areas, MDC should stabilize eroding banks and establish forested corridors in order to normalize the rates of channel movement and sedimentation while providing a source of large woody debris as fish structure.

Public Use Information

Public use of Fabius River watershed streams is generally low, partially because most people are unaware of the high-quality fishing/floating opportunities that exist there. People who enjoy Ozark streams may have stereotyped northern Missouri streams as turbid, unattractive ditches that contain primarily non-game fish. While this may be true of some highly altered channels in the prairie region, several streams in the Fabius River watershed flow along impressive limestone bluffs and through scenic forested corridors. Most support diverse aquatic communities which provide good fishing for an even greater variety of sport fish than exist in many Ozark streams.

MDC could increase public use and appreciation of Fabius River watershed streams by developing a brochure describing stream recreational opportunities. Such a brochure would include colored pictures, simple stream maps with mileages, access sites, and camping areas clearly marked, descriptions of other local attractions, and fishing opportunities/regulations.

Statewide news releases and an article in the Conservationist magazine might also help to inform potential users of the opportunities awaiting them in the Fabius River watershed.

Conservation of Aquatic Communities

Statewide, the Department of Conservation is developing a long-term Resource Assessment and Monitoring program (RAM). The objective is to establish standardized sampling methods for several stream ecosystem attributes, especially biotic communities, that will allow scientists to provide an accurate, legally defensible portrayal of conditions and trends. Sampling will occur at random and fixed sites to allow statewide or individual watershed assessments.

Information gathered from this effort may be used to prioritize watersheds for conservation.

Long-Term Fish Community Monitoring

Long-term monitoring to assess stream fish community trends has not been conducted in the Fabius River watershed. Although some sites within the basin may be included in the statewide RAM program, extensive sampling within that framework is not likely to occur for several years. In the meantime, in order to monitor trends in fish community composition and population levels, the Department of Conservation should conduct fish community surveys at sites randomly selected from among those surveyed during 1988-1989 (Table 11) at least every ten years in each sub-basin as follows: Fabius—one site; North Fabius—three sites; Middle Fabius— five sites; South Fabius—five sites.

Fishery Management and Research Needs

Stream fish communities in the Fabius River watershed seem to be imbalanced. Surveys have revealed the existence of relatively few fish-eating predators (flathead catfish, black bass, or walleye/sauger) but large numbers of insect-eating bottom feeders (channel catfish, river carpsuckers, freshwater drum, common carp, and a variety of native minnow species). Non-game fishes are represented mostly by species tolerant of the shallow depths and shifting substrates caused by excessive watershed erosion and subsequent stream channel sedimentation. Shifting substrates dramatically reduce biological productivity, so in channelized streams the large populations of insect-eating fish are almost entirely dependent upon terrestrial inputs or whatever invertebrate production occurs on in-channel woody debris. There are not enough predatory fish We know very little about the migration patterns and minimum habitat requirements of the key predator—flathead catfish. Also, we do not know if the relative scarcity of flathead catfish is due to overharvest under liberal regulations, illegal harvest, habitat deficiencies, or some combination of factors. We need basic research, starting with studies of flathead catfish movement and exploitation rate, in order to begin developing a broad range of strategies for effectively managing sport fishes in streams (e.g., regulation, stocking, and information/education in addition to habitat protection/restoration).

There is also a high-priority need for information on the movement and habitat use patterns of reintroduced lake sturgeon. These endangered fish were stocked by the Department of Conservation into Pool 24 of the Upper Mississippi River starting in the late 1980s and continuing well into the 1990s. We do not know the extent to which reintroduced lake sturgeon will pass through the navigation locks or seasonally migrate upstream in systems like the Fabius. A radiotelemetry study to identify movements and key habitats used by lake sturgeon would aid in restoring a viable population of this state endangered species.

Monitoring Contaminants in Fish

Fish contaminant monitoring has not been conducted within the Fabius River watershed as of 1998. However, the basin is included in a limited consumption advisory issued by the Missouri Department of Health for fish species with a high proportion of fat in their edible tissues (catfish, carp, buffalo, drum, suckers). Levels of concern for chlordane were reported in the early 1990s for catfish in neighboring watersheds and the Mississippi River.

The Department of Conservation should include the Fabius River watershed among those from which periodic samples are collected for purposes of determining whether a limited consumption advisory is warranted. If contaminant concentrations are below action levels, the Department of Health may wish to reconsider the broad advisory currently in effect.

Long-Term Mussel Community Monitoring

Mussels are abundant in basin streams. Qualitative mussel surveys were conducted in the three main streams of the Fabius River watershed in 1991; but extensive, basin-wide surveys have not been conducted. The Department of Conservation needs to assess species diversity and abundance by conducting a carefully designed, system-wide survey. Survey sites and sampling periodicities should be consistent with RAM and other fish survey protocols.

Supporting Other Agencies and Organizations

The Missouri Department of Conservation works with many other governmental agencies and private conservation organizations in the process of managing stream resources. The following formal or traditional interactions are among the most significant in frequency and scope, and they should be continued:

Missouri Department of Natural Resources (DNR)

MDC assists DNR by periodically nominating pristine or otherwise valuable stream reaches for "Outstanding State Resource Water" status; recommending water quality standard classifications for stream reaches of special concern; and assisting in water pollution investigations whenever an event results in the loss of aquatic life. In such cases, MDC's role is to document the number of dead fish and other aquatic organisms and report to DNR the estimated value of animals lost according to formulas established by the American Fisheries Society. MDC should continue its coordination efforts with DNR in order to ensure efficient use of state government resources in the conservation of streams in the Fabius River watershed.

Missouri Department of Health (DOH)

MDC assists DOH by periodically collecting fish from select streams and preparing tissue samples for analysis of pesticide and heavy metal contaminants. We cooperate with DOH in advising anglers about precautions to take in the consumption of fish. MDC should proceed with plans to collect tissue samples from carp and bass in the South Fabius River at Black Hawk Access approximately every three years.

U.S. Army Corps of Engineers (COE)

MDC joins several other agencies in commenting to COE and DNR about activities in streams which require permit under Sections 404 and 401, respectively, of the federal Clean Water Act. COE requires a Section 404 permit for operators who propose to deposit or stockpile material in stream channels; and DNR requires a Section 401 permit for any activity that could significantly degrade water quality. MDC biologists help to disseminate information about stream-friendly sand and gravel removal practices to county commissions, contractors, and landowners.

MDC personnel are often the first agency representatives contacted by neighbors when individuals or public entities engage in what appear to be unpermitted and destructive practices in and along streams. Several serious incidents of Section 404 violation in the Fabius River watershed (mostly Troublesome Creek) since 1980 have prompted MDC biologists to assess impacts and recommend potentially acceptable terms of mitigation or restoration. However, only the COE or EPA (Environmental Protection Agency) can impose such requirements. MDC biologists should remain vigilant advocates for the interests of all riparian residents, upstream and downstream, who may be adversely affected by the activities of those few who knowingly violate Sections 404 or 401 of the Clean Water Act.

MDC recognizes that regulations are necessary to protect streams and their watersheds. Previous hopes that voluntary efforts alone would afford reasonable protection were unrealistic. Watershed management must be approached in a balanced, market-based manner that falls somewhere in the continuum between regulatory protection and voluntary conservation efforts.

Conservation Federation of Missouri (CFM)

MDC facilitates and promotes Stream Team, a program initiated by CFM which seeks to enlist volunteers in the stream conservation effort. As of fall 1998, only two Teams had adopted streams within the Fabius River watershed—Team #448 (Middle Fabius River) and Team #1009 (South Fabius River). Far more citizen interest and volunteer effort will be needed for any significant stream improvements to occur within the Fabius River watershed.

Assisting Citizen-Led Watershed Conservation Efforts

We are convinced that the watershed conservation approach will work only if there is widespread recognition that social, economic, and environmental values associated with streams are compatible. If that can be achieved, success will depend upon local initiatives to form diverse partnerships of committed groups and individuals under the leadership of landowners and other local interests.

Watershed restoration is essential to restoring the primary processes that create and maintain fish habitat in healthy stream ecosystems. The most critical and affordable first step in watershed restoration is passive restoration—the cessation of human activities that are causing degradation or preventing recovery (e.g., channelization, riparian corridor clearing, indiscriminate gravel dredging, and streamside livestock grazing). Active restoration (e.g., tree revetments and riparian corridor tree plantings) should be considered only if recovery fails to occur over a reasonable period of time while using passive techniques (e.g., livestock exclusion and natural regeneration of woody plants). Because restoring degraded stream ecosystems is more costly and risky than simply protecting fully functional sites, we suggest that protecting and preserving intact riparian ecosystems be the highest priority of watershed-scale restoration efforts.

Protecting Healthy Riparian Corridors — Stream Stewardship

A program aimed at conserving healthy forested stream corridors by placing them into permanent easements using Stream Stewardship Agreements (SSA) was piloted in Marion County between 1992 and 1995. That effort resulted in the permanent conservation of 88 acres of 100- to 200-foot-wide forested corridor on four ownerships along 2.4 miles of the South Fabius River.

The infrastructure now exists for MDC to facilitate the permanent conservation of healthy stream corridors, but measurable impact will require funding from a variety of sources. Enrollment of streamside lands in continuous CRP (Conservation Reserve Program) will not substitute for enrollment in SSA or other permanent easement programs because healthy forested corridors cannot be enrolled in CRP, and land enrolled in CRP buffers may be converted back to crop production at the end of short-term contract periods (10 to 15 years). However, CRP may provide a viable first step for landowners on the long path toward converting eroding floodplain cropfields or pastures into functional riparian corridors.

Passively Restoring Mildly Degraded Riparian Corridors — Livestock Exclusion

The activity of livestock can degrade physical aspects of water quality by causing streambank erosion, resulting in turbidity and stream channel sedimentation. Chemical aspects of water quality can be degraded by livestock waste products. In some situations, streambank healing, corridor reforestation, and improved water quality can be achieved simply by excluding livestock from stream corridors. For fencing to be attractive to landowners, an alternative source of livestock water must be available (e.g., upland ponds, or shallow floodplain wells tapped by nose pumps or solar-powered pumps). Some landowners may have potential alternative water sources on their property, but may not have the money or the technical support to adopt new technology. Cost-share money for fencing and alternative watering may be available through a variety of federal and state programs. Department of Conservation biologists are available to assist landowners in selecting a practical alternative to instream watering of livestock.

Actively Restoring Moderately to Severely Degraded Corridors

A 75% cost-share program for stream restoration practices (e.g., tree revetments and riparian corridor tree plantings) was piloted by MDC in Sullivan County between 1990 and 1993. The program had no participants, despite the fact that 41% of county landowners were aware of monetary incentives. The program lacked many elements critical to the adoption of innovation in agricultural communities, including relative economic advantage and value compatibility. The problems and their solutions were often complex, and MDC assistance had stipulations (ten-year forested corridors 50 to 100 feet wide) which many landowners were unwilling to accept. The lesson learned? Most rural northeastern Missouri landowners may not be prepared to make the personal sacrifices in time, money, and values needed to restore moderately to severely degraded stream habitats on their property. Available funds might be better spent first on protecting healthy riparian corridors and passively restoring those which are only mildly degraded.

Educating Future Watershed Stewards

Educating our youth about the complexities of watershed processes and problems will be critically important in advancing the science and art of watershed conservation. Today's youth are more technologically oriented and therefore more likely than their predecessors to embrace complex information systems. And because of changes in classroom teaching strategy, they are more likely to work effectively in problem-solving teams once they become adults.

MDC has found that students in and around the 6th grade are particularly receptive to messages about stream conservation because they can understand most concepts and evaluate new ideas with relatively little social or cultural bias. Classroom teachers may find helpful lesson- planning materials in Missouri's Stream Team Curriculum, a watershed-based curriculum developed by teachers, for teachers, that will help students to meet environmental education goals in the Missouri Performance Standards.

Junior high and high school students in vocational agricultural programs may also be prime candidates for watershed conservation education because they are more likely than others to become landowners and other important members of rural communities. Involving these students in hand-on stream conservation activities may contribute to the creation of a new generation of landowners committed to stream ecosystem integrity.

Citizen Primer to Leadership in Watershed Conservation

This section is included as a starting point for citizens who wish to lead or contribute significantly to watershed-based stream conservation efforts. The proliferation of information about watershed planning can be intimidating to individuals or groups who have decided that they have a problem they wish to fix. To facilitate that process, we recommend that potential leaders and contributors to watershed conservation efforts first familiarize themselves with a summary of lessons learned over the past decade about what works and what does not. The list in Table 16 combines the Top 10 Watershed Lessons Learned published by the United States Environmental Protection Agency (1997) with the ten principles for effectively coordinating watershed-based programs listed by Turner (1997). These documents are highly recommended reading.

Citizens determined to develop and implement watershed conservation plans can also obtain critically important information about organizing and funding such projects by visiting the Internet websites listed in Table 17. These sites contain convenient links to many other sites that, in the aggregate, provide enough information about the watershed conservation process to help any individual or group get started in an informed and effective manner.

Table 15. Development needs on existing stream access areas in the Fabius River watershed as of March, 1999.

Access Area Name	Stream	Development Need
Tolona	Middle Fabius	Entrance road, 5-car parking area, concrete boat ramp, bank protection
Deer Ridge	Middle Fabius	Entrance road, 5-car parking area, concrete boat ramp
Sunrise	South Fabius	Entrance road, 5-car parking area, concrete boat ramp, bank protection
Dunn Ford	South Fabius	Concrete boat ramp
Black Hawk	South Fabius	Concrete boat ramp

Table 11. Fish sampling site locations in the Fabius River watershed, 1988-1989.

North Fabius Fish Sampling Sites		**Middle Fabius Fish Sampling Sites**		**South Fabius Fish Sampling Sites**	
Station Number	**Legal Description**	**Station Number**	**Legal Description**	**Station Number**	**Legal Description**
10	nw¼35 66n13w	26	ne¼23 65n13w	42	ne¼06 61n10w
9	sw¼06 66n13w	25	n½08 64n12w	41	n½13 60n09w
8	sw¼05 66n14w	24	se¼04 64n13w	40	ne¼23 59n07w
7	e½05 66n12w	23	s½09 65n14w	39	se¼14 62n12w
6	se¼31 66n12w	22	ne¼28 64n12w	38	nw¼18 63n12w
5	ne¼27 65n11w	21	ne¼12 64n12w	37	nw¼03 62n12w
4	ne¼19 64n10w	20	se¼13 63n12w	36	ne¼16 60n10w
3	se¼16 61n07w	19	ne¼02 62n11w	35	ne¼08 60n10w
2	e½1960n06w	18	se¼04 62n10w	34	ne¼36 61n11w
Fabius River at>	<Soulard Access	17	e½10 62n10w	33	ne¼11 59n09w
1	se¼19 59n05w	16	se¼01 62n10w	32	sw¼03 58n07w
		15	n½14 63n11w	31	sw¼21 59n08w
		14	s½09 62n09w	30	nw¼21 59n06w
		13	se¼03 61n08w	29	se¼16 61n12w
		12	s½24 60n07w	28	nw¼33 61n11w
		11	nw¼05 60n07w	27	ne¼29 60n10w

Table 16. Ten useful watershed conservation principles.*

1) For the watershed conservation approach to work, there must be widespread recognition that social, economic, and environmental values are compatible.
2) Successful watershed conservation requires the formation and support of diverse partnerships under the authority of landowners and other local interests.
3) Leadership is critical in the watershed approach to conservation.
4) A good coordinator is key to successful watershed conservation projects.
5) The best plans have clear visions, goals, and action items.
6) Good tools (planning guides, technical assistance, and funding sources) are available to help watershed groups achieve their goals.
7) It is important to start small and demonstrate success before working on larger scales, celebrating even minor success as it occurs.
8) Plans are most likely to succeed if implemented on a manageable scale.
9) Public awareness, education and involvement are keys to building and maintaining support for watershed conservation efforts.
10) Measuring and communicating progress is essential to the success of watershed conservation efforts.

*For EPA Publication 840-F-97-001, call the National Center for Environmental Publications and Information at 1-800-490-9198.

Table 17. Internet websites containing important information for Missouri watershed planners.

- **Conservation Technology Information Center -** http://www.ctic.purdue.edu/, CTIC is a non-profit, public-private partnership equipping agriculture with realistic, affordable, and integrated solutions to environmental concerns.
- **EPA Watersheds and Wetlands -** http://www.epa.gov/OWOW/ This site, created and maintained by the federal Environmental Protection Agency, is a good starting point for information about watersheds and water quality.
- **Funding Sources for Watershed Conservation -** http://www.epa.gov/OWOW/watershed/wacademy/fund.html#forword This site contains a comprehensive listing of private and public sources of watershed project funding, with links to many individual sites and references to many useful publications.
- **Know Your Watershed -** http://www.ctic.purdue.edu/KYW/KYW.html This initiative works to encourage the formation of local, voluntary partnerships among all watershed stakeholders for the purpose of developing and implementing watershed plans based upon shared visions of the future.
- **Missouri Stream Team -** http://www.rollanet.org/~streams/ This site provides specific information on activities, programs, and funding sources for volunteers who have adopted Missouri streams or otherwise committed themselves to conserving stream resources in Missouri.
- **Missouri Watershed Information Network -** http://outreach.missouri.edu/mowin/ This site serves as a clearinghouse for information about Missouri watersheds.
- **River Network -** http://www.rivernetwork.org/wag.htm This organization supports development of local watershed partnerships through its Watershed Assistance Grants program. They seek to fund projects in diverse geographies that have demonstration value on a national scale.

Angler Guide

Fishing Prospects for Streams in the Fabius River Watershed

Fishing quality is highly variable depending upon location within the watershed. Almost 60% of the North Fabius River has been channelized (straightened), so the deep pools that once harbored large flathead catfish and other sportfish have been replaced by long, shallow, sandy runs. As a result, the North Fabius River provides some fishing for carp and small to mid-size channel catfish, but otherwise lacks angling appeal.

The South Fabius and Middle Fabius rivers, however, have some of the best fish habitat and offer some of the finest fishing opportunity in northeastern Missouri. The reason? The South Fabius River is only 10% channelized, and the Middle Fabius is almost entirely unaltered from its naturally meandering condition. Also, both streams generally have excellent forest buffers.

The Middle Fabius River has a desirable mix of pools, riffles, snags (dead trees), and drift piles that are home to good numbers of nice-sized channel catfish. In fact, the Middle Fabius River may be the best channel catfish stream in northeastern Missouri. In addition, anglers should not be surprised to encounter big flathead catfish, large carp, and catchable-size smallmouth bass in suitable habitats. Wade fishing the woody structure is popular on the Middle Fabius. Public access exists at Tolona Access in Lewis County and on the Deer Ridge Conservation Area.

The South Fabius River provides excellent fishing opportunity, often in association with outstanding scenery wherever the river wanders against the ancient limestone bluffs that border its flood plain. Sportfish diversity eclipses that of most Ozark streams. In a single float trip, anglers using a variety of methods and focusing their efforts on good pools and woody habitats can expect to encounter quality-size flathead catfish, channel catfish, white crappie, freshwater drum, smallmouth bass, and walleye. Public access exists at White Oak Bend Access in Knox County, and Dunn Ford, Black Hawk, and Sunrise accesses in Marion County. Soulard Access in Marion County, located below the confluence of all the Fabius River tributaries, offers boating access and five rock dikes that provide bank fishing in and around the holes created by the scouring action of water flowing over the dikes.

Significant reaches of the South Fabius and Middle Fabius rivers can be floated by canoe or jon boat much of the year. Under low flow conditions, there is a more frequent need to drag watercraft over riffles and debris than in the popular Ozark float streams. But unlike the Ozarks, anglers will experience isolation, litter-free beauty, and near-wilderness conditions within the forested river corridor, in addition to good fishing for a wide variety of species. Detailed float trip information and maps highlighting public stream access areas can be obtained by calling the Northeast Regional Service Center of the Missouri Department of Conservation at 660-785-2420.

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Glossary

Alluvial soil: Soil deposits resulting directly or indirectly from the sediment transport of streams, deposited in river beds, flood plains, and lakes.

Aquifer: An underground layer of porous, water-bearing rock, gravel, or sand.

Benthic: Bottom-dwelling; describes organisms which reside in or on any substrate.

Benthic macroinvertebrate: Bottom-dwelling (benthic) animals without backbones (invertebrate) that are visible with the naked eye (macro).

Biota: The animal and plant life of a region.

Biocriteria monitoring: The use of organisms to assess or monitor environmental conditions.

Channelization: The mechanical alteration of a stream which includes straightening or dredging of the existing channel, or creating a new channel to which the stream is diverted.

Concentrated animal feeding operation (CAFO): Large livestock (ie. cattle, chickens, turkeys, or hogs) production facilities that are considered a point source pollution, larger operations are regulated by the MDNR. Most CAFOs confine animals in large enclosed buildings, or feedlots and store liquid waste in closed lagoons or pits, or store dry manure in sheds. In many cases manure, both wet and dry, is broadcast overland.

Confining rock layer: A geologic layer through which water cannot easily move.

Chert: Hard sedimentary rock composed of microcrystalline quartz, usually light in color, common in the Springfield Plateau in gravel deposits. Resistance to chemical decay enables it to survive rough treatment from streams and other erosive forces.

Cubic feet per second (cfs): A measure of the amount of water (cubic feet) traveling past a known point for a given amount of time (one second), used to determine discharge.

Discharge: Volume of water flowing in a given stream at a given place and within a given period of time, usually expressed as cubic feet per second.

Disjunct: Separated or disjoined populations of organisms. Populations are said to be disjunct when they are geographically isolated from their main range.

Dissolved oxygen: The concentration of oxygen dissolved in water, expressed in milligrams per liter or as percent.

Dolomite: A magnesium rich, carbonate, sedimentary rock consisting mainly (more than 50% by weight) of the mineral dolomite $(CaMg(CO_3)_2)$.

Endangered: In danger of becoming extinct.

Endemic: Found only in, or limited to, a particular geographic region or locality.

Environmental Protection Agency (EPA): A Federal organization, housed under the Executive branch, charged with protecting human health and safeguarding the natural environment — air, water, and land — upon which life depends.

Epilimnion: The upper layer of water in a lake that is characterized by a temperature gradient of less than 1^{o} Celsius per meter of depth.

Eutrophication: The nutrient (nitrogen and phosphorus) enrichment of an aquatic ecosystem that promotes biological productivity.

Extirpated: Exterminated on a local basis, political or geographic portion of the range.

Faunal: The animals of a specified region or time.

Fecal coliform: A type of bacterium occurring in the guts of mammals. The degree of its presence in a lake or stream is used as an index of contamination from human or livestock waste.

Flow duration curve: A graphic representation of the number of times given quantities of flow are equaled or exceeded during a certain period of record.

Fragipans: A natural subsurface soil horizon seemingly cemented when dry, but when moist showing moderate to weak brittleness, usually low in organic matter, and very slow to permeate water.

Gage stations: The site on a stream or lake where hydrologic data is collected.

Gradient plots: A graph representing the gradient of a specified reach of stream. Elevation is represented on the Y-axis and length of channel is represented on the X- axis.

Hydropeaking: Rapid and frequent fluctuations in flow resulting from power generation by a hydroelectric dam's need to meet peak electrical demands.

Hydrologic unit (HUC): A subdivision of watersheds, generally 40,000-50,000 acres or less, created by the USGS. Hydrologic units do not represent true subwatersheds.

Hypolimnion: The region of a body of water that extends from the thermocline to the bottom and is essentially removed from major surface influences during periods of thermal stratification.

Incised: Deep, well defined channel with narrow width to depth ration, and limited or no lateral movement. Often newly formed, and as a result of rapid down-cutting in the substrate

Intermittent stream: One that has intervals of flow interspersed with intervals of no flow. A stream that ceases to flow for a time.

Karst topography: An area of limestone formations marked by sinkholes, caves, springs, and underground streams.

Loess: Loamy soils deposited by wind, often quite erodible.

Low flow: The lowest discharge recorded over a specified period of time.

Missouri Department of Conservation (MDC): Missouri agency charged with: protecting and managing the fish, forest, and wildlife resources of the state; serving the public and facilitating their participation in resource management activities; and providing opportunity for all citizens to use, enjoy, and learn about fish, forest, and wildlife resources.

Missouri Department of Natural Resources (MDNR): Missouri agency charged with preserving and protecting the state's natural, cultural, and energy resources and inspiring their enjoyment and responsible use for present and future generations.

Mean monthly flow: Arithmetic mean of the individual daily mean discharge of a stream for the given month.

Mean sea level (MSL): A measure of the surface of the Earth, usually represented in feet above mean sea level. MSL for conservation pool at Pomme de Terre Lake is 839 ft. MSL and Truman Lake conservation pool is 706 ft. MSL.

Necktonic: Organisms that live in the open water areas (mid and upper) of waterbodies and streams.

Non-point source: Source of pollution in which wastes are not released at a specific, identifiable point, but from numerous points that are spread out and difficult to identify and control, as compared to point sources.

National Pollution Discharge Elimination System (NPDES): Permits required under The Federal Clean Water Act authorizing point source discharges into waters of the United States in an effort to protect public health and the nation's waters.

Nutrification: Increased inputs, viewed as a pollutant, such as phosphorous or nitrogen, that fuel abnormally high organic growth in aquatic systems.

Optimal flow: Flow regime designed to maximize fishery potential.

Perennial streams: Streams fed continuously by a shallow water table an flowing year-round.

pH: Numeric value that describes the intensity of the acid or basic (alkaline) conditions of a solution. The pH scale is from 0 to 14, with the neutral point at 7.0. Values lower than 7 indicate the presence of acids and greater than 7.0 the presence of alkalis (bases).

Point source: Source of pollution that involves discharge of wastes from an identifiable point, such as a smokestack or sewage treatment plant.

Recurrence interval: The inverse probability that a certain flow will occur. It represents a mean time interval based on the distribution of flows over a period of record. A 2-year recurrence interval means that the flow event is expected, on average, once every two years.

Residuum: Unconsolidated and partially weathered mineral materials accumulated by disintegration of consolidated rock in place.

Riparian: Pertaining to, situated, or dwelling on the margin of a river or other body of water.

Riparian corridor: The parcel of land that includes the channel and an adjoining strip of the floodplain, generally considered to be 100 feet on each side of the channel.

7-day Q^{10}: Lowest 7-day flow that occurs an average of every ten years.

7-day Q^2: Lowest 7-day flow that occurs an average of every two years.

Solum: The upper and most weathered portion of the soil profile.

Special Area Land Treatment project (SALT): Small, state funded watershed programs overseen by MDNR and administered by local Soil and Water Conservation Districts. Salt projects are implemented in an attempt to slow or stop soil erosion.

Stream Habitat Annotation Device (SHAD): Qualitative method of describing stream corridor and instream habitat using a set of selected parameters and descriptors.

Stream gradient: The change of a stream in vertical elevation per unit of horizontal distance.

Stream order: A hierarchical ordering of streams based on the degree of branching. A first order stream is an unbranched or unforked stream. Two first order streams flow together to make a second order stream; two second order streams combine to make a third order stream. Stream order is often determined from 7.5 minute topographic maps.

Substrate: The mineral and/or organic material forming the bottom of a waterway or waterbody.

Thermocline: The plane or surface of maximum rate of decrease of temperature with respect to depth in a waterbody.

Threatened: A species likely to become endangered within the foreseeable future if certain conditions continue to deteriorate.

United States Army Corps of Engineers (USCOE) and now (USACE): Federal agency under control of the Army, responsible for certain regulation of water courses, some dams, wetlands, and flood control projects.

United States Geological Survey (USGS): Federal agency charged with providing reliable information to: describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect the quality of life.

Watershed: The total land area that water runs over or under when draining to a stream, river, pond, or lake.

Waste water treatment facility (WWTF): Facilities that store and process municipal sewage, before release. These facilities are under the regulation of the Missouri Department of Natural Resources.