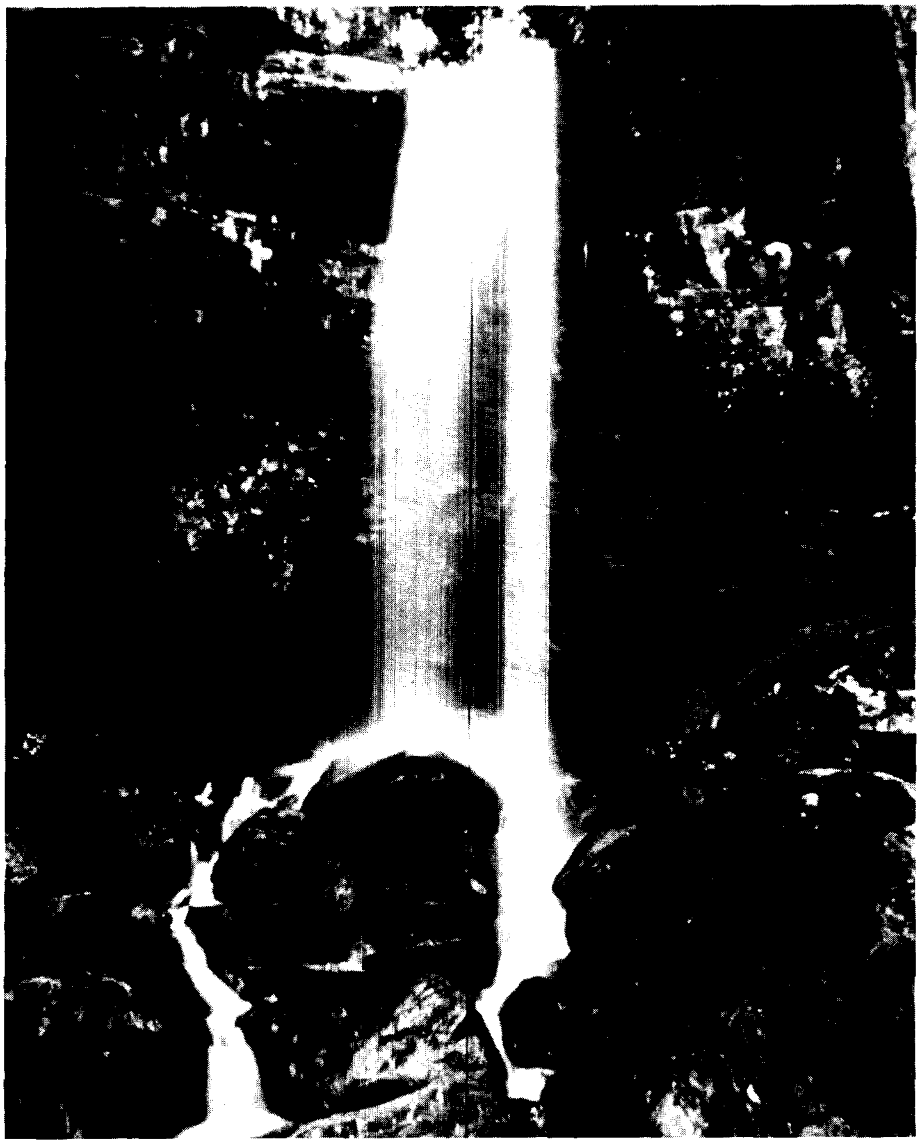
ENVIRONMENTAL INVENTORY AND MANAGEMENT PLAN FOR BAD BRANCH WILD RIVER, KENTUCKY



PREPARED BY
KENTUCKY STATE NATURE PRESERVES COMMISSION

FOR
KENTUCKY DIVISION OF WATER
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET

ENVIRONMENTAL INVENTORY

AND

MANAGEMENT PLAN

FOR

BAD BRANCH WILD RIVER, KENTUCKY

Prepared by
Kentucky State Nature Preserves Commission

Margaret Shea
Principal Investigator

With Contributions from:

Joyce Bender
Project Coordinator and Stewardship Coordinator

Ronald Cicerello
Aquatic Biologist

Marc Evans
Botanist

Kyle Napier
Administrative Assistant

Brainard Palmer-Ball
Terrestrial Zoologist

Prepared for and Submitted to the
Kentucky Division of Water
Natural Resources and Environmental Protection Cabinet

This project was financed by the Kentucky Division of Water through Memorandum of Agreement Number 010531. The contents do not necessarily reflect the views and policies of the Kentucky Division of Water.

ACKNOWLEDGEMENTS

Thanks to the following people for their contributions to this report: Otis Adams; Charles Bailey, formerly of the Kentucky State Nature Preserves Commission (KSNPC); Henry Baker; Bill Blackburn, Kentucky Department of Transportation; Arlie Brock; William R. Buck; Ronald S. Caldwell, Lincoln Memorial University; Sam Call, Division of Water (DOW); Lester Cornett; Roy Crawford III; Richard Hannan, KSNPC; Richard C. Harris; Varie and William Hensley; Dillard Hubbard; Morgan Jones, Kentucky Wild Rivers Program, DOW; John R. MacGregor, United States Forest Service (USFS); Jim MacIntyre, USFS; John Maggard; Lythia Metzmeier, DOW; Johnnie Mullins; Kerry W. Prather, Kentucky Department of Fish and Wildlife Resources; Alan Risk, Morehead University; Guenter A. Schuster, Eastern Kentucky University; Winnie and Woodrow Short; Ronnie Smith; Taez Sturgill; Jim Wright.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. INTRODUCTION

A. Statement of Purpose

Nine of Kentucky's most undisturbed streams are protected by the Wild Rivers statutes, passed in 1976 by the Kentucky General Assembly. These streams have been designated as wild rivers to provide legal protection for their significant natural and cultural features. Bad Branch, the most recent addition to the Wild Rivers System, was designated as a Wild River by an act of the 1986 General Assembly. To ensure that the streams are adequately protected, the Wild River statutes require that a management plan be written for each of the wild rivers (Division of Water Resources 1976, KRS 146.220). The plan generates a long-range strategy for maintaining the high quality of the stream, its surrounding habitat and cultural features while also providing for appropriate recreation, education and scientific uses. A biological inventory and review of natural and cultural resources is included with the management plan for this wild river because this information is necessary for determining appropriate management of the area. Important and vulnerable areas were identified through the inventory to ensure that they will be properly protected. The Kentucky Division of Water (DOW) of the Department for Natural Resources and Environmental Protection Cabinet is responsible for administering the Wild Rivers System.

The Natural Resources and Environmental Protection Cabinet, through its development of the 1990-1992 Environmental Management Plan, identified the resources to fund the development of management plans for two wild rivers. This report is the culmination of the effort undertaken by the Kentucky State Nature Preserves Commission through Memorandum of Agreement Number 010531 with the Kentucky DOW to develop a management plan and environmental inventory for the Bad Branch Wild River.

B. Location

Bad Branch is located in southeastern Kentucky in Letcher County, 4.8 km (3 mi.) west of the Virginia border along KY 932 and 7.2 km (4.5 mi.) south-southeast of Whitesburg, Kentucky (Fig. 1). Several tributaries, their origins at approximately 829 m msl (mean sea level) (2720 ft. msl) along the crest of Pine Mountain, join to form Bad Branch. The stream flows along the south face of Pine Mountain into the Poor Fork of the Cumberland River. Bad Branch is entirely within the proclamation boundary of the Jefferson National Forest, and a tract of Forest Service-owned land is just east of the Bad Branch watershed. The proclamation boundary of the national forest outlines an area that the Forest Service has an intent to purchase; privately-owned land within the boundary is not under the control of the Forest Service. Further to the west of the wild river is Pine Mountain Wildlife Management Area, which is managed by the Kentucky Department of Fish and Wildlife Resources (KDFWR). The area designated as the wild river corridor includes the river and "the visual horizon from the river up to 2000 feet from the centerline of the river" (Division of Water Resources 1976)(Fig. 2). The wild river corridor is approximately 537 ha (1327 acres) while the entire watershed of Bad Branch covers an area

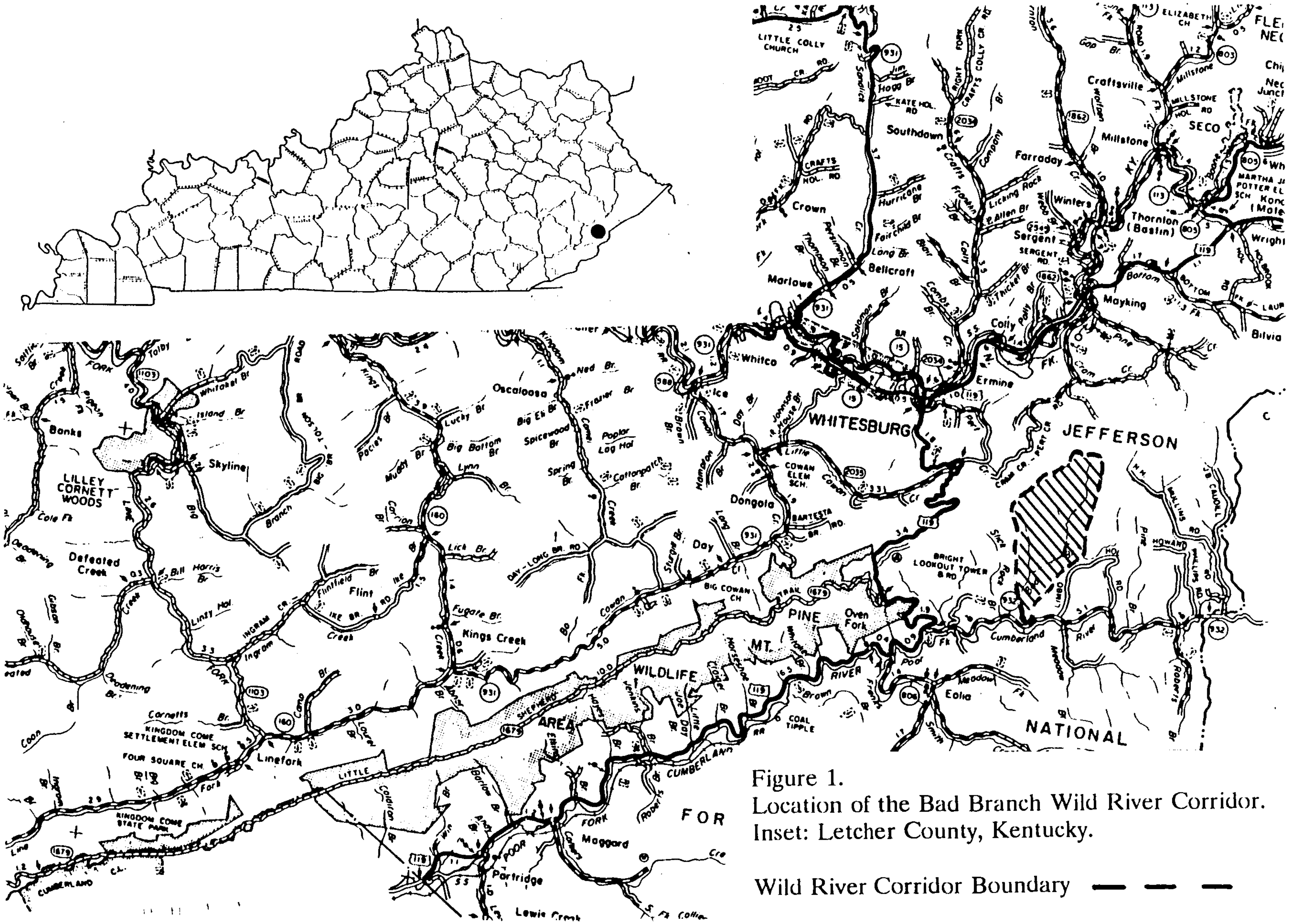


Figure 1.
Location of the Bad Branch Wild River Corridor.
Inset: Letcher County, Kentucky.

Wild River Corridor Boundary — — —

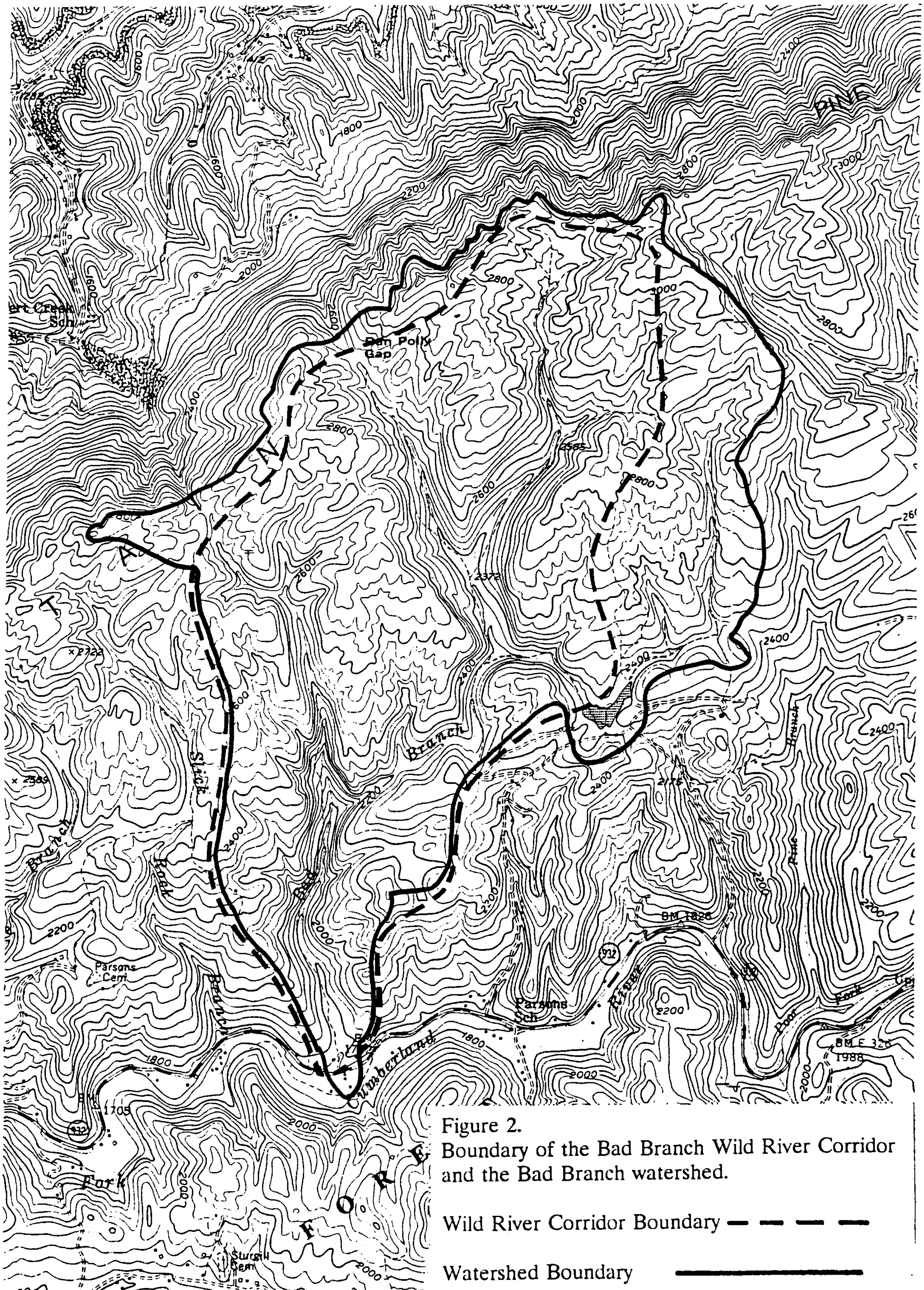


Figure 2.
Boundary of the Bad Branch Wild River Corridor and the Bad Branch watershed.

Wild River Corridor Boundary — — — —

Watershed Boundary ————

of approximately 668 ha (1651 acres). Two portions of the Bad Branch watershed were intentionally omitted from the wild river corridor, approximately 0.16 km (0.1 mi.) of the stream between KY 932 and the mouth of Bad Branch and an eastern tributary which has an artificial impoundment (Fig. 2). The excluded portions of Bad Branch will still be discussed in the inventory and management plan because they affect the rest of the watershed.

C. Road and Trail Accessibility

Bad Branch can be reached from KY 932, which crosses the stream approximately 2.8 km (1.7 mi.) east of the junction of KY 932 and US 119. Limited parking is available on the north side of KY 932 near where it crosses Bad Branch. The headwaters of the stream can be reached by several unimproved roads and jeep trails. The first road east of the intersection of KY 932 and Bad Branch leads to the headwaters of the stream. The portion of this road that leads into the Bad Branch watershed is privately owned and requires a 4-wheel-drive vehicle. The second road east of Bad Branch leads to the artificial impoundment that was created on one of the Bad Branch tributaries. The portion of the Bad Branch watershed with the artificial impoundment is privately owned. A Forest Service road, the third road east of Bad Branch, also provides access to the tributaries that form Bad Branch. This road can be followed north to a foot trail that leads from Forest Service property west into the upper watershed of Bad Branch and its tributaries (See Fig. 3).

Many trails transect the wild river corridor, including old logging roads, all terrain vehicle (ATV) trails and foot paths. A foot trail begins at the parking area and reaches the crest of Pine Mountain. This trail follows an old logging road to the head of Bad Branch's western-most tributary (Fig. 3). A spur trail leads east to the waterfall. Several logging and ATV roads follow Bad Branch above the waterfall, and a very steep foot trail leads up the north side of Pine Mountain to Ran Polly Gap.

D. Land Ownership - Public and Private

Most land within the wild river corridor is owned by two conservation organizations. The Kentucky State Nature Preserves Commission (KSNPC), a state agency, owns 176 ha (435 acres) (Fig. 4, tract 8). The Nature Conservancy (TNC), a private, nonprofit organization, owns 483 ha (1194 acres) (Fig. 4, tract 7). The area owned by these two conservation organizations has been dedicated as a state nature preserve. Dedication provides land with the highest legal protection available in the state (KRS 146.410-146.535). Approximately 49 ha (121 acres) within the Bad Branch watershed is owned by private individuals. Figure 4 shows the boundary of the wild river corridor and property ownership boundaries within the corridor. Table 1 gives property ownership information for land within the wild river corridor. Two private owners have conservation agreements with TNC and KSNPC. The area included in tract 1 (Fig. 4), totalling 83 ha (205 acres), is under a management lease which allows TNC to manage the property. Tract 6 is under a Natural Areas Registry agreement with TNC and KSNPC. This agreement states that the owner will

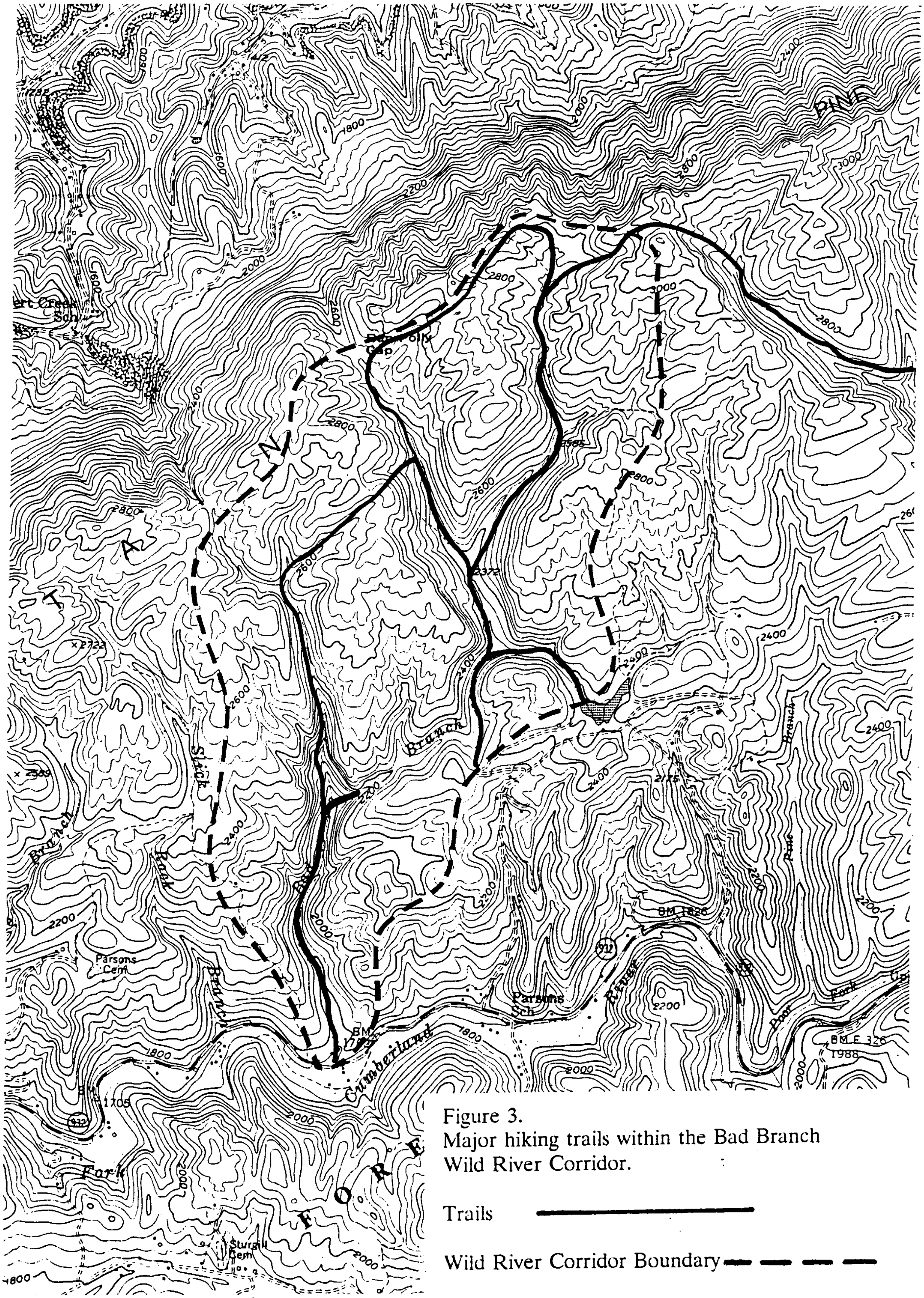


Figure 3.
Major hiking trails within the Bad Branch Wild River Corridor.

Trails

Wild River Corridor Boundary

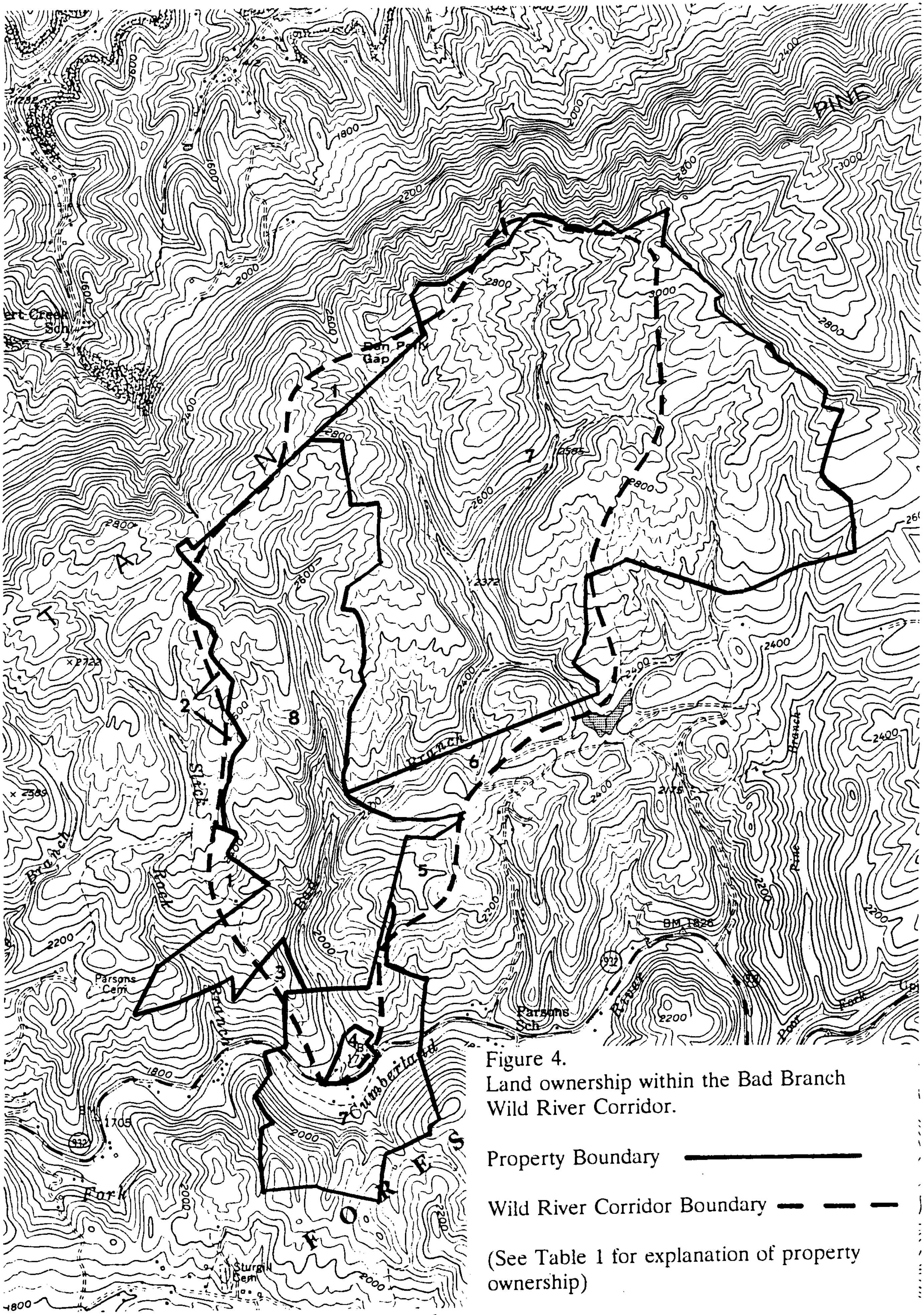


Figure 4.
Land ownership within the Bad Branch Wild River Corridor.

Property Boundary

Wild River Corridor Boundary

(See Table 1 for explanation of property ownership)

Table 1.
Property ownership within the Bad Branch Wild River Corridor.

Tract	Ownership
1	Private - Management lease with TNC
2	Private
3	Private
4	Private
5	Private
6	Private - Registry agreement with TNC and KSNPC
7	TNC
8	KSNPC

not alter the property in any way that is detrimental to its ecology. The owner also agrees to inform TNC or KSNPC of plans to sell the property.

E. Coordination with Other Agencies

DOW is responsible for periodically inspecting the wild river corridor to ensure that regulations protecting the area are upheld and to monitor the quality of the stream's water. Most of the land within the wild river corridor is owned by conservation organizations, KSNPC and TNC. The activities of these organizations are consistent with the goals of the Wild Rivers Program. The United States Forest Service owns land adjacent to the Bad Branch watershed. Forest Service employees have worked with TNC to block Forest Service roads that lead into the Bad Branch watershed to prevent ATV access. Eastern Kentucky University has assisted with biological monitoring of the area.

II. CULTURAL RESOURCES

A. Land Use

1. Regional

Letcher County ranks 54th among the 120 Kentucky counties in total area. Population size of the county in 1990 was 27,000 compared to 40,592 in 1940 when the coal business was prospering (United States Bureau of the Census 1940, 1990).

Coal mining, both strip and deep mining, is the major industry in Letcher County. Coal mining provides half of the total wages for Letcher County (Karan and Mather 1977, Department of Existing Business and Industry 1991). Letcher County is also one of the top three counties in the eastern coal field in numbers of surface mines. The other main sources of employment in Letcher County are retail sales, services and transportation and public utilities (United States Department of Commerce 1989).

A portion of the Jefferson National Forest, covering 342 ha (845 acres), is in Letcher County just east of Bad Branch. The area, purchased by the Forest Service in the 1960s, was logged in the 1940s; there are no plans for logging the forest in the current 10 year management plan for the area (J. MacIntyre, pers. comm.). The oil and gas rights for the area have been leased to a private company. The company has not begun to explore the area; however, they are in the process of exploring nearby areas.

The Kentucky Department of Transportation has plans to improve US 119 between Whitesburg and Partridge, Kentucky. This construction, planned to begin in 1996, could severely harm the Bad Branch watershed if a route is chosen that intersects the area. DOT has completed an environmental assessment of the area and is aware of the presence of this significant area (B. Blackburn, pers. comm.).

2. Local

Most the Bad Branch Wild River Corridor is used for rare species protection, education and passive recreation as stipulated by the regulations of the conservation organizations that own the property. KSNPC has owned 176 ha (435 acres) within the Bad Branch watershed since 1985. TNC has owned 69 ha (170 acres) within the watershed since 1984 and purchased an additional 414 ha (1023 acres) in 1990. Several small portions of the wild river corridor are privately-owned (Fig. 4). Most of the privately-owned land is completely undeveloped and has had no recent disturbance. There are two small, family cemeteries within the watershed, one on tract 4 and a second on tract 6 (Fig. 4). These private landowners also maintain a small vegetable garden on their property. Tract 5 contains an old cabin and saw mill site in a 1-2 ha (2.5-5 acre) clearing (Fig. 4). There has been no logging within the corridor since the 1940s.

B. History and Archaeology

1. Prehistoric Perspective

a. Regional

The Kentucky Heritage Council has divided the state into seven management areas based on major drainages and landform divisions. The Bad Branch Wild River Corridor is within the Interior Mountains Section of the Upper Kentucky/Licking management area. Due to its rugged terrain, this area is one of the lesser-studied regions of the state (Pollack 1990).

There were five major archaeological periods in Kentucky during prehistoric times: the Paleoindian, Archaic, Woodland, Mississippian and Fort Ancient periods. The Interior Mountains Section of Kentucky contains sites from all of these periods except the Mississippian (Pollack 1990).

Paleoindian Period (11000 BC - 8000 BC)

Paleoindians are the first people known to have lived in Kentucky. Because they were nomadic big-game hunters and gatherers, they left little cultural material. Projectile points and some tools are the evidence of their presence in Kentucky (Niquette and Henderson 1984). During this period, the last of the Pleistocene glaciers advanced and retreated. Toward the end of the period, climate was warming and the vegetation was changing from coniferous forests and grasslands to mixed deciduous hardwood forests, and the Pleistocene megafauna was becoming extinct (Pollack 1990, Niquette and Henderson 1984).

There are three late Paleoindian sites reported from the Interior Mountains Section. This comprises 1.3% of all sites from this period in Kentucky (Pollack 1990). One of the sites is a rockshelter (Bush 1988), and the other two sites are isolated artifacts (Rolingson 1974, Bush 1988). The few sites may indicate that this region of Kentucky was not heavily used during the Paleoindian period. It is also possible that local collectors have removed many artifacts or that many artifacts are buried and have not been recovered (Niquette and Henderson 1984).

Archaic Period (8000 BC - 1000 BC)

The people of this period were semi-nomadic hunters and gatherers; however, they travelled less than the Paleoindians and made more thorough use of all the resources in a smaller area. The climate by the end of the period was similar to today's. Group size increased during the period and ceremonies, especially those related to burials, became more important. Regionalization of cultures increased during this time, reflected in regional projectile point styles. The cultivation of local plants and animals began during this period, and a wider variety of tools was developed (Niquette and Henderson 1984, Pollack 1990).

There are 36 known sites from this period in the Interior Mountains Section, less than 2% of the known sites from the Archaic period in Kentucky (Pollack 1990). The sites occur in rockshelters (Bush 1988) on floodplains, terraces, ridgetops and hillsides (Gatus and Sanders 1978).

Woodland Period (1000 BC - 1000 AD)

During this period, gardening, hunting and gathering were used to obtain food. Cultivated plants became more important as a source of food. Hunting was still important to survival, and it is thought that the bow and arrow were developed during the Woodland Period. A distinctive characteristic of this period is the appearance of fired ceramics which were usually cord-marked or fabric-impressed. Mortuary ceremonies became more elaborate throughout this period (Niquette and Henderson 1984, Pollack 1990).

There are 58 Woodland sites in the Interior Mountains Section. These sites are found in rockshelters (Fryman et al. 1967, Purrington 1967a, Gatus 1981, Bush and Thomas 1986), caves, open areas and on earth mounds (Pollack 1990).

Mississippian Period (900 AD - 1700 AD)

Planned towns and complex social and political systems developed during the Mississippian period. These people were hunter-gatherer-farmers and represent the peak of prehistoric Indian culture in eastern North America (Niquette and Henderson 1984). There are no known sites from this period in the Interior Mountains Section (Pollack 1990).

Fort Ancient Period (1000 AD - 1750 AD)

The people of this period focussed on the cultivation of corn and beans and were also hunters and fishers. They were only found in the eastern third of Kentucky, primarily residing in uplands along major drainages. Unlike the Mississippian cultures, they had no complex local and regional system of settlement. Their style of ceramics, tempered with shell, is a distinguishing feature of the group.

There are 10 known sites from this period in the Interior Mountains Section (Pollack 1990). These sites are found in rockshelters and in open areas (Fryman et al. 1967; Purrington 1967a, b). One site is a stone mound.

b. Local

A brief archaeological survey was made of the cliffline along the southern end of Bad Branch (Henderson 1989). No previous surveys had been made of the Bad Branch watershed. One large rockshelter had a large trench dug in its floor suggesting that artifact collectors had visited the site. A cord-marked, sandstone, tempered potsherd was found in a rockshelter on the northwest side of the falls. This piece of pottery was probably from the woodland period (1000 BC - 1000 AD) or the late prehistoric period (1000 AD - 1750 AD)(Henderson 1989). The only other indication of prehistoric use of this area is from a local artifact collector who reported collecting from the Bad Branch Wild River Corridor.

c. Protection Needs

Because the Bad Branch area is primarily owned by conservation organizations, it will not be developed. The most important step in protecting the archaeological resources of the area is preventing development. Since the preserve will be open to the public, surveys are needed to determine the location of significant sites and ensure that they are protected from disturbance by humans. A complete assessment of the preserve's archaeological resources should be performed by a professional archaeologist. Once sites have been located and mapped, appropriate actions should be taken to protect them from human disturbance.

2. Historic Perspective

a. Regional

The first records of European-Americans visiting the area that is now Letcher County, Kentucky are from the early 1750s; however, the area was not settled until more than 40 years later. The earliest settlers were from Virginia and arrived in Letcher County in 1796. These settlers crossed Pine Mountain at Ran Polly Gap, which is within the Bad Branch watershed, and settled in the present location of Cornettsville (Adams 1984). A large wave of migration into the area occurred in the early 1800s. By 1810, 100 families were settled in what is now Letcher County (Cornett 1967).

Letcher County was established in 1842 from parts of Perry, Harlan and Pike counties. The county was named for the governor of Kentucky at the time, Robert P. Letcher, and Whitesburg was chosen as the county seat (Cornett 1967).

When the Civil War broke out, Letcher County, like the rest of Kentucky, was politically divided. Although there were slave-owners in Letcher County, most of the residents supported the Union. The only battle of the war fought in Letcher County was at Pound Gap where the Confederate troops were defeated (Cornett 1967).

There was no peace in south-east Kentucky following the Civil War. Beginning in the 1880s, several family feuds began in the counties surrounding Letcher County. By 1890, the feuding spread into Letcher County (Cornett 1967).

The most important industries in Letcher County in the 1800s were farming and leather tanning. Other less common trades included making guns, wagons and barrels. Logging became an important industry to the county after the Civil War. By the turn of the century, the coal industry had taken over the economy of the county (Cornett 1967).

In the early 1900s, coal companies began purchasing the mineral rights to land in Letcher County. Mining the coal did not become practical until after 1912 when the first railroad into Letcher County was completed; mining operations began in 1916. The coal industry brought money and people into the county especially during World Wars I and II, which created booms for the coal industry. The coal industry in this part of Kentucky has declined since the boom during World War II (Cornett 1967).

b. Local

1. Previous Land Use

The Bad Branch watershed has been exploited in many ways throughout its history. The most extensive use of the watershed occurred in the 1940s when all but a small area was logged. The forest was reported to be mature just prior to logging (Braun 1935). All trees greater than 0.3 m (12 in.) in diameter were removed during the logging. Trees were cut using 2.1 m (7 ft.), two men, cross-cut saws; however, these were not always long enough to clear the width of the largest trees which were between 2.1 m (7 ft.) and 2.4 m (8 ft.) in diameter (A. Brock, W. Short, T. Sturgill, pers. comm.).

The portion of the watershed below the Bad Branch waterfall was logged by William Sargent Lumber Company from 1942-1944 (Fig. 5a). A small patch of hemlocks near the mouth of the stream was left uncut. A mill and two small houses for workers were built just west of the mouth of Bad Branch (A. Brock, W. Short, pers. comm.).

The forest above the falls was cut between 1945 and 1948 by Bruce Burns Mill (Fig. 5b). Because access to the area above Bad Branch Falls was difficult, eight shacks, a boarding house and a mill were set up near the stream while the area was being logged. A larger house was built for the foreman. Many of the roads that are present in the upper portion of the watershed were originally built as logging roads. Bulldozers were used to carry the logs out along these roads, and a team of mules was used to move logs on steep slopes (H. Baker, A. Brock, V. Hensley, W. Hensley, J. Maggard, T. Sturgill, pers. comm.).

After logging, fires occurred along Bad Branch about once a year. The fires may have occurred naturally; however, many were thought to be deliberately ignited (O. Adams, A. Brock, D. Hubbard, J. Maggard, W. Short, T. Sturgill, pers. comm.). The last fire reported from the area occurred in the late autumn of 1960, when between 120 and 140 ha (approximately 300-350 acres) above the falls burned (J. Mullins, J. Wright, pers. comm.).

The Bad Branch watershed also has been used for farming and grazing cattle. Figure 6 indicates the approximate location of cleared areas that were used for farming or grazing cattle. The largest farm was located where an artificial pond is now found (Fig. 6, #3; Fig. 7). This area was farmed between 1860 and 1920 (J. Hubbard, pers.

5a

5b

Figure 5.
5a Logging operation within the Bad Branch watershed.
5b Cleared area after logging of the watershed.

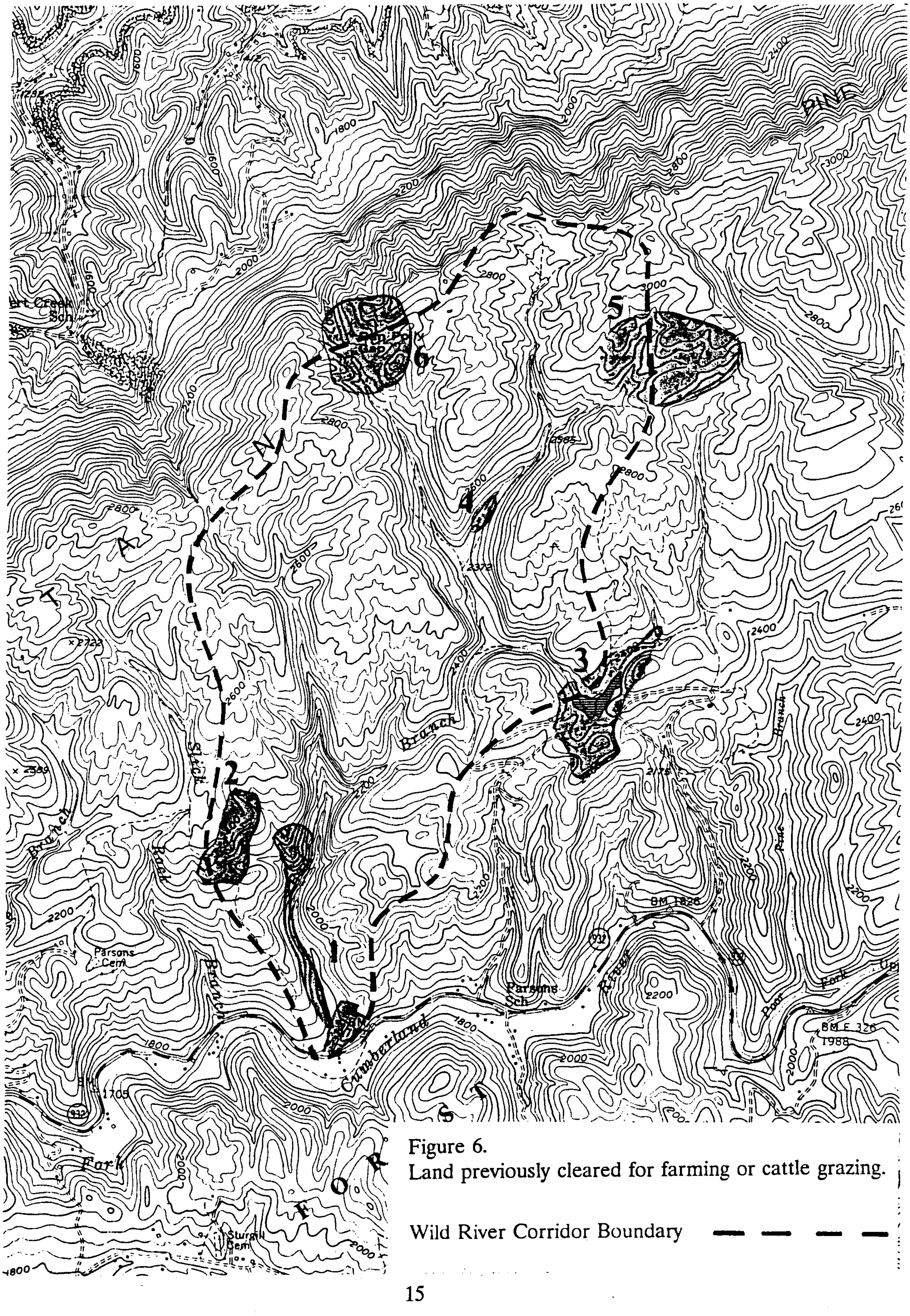


Figure 6.
Land previously cleared for farming or cattle grazing.

Wild River Corridor Boundary — — — —

Figure 7.
Farmstead at current site of artificial pond.

comm.). The remaining areas outlined in Figure 6 were farmed during the following periods: area 1 - 1900-1940, area 2 - 1860-1940, area 4 - 1940-1950, area 5 - early 1900s and area 6 in the 1860s. Home sites were associated with the farms, and a family cemetery remains within the watershed on privately-owned land (Fig. 4, tract 4).

A farming practice known as new-grounds also was used within the Bad Branch watershed. In this farming method, areas were cleared and farmed for several years. When the soil became poor, the farmer would move to "new ground". This practice was most common in the mid 1800s; however, it may have been used as late as the 1920s (Bowles 1949). It is not known which areas within the watershed were farmed using this practice.

The Bad Branch watershed was probably used for open-range grazing. Since Kentucky was the last state to prohibit this practice, Bad Branch could have been grazed in this manner as late as 1920 (Bowles 1949).

During Prohibition, Bad Branch was a popular spot for moonshiners to set up stills (Fig. 8). The area was ideal for whiskey production since water and hiding places were plentiful. During the 1930s, there were five stills in operation in the Bad Branch watershed (J. Maggard, pers. comm.). Whiskey production continued within the watershed after prohibition was abolished. Some whiskey production may still occur in the area, although on a smaller scale (J. Maggard, T. Sturgill, pers. comm.). A path through Ran Polly Gap was used to transport moonshine for sale.

The Bad Branch area does not have significant coal deposits, saving it from the impact of mining. There are small deposits of coal; however, and one mine is known from the area. The remains of this mine are 12 m (39 ft.) long and 1 m (3 ft.) high and are located near the mouth of Bad Branch above a sulfur spring. Coal was mined during the 1940s when the site was being logged. The mine was used to provide coal for a local family for heating their home and was not a commercial operation (L. Cornett, pers. comm.).

2. Myths and Legends

Many stories about Bad Branch have become well known among the area natives. The most famous of these stories claims that silver was found near High Rock, a rock outcrop at the crest of Pine Mountain within the Bad Branch watershed. According to the story, a man named Calvin Sturgill was hunting near High Rock in the late

Figure 8.
Moonshine whiskey production within the Bad Branch watershed.

Clay, W. M. 1975. The fishes of Kentucky. Kentucky Department of Fish and Wildlife Resources, Frankfort, Kentucky, USA.

Cordell, H. K. , J. C. Bergstrom, D. B. K. English and J. C. Betz. 1988. Projections of future growth of outdoor recreation in the United States. Pages 203-209 *in* A. H. Watson, compiler. Outdoor recreation benchmark 1988: Proceedings of the national outdoor recreation forum. Southeastern Forest Experiment Station, Asheville, North Carolina, USA.

Cornett, W. T. 1967. Letcher County, Kentucky: a brief history. State-wide Printing Company, Prestonsburg, Kentucky, USA.

Department of Existing Business and Industry. 1991. Kentucky economic statistics: Kentucky open for business. Department of Existing Business and Industry, Division of Research and Planning, Frankfort, Kentucky, USA.

Division of Conservation, Cooperative Soil Survey. 1989. Unpublished data. Frankfort, Kentucky, USA.

Division of Water Resources. 1976. Wild Rivers Act. Wild Rivers Section, Kentucky Department for Natural Resources and Environmental Protection, Frankfort, Kentucky, USA. (Kentucky Revised Statutes 146.200-146.360; Volume 7).

Evans, M. Unpublished draft. Kentucky Ecological Communities. Version 6.64322. Kentucky State Nature Preserves Commission, Frankfort, Kentucky, USA.

Faust, R. J., G. R. Banfield, and G. A. Willinger. 1980. A compilation of ground water quality data for Kentucky. Open file report 80-685. United States Geological Survey, Louisville, Kentucky, USA.

Fenneman, N. M. 1938. Physiography of the eastern United States. McGraw-Hill Book Company, New York, New York, USA.

Fowler, D. K., J. R. MacGregor, S. A. Evans and L. E. Schaaf. 1985. The common raven returns to Kentucky. American Birds 39:852-853.

Fryman, F. B., Jr., M. L. Fryman and M. J. Rodeffer. 1967. A preliminary survey of the proposed Parker Branch Reservoir, Laurel, Jackson and Rockcastle counties, Kentucky. Manuscript on file, Museum of Anthropology, University of Kentucky, Lexington, Kentucky, USA.

Garner, H. F. 1974. The origin of landscapes: a synthesis of geomorphology. Oxford University Press, New York, New York, USA.

1800s. A huge storm had recently swept through the area, and Calvin came across a large tree that had blown over. He saw something shiny among the roots of the toppled tree and realized that it was silver. As he dug through the soil near the tree, he discovered more silver. It is said that Calvin made coins from the silver and was arrested for counterfeiting, but he was released when it was discovered that his coins were pure silver. Some people say that he died without telling anyone where he found the silver. Others say that he left a map of the location, but it was destroyed in a rainstorm (A. Brock, W. Hensley, J. Maggard, T. Sturgill, J. Wright, pers. comm.).

Another popular story involves a rockshelter known as Jane Rock located just south of Ran Polly Gap. The rockshelter is named for a young woman who used the shelter as a home in the early 1800s. Jane was sent away by her family because she was unmarried and pregnant. Neighbors brought her food during her pregnancy. Nothing is known about what happened to her after the baby was born (J. Maggard, pers. comm.).

An interesting feature occurs just outside of the Bad Branch watershed just north of Ran Polly Gap. The "Bull Hole" is a "bottomless pit" that is thought by some to open into a system of caverns that empties into the Poor Fork. The hole is named for a prize bull that escaped from its owner and fell into the hole. Randolph Polly was lowered nearly 150 m (492 ft.) into the hole to reach the bottom and find the dead bull. According to a local saying, the politician who loses a county election must throw himself in the bullhole (J. Maggard, pers. comm.; T. Sturgill; Whitesburg Mountain Eagle 1992; J. Wright).

c. Protection Needs

Certain historical features of the area that do not significantly interfere with the natural features of the area should be protected from disturbance. Evidence of historic utilization of the corridor should be protected in order to preserve the past culture of the area. Two interesting features that should be protected are old still sites and the remaining sections of old wooden logging roads.

III. NATURAL RESOURCES

A. Physiography

Bad Branch is within the Cumberland Mountains Section of the Appalachian Plateaus Physiographic Province (Fenneman 1938). The Appalachian Plateaus Physiographic

Province was originally a narrow band of folded mountains. Over time, the mountains have been destroyed and uplifted repeatedly. The center area of the province is now lower than its margin in many places. The Cumberland Mountains Section of the Appalachian Plateaus Physiographic Province is higher in elevation than adjacent areas due to its erosion-resistent bedrock (Fenneman 1938).

B. Topography

Bad Branch is on the northeast end of Pine Mountain. The elevation of Pine Mountain ranges from 640-700 m msl (2100-2300 ft. msl) in its southwestern half to 793-853 m msl (2600-2800 ft. msl) in its northeastern half, with a long swell rising above 914 m msl (3000 ft. msl) (Fenneman 1938). Bad Branch flows from the crest of Pine Mountain south to the Poor Fork of the Cumberland River. The erosive action of Bad Branch has formed the spectacular gorge that surrounds portions of the stream. The gorge varies in elevation from 829 m msl (2720 ft. msl) at its upper reaches to 536 m msl (1758 ft. msl) at the mouth of Bad Branch.

C. Geology

1. Regional Geology

In Kentucky, the bedrock that underlies the Appalachian Plateaus Physiographic Province is Pennsylvanian-age sandstones, conglomerates, shales, limestones and coal. Due to its resistance to erosion, sandstones are frequently found at the surface. This physiographic province of Kentucky is rich in coal, natural gas and petroleum (Karan and Mather 1977).

2. Site Geology

The Bad Branch area has Lower and Middle Pennsylvanian age rocks including sandstone, siltstone, shale and coal of the Lee Formation (Middlesboro, Hensley and Bee Rock Sandstone members) and the Hance Formation (Rice and Wolcott 1973). Coal deposits occur in vertical strata on the south face of Pine Mountain; however, it is not economically feasible to mine this coal at this time.

D. Climate

1. Regional Climate

The Appalachian Plateaus Physiographic Province is a humid, mesothermal region with a mild, rainy climate (Trewartha 1954). Fall is the driest and spring is the wettest season; however, the difference is not great. This portion of the state has the highest number of rainy days, averaging 150 days/year with precipitation (Karan and Mather 1977).

Winds travel across the state predominantly from west to east. When low-pressure storm systems move into the state, they circulate counterclockwise and carry warm, moist air from the south. High-pressure, fair-weather systems circulate clockwise and bring cool, dry northern air into the state (Karan and Mather 1977).

There is an average of 181 frost-free days in this portion of the state. The average annual precipitation is 1.1 m (43.21 in.), and the average annual snowfall is 0.4 m (15.6 in.). Mean temperature is 15° C (58.1° F), with a mean January temperature of 4° C (38.1° F) and a mean July temperature of 26° C (77.1° F). Temperature and precipitation information is from Pikeville, Kentucky, approximately 40 km (25 mi.) north-northeast of Whitesburg (Karan and Mather 1977).

2. Microclimates

Although there are no climatological data from within the Bad Branch watershed, the presence of Bad Branch and the surrounding gorge have a significant effect on the climate of the wild river corridor. The presence of the stream increases the humidity of the surrounding area. The gorge runs north to south and acts to block out the early morning and late afternoon sun, resulting in significantly cooler temperatures within the gorge.

The west-facing slope of the gorge, receiving the force of the prevailing winds, experiences a drier climate than the relatively protected east-facing slope. The northern-most portion of the corridor at the summit of Pine Mountain has areas of bare rock. These areas are exposed to the wind and sun, making them very hot and dry and thus inhospitable to the establishment of vegetation.

E. Hydrology

1. Surface Water

Bad Branch originates on the southeast-facing slope of Pine Mountain in southeastern Letcher County, flows south approximately 4.4 km (2.7 mi.), and discharges into the Poor Fork of the Cumberland River (Harker et al. 1980a)(Fig. 2). Elevations at the headwaters and mouth of the approximately 7.25 km^2 (2.8 mi.^{2}) Bad Branch watershed are 829 m (2720 ft.) and 536 m (1760 ft.), respectively, yielding an approximate gradient of 66 m/km (355 ft./mi.). The actual gradient is somewhat less, however, because an 18.3 m (40 ft.) waterfall bisects the watershed. Mainstream Bad Branch has three main tributaries, two of which enter above the falls and the third immediately below. In the 1960s, the eastern tributary above the falls was impounded approximately 0.5 km (0.3 mi.) above the Bad Branch confluence to form a small (ca 2.3 ha (5.7 acre)) pond (R. Crawford III, pers. comm.). Springs, some sulfurous, issue at several points along the stream. The most notable spring is located near the second foot bridge along the trail between the parking lot off of KY 932 and Bad Branch falls.

Stream-side vegetation forms a closed or nearly closed canopy over most of Bad Branch. Undercut banks and logs are common in and along the stream. The stream substratum is exposed bedrock in several places. Riffles are generally short and shallow, and are comprised of clean boulders, cobble, gravel and sand. Pools are underlain by bedrock overlain with sand; large, densely packed boulders; and boulders, cobbles and finer materials. Even during the drought of 1991, depth in some pools below the falls exceeded 1 m (3 ft.).

Laboratory and field analyses of water samples indicate that Bad Branch has cold, well-oxygenated water of excellent quality (Tables 2 and 3)(Harker et al. 1980a). For those constituents measured, Bad Branch meets Kentucky surface water standards (401 KAR 5:031) for warm and cold water aquatic habitat. The pH standard of 6-9 for warm water aquatic habitat is exceeded, but this is believed to be a natural background condition. Except for cadmium, chromium, lead and nickel, domestic water supply standards also are met. Standards for these constituents were exceeded for the 21 August 1979 sample but not subsequently. The concentrations of many other constituents measured on 21 August 1979 are higher than more recent analyses suggesting errors in the analysis of 1979 samples. All water quality parameters are representative of values expected for well-forested, undisturbed watersheds draining Pennsylvanian age lithologies.

Discharge at the mouth of Bad Branch was 0.98 m^3/s on 21 August 1979 (Harker et al. 1980a), and 0.056 m^3/s on 11 July 1991, a drought year. Measurements made upstream from the mouth are even lower, as expected. No assessment has been made for the 7.25 km^2 (2.8 $mi.^2$) Bad Branch watershed, but the 7 day-10 year discharge (low flow) for most streams draining less than 259 km^2 (100 $mi.^2$) is zero (Leist et al. 1982). Bad Branch is a high quality stream that naturally approaches zero low flow even during non-drought periods.

2. Ground Water

Bad Branch ground water quality was measured only once, at a dug well in June 1960 (Faust et al. 1980)(Table 4), and met all current surface water standards for constituents examined. Compared to other sources in the Appalachian Plateaus Physiographic Province, Bad Branch ground water contains lower concentrations of dissolved constituents than Lee Formation drilled wells, and is comparable to or of higher quality than dug wells in valley alluvium and Lee Formation springs (Price et al. 1962). Some constituents (sulfate, fluoride and hardness) are lower than or comparable to Bad Branch surface water concentrations (Price et al. 1962).

3. Potential Effects of Mining on Hydrology

Major disturbances, such as mining, in the watershed would greatly alter the excellent surface and ground water quality. Acidity and low alkalinity values indicate that any disturbances in the drainage such as mining would alter and degrade water

Table 2.
Bad Branch chemical characteristics.

Constituents[1]	Collection dates									
	8/21/79	2/23/86	4/30/87	6/20/90	10/10/90	2/19/91	5/22/91	8/27/91	11/18/91	2/11/92
Acidity	4.4	1.08	-	7.25	4.36	6.3	4.6	1.7	2.4	1.47
Alkalinity	2.4	0.1	0.7	0.14	0.8	<0.1	0.2	0.1	1.7	6.97
Biochem O_2 Demand (5 day)	-	-	-	-	0.7	-	-	-	-	-
Chloride	0.5	0.9	<0.1	1.21	1.21	2.8	1.6	1.3	1.7	<1
Chem Oxygen Demand	-	3.6	-	-	0.7	-	-	-	-	-
Cyanide, free	-	<0.01	-	-	-	-	-	-	-	-
Flouride	-	<0.10	-	-	-	-	-	-	-	-
pH	6.4	5.5	5.6	5.6	-	-	6.25*	5.09*	5.6*	5.19*
Sulfates	6.8	5.80	5.06	4.18	6.16	8.2	6.44	9.6	5.12	10.1
Total Solids	-	-	-	-	-	36	31	16	40	16
Suspended Solids	-	6	1	1	1	6	4	1	1	<1
Total Organic Carbon	-	1.1	-	-	2.0	-	-	-	-	-
Ammonia Nitrogen, Total	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.151	<0.05	<0.05
Nitrate-Nitrite Nitrogen	-	0.050	0.035	0.050	0.010	0.044	<0.005	0.074	<0.005	0.005
Total Kjeldahl Nitrogen	-	0.177	0.248	0.107	<0.05	0.112	0.1	0.089	<0.05	0.109
Phosphorus	-	0.002	0.003	<0.005	<0.005	-	<0.005	<0.005	-	<0.005
Aluminium, Total	0.00	0.059	0.053	0.109	0.084	0.022	0.065	0.168	0.076	0.101
Arsenic, Total	0.02	<0.001	-	-	0.012	-	<0.002	<0.002	<0.002	<0.002
Barium, Total	0.02	0.017	-	-	0.016	-	0.052	0.033	0.024	0.022
Beryllium, Total	0.00	<0.001	-	-	-	-	-	-	-	-
Boron, Total	0.01	-	-	-	-	-	-	-	-	-

Table 2 (continued).

Constituents[1]	8/21/79	2/23/86	4/30/87	6/20/90	10/10/90	2/19/91	5/22/91	8/27/91	11/18/91	2/11/92
	Collection dates									
Cadmium, Total	0.03	<0.001	-	-	<0.001	-	<0.001	<0.001	<0.001	<0.001
Chromium, Total	0.14	0.008	-	-	0.004	-	0.008	0.001	0.001	0.001
Cobalt, Total	0.13	-	-	-	-	-	-	-	-	-
Copper, Total	0.00	0.001	-	-	0.003	-	0.018	<0.001	0.003	0.001
Germanium, Total	0.00	-	-	-	-	-	-	-	-	-
Iron, Total	0.03	0.010	0.03	0.09	<0.01	0.21	<0.01	0.27	<0.01	0.02
Lead, Total	0.12	<0.001	-	-	0.008	-	<0.002	<0.002	<0.002	<0.002
Lithium, Total	0.02	-	-	-	-	-	-	-	-	-
Manganese, Total	0.02	0.010	0.02	0.04	0.01	0.03	0.02	0.03	0.01	0.022
Mercury, Total	0.00	0.0003	-	-	<0.0001	-	<0.0001	0.0002	<0.0001	<0.0001
Molybdenum, Total	0.00	-	-	-	-	-	-	-	-	-
Nickel, Total	0.12	0.015	-	-	-	-	-	-	-	-
Selenium, Total	0.00	0.003	-	-	-	-	-	-	-	-
Silicon, Total	2.33	-	-	-	-	-	-	-	-	-
Silver, Total	0.00	<0.001	-	-	-	-	-	-	-	-
Strontium, Total	0.01	-	-	-	-	-	-	-	-	-
Tin, Total	0.00	-	-	-	-	-	-	-	-	-
Titanium, Total	0.23	-	-	-	-	-	-	-	-	-
Vanadium, Total	0.00	-	-	-	-	-	-	-	-	-
Zinc, Total	0.11	0.005	0.013	<0.001	0.002	0.026	0.118	0.013	0.0433	0.005
Calcium, Total	0.95	0.910	-	-	3.1	-	4.5	3.1	<0.05	0.899
Magnesium, Total	0.36	0.720	-	-	0.88	-	0.93	0.4	0.65	0.546

Table 2 (continued).

Constituents[1]	8/21/79	2/23/86	4/30/87	6/20/90	10/10/90	2/19/91	5/22/91	8/27/91	11/18/91	2/11/92
	Collection dates									
Potassium, Total	2.09	0.360	-	-	0.73	0.35	0.32	0.34	0.42	0.307
Sodium, Total	1.02	0.326	-	-	0.2	-	<3.5	0.3	0.3	0.319
Hardness	15*	4.35	8.0	5.87	10.2	4.3	4.4	4.4	5.6	4.09

All analyses by Kentucky Department for Environmental Protection, except 8/21/79 by U.S. Forest Service (from Harker et al. 1980a).

1. Laboratory measurements in mg/l unless indicated otherwise.

* Field measurement.

Table 3.
Physical characteristics of Bad Branch.

Parameter		1979[1] station 1	1981[2] station 2	1981[2]	1986[3]	1987[2]	1991[4]
Air Temp (°C)		27	-	-	-	-	-
Water Temp (°C)		17	18.3	18.3	-	17.2	-
Width	Pool (m)	3-5	1.5*	1.5*	-	3.7*	4
	Riffle (m)	3-5	-	-	-	-	-
Depth	Pool (m)	0.3-1.3	0.09*	0.08*	-	0.31*	0.24
	Riffle (m)	0.075-0.15	-	-	-	-	-
Velocity	Riffle (m/s)	0.368	0.3*	0.3*	-	0.3*	0.26
	Depth (m)	0.093	-	-	-	-	-
	Width (m)	2.87	-	-	-	-	-
Discharge (m^3/s)		0.98	0.04	0.04	-	0.5	0.056
Turbidity (NTU)		1.2	-	-	1.2	-	-
Conductivity (umhos)		19 (22.7)#	-	-	19.4	-	-
Dissolved O_2 (mg/l)		8.2	9.0	6.0	-	9.3	-

1. Harker et al. 1980a; 2. Axon and Carroll 1989; 3. Kentucky Division of Water; 4. Kentucky State Nature Preserves Commission.
* habitat not indicated.
# laboratory measurement.

Table 4.
Groundwater from Bad Branch, and drilled and dug wells and springs in the Cumberland Mountains of the Appalachian Plateaus Physiographic Province.

Constituents	Bad Branch[1]	Lee Formation drilled wells[2]	Alluvial valley dug wells[2]	Lee Formation springs[2]
Iron (ug/l as Fe)	240.0	450.0	170.0	180.0
Bicarbonate (mg/l as HCO_3)	10.0	81.0	16.0	39.0
Sulfate (mg/l)	2.4	19.0	14.0	7.2
Chloride (mg/l)	4.0	8.5	4.0	38.0
Fluoride (mg/l)	0.1	0.3	0.1	0.1
Nitrate (mg/l)	0.4	1.7	6.3	3.2
Hardness (mg/l)	6.0	38.0	20.0	45.0
Hardness, non-carbonate (mg/l)	0.0	-	-	-
Conductivity (umhos)	36.0	304.0	84.2	204.0
ph	5.9	-	-	-
Well depth, m(ft)	2.9 (9.5)	-	-	-

1. Faust et al. 1980; 2. Price et al. 1962.

quality. Acidity may result when insufficient alkalinity is present in the water to buffer pH changes caused by the presence of carbon dioxide dissolved in the water, tannic acid and/or hydrolyzed inorganic salts.

Disturbance from mining is not permitted within the wild river corridor. Surface mining of areas within wild river corridors is expressly prohibited by the Wild Rivers Act, under KRS 146.290. The location and amount of coal available within the watershed makes mining economically unfeasible. The conservation organizations that own the majority of the watershed also own the mineral rights to the property. The fact that these areas are dedicated state nature preserves ensures that mining will never occur because it is not permissible under the statutes of KSNPC.

F. Geomorphology

1. Introduction

Geomorphology is the study of landforms and how they develop. The study of geomorphology includes factors from the fields of geology, geography, hydrology and climatology. Major geological events resulted in the formation of Pine Mountain; however, less dramatic factors also have contributed to the creation of the landforms within the Bad Branch watershed. The erosive action of the stream has been an important factor in the formation of the physical features within the watershed. Bedrock, elevation, climate and time also contribute to the physical geology of the area. These factors have resulted in the creation of many spectacular landforms at Bad Branch, including High Rock and Bad Branch Falls, two of the most popular sites in the area.

2. Features and Descriptions

Pine Mountain stretches for 200 km (124 mi.) from West Virginia to Tennessee. The mountain was formed by a thrust fault which turned rock layers upward at a sharp angle, exposing rocks that were normally 610 m (2000 ft.) below the soil surface. The exposed rock layers can still be seen; sandstone outcrops are scattered along the crest of the mountain. The largest of the rock outcrops within the Bad Branch watershed is known as High Rock. The view from High Rock is spectacular, overlooking Whitesburg to the north and Big Black Mountain to the south.

An important feature of Pine Mountain that occurs within the Bad Branch watershed is Ran Polly Gap. This gap in the mountain probably began as a fracture in the rock. Stress from the upthrust that created Pine Mountain may have caused the fracture to become a fissure (Garner 1974). In addition to being an interesting landform, Ran Polly Gap is historically important as a travel corridor of early settlers crossing over Pine Mountain.

Much of Bad Branch is lined by a steep sandstone gorge which reaches heights of more than 30 m (approximately 100 ft.). The gorge was created when water eroded shale deposits and left behind the more resistant sandstone. Frost heave and gravity contribute to the erosion of sandstone by causing fractures in the rock. Fractures in sandstone usually occur where horizontal bedding planes meet vertical joint planes.

Many rockshelters are found in the sandstone cliffs that line Bad Branch. Rockshelters differ from caves in that either the height or the width is greater than the depth of penetration into the rock. Rockshelters can form when pockets of shale are eroded by the stream leaving the more durable sandstone. A rockshelter also can be formed when a fracture causes a block of sandstone to separate from the cliff.

At least one cave is found within the Bad Branch watershed. Located approximately 0.4 km (0.25 mi.) southeast of High Rock, the cave, known as "Smokey Cave" by locals, has a 1.2 m (4 ft.) by 1.2 m (4 ft.) opening and extends 30 m (approximately 100 ft.) into the cliff. A local legend suggests that a second cave, associated with the "Bull Hole" opening north of Ran Polly Gap, runs beneath the Bad Branch watershed. According to some, this hole opens into a large system of caverns which empty into the Poor Fork.

A significant and well-known feature of Bad Branch is its 18.3 m (60 ft.) waterfall. The falls may have formed as a result of the erosive effects of the stream and frost heave on sandstone. The large waterfall is found at the transition point between a Bee Rock Sandstone Member and a Hensley Sandstone Member. A fracture could have occurred at this joint between the two types of rock and resulted in large blocks of rock being broken away. Other interesting geological features found within the stream include erosional potholes, deep pools, large sandstone fracture blocks and many smaller boulders.

G. Soils

1. Introduction

Three major soil associations are found in the Bad Branch Wild River Corridor. A Lily-Steinsburg complex is found on ridgetops and sideslopes of the upper watershed on Bad Branch. These loamy soils form over sandstone and are usually 0.5 m-1.0 m (20 in.-40 in.) deep. A Steinsburg-Latham-Rock outcrop association is found on steep ridgetops and upper sideslopes and is most abundant in the lower watershed of Bad Branch. These soils are loamy and are 0.5 m-1.0 m (20 in.-40 in.) deep. A Rigley-Shelocta-Rock outcrop association is found on steep hillsides along the stream and on the lower slopes adjacent to Bad Branch. This association of soils is well-drained and loamy and usually 1.2 m (48 in.) deep (Division of Conservation, Cooperative Soil Survey 1989).

2. Descriptions

Lily Series Soils are formed in residuum weathered from sandstone. These soils are well drained with a moderately rapid permeability and moderate available water capacity. The fertility of this soil is medium, and organic matter content is low. The surface layer is brown loam and is 0.2 m (8 in.) thick. The subsoil from 0.2 m-0.6 m (8 in.-24 in.) is strong brown clay loam and from 0.6 m-0.8 m (24 in.-30 in.) is strong brown, sandy clay loam (Division of Conservation, Cooperative Soil Survey 1989).

Steinsburg Series Soils are formed in residuum weathered from sandstone. These soils are strongly acidic and low in fertility and organic matter content. This soil has a low moisture holding capacity and moderate permeability. The surface layer of this soil is a very dark grayish brown and dark yellowish brown loam. The subsoil reaches a depth of 0.5 m (20 in.) and is brown and strong brown, gravelly loam. The subsoil is composed of 20% coarse fragments. The substratum is yellowish brown, gravelly sandy loam (Division of Conservation, Cooperative Soil Survey 1989).

Rigley Series Soils are formed in acid colluvial material. They are well drained with moderately rapid permeability and moderate available water capacity. Fertility is medium, and organic matter content is low. The surface layer is 0.13 m (5 in.) of dark grayish brown, fine sandy loam over 0.11 m (4 in.) of dark yellowish brown, fine sandy loam. The subsoil from 0.2 m-1.1 m (9 in.-45 in.) is brown and yellowish brown, gravelly sandy loam with a few mottles at 0.9 m-1.1 m (39 in.-45 in.). From 1.1 m-1.5 m (45 in.-60 in.) the subsoil is yellowish brown, gravelly sandy loam (Division of Conservation, Cooperative Soil Survey 1989).

Shelocta Series Soils are formed in weathered colluvial material from acid shale. Available water capacity is moderate to high, and the soil is well drained with moderate permeability. Natural fertility is medium, and organic matter content is low. The surface is 0.3 m (10 in.) of dark grayish-brown silt loam. The subsoil is yellowish-brown and from 0.25 m-0.5 m (10 in.-20 in.) it is silt loam, from 0.5 m-0.8 m (20 in.-32 in.) it is silty clay loam, and from 0.8 m-1.2 m (32 in.-46 in.) it is channery silty clay loam. The substratum from 1.2 m-1.4 m (46 in.-54 in.) is yellowish-brown, channery silt loam (Division of Conservation, Cooperative Soil Survey 1989).

Latham Series Soils are formed in residuum weathered from shale. They are well drained with slow permeability. Available water capacity is moderate. The surface soil is 0.11 m (4 in.) of dark brown silt loam over 0.08 m (3 in.) of yellowish brown silt loam. Subsoil is 0.11 m (4 in.) of yellowish brown silty clay loam over 0.36 m (14 in.) of yellowish brown and strong brown silty clay. The substratum is soft clay shale (Division of Conservation, Cooperative Soil Survey 1989).

3. Use of Soils for Wildlife

All three of these soil complexes are classified as good areas for woodland wildlife and for openland wildlife on slight to moderate slopes. These soils are not appropriate for wetland plants or wildlife. Trees and herbs will grow well on these soils; however, grasses will not survive on steep slopes with these soils (Division of Conservation, Cooperative Soil Survey 1989).

4. Use of Soils for Woodland

The soil complexes found at Bad Branch are appropriate for use as woodlands; however, on steeper slopes there are likely to be problems with erosion and the use of heavy machinery (Division of Conservation, Cooperative Soil Survey 1989).

5. Trail Suitability

These soil complexes are appropriate for trail development on level areas. Building trails on steep slopes can lead to problems with erosion. Latham Series Soils are less appropriate for trail development. Erosion may be a problem on moderate slopes with this soil type (Division of Conservation, Cooperative Soil Survey 1989).

IV. BIOLOGICAL INVENTORY

A. Aquatic Biology

1. Introduction

Because of its small size and inaccessibility, relatively little has been published about the aquatic biota of Bad Branch. Most of our knowledge is based on an intensive natural heritage inventory (Harker et al. 1980a), and suitability assessments for stocking and subsequent evaluation of introduced brook trout (*Salvelinus fontinalis*)(Axon and Carroll 1989).

2. Review of Data and Determination of Needs

a. Algae

The algal flora consists primarily of green algae that are members of the group Zygnematales (Table 5). Also present are *Ulothrix subtilissima*, a green alga within the group Oedogoniales; *Schizothrix calcicola*, a blue green alga; and several species of Bacillariophyceae (diatoms)(Tables 6-7)(Harker et al. 1980a). The diatom community is highly diverse (H'=1.0365) and

Table 5.
Algae of Bad Branch (exclusive of diatoms).

Scientific name
Chlorophycophyta
Actinotaenium cucurbita var. *cucurbita* f. *minus*
Closterium tumidum
C. sp.
Cosmarium undulatum var. *minutum*
C. sp.
Cylindrocystis brebissonii
Mougeotia sp.
Staurastrum hirsutum
S. punctulatum
Ulothrix subtilissima
Cyanochloronta
Schizothrix calciola

Source: Harker et al. 1980a.

Table 6.
Bad Branch diatom taxa not encountered in percent relative abundance count.

Scientific name
Achnanthes reimeri
A. subrostrata var. *appalachiana*
Cymbella perpusilla
Diatomella balfouriana
Fragilaria virescens var. *capitata*
Frustulia rhomboides
Gomphonema acuminatum
G. truncatum var. *cuneatum*
G. sp. 1
Meridion circulare
Navicula elginensis
Rhopalodia gibberula var. *vanheurckii*

Sources: Camburn 1982b, Harker et al. 1980a.

Table 7.
Diatom percent relative abundance in Bad Branch.

Scientific name	% Relative abundance
Achnanthes chlidanos	1.0
A. detha	0.3
A. lanceolata	0.9
A. marginulata	1.7
A. minutissima	1.0
A. spp.	1.2
Anomoeoneis serians var. *brachysira*	10.5
Eunotia exigua	16.6
E. rhomboidea	9.8
E. septentrionalis	1.9
E. sudetica	7.0
E. tenella	12.4
E. sp. 1	21.7
E. spp.	3.3
Frustulia rhomboides var. *crassinervia*	0.3
F. rhomboides var. *saxonica*	0.5
Gomphonema angustatum	0.2
G. gracile	1.9
G. grunowii	0.3
G. parvulum	0.3
G. spp.	0.5
Navicula angusta	1.7
N. contenta f. *biceps*	0.2
Navicula spp.	1.4
Pinnularia burkii	0.2
Surirella delicatissima	0.7
S. sp.	0.3
Synedra famelica	0.9
Tabellaria flocculosa	0.9

Source: Harker et al. 1980a.

moderately equitable (J'=0.7414)(Table 7). Of the 36 diatom species in the community (Table 6-7), only *Anomoeoneis serians* var. *brachysira*, *Eunotia exigua*, *E. tenella*, and *E.* sp. 1 were abundant (Camburn 1982a, Harker et al. 1980a). At none of 30 other sites examined in the upper Cumberland River basin by Harker et al. (1980a) were these species abundant. Bad Branch also supports a population of *Diatomella balfouriana*, only the second known occurrence of this diatom in the eastern United States (Camburn 1982b). The nutrient-poor, soft water of Bad Branch is reflected by the species composition and total relative abundance (72.7%) of several *Eunotia* species. This genus is typically associated with soft water containing low levels of calcium and chloride (Patrick and Reimer 1966).

b. Macroinvertebrates

The Bad Branch macroinvertebrate community is probably typical of high quality streams in the southeastern Appalachian Plateaus (Table 8)(Harker et al. 1980a). In addition to the crayfishes *Cambarus distans* and *C. robustus*, the watershed also is inhabited by *C. buntingi*, *C. dubius* and *C. parvoculus*. Species diversity (H'=1.1931) and equitability (J'=0.9023) were high in August 1979, with ephemeropterans and trichopterans the major constituents of the fauna. In 1981, diversity and equitability were high to moderate in spring and summer, but declined in fall when cold water may have affected sample collection (Axon 1982, Axon and Carroll 1989). Fall aquatic macroinvertebrate diversity is often lower than during other seasons because many insects are present in the egg or early instar stages and are easily missed during sampling. In each season, the fauna was dominated by Plecopterans, Trichopterans, and Dipterans. Mean density (number/m^2) in 1979 was 320 in August and 93 in the fall. In 1981 mean density was 551 in the summer and 297 in the fall.

Additional analysis of the aquatic macroinvertebrate data presented by Harker et al. (1980a) using metrics presented by Plafkin et al. (1989) indicates that Bad Branch is an excellent, high quality southeastern Kentucky headwater stream. Values of 34 for species richness, 20 for the Ephemeroptera, Plecoptera, Trichoptera Index, and 58 for percent Community Dominance place Bad Branch in the nonimpaired biological condition category. Macroinvertebrate communities in this category are comparable to the best expected within an ecoregion, having balanced trophic structure and optimum community structure for stream size and habitat quality (Plafkin et al. 1989). Comparison of Harker et al. (1980a) and Axon (1982) data sets using the Jaccard coefficient of community similarity yielded a value of 0.59. In general, values above 0.50 are considered similar. Identifications by Axon (1980) generally were made to the generic level which probably negatively affected the similarity of the data sets. Nonetheless, the value indicates that the

Table 8.
Aquatic macroinvertebrates collected from Bad Branch.

Scientific name	Qualitative		Quantitative	
	1979[1]	1991[3]	1979[1]	1981[2]
Branchiobdellida	-	-	-	X
Asellidae				
Asellus sp.	-	-	-	X
Cambaridae				
Cambarus distans	X	X	-	-
C. robustus	X	-	X	-
C. buntungi	-	X	-	-
C. sp.	-	-	-	X
Baetidae				
Baetis sp.	X	-	X	-
Baetiscidae				
Baetisca carolina	X	-	-	X
Ephemerellidae				
Ephemerella hispida(?)	X	-	-	-
Eurylophella sp.	-	X	-	-
Ephemeridae				
Ephemera sp.	-	X	-	-
Litobrancha recurvata**	-	X	-	-
Heptageniidae				
Epeorus (*Iron*) sp.	X	-	-	-
Heptagenia sp. 1	X	-	X	-
H. sp. 2	-	-	X	-
H. sp.	-	-	-	X
Stenacron interpunctatum	X	-	X	-
*Stenonema meririvulanum***	-	X	-	-
Leptophlebiidae				
Paraleptophlebia sp.	X	-	X	X

Table 8 (continued).

Scientific name	Qualitative 1979[1]	Qualitative 1991[3]	Quantitative 1979[1]	Quantitative 1981[2]
Siphlonuridae				
Ameletus sp.	-	-	-	X
Leuctridae				
Leuctra ferruginea	X	-	X	-
Leuctra sp.	-	X	-	X
Peltoperlidae				
Peltoperla arcuata	-	X	-	-
Peltoperla sp.	X	-	X	X
Perlidae				
Acroneuria abnormis	X	-	X	-
A. carolinensis	X	-	X	-
A. sp.	-	-	-	X
Eccoptura xanthenes	-	X	-	-
Aeshnidae				
Aeschna sp.	-	X	-	-
Boyeria vinosa	X	-	-	X
Cordulegastridae				
Cordulegaster sp.	X	X	-	X
Hydracarina	-	-	-	X
Gerridae				
Gerris remigis	X	X	-	X
Gerris sp.	-	X	-	-
Trepobates sp.	-	X	-	-
Veliidae				
Rhagovelia obesa	X	-	X	X
Rhagovelia sp.	-	X	-	-

Table 8 (continued).

Scientific name	Qualitative 1979[1]	Qualitative 1991[3]	Quantitative 1979[1]	Quantitative 1981[2]
Dryopidae				
Helichus basalis	X	-	X	-
Helichus sp.	-	-	-	X
Elmidae				
Promoresia tardella	X	-	-	-
Promonesia sp.	-	-	-	X
Stenelmis sp.	X	-	X	X
Psephenidae				
Ectopria nervosa	X	-	-	X
Ectopria sp.	-	X	-	-
Psephenus herricki	-	-	X	X
Glossosomatidae				
Glossoma sp.	-	X	-	-
Hydropsychidae				
Ceratopsyche sparna	-	X	-	-
Cheumatopsyche sp.	X	X	X	X
Diplectrona modesta	-	X	-	-
Hydropsyche betteni	-	X	-	-
Parapsyche cardis**	-	X	-	-
Symphitopsyche slossonae	X	-	-	-
S. sparna	X	-	X	-
Hydroptilidae	-	-	-	X
Limnephilidae				
Pycnopsyche sp.	X	-	-	X
Astenophylax (=*Hydatophylax*) sp.	-	-	-	X
Philopotamidae				
Dolophilodes distinctus	-	X	-	-
Dolophilodes sp.	X	-	X	X

Table 8 (continued).

Scientific name	Qualitative 1979[1]	Qualitative 1991[3]	Quantitative 1979[1]	Quantitative 1981[2]
Polycentropodidae				
Polycentropus sp.	-	X	X	X
Rhyacophilidae				
Rhyacophila sp.	X	-	X	X
Uenoidae				
*Neophylax anigua**	-	X	-	-
Athericidae				
Atherix sp.	-	-	-	X
Ceratopogonidae				
Probezzia/Bezzia /Johannsenomyia	-	-	-	X
Simuliidae				
Simulium sp.	-	-	-	X
Chironomidae				
Group A	X	-	-	X
Group B	X	-	X	X
Tabanidae				
Tabanus sp.	-	-	-	X
Tipulidae				
Dicranota sp.	X	-	-	-
Hexatoma sp.	-	-	X	X
Tipula sp.	-	X	-	-

1. Harker et al. 1980a; 2. Axon 1981; 3. G. A. Schuster, pers. comm.
* indicates a new state record.
** indicates a new state record, identification tentative.

community is relatively stable and viable, and further demonstrates that Bad Branch is a stream of high quality.

Collections made in September 1991 by G. A. Schuster (pers. comm.) of Eastern Kentucky University and his students added several new taxa to the Bad Branch fauna, including at least three new state records (Table 8). These results suggest that additional sampling, especially for adults, could yield further significant information about the fauna of Bad Branch and Kentucky.

c. Fishes

Fourteen species of fishes have been collected from Bad Branch (Table 9). Bailey (1948) reported arrow darter (*Etheostoma sagitta sagitta*)(as *Poecilichthys sagitta*) from Bad Branch in a taxonomic revision of this and related taxa. In addition to arrow darter, Harker et al. (1980a) collected eight other species (blacknose dace (*Rhinichthys atratulus*), central stoneroller (*Campostoma anomalum*), creek chub (*Semotilus atromaculatus*), green sunfish (*Lepomis cyanellus*), northern hog sucker (*Hypentelium nigricans*), rainbow darter (*Etheostoma caeruleum*), stripetail darter (*E. kennicotti*) and white sucker (*Catostomus commersoni*)) from Bad Branch and added impetus for protection of the watershed by identifying the stream as one of the highest quality remaining in the upper Cumberland River basin. Several of these species and bluegill (*Lepomis macrochirus*) were collected in 1979 when the KDFWR examined Bad Branch to determine its suitability for brook trout introductions. Several of these species were collected subsequently when the KDFWR assessed the success of the introductions (Axon 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987; Axon and Carroll 1989). Sampling by KSNPC personnel during 1991 added emerald darter (*E. baileyi*), johnny darter (*E. n. susanae*) and largemouth bass (*Micropterus salmoides*) to the Bad Branch fauna. Johnny darter is a candidate for listing as endangered or threatened by the United States Fish and Wildlife Service (1991) and an endangered Kentucky fish (Kentucky State Nature Preserves Commission 1991). Six of the 14 fish species known from Bad Branch were collected above Bad Branch falls (blacknose dace, bluegill, brook trout, creek chub, largemouth bass and stripetail darter), two of which were only collected there (bluegill and largemouth bass), and 12 species are known from below the falls (arrow darter, blacknose dace, brook trout, central stoneroller, creek chub, emerald darter, green sunfish, johnny darter, northern hog sucker, rainbow darter, stripetail darter and white sucker).

The Bad Branch fish fauna is characteristic of high quality upland headwater streams on the Appalachian Plateaus. Twelve (32%) of 38 fish taxa native to the upper Cumberland River upstream from Cumberland Falls (Burr and Warren 1986) have been collected in Bad Branch. Much of this

Table 9.
Fishes collected from Bad Branch.

Scientific name	Common name
Campostoma anomalum	central stoneroller
Catostomus commersoni	white sucker
Etheostoma baileyi *	emerald darter
Etheostoma caeruleum *	rainbow darter
Etheostoma kennicotti	stripetail darter
Etheostoma nigrum susanae 1,*	johnny darter
Etheostoma sagitta sagitta	arrow darter
Hypentelium nigricans *	northern hog sucker
Lepomis cyanellus	green sunfish
Lepomis macrochirus 2,*	bluegill
Micropterus salmoides 2,*	largemouth bass
Rhinichthys atratulus *	blacknose dace
Salvelinus fontinalis 2,*	brook trout
Semotilus atromaculatus *	creek chub

Sources: Bailey 1948; Harker et al 1980a.
1. state endangered, federal candidate.
2. non-native species.
* collected in 1991.

fauna (e.g., central stoneroller, emerald darter, green sunfish, northern hog sucker, white sucker) may occupy Bad Branch only occasionally because of its small size (Harker et al. 1980a). The fauna is dominated numerically by brook trout and creek chub, but brook trout contributes the most biomass (Axon 1983, 1984; Axon and Carroll 1989; personal observation).

3. Discussion

As indicated by Harker et al. (1980a), the diatom, macroinvertebrate, and fish communities of Bad Branch are diverse and reflect the stream's overall excellent water quality. Humans have altered and degraded the physical and chemical characteristics of most Kentucky streams, even those in small, relatively isolated headwater drainages. These activities also have adversely changed the aquatic communities these streams support. Remnant high quality streams such as Bad Branch and the native aquatic community it supports are important reminders of the natural heritage we have lost and benchmarks against which we can measure the recovery or continuing decline of similar systems. As such, they should be protected from alteration or degradation.

4. Rare Species

Several rare aquatic organisms are known from Bad Branch. *Diatomella balfouriana* was collected from a sandstone cliff in the gorge, apparently only the second report of this diatom in the eastern United States (Camburn 1982b). This genus is rare worldwide and is found in cool water with low mineral content in mountainous areas (Patrick and Reimer 1966).

Several new state records for aquatic macroinvertebrates have been discovered within the Bad Branch watershed: *Litobrancha recurvata*, *Neophylax anigua*, *Parapsyche cardis* and *Stenonema meririvulanum*. The identification of *Stenonema meririvulanum* is still tentative. These discoveries are new state records for the genera *Litobrancha* and *Parapsyche* (G. A. Schuster, pers. comm.).

A subspecies of Johnny darter that is restricted to the upper Cumberland River in Kentucky and Tennessee above Cumberland Falls was collected from Bad Branch for the first time in 1991. This taxon is a candidate for listing as endangered or threatened by the United States Fish and Wildlife Service (1991) and is listed as endangered by KSNPC (1991). This resident of the Poor Fork near the mouth of Bad Branch probably enters the stream only occasionally.

5. Non-native Species

Brook trout is not native to Kentucky (Burr and Warren 1986) and was introduced in Bad Branch for sportfishing in 1980. Reproduction is occurring in the stream as judged from the collection of specimens representing at least three year classes during the summer of 1991. The introduction of brook trout may have altered the Bad Branch fish community through predation on and/or competition with native fishes for food and space. Although not widely known, the presence of brook trout in Bad Branch invites anglers who may trample rare plants and litter the area. Furthermore, discharged blasting caps and wire used to illegally harvest brook trout have been found in Bad Branch (Axon 1981). Although it may be impractical to eliminate this fish from the stream, further introductions should not be permitted, their presence should not be advertised, and any specimens encountered during sampling should not be returned to the stream.

Largemouth bass is not native to the Cumberland River above Cumberland Falls (Clay 1975, Burr and Warren 1986), but was stocked in the pond above Bad Branch falls along with bluegill, which is native to the upper Cumberland River above Cumberland Falls, but not to Bad Branch. If the property that includes this pond is purchased by TNC or KSNPC, it should be drained in order to eliminate this unnatural habitat and these two non-native species.

B. Terrestrial Animals

1. Introduction

The Bad Branch watershed supports a diverse array of terrestrial animals. The variety of animals present can be attributed to the number of different habitats present as well as the lack of recent disturbance to the area. A number of unusual terrestrial vertebrate species are found within the watershed, including at least six species listed as rare by KSNPC (1991). An additional 101 terrestrial vertebrates have been reported from the site. Because of the cooler temperatures within the deep, protected gorges of Bad Branch, many animals present are near the southernmost extent of their range.

2. Review of Data and Determination of Needs

The Bad Branch terrestrial snail (Gastropoda) fauna has not been systematically sampled, but incidental collections and tentative identifications made by J. R. MacGregor (pers. comm.) have revealed the presence of at least 12 species (Table 10). According to Hubricht (1985), several of these snails are found only in the leaf litter of wooded areas, while other species have broad habitat ranges and may live in wooded areas, on roadsides or in urban areas. None of the snail species reported from the Bad Branch watershed are known to be rare. The diversity of the Bad Branch land snail fauna could approach that of Black Mountain and may include Pine and/or Cumberland Mountain rarities (J. R. MacGregor, pers. comm.).

A biological survey of the Bad Branch watershed in 1978 and 1979 provided some information on terrestrial vertebrates (Harker et al. 1979). This study found a diverse array of small mammals, which can be attributed to the variety of habitat

Table 10.
Land snails (Gastropoda) collected from Bad Branch.

Scientific name[1]	Habitat[2]
Anguispira alternata	Wide tolerance, woods to urban areas.
Haplotrema concavum	Leaf litter in upland woods.
Mesodon appressus	Rocky places to urban areas.
Mesodon normalis	Calcareous soils in ravines, mountains to 5000 ft.
Mesodon sayanus	Moist leaf litter or near logs on wooded hillsides.
Mesomphix sp.	No information.
Paravitrea sp.	No information.
Stenotrema edvardsi	Logs and leaf litter in rocky woods.
Stenotrema leai	Meadows, roadsides, near springs, in floodplain woods.
Triodopsis albolabris	Wide tolerance, wooded hillsides to urban areas.
Triodopsis anteridon	Leaf litter and logs on wooded hillsides and in ravines.
Triodopsis sp.	No information.

1. J.R. MacGregor, pers. comm.; 2. Hubricht 1985.

types within the watershed. Five distinct terrestrial habitat types available for small mammals at Bad Branch are listed by Harker et al. (1979): open woodland, boulder or log-strewn woodland, talus area, wet rock face and boulder-strewn creek edge. Miscellaneous observations from other field work in the watershed have provided additional information on terrestrial vertebrates including amphibians, reptiles, birds and mammals (KDFWR Nongame Wildlife Program, pers. comm.; J. R. MacGregor, pers. comm.)(Table 11).

Based on the review of data from the Bad Branch watershed, it was determined that 1991 sampling should emphasize small mammals. The sampling effort was undertaken to confirm the continued presence of rare species previously documented at Bad Branch and to obtain a more comprehensive picture of the area's terrestrial small mammal fauna. Information gathered on other terrestrial vertebrate species was limited to coincidental observations.

3. Field Collection Methods

The Bad Branch watershed was sampled for small mammals during the spring and fall of 1991. Spring sampling was undertaken between March 20 and mid-June; fall sampling was conducted between October 1 and mid-December. Twenty-four sampling sites were established, 14 sites above the waterfall and ten sites below. Pitfall traps, bottle traps, Sherman live traps and snap traps were used. There were approximately 17,700 total trap nights during the sampling period with approximately 760 snap trap nights, 240 Sherman trap nights, 9,300 pitfall trap nights and 7,500 bottle trap nights. Of the 24 sampling sites, 3 were open, disturbed sites; 5 were in rockshelters; 4 were on rocky talus slopes; 1 was on a subxeric slope; 3 were in boggy areas; and 8 were in moist ravines.

Data on breeding birds of the Bad Branch watershed were obtained during trail surveys conducted on 7 and 13 June 1991. Trail count data from these two surveys were summarized to generate most of the list of breeding birds in Table 11.

One attempt was made to conduct mist-net sampling for bats within the Bad Branch watershed. On the evening of 9 August 1991, two net sets were erected along the margin of the pond above the falls.

Additional information on terrestrial vertebrates was gathered coincidental to these sampling efforts. This included miscellaneous observations of small mammals, furbearers, large mammals, breeding birds, amphibians and reptiles.

4. Field Collection Results

Trail surveys for breeding birds conducted in June 1991 yielded observations of 36 species suspected of or confirmed to be breeding in the Bad Branch watershed

Table 11.
Terrestrial vertebrates of Bad Branch Wild River Corridor.

Scientific name	Common name
Salamanders	
Ambystoma maculatum	spotted salamander
Aneides aeneus	green salamander
Desmognathus f. fuscus	northern dusky salamander
D. monticola	seal salamander
D. ochrophaeus	mountain dusky salamander
D. welteri	black mountain salamander
Eurycea cirrigera	southern two-lined salamander
E. l. longicauda	longtail salamander
Gyrinophilus p. porphyriticus	northern spring salamander
Hemidactylium scutatum	four-toed salamander
Notophthalmus v. viridescens *	red-spotted newt
Plethodon glutinosus	northern slimy salamander
P. kentucki *	Cumberland Plateau salamander
P. richmondi	ravine salamander
Pseudotriton montanus diasticus *	midland mud salamander
P. r. ruber	northern red salamander
Frogs and Toads	
Bufo a. americanus	eastern American toad
Hyla chrysocelis	Cope's gray treefrog
Pseudacris brachyphona	mountain chorus frog
P. c. crucifer	northern spring peeper
Rana clamitans melanota *	green frog
R. palustris	pickerel frog
R. sylvatica *	wood frog
Reptiles	
Agkistrodon contortrix mokasen *	northern copperhead
Carphophis a. amoenus	eastern worm snake
Coluber c. constrictor	northern black racer
Crotalus horridus *	timber rattlesnake
Diadophis punctatus edwardsii	northern ringneck snake

Table 11 (continued).

Scientific name	Common name
Elaphe o. obsoleta	black rat snake
Eumeces fasciatus	five-lined skink
Heterodon platyrhinos	eastern hognose snake
Lampropeltis t. triangulum	eastern milk snake
Nerodia s. sipedon	northern water snake
Sceloporus undulatus hyacinthinus *	northern fence lizard
Storeria o. occipitomaculata	northern redbelly snake
Terrapene c. carolina	eastern box turtle
Thamnophis s. sirtalis	eastern garter snake
Birds (breeding)	
Accipiter striatus 2,*	sharp-shinned hawk
Archilochus colubris *	ruby-throated hummingbird
Bonasa umbellus *	ruffed grouse
Bubo virginianus	great horned owl
Buteo jamaicensis	red-tailed hawk
Caprimulgus vociferus	whip-poor-will
Cardinalis cardinalis *	northern cardinal
Cathartes aura *	turkey vulture
Coccyzus americanus *	yellow-billed cuckoo
Corvus brachyrhynchos *	American crow
Corvus corax 1,*	common raven
Cyanocitta cristata *	blue jay
Dendroica caerulescens *	black-throated blue warbler
D. dominica *	yellow-throated warbler
D. pinus *	pine warbler
D. virens *	black-throated green warbler
Dryocopus pileatus *	pileated woodpecker
Empidonax virescens *	acadian flycatcher
Helmitheros vermivorus *	worm-eating warbler
Hylocichla mustelina *	wood thrush
Limnothlypis swainsonii *	Swainson's warbler
Meleagris gallopavo *	wild turkey
Mniotilta varia *	black-and-white warbler
Myiarchus crinitus *	great crested flycatcher
Oporornis formosus *	Kentucky warbler

Table 11 (continued).

Scientific name	Common name
Otus asio	common screech owl
Parus bicolor *	tufted titmouse
P. carolinensis *	Carolina chickadee
Passerina cyanea *	indigo bunting
Philohela minor	American woodcock
Picoides pubescens *	downy woodpecker
P. villosus *	hairy woodpecker
Pipilo erythrophthalmus *	rufous-sided towhee
Piranga olivacea *	scarlet tanager
Polioptila caerulea *	blue-gray gnatcatcher
Sayornis phoebe *	eastern phoebe
Seiurus aurocapillus *	ovenbird
Sitta carolinensis *	white-breasted nuthatch
Strix varia	barred owl
Thryothorus ludovicianus *	Carolina wren
Turdus migratorius *	American robin
Vireo solitarius *	solitary vireo
V. griseus *	red-eyed vireo
Wilsonia citrina *	hooded warbler
Mammals	
Blarina brevicauda *	short tailed shrew
Didelphis marsupialis *	opossum
Glaucomys volans *	southern flying squirrel
Lynx rufus	bobcat
Marmota monax *	groundhog
Microtus [Pitymys] pinetorum *	pine vole
Mephitis mephitis *	striped skunk
Mustela frenata *	longtail weasel
M. vison *	mink
Napaeozapus insignis *	woodland jumping mouse
Neotoma floridana magister 3,*	eastern wood rat
Odocoileus virginianus *	whitetail deer
Parascalops breweri *	hairy-tail mole
Peromyscus leucopus *	white-footed mouse
P. maniculatus nubiterrae *	cloudland deermouse
Procyon lotor *	raccoon

Table 11 (continued).

Scientific name	Common name
Sciurus carolinensis *	eastern gray squirrel
Sorex cinereus 2,*	masked shrew
S. dispar 1,4	long-tailed shrew
S. fumeus *	smoky shrew
S. hoyi winnemana 4,*	pygmy shrew
Synaptomys cooperi *	southern bog lemming
Tamias striatus *	eastern chipmunk
Urocyon cinereoargenteus *	gray fox
Ursus americanus 2,*	black bear
Vulpes fulva *	red fox

Sources: Harker et al. 1979; Kentucky Department of Fish and Wildlife Resources Nongame Wildlife Program, pers. comm.; J.R. MacGregor, pers. comm. * collected/observed in 1991. 1. state endangered; 2. state special concern; 3. federal candidate; 4. former federal candidate.

(Table 11). Observations made during other field work in 1991 provided data for eight additional species, bringing the total number of breeding birds documented from the watershed to 44.

Small mammal sampling within the Bad Branch watershed undertaken in 1991 yielded 44 captures of 9 species. Hairy-tail mole (*Parascalops breweri*) and pine vole (*Microtus pinetorum*) were documented for the first time in the Bad Branch watershed. Collections made in 1991 also verified the presence of two rare small mammals previously known from the watershed: masked shrew (*Sorex cinereus*) and pygmy shrew (*Sorex hoyi winnemana*); however, the long-tailed shrew (*Sorex dispar*) was not relocated. In addition, the presence of five common small mammals previously known from the watershed was confirmed (Table 11). Incidental observations during the sampling period provided information on other mammals including black bear (*Ursus americanus*) and eastern wood rat (*Neotoma floridana magister*). Sampling and observations in 1991 brought the total number of mammals documented from the watershed to 26.

No bats were captured during the one night of mist-net sampling. The weather was stormy and conditions were not favorable for bats to forage.

Although no specific effort to sample for amphibians and reptiles was undertaken in 1991, observations of these animals were recorded during other activities conducted in the Bad Branch watershed. Surprisingly, no amphibians or reptiles were captured in pitfall traps used to sample for small mammals. A total of five amphibians and three reptiles was observed in the watershed in 1991.

5. Discussion of Inventory Results

Birds characteristic of forested habitats are conspicuous in the Bad Branch watershed. The general lack of open habitats reduces the diversity of birds; however, small openings along clifflines and rock outcrops and artificial openings are inhabited by a few species that typically use more open habitats. Sampling in 1991 indicated that the Bad Branch watershed still has a diverse assemblage of small mammals. Although long-tailed shrew was not recaptured in 1991, it has proven to be difficult to capture, and it is believed that the species probably still resides in the watershed in low density.

Although no bats were captured during the one attempt at sampling, it is likely that several species, including rarities, use the Bad Branch watershed. A small cave just below the crest of the mountain may be used by small numbers of bats during spring, summer and fall.

Sampling for amphibians and reptiles was not undertaken in 1991; however, previous work and coincidental observations during 1991 have provided a good baseline list of the herpetofauna. More comprehensive sampling of the entire spectrum of habitats would likely yield additional species.

6. Rare Species

Seven rare terrestrial vertebrate species are known from the Bad Branch Wild River Corridor. Two rare bird species are known from the watershed. At least one nesting pair of common ravens (*Corvus corax*) has been known from Bad Branch since 1982 (Fowler et al. 1985, Kentucky Natural Heritage Program 1991). This is the only confirmed nesting site for ravens in Kentucky. The raven is listed as endangered in the state (Kentucky State Nature Preserves Commission 1991). An adult sharp-shinned hawk (*Accipiter striatus*) was encountered within the Bad Branch watershed above the falls in June 1991. The bird appeared to be behaving territorially. The sharp-shinned hawk is a special concern species in Kentucky (Kentucky State Nature Preserves Commission 1991). This observation represented the first ever breeding season record for this rare raptor within the Bad Branch watershed. Other uncommon species that were observed in the Bad Branch watershed include solitary vireo (*Vireo solitarius*) and black-throated blue warbler (*Dendroica caerulescens*). During the summer, these species are restricted to the Cumberland Mountains in Kentucky. The uncommon Swainson's warbler (*Limnothlypis swainsonii*) also is present regularly in summer in the Bad Branch watershed.

Five rare mammals are known from the watershed: black bear (*Ursus americanus*), eastern wood rat (*Neotoma floridana magister*), long-tailed shrew, masked shrew and pygmy shrew. Observations indicate that black bear, a state special concern species (Kentucky State Nature Preserves Commission 1991), is known from the watershed. Eastern wood rat is a candidate for listing as endangered or threatened (C2) by the United States Fish and Wildlife Service (1991); however, it is not listed as rare within the state of Kentucky. Long-tailed shrew is endangered within Kentucky (Kentucky State Nature Preserves Commission 1991) and was formerly a candidate for listing as endangered or threatened by the United States Fish and Wildlife Service. The species is now category 3C, indicating that it has been found to be more common than was previously thought or that it is not subject to any identifiable threat (United States Fish and Wildlife Service 1991). Likewise, pygmy shrew is listed as 3C by the United States Fish and Wildlife Service (1991). Despite its former consideration for federal listing, pygmy shrew has not been considered rare in Kentucky. Masked shrew is a species of special concern in Kentucky (Kentucky State Nature Preserves Commission 1991).

7. Non-native Species

There are no records of non-native terrestrial animal species within the Bad Branch watershed.

C. Flora and Natural Communities

1. Introduction

The unique quality of the vegetation of Bad Branch was first described by Braun (1935) just before logging of the area. Her intensive study of Pine Mountain provides base-line data that can be used to study the long-term effects of logging.

The topographic diversity of the Bad Branch watershed contributes to the diversity of plants in the area. The crests and valleys of Pine Mountain provide a variety of slopes, aspects and soil types for plants to colonize. Despite logging of the area in the 1940s, the young forests are still rich and diverse. Nineteen species of rare plants are known from the watershed (Kentucky Natural Heritage Program 1991), including species that are typically found in more northern or high mountain areas. There is also a diversity of communities within the watershed; nine natural community types can be distinguished within the area.

2. Review of Data

Braun (1935) originally described the plant communities and species composition of the Bad Branch area. Several more recent studies have been made of the plant community composition of this area since it was logged in the 1940s (Harker et al. 1979, Harker and Phillippi 1980, Harker et al. 1980b)(Table 12). The most dramatic change in species composition since Braun's study is a result of the chestnut blight, which eliminated all American chestnut (*Castanea dentata)* trees from the canopy. When Braun was studying the Bad Branch area in 1935, American chestnut trees were beginning to die as a result of this disease. Many American chestnut stumps are still living and produce stump sprouts; however, these trees do not survive to maturity.

Logging also has altered the natural communities of Bad Branch, causing changes in the proportions of species present in the communities. In the moist forests next to streams, for example, the proportion of tulip poplar (*Liriodendron tulipifera*) has increased and the proportion of hemlock (*Tsuga canadensis*) has decreased (Table 12). Hemlocks are abundant in the understory; however, and they will probably return to dominate the canopy.

The ridgetop communities also have shown a shift in the abundance of certain species. Before logging, there was a greater proportion of oaks and pines than is now found on ridgetops. Since logging, there has been an increase in the proportion of red maple (*Acer rubrum*) and tulip poplar (Table 12). Braun's data indicate that the ridgetops are sometimes occupied by a pine/oak community and sometimes occupied by a mixed oak community. More recent data (Harker and Phillippi 1980) combines the ridgetop communities into one community type. Table 12 shows examples of the

Table 12.
Composition of plant communities - Bad Branch Wild River Corridor.

Scientific name	Common name	Percent Composition: Hemlock Grove '35[1]	Hemlock Grove '79[2]	Valleys/Gorges '35[1]	Valleys/Gorges '79[2]	Valleys/Gorges '80a[3]	Ridgetops '35-P[1]	Ridgetops '35-O[1]	Ridgetops '80[4]
Acer pensylvanicum	striped maple	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0
Acer rubrum	red maple	14.0	14.6	5.5	1.6	6.4	0.0	0.0	10.5
Acer saccharum	sugar maple	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0
Betula lenta	sweet birch	0.0	0.0	1.4	10.9	0.0	0.0	0.0	2.7
Betula allegheniensis	yellow birch	6.0	0.0	9.6	8.6	14.9	0.0	0.0	0.0
Carya glabra	pignut hickory	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
Carya ovata	shagbark hickory	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0
Carya spp.	hickory species	0.0	0.0	0.7	0.0	2.1	0.0	0.0	0.0
Carya tomentosa	mockernut hickory	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7
Castanea dentata	American chestnut	4.0	0.0	2.7	0.0	0.0	7.0	20.0	0.0
Cornus florida	flowering dogwood	0.0	0.0	0.0	0.0	2.1	0.0	0.0	1.1
Fagus grandifolia	beech	0.0	0.0	2.7	0.0	4.3	0.0	0.0	0.0
Juglans cinerea	butternut	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0
Liriodendron tulipifera	tulip poplar	7.0	8.3	11.6	46.1	31.9	0.0	7.0	12.2
Magnolia acuminata	cucumber tree	D	0.0	0.7	0.0	0.0	0.0	0.0	3.4
Magnolia fraseri	fraser's magnolia	D	0.0	1.4	3.9	0.0	0.0	0.0	1.9
Magnolia macrophylla	great-leaved magnolia	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0
Magnolia tripetala	umbrella tree	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0
Nyssa sylvatica	black gum	D	4.2	1.4	0.8	0.0	3.0	3.0	4.6
Oxydendrum arboreum	sourwood	D	0.0	0.0	6.3	6.4	3.0	5.0	9.1
Pinus echinata	yellow pine	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0
Pinus rigida	pitch pine	0.0	0.0	0.0	0.0	0.0	46.0	0.0	11.0
Pinus virginiana	Virginia pine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9

Table 12 (continued).

Scientific name	Common Name	Percent Composition							
		Hemlock Grove		Valleys/Gorges			Ridgetops		
		'35[1]	'79[2]	'35[1]	'79[2]	'80a[3]	'35-P[1]	'35-O[1]	'80[4]
Quercus alba	white oak	13.0	0.0	0.0	0.0	2.1	0.0	18.0	4.6
Quercus coccinea	scarlet oak	0.0	0.0	0.0	0.0	0.0	6.0	0.0	1.1
Quercus montana	chestnut oak	D	0.0	1.4	3.1	2.1	19.0	47.0	13.3
Quercus rubra var *borealis*	northern red oak	0.0	0.0	1.4	1.6	2.1	0.0	0.0	8.8
Quercus velutina	black oak	0.0	0.0	0.0	0.0	0.0	6.0	0.0	1.5
Robinia pseudoacacia	black locust	0.0	0.0	0.0	0.0	2.1	0.0	0.0	3.0
Sassafras albidum	sassafras	0.0	0.0	0.0	0.8	0.0	0.0	0.0	3.8
Tilia heterophylla	basswood	0.0	0.0	3.4	0.0	4.3	0.0	0.0	0.0
Tsuga canadensis	hemlock	45.0	72.9	56.2	10.2	14.9	0.0	0.0	0.8

1. Braun 1935 ('35-P=Pine-dominated forest, '35-O=Oak-dominated forest); 2. Harker et al. 1979; 3. Harker et al. 1980b; 4. Harker and Phillippi 1980.
D - the percentage of these species sums to 8%.

species composition of these two plant community types. The current ridgetop communities are still recovering from logging and are likely to evolve into oak-dominated and mixed pine-oak forests.

The only portion of the watershed that was not logged in the 1940's is the "hemlock grove", an area dominated by mature hemlocks near the mouth of Bad Branch. This area has changed somewhat in species composition since 1935 (Table 12), including a significant increase in hemlock as well as declines in American chestnut, white oak and yellow birch.

3. Field Collection Methods

Aerial photographic interpretation was used to determine the distribution of community types within the Bad Branch watershed. Representative sections of the Bad Branch watershed were walked to qualitatively assess the natural community types present and to verify aerial photo interpretation. An acid seep community was recently discovered in the watershed and was visited to determine its species composition. This area's vegetation is unique enough to be considered a distinct community; however, the area is too small to be apparent on aerial photographs. Community types were delineated into the current Natural Community Classification System for Kentucky (Evans, unpublished draft).

4. Results

a. Species Lists and Description of Natural Communities

1. Lichens, Liverworts and Mosses of Bad Branch

A survey begun in 1986 provided information on the mosses present within the Bad Branch Wild River Corridor (Table 13)(Risk, unpublished draft). Inventory work completed in 1991 provided information on the lichens of Bad Branch (Harris and Buck, unpublished draft)(Table 13). A total of 52 lichen taxa, 23 liverwort taxa and 129 moss taxa have been documented from the Bad Branch area by Harris and Buck (unpublished draft).

2. Vascular Plants of Bad Branch and their Natural Communities.

No floristic study has been conducted at Bad Branch. Information on species present within the watershed has been compiled from several sources (Braun 1935, Harker et al. 1979, Harker and Phillippi 1980, Harker et al. 1980b). Table 14 lists a total of 233 vascular plant species documented from the Bad Branch watershed. Nomenclature follows Kartesz and Kartesz (1980). The column titled

Table 13.
Lichens, liverworts and mosses of Bad Branch Wild River Corridor.

Scientific name
Lichens[1]
Arthonia taediosa Nyl.
Bacidia schweinitzii (Fr. ex Michener) Schneider
Baeomyces absolutus Tuck.
Biatora helvola (Koerber) Hellbom
Buellia stillingiana Steiner
Canoparmelia caroliniana (Nyl.) Elix and Hale
Catinaria atropurpurea (Schaerer) Vezda and Poelt
Ciferriolichen lyratus (Harris) Harris
Cladonia caespiticia (Pers.) Floerke
Cladonia furcata (Hudson) Schrader
Cladonia ochrochlora (Floerke)
Cladonia petrophila Harris
Cladonia squamosa (Scop.) Hoffm.
Dermatocarpon luridum (With.) Laundon
Dimerella pineti (Ach.) Vezda
Graphis scripta (L.) Ach.
Hymenelia lacustris (With.) Poelt and Vezda
Lecanora caesiorubella Ach. ssp. *prolifera* (Fink in Hedr.) Harris
Lecanora cinereofusca H. Magn.
Lecanora hybocarpa (Tuck.) Brodo
Lecanora thysanophora Harris
Lepraria zonata Brodo
Leptogium cyanescens (Rabenh.) Koerber
Menegazzia terebrata (Hoffm.) Massal.
Micarea peliocarpa (Anzi) Coppins and R. Snat.
Myelochroa aurulenta (Tuck.) Elix and Hale
Nadvornikia sorediata Harris
Nephroma helveticum Ach.
Ochrolichia yasudae Vainio
Parmelia aquarrosa Hale
Parmelinopsis horrescens (Taylor) Elix and Hale
Parmelinopsis minarum (Vainio) Elix and Hale
Parmotrema gardneri (Dodge) Serusiaux
Peltigera poludactyla (Necker) Hoffm.
Pertusaria multipunctiodes Dibben

Table 13 (continued).

Scientific name
Pertusaria subpertusa Brodo
Pertusaria waghornei Hult.
Phaeophyscia rubropulchra (Degel.) Essl.
Phlyctis sp.
Physicia americana Merr. in Evans and Meyrow.
Physicia subtilis Degel.
Porpidia albocaerulescens (Wulfen) Hertel and Knoph
Punctelia rudecta (Ach.) Krog
Pyrrhospora varians (Ach.) Harris
Pyxine sorediata (Ach.) Mont.
Rhizocarpon hochstetteri (Koerber) Vainio
Rimelia subisidiosa (Muell. Arg.) Hale and Fletcher
Rinodina tephraspis (Tuck.) Herre
Sarcogyne similis H. Magn.
Thelotrema subtile Tuck.
Trypethelium virens Tuck. ex Michener
Umbilicaria mammulata (Ach.) Tuck.
Liverworts[1]
Bazzania trilobata (L.) S. Gray
Blepharostoma trichophyllum (L.) Dum.
Calypogeia mulleriana (Schiffn.) K. Mull.
Cephalozia lunulifolia (Dum.) Dum.
Cololejeunea biddlecomiae (Aust.) Evans
Conocephalum conicum (L.) Lindb.
Diplophyllum apiculatum (Evans) Steph.
Frullania tamarisci (L.) Dum. subsp. *asagrayana* (Mont.) Hatt.
Jubula pennsylvanica (Steph.) Evans
Kurzia sylvatica
Lejeunea latevirens Nees et Mont.
Leucolejeunea clypeata (Schwein.) Evans
Marsupella sphacelata (Gieseke) Dum.
Metzgeria crassipilis (Lindb.) Evans
Nowellia curvifolia (Dicks.) Mitt.
Odontoschisma prostratum (Sw.) Trev.
Plagiochila austini Evans

Scientific name
P. porelloides (Torrey ex Nees) Lindenb.
Porella platyphylla (L.) Pfeiff.
Radula complanata (L.) Dum.
R. obconica Sull.
Scapania nemorosa (L.) Dum.
Trichocolea tomentella (Ehrh.) Dum.
Mosses[2]
Amblystegium serpens (Hedw.) Schimp. in B.S.G.
Anacamptodon splachnoides (Froel. ex Brid.) Brid.
Andreaea rothii Web. & Mohr
Anomodon attenuatus (Hedw.) Hub.
A. rostratus (Hedw.) Schimp.
Atrichum angustatum (Brid.) Bruch & Schimp. in B.S.G.
A. undulatum (Hedw.) P.-Beauv.
Aulacomnium heterostichum (Hedw.) BSG.
A. palustre (Hedw.) Schwaegr.
Barbula unguiculata Hedw.
Bartramia pomiformis Hedw.
Brachythecium oxycladon (Brid.) Jaeg.
B. plumosum (Hedw.) Schimp. in B.S.G.
B. rivulare Schimp. in B.S.G.
Brotherella recurvans (Mx.) Fleisch.
Bryhnia graminicolor (Brid.) Grout
B. novae-angliae (Sull. & Lesq. in Sull.) Grout
Bryoandersonia illecebra (Hedw.) Robins.
Bryum argenteum Hedw.
B. capillare Hedw.
B. lisae var. *cuspidatum* (Bruch & Schimp. in B.S.G.) Marg.
B. pseudotriquetrum (Hedw.) Gaertn. et al.
Callicladium haldanianum (Grev.) Crum
Campylium chrysophyllum (Brid.) J. Lange
Campylopus tallulensis Sull. & Lesq.
Ceratodon purpureus (Hedw.) Brid.
Cirriphyllum piliferum (Hedw.) Grout
Climacium americanum Brid.

Table 13 (continued).

Scientific name
Ctenidium molluscum (Hedw.) Mitt.
Dicranella heteromalla (Hedw.) Schimp.
Dicranodontium asperulum (Mitt.) Broth.
D. denudatum (Brid.) Britt. in Williams
Dicranum condensatum Hedw.
D. flagellare Hedw.
D. fulvum Hook.
D. montanum Hedw.
D. polysetum Sw.
D. scoparium Hedw.
Diphyscium cumberlandianum Harvill
D. foliosum (Hedw.) Mohr
Ditrichum pusillum (Hedw.) Hampe.
Entodon brevisetus (Hook. & Wils. in Wils.) Lindb.
E. macropodus (Hedw.) C. Mull.
E. seductrix (Hedw.) C. Mull.
Eurhynchium hians (Hedw.) Sande-Lac.
E. pulchellum (Hedw.) Jenn.
Fissidens asplenioides Hedw.
Fissidens bryoides Hedw.
F. cristatus Wils. ex Mitt.
F. osmundioides Hedw.
F. subbasilaris Hedw.
F. taxifolius Hedw.
Fontinalis hypnoides Hartm. (*F. flaccida*?) *
F. novae-angliae Sull.
Forsstroemia trichomitria (Hedw.) Lindb.
Grimmia alpicola Hedw.
G. pilifera P.-Beauv.
Gymnostomum aeruginosum Sm.
Haplohymenium triste (Ces. in DeNot.) Kindb.
Hedwigia ciliata (Hedw.) P.-Beauv.
Herzogiella striatella (Brid.) Iwats.
Heterocladium macounii Best
Heterophyllium affine (Hook. in Kunth.) Fleisch.
Homalia trichomanoides fo. *gracilis* (James ex Peck) Crum
Homomallium adnatum (Hedw.) Broth.
Hookeria acutifolia Hook. & Grev.

Table 13 (continued).

Scientific name
Hygrohypnum micans (Mitt.) Broth.
Hypnum curvifolium Hedw.
H. fertile *
H. imponens Hedw.
H. pallescens (Hedw.) P.-Beauv.
Isopterygiopsis mulleriana (Schimp.) Iwats.
I. tenerum (Sw.) Mitt. *
Leucobryum albidum (Brid. ex P.-Beauv.) Lindb.
L. glaucum (Hedw.) Angstr. in Fries
Leucodon julaceus (Hedw.) Sull.
Loeskeobryum brevirostre (Brid.) Fleisch. in Broth.
M. hornum Hedw.
M. thomsonii Schimp. *
Myurella sibirica (C. Mull.) Reim.
Neckera pennata Hedw.
Orthotrichum pusillum Mitt.
Oxystegus tenuirostris (Hook. & Tayl.) A. J. E. Sm.
Philonotis fontana (Hedw.) Brid.
Plagiomnium ciliare (C. Mull.) T. Kop.
Plagiothecium cavifolium (Brid.) Iwats.
P. denticulatum (Hedw.) Schimp. in BSG *
Platygyrium repens (Brid.) Schimp. in BSG
Platyhypnidium riparioides (Hedw.) Rich.
Pohlia nutans (Hedw.) Lindb.
Polytrichum commune Hedw. var. *commune*
P. commune var. *perigoniale* (Mx.) Hampe
P. juniperinum Hedw.
P. ohioense Ren. & Card.
P. pallidisetum Funck
P. strictum Brid.
Pseudotaxiphyllum elegans (Brid.) Iwats.
Pylaisiadelpha tenuirostris (Bruch & Schimp. ex Sull) Buck
Pylaisiella intricata (Hedw.) Grout
Racomitrium aciculare (Hedw.) Brid.
R. heterostichum (Hedw.) Brid.
Rhabdoweisia crispata (With.) Lindb.
Rhizomnium appalachianum T. Kop.
R. punctatum (Hedw.) T. Kop.

Table 13 (continued).

Scientific name
Rhodobryum roseum (Hedw.) Limpr.
Schistidium apocarpum (Hedw.) Bruch & Schimp. in B.S.G.
Schwetschkeopsis fabronia (Schwaegr.) Broth.
Sciaromium lescurii (Sull.) Broth.
Sematophyllum adnatum (Michx.) Britt.
S. demissum (Wils.) Mitt.
S. marylandicum (C. Mull.) Britt.
Sphagnum sp.
Sphagnum compactum DC. in Lam. & DC.
S. fallax (Klinggr.) Klinggr.
S. lescurii Sull. in Gray
S. magellanicum Brid.
S. palustre L.
S. quinquefarium (Lindb. ex Braithw.) Warnst.
S. russowii Warnst.
Steerecleus serrulatus (Hedw.) Robins.
Taxiphyllum taxirameum (Mitt.) Fleisch.
Tetraphis pellucida Hedw.
Tetrodontium brownianum (Dicks.) Schwaegr.
Thamnobryum alleghaniense (C. Mull.) Nieuwl.
Thelia hirtella (Hedw.) Sull. in Sull. & Lesq.
Thuidium delicatulum (Hedw.) Schimp. in B.S.G.
Tortella humilis (Hedw.) Jenn.
Ulota crispa (Hedw.) Brid.
U. hutchinsiae (Sm.) Hammar

1. R. Harris and B. Buck, unpublished draft; 2. Alan Risk, unpublished draft.
* identification tentative.

Table 14.
A preliminary list of the flora of Bad Branch Wild River Corridor.

Scientific name	Common name	Habit	Community
Acer pensylvanicum	striped maple	T	AM
Acer rubrum	red maple	T	AS,AM,HM,AX,PO,DC
Acer saccharum	sugar maple	T	HM,AM
Actaea pachypoda	doll's-eyes	H	HM,AM
Adiantum pedatum	maidenhair fern	H	HM,AM
Aesculus flava	buckeye	T	HM,AM
Agrostis perennans	autumn bentgrass	H	DC,PS
Aletris farinosa	colicroot	H	AX,PO,VP
Amelanchier arborea	serviceberry	T	AM,AX,PO
Andropogon virginicus	broomsedge	H	DC,PO,PS
Anemone sp.	anemone	H	AM,AX
Aplectrum hyemale	puttyroot	H	HM,AM
Arabis canadensis	sicklepod	H	AM,AX
Arisaema triphyllum	jack in the pulpit	H	HM,AM
Aronia melanocarpa	black chokeberry	S	AC,MC
Asimina triloba	pawpaw	T	HM,AM
Asplenium montanum	mountain spleenwort	H	MC
Asplenium trichomanes	maidenhair spleenwort	H	MC
Aster cordifolius	heart-leaved aster	H	AM,HM
Aster lateriflorus	starved aster	H	PO,PS
Aster linariifolius	stiff-leaved aster	H	AX,PO,PS
Aster patens	spreading aster	H	PO
Athyrium filix-femina	southern lady fern	H	MC,AM
Aureolaria sp.	foxglove	H	PS,PO
Baptisia tinctoria 1	yellow wild indigo	H	PS,PO,DC
Betula alleghaniensis	yellow birch	T	HM,AM

Table 14 (continued).

Scientific name	Common name	Habit	Community
Betula lenta	sweet birch	T	HM,AM
Botrychium dissectum	common grapefern	H	HM,AM
Botrychium matricariifolium 1	matricary grape-fern	H	HM
Boykinia aconitifolia 1	brook saxifrage	H	HM,AM
*Bromus inermis**	smooth bromegrass	H	PO,AX
Calycanthus floridus	sweet shrub	S	HM,AM
Carex debilis	sedge	H	AS
Carex intumescens	sedge	H	AS
Carex parsina	sedge	H	AS
Carex scabrata	sedge	H	AS
Carex torta	sedge	H	AS
Carpinus caroliniana	ironwood	T	HM,AM
Carya glabra	pignut hickory	T	AX
Carya ovata	shagbark hickory	T	AX
Carya tomentosa	mockernut hickory	T	AX
Castanea dentata	American chestnut	T	HM,AX,AM,PS
Caulophyllum thalictroides	blue cohosh	H	HM,AM
Celtis occidentalis	hackberry	T	HM,AM
Chenopodium hybridum	maple-leaved goosefoot	H	HM,AM
Chimaphila umbellata	pipsissewa	H	HM,AM,PO,AX
Chrysopsis mariana	Maryland aster	H	PO,PS
Cimicifuga racemosa	black cohosh	H	AM
Circaea alpina 1	small enchanter's nightshade	H	HM, AM
Circaea lutetiana	enchanter's nightshade	H	HM
Cleistes divaricata 3	spreading pogonia	H	MC
Clematis virginiana	virgin's bower	H	AX,AM
Clethra acuminata	sweet pepper bush	T	MC,HM,AM,AX

Table 14 (continued).

Scientific name	Common name	Habit	Community
Clintonia umbellulata	Clinton's lily	H	HM,AM
Collinsonia canadensis	richweed	H	AM
Cornus florida	flowering dogwood	T	HM,AM
Corydalis sempervirens 3	pale corydalis	H	DC
Cymophyllus fraseri 2	Fraser's sedge	H	AM,HM
Cypripedium acaule	pink lady's slipper	H	AX,PO
Cypripedium calceolus	yellow lady's slipper	H	AM
Danthonia sericea	downy oatgrass	H	PO
Danthonia spicata	poverty oatgrass	H	PS,PO
Dennstaedtia punctilobula	hay-scented fern	H	DC
Dicanthelium boscii	a panic grass	H	PO,AX
Dicanthelium clandestinum	a panic grass	H	AM,HM
Dicanthelium commutatum	a panic grass	H	AM,HM
Dicanthelium depauperatum	a panic grass	H	AX,PO
Dicanthelium latifolium	a panic grass	H	AX,PO
Dicanthelium sphaerocarpon	a panic grass	H	AX,PO,HM,AM
Dioscorea villosa	wild yam	H	AM,HM
Diospyros virginiana	persimmon	T	PO
Disporum lanuginosum	yellow mandarin	H	AM
Disporum maculatum	nodding maculatum	H	AM
Dryopteris intermedia	fancy fern	H	DC,AM
Dryopteris marginalis	marginal shield fern	H	DC,AM
Epigaea repens	trailing arbutus	S	DC,PO
Erigeron annuus	daisy fleabane	H	AX,PO
Euonymous americanus	strawberry bush	S	AM
Eupatorium fistulosum	trumpetweed	H	AS
Eupatorium maculatum	joe-pye weed	H	AM,AS

Table 14 (continued).

Scientific name	Common name	Habit	Community
Eupatorium rotundifolium	round-leaved boneset	H	AX
Eupatorium rugosum	white snakeroot	H	AM
Fagus grandifolia	beech	T	HM,AM
Fragaria virginiana	wild strawberry	H	HM,AM,PO,AX,DC,MC
Fraxinus americana	American ash	T	HM,AM
Galax urceolata	galax	H	PO
Galearis spectabilis	showy orchid	H	AM
Gaultheria procumbens	wintergreen	H	DC,PO
Gaylussacia baccata	black huckleberry	S	AX,PO,VP
Gentiana decora 2	showy gentian	H	PO
Geranium maculatum	wild geranium	H	AM
Gerardia sp.	gerardia	H	PO
Glyceria striata	fowl mannagrass	H	AX
Goodyera pubescens	downy rattlesnake plantain	H	AM,HM
Hamamelis virginiana	witch-hazel	S	AM,HM,AX
Hedyotis caerulea	bluets	H	AM,HM
Hedyotis michauxii 2	Michaux's bluets	H	HM
Heuchera americana	American alumroot	H	AX
Heuchera longiflora	longflowered alumroot	H	AX
Heuchera parviflora	hairy alumroot	H	DC,AX,MC
Hexastylis contracta 1,4	southern heartleaf	H	HM,AM
Hexastylis virginica	little brown jug	H	AM,HM
Hieracium scabrum	rough hawkweed	H	AX,PO
Hydrangea arborescens	wild hydrangea	S	AM,HM
Hypericum hypericoides	St. John's-wort	H	PO
Hypoxis hirsuta	yellow stargrass	H	DC,PS
Hystrix patula	bottle brush grass	H	AX,PO

Table 14 (continued).

Scientific name	Common name	Habit	Community
Ilex opaca	American holly	T	AM,HM
Istotria verticillata	whorled pogonia	H	AM,AX
Juglans cinerea 3,4	white walnut	T	AM,HM
Juglans nigra	black walnut	T	AM,HM
Kalmia latifolia	mountain laurel	S	AS,DC,MC,AX,PO,HM,AM
Lespedeza hirta	hairy bush clover	H	PO,PS,DC
Leucothoe recurva 2	fetterbush	S	VP
Lindera benzoin	spicebush	S	AS,HM,AM
Linum virginianum	wild yellow flax	H	PS,DC
Liparis lilifolia	large twayblade	H	AM,HM
Liriodendron tulipifera	tulip poplar	T	HM,AM,AS,AX
Listera smallii 2	kidney-leaf twayblade	H	AM,HM
Luzula campestris	woodrush	H	AM,AX
Lycopodium lucidulum	shining club moss	H	HM,MC,AM
Lycopodium obscurum	ground pine	H	HM,AM
Lycopodium porophilum	rock clubmoss	H	MC
Lycopodium tristachyum	ground cedar	H	AX,PO
Lysimachia quadrifolia	whorled loosestrife	H	AX,PO
Lysimachia tonsa	loosestrife	H	AX,PO
Magnolia acuminata	cucumber tree	T	AM,HM
Magnolia fraseri	Fraser's magnolia	T	AM,HM
Magnolia macrophylla	great-leaved magnolia	T	AM,HM
Magnolia tripetala	umbrella tree	T	AM,HM
Medeola virginiana	indian cucumber-root	H	AS,AM,HM
*Miscanthus sinensis**	eulalia	H	
Mitchella repens	partridge berry	H	AX,DC,MC,HM,AM,PO
Monotropa uniflora	indian pipe	H	AX,PO

Table 14 (continued).

Scientific name	Common name	Habit	Community
Muhlenbergia sylvatica	muhly grass	H	AM,HM
Muhlenbergia tenuiflora	muhly grass	H	PO,AX
Nyssa sylvatica	black gum	T	AM,HM,PO
Oenothera perennis 1	small sundrops	H	AM,HM
Oenothera sp.	primrose	H	AM,HM
Orobanche uniflora	one-flowered cancerroot	H	HM
Osmunda cinnamomea	cinnamon fern	H	AS,MC,AM
Osmunda regalis	royal fern	H	AS,MC
Oxalis acetosella	wood-shamrock	H	HM,AM
Oxydendrum arboreum	sourwood	T	HM,AX,PS,PO
Oxypolis rigidior	cowbane	H	AS,PS
Parthenocissus quinquefolia	Virginia creeper	V	AX,PO,AM,HM
Pedicularis canadensis	early woodbetony	H	AX,PO,AM,HM
Phacelia bipinnatifida	fern-leaved phacelia	H	AM,HM
Pinus echinata	shortleaf pine	T	PO,AX
Pinus rigida	pitch pine	T	PO,DC,PS
Pinus virginiana	Virginia pine	T	VP,DC,PO,PS
Pityopsis graminifolia	silkgrass	H	PS,PO
Platanthera ciliaris	yellow fringed orchid	H	AS
Platanthera clavellata	small green wood orchid	H	AS
Platanthera flava var. *herbiola*	tubercled rein-orchid	H	HM
Platanus occidentalis	sycamore	T	AM,HM
Poa sp.	bluegrass	H	
Podophyllum peltatum	May apple	H	AM,HM
Pogonia ophioglossoides 1	rose pogonia	H	AS
Polygala curtissii	Curtiss' milkwort	H	AX
Polygonatum pubescens	hairy Soloman's seal	H	AM,HM

Table 14 (continued).

Scientific name	Common name	Habit	Community
Polygonum punctatum	water smartweed	H	AM,HM
Polypodium virginianum	rock cap fern	H	DC
Polystichum acrostichoides	Christmas fern	H	AX,HM,AM
Potentilla simplex	common cinquefoil	H	AX,PO,AM,HM
Prenanthes sp.	rattlesnake root	H	
Pteridium aquilinum	bracken fern	H	DC
Pyrularia pubera	buffalo nut	S	AX
Quercus alba	white oak	T	PO,AM,AX,HM
Quercus coccinea	scarlet oak	T	PS,AX,PO,VP
Quercus montana	chestnut oak	T	PO,AX,PS,HM,VP
Quercus rubra var. *borealis*	northern red oak	T	AM,AX,HM
Quercus velutina	black oak	T	PS,PO
Ranunculus allegheniensis 2	Allegheny mountain crowfoot	H	HM
Ranunculus recurvatus	hooked crowfoot	H	HM,AM
Rhododendron catawbiense	mountain rosebay	S	DC
Rhododendron calendulaceum	flame azalea	S	HM,AX,PO
Rhododendron maximum	great rhododendron	S	AS,HM,AX
Rhus copallina	winged sumac	S	DC,PS,PO
Robinia pseudoacacia	black locust	T	HM
Rubus allegheniensis	blackberry	S	AX,AM,HM,PO
Rubus enslenii	dewberry	S	AX,AM,HM,PO
Salix sericea	silky willow	T	AM,HM
Sambucus canadensis	elderberry	S	AM,HM
Sanguisorba canadensis 1	Canada burnet	H	HM
Sanicula canadensis	short-styled snakeroot	H	HM,AM,PO,AX
Sanicula smallii	snakeroot	H	HM,AM,PO,AX
Sassafras albidum	sassafras	T	DC,PS,PO

Table 14 (continued).

Scientific name	Common name	Habit	Community
Saxifraga michauxii 1	Michaux's saxifrage	H	HM
Schizachyrium scoparium	little bluestem	H	DC,PO,PS
Scirpus cyperinus	bulrush	H	AS
Scutellaria elliptica	hairy skullcap	H	MC
Sedum ternatum	wild stonecrop	H	AX
Senecio obovatus	round-leaved ragwort	H	HM,AM
Silene rotundifolia	catchfly	H	MC
Smilacina racemosa	false Solomon's seal	H	AX,AM
Smilax sp.	greenbriar	V	PO
Solidago erecta	erect goldenrod	H	PO,AX
Solidago flexicaulis	zigzag goldenrod	H	HM,AM
Solidago odora	sweet goldenrod	H	AX
Sorghastrum nutans	indian grass	H	PO,PS
Spiranthes cernua	nodding ladies'-tresses	H	HM,AM
Stellaria pubera	giant chickweed	H	HM,AM
Tephrosia virginiana	goat's rue	H	PO
Thalictrum clavatum	cliff meadow rue	H	MC
Thelypteris hexzagonoptera	broad beech fern	H	AM
Thelypteris noveboracensis	New York fern	H	AS
Tiarella cordifolia	foamflower	H	HM,AM
Tilia americana	basswood	T	HM,AM
Tilia heterophylla	white basswood	T	HM,AM
Trautvetteria carolinensis	false bugbane	H	HM,AM
Trillium erectum	red trillium	H	HM,AM
Trillium grandiflorum	large-flowered trillium	H	AM
Trillium undulatum 2	painted trillium	H	HM,AM
Tsuga canadensis	hemlock	T	HM,AS

Table 14 (continued).

Scientific name	Common name	Habit	Community
Toxicodendron radicans	poison ivy	V	HM,AM,AX
Uvularia perfoliata	bellwort	H	HM,AM
Uvularia grandiflora	large-flowered bellwort	H	HM,AM
Vaccinium arboreum	bush blueberry	S	DC,PO,AX,VP
Vaccinium stamineum	gooseberry	S	PO,AX,VP
*Verbascum thaspus**	woolly mullein	H	PO,AX
Veronica officinalis	drug speedwell	H	PO,AX
Viburnum acerifolium	maple-leaved viburnum	S	HM,AM
Viburnum cassinoides	withe-rod	S	PO
Viola conspersa	dog violet	H	HM
Viola hastata	halberd-leaved violet	H	HM
Viola macloskeyi ssp. *pallens*	sweet white violet	H	HM,AM
Viola priceana	common blue violet	H	HM,AM
Viola rostrata	long-spurred violet	H	HM
Viola rotundifolia	round-leaved yellow violet	H	HM
Viola sororia	wooly blue violet	H	HM,AM
Vitis aestivalis	summer grape	S	AX,PO
*Yucca filimentosa**	bear-grass	H	AX,PO

Sources: Braun 1935, Harker et al. 1979, Harker and Phillippi 1980, Harker et al. 1980b.
1. state endangered species; 2. state threatened species; 3. state special concern species; 4. federal candidate.
* non-native species.
Habit: T=tree, S=shrub, V=vine, H=herb.
Community: AM = Appalachian Mesophytic Forest, AS = Acid Seep, AX = Appalachian Sub-xeric Forest, DC = Dry Sandstone Cliff/Rock Outcrop, HM = Hemlock Mixed Forest, MC = Moist Sandstone Cliff/Rock Outcrop, PO = Appalachian Pine-Oak Forest, PS = Pine Savanna/Woodland, VP = Virginia Pine Forest.

"habit" indicates the growth habit of the species (T=tree, S=shrub, V=vine, H=herb). The natural community type(s) in which each species occurs is identified in the final column. A key to abbreviations for habit and the natural communities is at the end of Table 14. The communities present are described in further detail in the next section.

b. Natural Community Classification

A natural community is a group of organisms interrelated with each other and with their environment (White 1978). Under similar environmental conditions, communities tend to repeat themselves and are thus recognizable as more or less distinct. Nine natural communities are recognized at Bad Branch, based on the current classification system used for Kentucky (Evans, unpublished draft). Five natural community types dominate the ridges and valleys that surround Bad Branch, and four additional natural communities are found less frequently (Fig. 9). Delineation of the communities of Bad Branch is difficult because they are young and the natural community classification system is based on mature communities (Evans, unpublished draft). Rather than classifying the communities based on their current species composition, they were classified according to their expected composition when the communities are mature. Current species composition and information on species composition before logging (Braun 1935) were used to predict the natural community types that will be present when the forests of Bad Branch are mature. Logging, farming and grazing have affected microclimate, soil and seed availability; however, the recovery so far suggests that the area will return to community types similar to those present before logging. These disturbances to the area have created larger areas of more xeric habitat as a result of soil erosion and compaction and higher insolation. The extensive area of pine-oak community present within the watershed may in part reflect the impact of human disturbances. As recovery of the area progresses, the more mesic communities may expand and the drier communities may become less abundant.

The dominant community type present on the lower slopes adjacent to streams is a hemlock-mixed forest (approximately 120 ha (297 acres)), although an Appalachian mesophytic forest (approximately 20 ha (50 acres)) is found less frequently in these low, moist areas and on lower, north facing or other protected slopes (Fig. 9). The upper slopes and mid slopes support a successional stage of an Appalachian sub-xeric forest dominated by oaks (approximately 170 ha (420 acres)). This community type sometimes grades into an Appalachian pine-oak forest (approximately 180 ha (445 acres)). On dry cliff edges, there are almost pure stands of Virginia pine composing a Virginia pine forest community (approximately 10 ha (25 acres)).

Several additional community types cover smaller areas of the Bad Branch watershed. Adjacent to the crest of the mountain is a thin band of open pine woods (approximately 10 ha (25 acres)). This could be a small remnant of a pine savanna/woodland community. Dry and moist (depending on aspect) sandstone cliff/rock outcrop communities are found on bare rock along ridgetops, along the crest of the mountain and along the steep cliffs that line portions of the stream. These communities are dominated by lichens and mosses with vascular plants restricted to pockets of soil in cracks, depressions and ledges. There is no estimate of area for these communities because they are often found on almost vertical cliffs; therefore, a map cannot be used to estimate their area. These communities, with the exception of several large, dry rock outcrops, are not represented on Figure 9 for the same reason. Just below the crest of the mountain, at the headwaters of a tributary of Bad Branch, is a small (approximately 1 ha (2.5 acres)) bog or acid seep community dominated by sphagnum moss.

The area covered by each community was estimated and is included to demonstrate the relative area covered by each community type. These areas are approximate; therefore, their sum does not equal the total area of the wild river corridor (537 ha (1327 acres)).

1. Hemlock-mixed Forest

Hemlock-mixed forests are found in moist ravines along Bad Branch and on some protected, lower slopes. Most examples of this community type within the Bad Branch watershed are in the early stages of development and are dominated by tulip poplar, with hemlock and yellow birch (*Betula allegheniensis*) as frequent components. The mature hemlock-mixed forest described by Braun (1935) was dominated by hemlock with tulip poplar and yellow birch as frequent components. The abundance of hemlock in the understory suggests that these areas are proceeding towards hemlock-mixed forest.

Other species present in the canopy of this community include beech (*Fagus grandifolia*), black locust (*Robinia pseudoacacia*), chestnut oak (*Quercus montana*), great-leaved magnolia (*Magnolia macrophylla*), northern red oak (*Quercus rubra* var. *borealis*), red maple, sourwood (*Oxydendrum arboreum*), sugar maple (*Acer saccharum*), white basswood (*Tilia heterophylla*) and white oak (*Quercus alba*). Areas near the stream often have a dense understory of great rhododendron (*Rhododendron maximum*). The shrub layer of the community includes American holly (*Ilex opaca*), maple-leaved viburnum (*Viburnum acerifolium*), poison ivy (*Toxicodendron radicans*), sweet pepperbush (*Clethra acuminata*), wild hydrangea (*Hydrangea arborescens*) and witch-

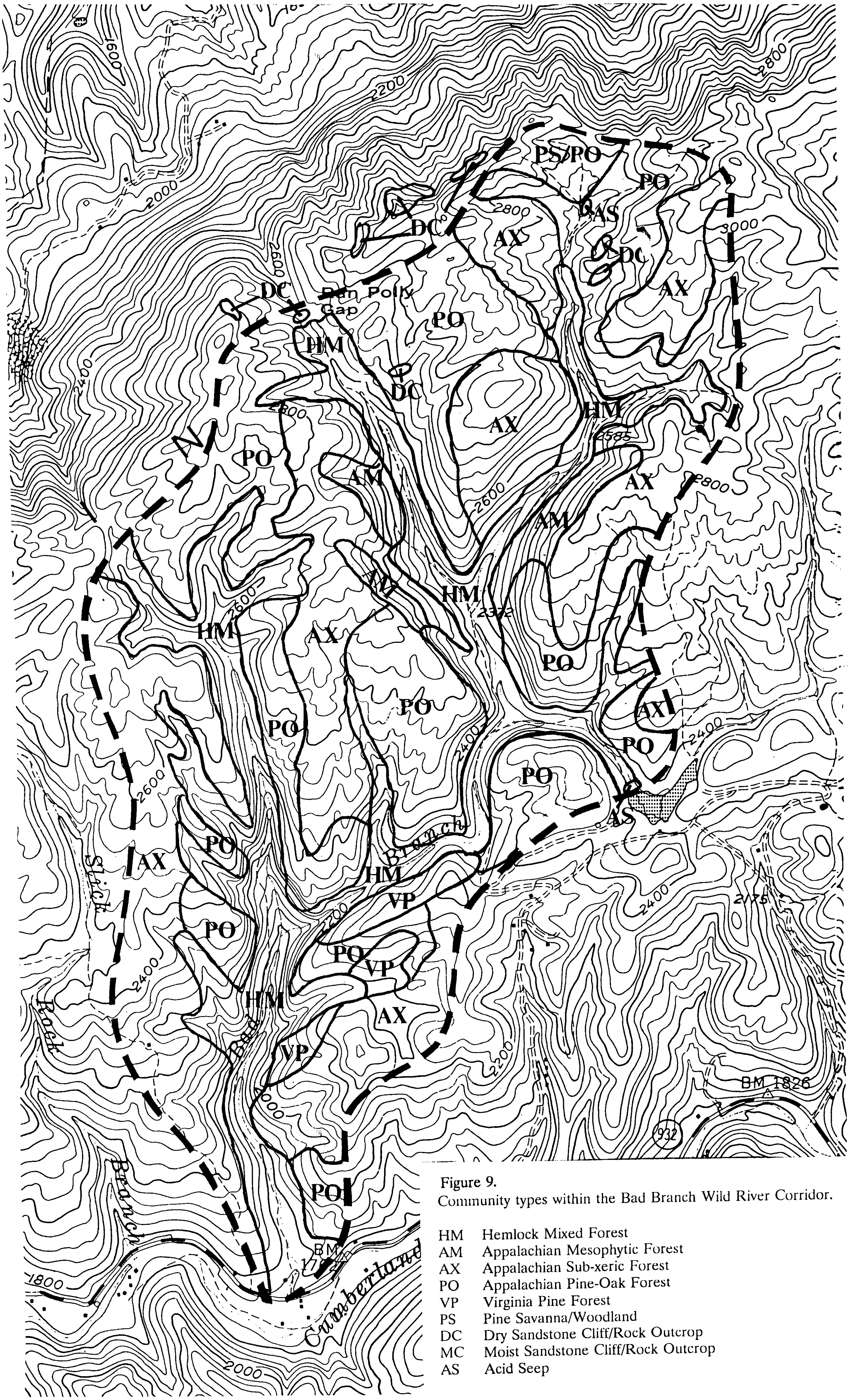


Figure 9.
Community types within the Bad Branch Wild River Corridor.

HM	Hemlock Mixed Forest
AM	Appalachian Mesophytic Forest
AX	Appalachian Sub-xeric Forest
PO	Appalachian Pine-Oak Forest
VP	Virginia Pine Forest
PS	Pine Savanna/Woodland
DC	Dry Sandstone Cliff/Rock Outcrop
MC	Moist Sandstone Cliff/Rock Outcrop
AS	Acid Seep

hazel (*Hamamelis virginiana*). The herb layer is not as diverse in the hemlock-mixed community as in the Appalachian mesophytic forest, partly due to dense shade and the hemlock duff that forms on the forest floor (Braun 1935). Plants commonly found in the herb layer of the hemlock-mixed community include Christmas fern (*Polystichum acrostichoides*), Clinton's lily (*Clintonia umbellulata*), dog violet (*Viola conspersa*), enchanter's nightshade (*Circaea lutetiana*), foamflower (*Tiarella cordifolia*), indian cucumber-root (*Medeola virginiana*), long-spurred violet (*Viola rostrata*), maidenhair fern (*Adiantum pedatum*), partridge berry (*Mitchella repens*) and shining clubmoss (*Lycopodium lucidulum*)(Braun 1935).

Portions of the Bad Branch watershed contain relatively mature examples of this community type. At the northern end of the western branch of Bad Branch there is a relatively mature area of hemlock-mixed forest.

2. Appalachian Mesophytic Forest

This community is found in moist ravines along the stream and on moist, protected lower slopes, often where the soils of these valleys become clayey (Braun 1935). The species composition of the community is similar to that of the hemlock-mixed forest; however, rather than hemlock dominating the community, many species are equally important. Tulip poplar currently dominates the community; however, as the community matures, dominance is expected to be shared more equally between many species. The mature community is dominated by beech, sugar maple, tulip poplar and white oak with American chestnut, blackgum (*Nyssa sylvatica*) and red maple as less common constituents. The understory is composed of buckeye (*Aesculus octandra*), flowering dogwood (*Cornus florida*), Fraser's magnolia (*Magnolia fraseri*), great-leaved magnolia (*Magnolia macrophylla*), ironwood (*Carpinus caroliniana*), pawpaw (*Asimina triloba*), sweet birch (*Betula lenta*), umbrella tree (*Magnolia tripetala*) and white basswood. Shrubs include blackberry (*Rubus allegheniensis*), maple-leaved viburnum, sweet-pepper bush and witch-hazel. The herb layer is rich and diverse and is composed of many ferns including broad beech fern (*Thelypteris hexagonoptera*), Christmas fern, cinnamon fern (*Osmunda cinnamomea*) and maidenhair fern. Other herbaceous species present include black cohosh (*Cimicifuga racemosa*), false Solomon's seal (*Smilacina racemosa*), foamflower, jack-in-the-pulpit (*Arisaema triphyllum*), large-flowered trillium (*Trillium grandiflorum*), nodding mandarin (*Disporum maculatum*), richweed (*Collinsonia canadensis*), showy orchis (*Galearis spectabilis*), wild geranium

(*Geranium maculatum*), yellow lady's slipper (*Cypripedium calceolus*) and yellow mandarin (*Disporum lanuginosum*) (Braun 1935; Evans, unpublished draft).

3. Appalachian Sub-xeric Forest

Appalachian sub-xeric forest is found on dry mid and upper slopes of the Bad Branch watershed. This community is most often found on south and west facing slopes and ridgetops where exposure to wind and sun creates a dry habitat. Many of these dry forests at Bad Branch are younger than the adjacent moist forest. This age difference may be due to repeated fires that occurred in the 1950s after the watershed was logged. The dry nature of these areas made them more susceptible to burning. Farming of these sites after the area was logged also may explain why the dry forests are younger.

The canopy of the Appalachian sub-xeric forest is often somewhat open and is dominated by oaks, with hickories also present (Evans, unpublished draft). At its current early state of succession, the forest contains many red maples and tulip poplars; however, numbers of these species are expected to decline as the forests mature. When Braun (1935) studied the area, American chestnut and white oak dominated the community, with chestnut oak, red maple, scarlet oak (*Quercus coccinea*) and tulip poplar also present. Understory plants included black huckleberry (*Gaylussacia baccata*), blueberry (*Vaccinium* sp.), great rhododendron, mountain laurel (*Kalmia latifolia)* and sourwood, and the herb layer was sparse with Curtiss' milkwort (*Polygala curtissii*), stiff-leaved aster (*Aster linariifolius*) and sweet goldenrod (*Solidago odora*)(Braun 1935; Evans, unpublished draft). Braun (1935) describes the soil where this community is found as sandy with many pebbles.

4. Appalachian Pine-oak Forest

This community is dominated by chestnut oak, pitch pine (*Pinus rigida*), shortleaf pine (*Pinus echinata*), Virginia pine (*Pinus virginiana*) and white oak, with black gum, black oak (*Quercus velutina*), scarlet oak, and sourwood less common. The pine-oak community is found on drier upper and mid-slopes which usually have a shallow layer of soil (Evans, unpublished draft). The understory is composed of the canopy species and persimmon (*Diospyros virginiana*), red maple, sassafras (*Sassafras albidum*) and serviceberry (*Amelanchier arborea*). The shrub layer is usually open and contains blueberries, box huckleberry, greenbriar (*Smilax* sp.) and winged sumac (*Rhus copallina*). The herb layer is very sparse, but varied, with downy oatgrass (*Danthonia sericea*), foxglove (*Aureolaria* sp.), goat's rue (*Tephrosia virginiana*), indian grass (*Sorghastrum nutans*), little bluestem (*Schizachyrium scoparium*), Maryland aster (*Chrysopsis mariana*), poverty oatgrass (*Danthonia spicata*), spreading aster (*Aster patens*), St. John's wort (*Hypericum hypericoides*) and stiff aster (Braun 1935). Braun (1935) reports that the soil in these areas is sandy with a pH between 3.9 and 5.0.

5. Virginia Pine Forest

Stands of almost pure Virginia pine are found in very dry areas at the edge of the tall cliffs that line Bad Branch. This community occurs as a narrow band of varying widths; it is not very extensive. Chestnut oak and scarlet oak are present in smaller numbers. This community is found on shallow, well-drained soil. The understory is dominated by blueberries and huckleberries (Evans, unpublished draft).

6. Pine Savanna/Woodland

Just below the crest of Pine Mountain is a narrow band of open pine forest. Earlier descriptions of this area indicate that it had an open canopy before logging (Braun 1935), suggesting that this feature of the community is not a result of anthropogenic disturbances. Exposure to sun and wind, sandy soil and periodic fires have maintained this sparse community (Braun 1935; Evans, unpublished draft). The litter created by the pines also acts to limit the number of species present (Braun 1935).

Braun (1935) described this area as an open forest dominated by pitch pine, with American chestnut, chestnut oak, scarlet oak and Virginia pine also present. The understory was dominated by grasses (indian grass and little bluestem) with scattered shrubs and some forbs (hairy bush clover (*Lespedeza hirta*), Maryland aster, silkgrass (*Pityopsis graminifolia*) and stiff aster). Currently, the community is open and dominated by pine, with oaks also present. Poverty oatgrass (*Danthonia spicata*) and yellow wild indigo (*Baptisia tinctoria*) are common in the understory. Other herbaceous plants present are similar to those described by Braun (1935).

This community is present in patches interspersed with Appalachian pine-oak forest. It is possible that the pine-oak forest will eventually take over this community if it does not experience periodic fire.

7. Dry Sandstone Cliff\Rock Outcrops

Dry sandstone cliff\rock outcrop communities have developed on the exposed bedrock along the ridgetops and crest of Pine Mountain and on the steep cliffs that line portions of the stream. These communities are most often found on south or west facing aspects where exposure to sun and wind cause severe, dry conditions. Lichens, mosses and ferns dominate this habitat. Vascular plants are limited to places where soil has developed or been deposited in cracks, depressions or ledges. Vascular plants present include alumroot (*Heuchera* sp.), blueberries, bracken fern (*Pteridium aquilinum*), fancy fern (*Dryopteris intermedia*), hairy bush clover, hay scented fern (*Dennstaedtia punctilobula*), little bluestem, marginal shield fern (*Dryopteris marginalis*), mountain laurel, mountain rosebay (*Rhododendron catawbiense*), partridge berry, pink corydalis (*Corydalis sempervirens*), pitch pine, red maple, rock cap fern (*Polypodium virginianum*), sassafras, trailing arbutus (*Epigaea repens*), Virginia pine, wild yellow indigo (*Baptisia tinctoria*), winged sumac and wintergreen (*Gaultheria procumbens*).

8. Moist Sandstone Cliff/Rock Outcrops

Moist sandstone cliff communities are most often found on steep, north or east facing exposures that are protected from the sun and wind. These communities are dominated by lichens, mosses and ferns. Vascular plants that compose this community include catchfly (*Silene rotundifolia*), cinnamon fern, cliff meadow rue (*Thalictrum clavatum*), hairy alumroot (*Heuchera parviflora*), maidenhair spleenwort (*Asplenium trichomanes*), mountain laurel, mountain spleenwort (*Asplenium montanum*), partridge berry, royal fern (*Osmunda regalis*), southern lady fern (*Athyrium filix-femina*) and sweet pepperbush.

9. Appalachian Open Acid Seep

This community is continuously wet as a result of poor drainage and water seepage. The canopy is open, and the ground cover is dominated by *Sphagnum* species. While many small seeps are scattered along Bad Branch, the largest acid seep community occurs just south of High Rock near the source of the eastern branch of Bad Branch. A dense sphagnum mat covers the bog, and shrubs (*Viburnum* sp.) are abundant. Other species present include bulrush (*Scirpus* sp.), cinnamon fern, goldenrod (*Solidago* sp.), hemlock, indian cucumber root, mountain laurel, New York fern (*Thelypteris noveboracensis*), partridge berry, pitch pine, red maple, rhododendron, royal fern, small green wood orchid (*Platanthera clavellata*), trumpetweed (*Eupatorium fistulosum*), tulip poplar and yellow fringed orchid (*Platanthera ciliaris*).

Information on the natural communities present at Bad Branch prior to logging of the area was obtained from Braun (1935); however, her classification of the communities of Pine Mountain is different than the classification system used in this report. Braun distinguished four broad forest types and 16 more specific forest types that are found along Pine Mountain (Table 15).

5. Discussion

The Bad Branch watershed has a diverse array of plant species and community types. Because of the diversity of edaphic factors such as topography, soils and geology, there is a greater number of communities on Pine Mountain than all the rest of the Cumberland Mountains (Braun 1935). Despite logging of Bad Branch in the 1940s, all of the rare species reported from the area prior to logging are still present (Kentucky Natural Heritage Program 1991). Species composition and dominance have changed somewhat as a result of disturbances to the area. The communities are in the early stages of recovery, and species dominance will continue to change. Most communities have shown an increased proportion of tulip poplar since logging; however, species that were dominant prior to logging are still present in lesser numbers. Since the same species are present, these communities may return to their pre-logging proportions of species as they mature. The damage to soils that occurred as a result of logging the Bad Branch watershed also will influence the succession of communities in the area. Disturbances to the area have probably resulted in more dry habitat; therefore, larger areas of the community types adapted to dry habitat. The acid seep community at Bad Branch was not described by Braun (1935), so the size of the community prior to logging is not known. If there was an overall drying trend as a result of soil erosion following logging, this would affect the acid seep; perhaps it was a larger, wetter area prior to the disturbances of logging.

Two less common community types found in the Bad Branch watershed were not logged and remain in a relatively undisturbed state. The dry sandstone rock outcrops that occur along the crest of the mountain have few trees and very little soil; therefore, they were not appropriate for logging or farming. The cliff communities also were protected from logging and farming by their steep slope, and they were protected from fire because of their exposed rock. While these community types were certainly impacted by adjacent logging, they remained relatively undisturbed.

6. Rare Species

Nineteen rare vascular plant species are found within the Bad Branch watershed (Kentucky Natural Heritage Program 1991)(Table 14). All of the rare

Table 15.
Braun's community types of Pine Mountain.

Forest type
pine/oak
pine
chestnut oak/pine
chestnut oak/chestnut
chestnut oak
chestnut/chestnut oak/red maple/pine
chestnut/chestnut oak/white oak/tulip poplar
chestnut/white oak
chestnut/white oak/tulip poplar
chestnut oak/chestnut/white oak
chestnut oak/chestnut/tulip poplar
chestnut/tulip poplar
mixed mesophytic
white oak/beech or white oak
beech/white oak
beech
sugar maple/beech/white oak
basswood/sugar maple/tulip poplar/chestnut
basswood/buckeye/sugar maple/tulip poplar
hemlock

Source: Braun 1935.

species reported by Braun in 1935 are still present. Two of these species, southern heart-leaf (*Hexastylis contracta*) and white walnut (*Juglans cinerea*), are candidates for listing by the United States Fish and Wildlife Service (1990) as federally endangered or threatened. The remaining species are endangered, threatened or special concern within the state of Kentucky. Bad Branch is the only known site in the commonwealth for fetterbush (*Leucothoe recurva*) and Canada burnet (*Sanguisorba canadensis*).

Precise locations of rare species are not included within this report in order to protect the plants from illicit collection. The conservation agencies that manage the property where the rare species are found are aware of the locations of the populations of the rare species and will work to protect these populations.

KSNPC (1991) does not include mosses on their list of endangered and threatened species; however, five mosses not previously reported in the literature for Kentucky are found at Bad Branch. *Homalia trichomanoides* fo. *gracilis* (James ex Peck) Crum. grows on the underside of limestone ledges and is found at two sites in Bad Branch. *Cirriphyllum piliferum* (Hedw.) Grout. is found at one site at Bad Branch. This moss grows on soil and rotten wood. *Polytrichum strictum* Brid. grows only in *Sphagnum* bogs and grows in one bog at Bad Branch. *Sphagnum fallax* (Klinggr.) Klinggr., a species common in northern bogs, is found at Bad Branch as is *S. quinquefarium* (Lindbe. ex Braithw.) Warnst. which occurs at two locations in Bad Branch (Risk, unpublished draft). The latter species is typically found in coniferous forests and was not expected to occur in Bad Branch.

Lichens also are not included in the KSNPC (1991) list of endangered and threatened species. Determining the rarity of lichens is especially difficult because their distribution is not well known. During their inventory of Bad Branch, Harris and Buck (unpublished data) tentatively listed six rare species of lichen that are present within the Bad Branch watershed: *Baeomyces absolutus*, *Catinaria atropurpurea*, *Ciferriolichen lyratus*, *Nadvornikia sorediata*, *Nephroma helveticum* and *Rinodina tephraspis*.

7. Non-native Species

Very few non-native plant species are present in the Bad Branch watershed, and those that do occur are not present in large numbers. Non-native species are primarily present in the area where camps were set up during the logging of the watershed. Introduced species that have been seen in the area include bear-grass (*Yucca filamentosa*), eulalia (*Miscanthus cinensis*) and woolly mullein (*Verbascum thaspus*).

V. RECREATION

A. Use of the Area

1. Traditional Use

Bad Branch was used extensively for hunting and fishing prior to logging. A reported decline in hunting after logging could be a result of the dense vegetation at that time. Animals that were most often hunted prior to logging were gray squirrel, pileated woodpeckers (*Hylatomus pileatus*), opossum, raccoon and ruffed grouse (*Bonasa umbellus*)(J. Maggard, pers. comm.). Animals also were trapped in the Bad Branch area, especially during the late 1800s and early 1900s. Species that were trapped for their coats include, bobcat, gray fox, mink, opossum, raccoon and weasel (J. Maggard, pers. comm.). Minks were the most prized catch, bringing $1 per inch during the depression (J. Maggard, pers. comm.). Fishing was not very popular at Bad Branch until 1980 and 1981 when the KDFWR stocked the stream with brook trout. Before the stream was stocked, only a few locals fished the pools of the stream for creek chubs.

In the past, Bad Branch was a popular camping area. Now that the area is a nature preserve, camping is prohibited. In the 1930s, Ed Baker leased land 0.8 km (0.5 mi.) south of Ran Polly Gap, set up several camps and built a one-room cabin. He visited these camps almost every weekend with boys from nearby areas (O. Adams, pers. comm.). Before 1970, campers did little damage to the area. In the early 1970s, however, 4-wheel drive vehicle enthusiasts began using many of the old logging roads in the area above the waterfall. The use of vehicles resulted in much disturbance to the area, including increased erosion, littering and building of semi-permanent camp sites. In the 1980s ATV use became popular in the area. Horseback riding has been another popular activity in Bad Branch; however, it is currently prohibited within the nature preserve.

In the early 1970s the Kentucky River Area Development District drew up plans to turn Bad Branch into a resort. The proposed resort, "Cloud City", would have been built at the top of Pine Mountain near Ran Polly Gap. Plans for the resort included lodges, cabins, summer homes and recreational facilities. The plans were dropped due to a lack of funding (Keck 1971).

2. Present Situation

According to visitor rosters set up at the main entrance to the nature preserve, there were 634 visitors to the area between January 1, 1990 and January 1, 1992. Due to visitor reluctance to sign rosters, this is likely to be an underestimate of the actual number of visitors. Guided nature hikes draw additional visitors to the site. One hike was sponsored by TNC in 1989, three TNC hikes and one KSNPC hike were given in 1990, and seven TNC hikes were given in 1991. The Pine Mountain Settlement School sponsors a hike for the general public once a year at Bad Branch, and the annual Mountain Heritage Festival in Whitesburg includes a hike to the Bad Branch waterfall. Other local organizations give hikes at Bad Branch, but the exact numbers are not known.

Certain activities that are prohibited within the preserve persist, including horseback riding, camping, ATV use and rock climbing. The property purchased in 1990 by TNC above Bad Branch Falls is most heavily used by horseback riders and ATV users. Since TNC acquired the land in 1990, they have worked to block roads so only hikers can use the area.

3. Future Projections

Local organizations have expressed interest in using Bad Branch to attract tourists to the area. KSNPC and TNC have limited publicity about the area in order to prevent excessive visitation. It is expected that visitation to the area will increase with or without a concerted publicity effort. Kentucky's Assessment and Policy Plan for Outdoor Recreation (Sandidge et al. 1989) suggests that there is some need for additional hiking facilities in southeastern Kentucky. Bad Branch is within the Kentucky River Area Development District which includes Breathitt, Knott, Lee, Leslie, Letcher, Owsley, Perry and Wolfe counties. A study of this area determined that use of hiking facilities is low; however, a poll indicated that people would hike more if better facilities were available (Sandidge et al. 1989).

Nationally, there is an expected increase in day hiking, 144% between 1987 and 2010 and 198% between 1987 and 2030 (Cordell et al. 1988). Between 1960 and 1982 there was a 200% increase in people participating in hiking and backpacking (Hartmann et al. 1988).

B. Facilities

1. Present Situation

Because most of the property within the Bad Branch Wild River Corridor is maintained as a nature preserve, there are essentially no developed facilities within the area. A parking area is maintained at the entrance to Bad Branch along KY 932. A system of trails is maintained within the preserve, and there is an introductory sign to the area and a sign-in sheet for visitors at the entrance.

2. Future Plans

There are no plans for developing more recreation facilities within the Bad Branch Wild River Corridor. The trail system has been expanded to provide access from the parking lot to the falls and to the crest of Pine Mountain. An improved sign will be placed at the trailhead to the falls to ensure that visitors see all the rules of the preserve and to provide visitors with a map of the new hiking trails.

VI. MANAGEMENT PLAN

A. Introduction

The high water quality, the wealth of rare species and the scenic beauty within the Bad Branch watershed make the area a high priority for protection. Managing this area properly requires a balance between needing to protect the natural features and allowing visitors to experience this unique area. Several economic development organizations have expressed interest in advertising Bad Branch in order to promote tourism in Letcher County. The impact of increased visitation on the preserve must be considered. Coordination between state and local agencies, private organizations and individuals is necessary to provide adequate protection for the area.

B. Management Objectives and Protection Strategies

The management objectives for the Bad Branch Wild River Corridor are to: 1) prevent destructive land use; 2) maintain high water quality; 3) maintain healthy populations of the rare species present and conduct additional inventories; 4) maintain or restore natural communities; and 5) provide the facilities necessary to use the area for recreational and educational day hiking without compromising the natural integrity of the area.

1. Prevention of Destructive Land Use

A wild river corridor is protected from certain destructive land uses by the Wild Rivers Act (KRS 146.200-146.350, Division of Water Resources 1976). The regulations that protect wild rivers (401 KAR 4:100 - 401 KAR 4:140) attempt to respect private landowners' rights while protecting the natural features of the area. The Act limits the construction of new buildings or roads, prohibits surface mining and limits selective logging and resource extraction such as oil and gas well drilling. The Kentucky Wild Rivers Program is responsible for monitoring the area quarterly and ensuring that the provisions of the Wild Rivers Act are upheld. Two conservation organizations, KSNPC and TNC, own 488 ha (1206 acres) of the 537 ha (1327 acres) within the wild river corridor, ensuring that this portion of the corridor is protected from development and other destructive land uses. The land owned by KSNPC and TNC is dedicated as a state nature preserve, which provides the highest level of protection for land in the Commonwealth of Kentucky. The law (KRS 146.410-146.535) states that the area cannot be used in ways that are inconsistent with natural area preservation.

Six parcels of land within the corridor are privately owned. Two of the private landowners have conservation agreements with KSNPC and TNC. One landowner has a management lease which allows TNC to manage the property. A second piece of property is under a registry agreement with KSNPC and TNC. The registry agreement states that the owner will not damage the ecology of the area and will inform KSNPC and TNC if they plan to sell the property. Available, privately-owned land should be purchased by KSNPC or TNC and dedicated, if possible, to provide the land with long-term protection.

In order to maintain the high quality of the Bad Branch watershed, high impact recreational activities should continue to be banned. Recreational activities that could damage the area include ATV use, rock climbing, horseback riding, camping, fishing and collecting of any plants, animals or artifacts. These activities are currently prohibited on property owned by KSNPC and TNC; however, the activities persist.

The rule prohibiting fishing requires stronger enforcement. KDFWR does not advertise Bad Branch as a trout fishing stream, but the fact is known locally. Considerable damage occurs when anglers leave the trail and slide down the steep slopes to the stream.

The most frequent violators of preserve regulations are ATV users and horseback riders. TNC has worked to discourage these activities by blocking trails and gating access roads. Because the gates are frequently vandalized, the work needs to be ongoing. The strategic placement of interpretive signage explaining the reasons for the road closure may increase the longevity of the barricades. An additional means of preventing misuse of the area is to hire a full-time preserve manager. The presence of a person in the area full-time will help to discourage prohibited activities within the watershed. During the spring, summer and fall of 1990 and 1991, TNC and KSNPC hired an intern to maintain and monitor their properties. ATV use and horseback riding within the preserve were markedly reduced. A full-time preserve monitor could patrol the watershed and report any violations of the Wild Rivers Act and/or KSNPC and TNC regulations.

Access to the preserve is officially limited to foot traffic to prevent soil erosion on the steep slopes that surround Bad Branch. The trail system follows old logging roads and ATV trails. Sections of the trail have been rebuilt to correct problems caused by erosion and slumping on the steep slopes. Stretches of the trail that run in the streambed will be re-routed to reduce damage to the water quality and aquatic organisms. The goal for the trail system is to maintain one loop trail that leads from the parking lot to the High Rock area with a spur trail to the base of the falls. Reducing the number of trails will lessen the impact of human activities over the entire watershed. Other existing trails will be blocked with brush and fallen trees and left for the forest to reclaim.

The archaeological features of the watershed should be protected. A more complete archaeological assessment of the corridor should be a high priority in order to determine locations of historic and prehistoric archaeological sites. A number of rockshelters occur on the east side of the gorge. These shelters should be inspected for evidence of prehistoric and historic human use. Remnants of stills and other evidence of moonshine operations should be recorded and mapped. Once a site is identified, it should be regularly monitored to determine if it is being damaged. Signs should be posted in rockshelters stating that artifacts should not be removed. In order to keep visitors away from the rockshelters, trails should be built away from clifflines (Henderson 1989). The vestiges of the log covered logging roads, better known as corduroy roads, should be documented and mapped and should not be incorporated into the trail system.

Proposed improvement to US 119 could damage the Bad Branch watershed. TNC, KSNPC and DOW should keep in contact with DOT to ensure that the plans for this road construction do not interfere with the protection of this significant area.

2. Maintenance of Water Quality

Excellent water quality is one of the unique and significant features of Bad Branch. The Wild Rivers statutes (KRS 146.220) prohibit land use within the watershed that could potentially harm the stream's water quality. Periodic water quality monitoring should continue to ensure that water quality remains high. Basic surface water quality constituents should continue to be examined quarterly by DOW, and more exhaustive analyses should be conducted every three to five years. Land use on private property within the watershed should continue to be monitored.

3. Maintenance of Rare Species and Additional Biological Inventories

An important reason for maintaining the quality of the Bad Branch watershed is to protect the rare species present in the area. Precise locations for rare species populations are not included in this report in order to protect them. KSNPC and TNC are aware of the locations of the rare species and are interested in their protection. Rare species within the wild river corridor should be regularly monitored to ensure that the populations are thriving. If a decline in a species is noticed, a thorough study should be undertaken to determine the problem and the appropriate solution. Recent investigations by university researchers have uncovered several important additions to the preserve's flora and fauna. Additional plant and animal inventories should be conducted to close the gaps in information and provide more complete data on the biodiversity of the area.

An inventory of the rare plants within the Bad Branch watershed was completed in 1990 and should be repeated every five years. To protect rare plants from damage by humans, new trails should not be located near occurrences. Existing trails that are near populations of rare species should be moved if there is evidence that the presence of the trail is detrimental to the health of the species.

Continued sampling and monitoring of the water quality, algae, fish and invertebrate populations are necessary to establish baseline information. This can be done by adding Bad Branch to the DOW biological monitoring program schedule or by implementing versions of the following suggested general procedures. Fishes should be sampled by electrofishing (depletion method) to determine population demographics (e.g. size, structure) at the same locations sampled previously by Axon (1982). Fish populations should be sampled periodically, perhaps every three years after the first year. Additional qualitative sampling should be done to see if species new to the watershed are present.

Invertebrates should be sampled in a hierarchical fashion. Presence/absence or general quantitative information should be recorded quarterly when DOW takes water samples. These samples should be collected at the KY 932 site which the DOW samples quarterly and at an additional upstream site. This would provide qualitative information about the presence of major groups, including water quality indicators. Every three to five years, more intensive quantitative sampling could be performed at established sample sites. All sampling should be standardized (time of year, location, sampling method and duration). Additional qualitative aquatic macroinvertebrate sampling needs to be undertaken because of the potential for additions to the fauna. In addition to further sampling of larval forms, late spring, summer and fall light trap samples are needed to collect adults for species level identifications (G. Schuster, pers. comm.). No sampling for terrestrial macroinvertebrates has been completed at Bad Branch. Sampling for terrestrial macroinvertebrates is necessary to determine whether there are any rare species within the wild river corridor.

A thorough inventory of the Bad Branch land snail fauna should be completed. A knowledgeable biologist sampling all habitats could complete this task in about a week.

Sampling for terrestrial vertebrates within the Bad Branch watershed should be repeated on a regular basis. It would be of value to determine whether the long-tailed shrew, a state endangered species and formerly a federal candidate for listing as endangered or threatened, is still present within the watershed. Sampling should be repeated every 10 years using pitfall traps, snap traps, Sherman live traps and bottle traps. Pitfall traps, which are effective for sampling for shrews, should be emphasized to determine whether the rare long-tailed shrew is still present. Inventories to verify the continued presence of the rare bird species within the watershed should be completed more often, perhaps every five years. More extensive sampling for bats is necessary within the wild river corridor to determine whether any rare bat species are found here. It is expected that these inventories will result in the discovery of new rare species at the site. A section of the trail to the falls was re-routed in 1989 to minimize disturbance to the raven's nesting site.

4. Maintenance and Restoration of Natural Communities

Nine natural communities have been identified within the Bad Branch corridor. Although the watershed was logged, the structure and composition of most of the existing community types has not been greatly altered. The majority of the natural communities will not require active management to regain their original condition. However, there are two communities that will require intervention in order to maintain the corridor's existing level of diversity.

It has been suggested that a lack of fire in the pine savanna/woodland near the crest of Pine Mountain has resulted in a decrease in understory species diversity and an increase in ericaceous cover. Research on the fire history of Pine Mountain might provide some insight on the effects of fire on this community. Sampling of the existing understory and further characterization of the community is essential to provide a baseline and to develop a management regime that will restore this community.

The Appalachian open acid seep is in jeopardy from encroaching woody species. The hydrology may have been altered by the construction of the road that borders the length of its western boundary. Additional research is necessary to determine the appropriate steps for restoring the vegetative composition and the hydrology.

Experimental manipulations should be attempted on a representative portion of the pine savanna/woodland community and the Appalachian open acid seep community to evaluate the chosen management regime. Each attempt should be monitored and the whole project evaluated to gauge success.

Although it is not within the boundary of the wild river corridor, the impoundment on the easternmost branch of Bad Branch is within the watershed and affects the remaining portions of the stream. This area is currently under a registry agreement with KSNPC and TNC. If possible, this area should be purchased by KSNPC or TNC. At that time, the pond should be drained and the dam removed. Fishes in the pond can be rotenoned or some can be trapped before rotenone treatment. Water quality and biological monitoring should accompany the draining of the pond to look at downstream impacts, which are expected to be short-term and minimal. The pond site should be allowed to undergo succession to a more natural state. Rare species associated with this site should be considered before decisions are made about altering the area. After the recovery of this area, it may be appropriate to include it in the wild river corridor. An act of the General Assembly would be required to add area to an existing wild river corridor.

Exotic animal species are not common within the Bad Branch watershed, with the exception of brook trout. If monitoring indicates that brook trout threaten the survival of or adversely impact native species, then active work to remove brook trout will be necessary. Exotic plants are not a problem within the Bad Branch Wild River Corridor at this time.

5. Recreational and Educational Facilities

Bad Branch has always had local appeal as a recreation area. The area will continue to be used for recreational day hiking. KSNPC and TNC will maintain trails for hiking. Trail markers in the form of small paint blazes will be installed on trees to aid hikers, and a brochure containing a trail map and information about the preserve and wild river will be developed for visitor use.

Requests to enhance the nature preserve's visibility as an attraction for regional tourism have been increasing in the past five years. The preserve's rare species and excellent water quality must not be jeopardized in an attempt to respond to such requests. Both KSNPC and TNC have agreed that there cannot be an increase in promotion of this area without on site full-time staff to accommodate visitor needs and monitor impacts to the preserve.

The Commission is mandated to provide for educational opportunities on its nature preserves. This is one avenue that has not been explored to its full potential at Bad Branch. Although hikes have been offered within the wild river corridor, the area has not been used as an outdoor classroom for school-aged children. The diversity of habitats, the abundance of birds and wildflowers, the cliffs and the stream itself offer a ready source of study topics. A future goal should be to have preserve staff work with local educators to realize the preserve's potential for classroom use. Both KSNPC and TNC would benefit from the opportunity to educate adult citizens about their objectives for the protection of rare species and natural areas.

Ideally, a full-time manager living on-site would alleviate concerns about illegal activities on the preserve, i.e. ATV and horse traffic, camping, rock climbing and plant collecting, and assist with the development of educational materials. Lilley Cornett Woods, another Letcher County natural area, can accommodate larger numbers of visitors because there are full time staff and summer interns to lead guided tours of the property. The Woods is protected from unrestricted human activities, and visitors can still enjoy an informative hike when accompanied by a staff member.

In the future, it might be possible to coordinate publicity for Bad Branch with county and regional tourism development interests if a full-time position was established and additional funds were available to hire preserve maintenance staff. An operating budget would have to be developed for the preserve to cover such things as an expansion of the existing parking facilities, additional signage, preserve brochures and other educational materials, preserve manager's residence, research grants and equipment, and maintenance equipment and supplies. KSNPC and TNC would have to secure these funds from outside sources. Perhaps matching funds or grants could be developed with the assistance of the local chamber of commerce or the area development district. Whatever the outcome of future opportunities for staff and program development, all growth will be carefully controlled and monitored so that nothing interferes with the protection of the watershed and the rare species that are found there.

For the present, the management of recreation and education within the wild river corridor will not change. Until additional funding is secured, program development cannot expand. The trail system will be monitored by KSNPC and TNC stewardship staff and maintained with the help of volunteers. Research and biological inventories will be encouraged. Guided hikes for local citizens and agency constituents will continue to be scheduled.

C. Management Responsibilities

TNC agreed to dedicate 977 ha (1088 acres) of their Bad Branch property into the state nature preserve system on March 4, 1992. Rules governing all land use activities are defined within the Articles of Dedication. According to the Articles, KSNPC and TNC jointly manage the Conservancy's acreage. KSNPC, TNC and DOW should draft a Memorandum of Understanding that clearly outlines the management responsibilities of KSNPC and TNC and the oversite responsibilities of DOW's Wild River Program.

VII. REFERENCES

Adams, A. 1984. Twixt me and Mose (Life in the hills of eastern Kentucky). A. Adams, Neon, Kentucky, USA.

Axon, J. R. 1980-1987. Annual performance report for statewide fisheries management project, Part III of IV, Subsection III: streams research and management. D-J Project Number F-50, Segment 2-9. Division of Fisheries, Kentucky Department of Fish and Wildlife Resources, Frankfort, Kentucky, USA.

Axon, J. R., and E. W. Carroll. 1989. Evaluation of brook trout introductions into a headwater stream in eastern Kentucky. Fisheries Bulletin 86. Kentucky Department of Fish and Wildlife Resources, Frankfort, Kentucky, USA.

Bailey, R. M. 1948. Status, relationships, and characters of the percid fish, *Poecilichthys sagitta* Jordan and Swain. Copeia 1948:77-84.

Bowles, I. A. 1949. History of Letcher County. The Hurst Printing Company, Lexington, Kentucky, USA.

Braun, E. L. 1935. The vegetation of Pine Mountain, Kentucky. American Midland Naturalist 14:517-565.

Burr, B. M., and M. L. Warren, Jr. 1986. A distributional atlas of Kentucky fishes. Scientific and Technical Series Number 4. Kentucky Nature Preserves Commission, Frankfort, Kentucky, USA.

Bush, D. R. 1988. New evidence of Paleoindian and Archaic occupations in Clay and Perry Counties, Kentucky. Pages 47-66 *in* C. D. Hockensmith, D. Pollack and T. N. Sanders, editors. Paleoindian and Archaic research in Kentucky. Kentucky Heritage Council, Frankfort, Kentucky, USA.

Bush, D. R. and J. E. Thomas. 1986. Phase II. Testing of four rockshelters within the Redbird Ranger District, Daniel Boone National Forest, Kentucky. David R. Bush, Incorporated, Cleveland, Ohio, USA.

Camburn, K. E. 1982a. Subaerial diatom communities in eastern Kentucky. Transactions of the American Microscopical Society 101:375-387.

Camburn, K. E. 1982b. The occurrence of thirteen algal genera previously unreported from Kentucky. Transactions of the Kentucky Academy of Science 43:74-79.

Clay, W. M. 1975. The fishes of Kentucky. Kentucky Department of Fish and Wildlife Resources, Frankfort, Kentucky, USA.

Cordell, H. K. , J. C. Bergstrom, D. B. K. English and J. C. Betz. 1988. Projections of future growth of outdoor recreation in the United States. Pages 203-209 *in* A. H. Watson, compiler. Outdoor recreation benchmark 1988: Proceedings of the national outdoor recreation forum. Southeastern Forest Experiment Station, Asheville, North Carolina, USA.

Cornett, W. T. 1967. Letcher County, Kentucky: a brief history. State-wide Printing Company, Prestonsburg, Kentucky, USA.

Department of Existing Business and Industry. 1991. Kentucky economic statistics: Kentucky open for business. Department of Existing Business and Industry, Division of Research and Planning, Frankfort, Kentucky, USA.

Division of Conservation, Cooperative Soil Survey. 1989. Unpublished data. Frankfort, Kentucky, USA.

Division of Water Resources. 1976. Wild Rivers Act. Wild Rivers Section, Kentucky Department for Natural Resources and Environmental Protection, Frankfort, Kentucky, USA. (Kentucky Revised Statutes 146.200-146.360; Volume 7).

Evans, M. Unpublished draft. Kentucky Ecological Communities. Version 6.64322. Kentucky State Nature Preserves Commission, Frankfort, Kentucky, USA.

Faust, R. J., G. R. Banfield, and G. A. Willinger. 1980. A compilation of ground water quality data for Kentucky. Open file report 80-685. United States Geological Survey, Louisville, Kentucky, USA.

Fenneman, N. M. 1938. Physiography of the eastern United States. McGraw-Hill Book Company, New York, New York, USA.

Fowler, D. K., J. R. MacGregor, S. A. Evans and L. E. Schaaf. 1985. The common raven returns to Kentucky. American Birds 39:852-853.

Fryman, F. B., Jr., M. L. Fryman and M. J. Rodeffer. 1967. A preliminary survey of the proposed Parker Branch Reservoir, Laurel, Jackson and Rockcastle counties, Kentucky. Manuscript on file, Museum of Anthropology, University of Kentucky, Lexington, Kentucky, USA.

Garner, H. F. 1974. The origin of landscapes: a synthesis of geomorphology. Oxford University Press, New York, New York, USA.

Gatus, T. W. 1981. The Hall Shelter: a multicomponent site in southeastern Kentucky. Thesis. University of Kentucky, Lexington, Kentucky, USA.

Gatus, T. W. and T. N. Sanders. 1978. A reconnaissance and evaluation of archaeological sites in Perry County, Kentucky. Archaeological Survey Report No. 9. Kentucky Heritage Commission, Frankfort, Kentucky, USA.

Harker, D. F., G. M. Gigante, R. R. Cicerello, A. R. Boebinger. 1980b. Recommended evaluation procedures for the determination of valuable fish and wildlife habitat. Technical Report. Kentucky State Nature Preserves Commission, Frankfort, Kentucky, USA.

Harker, D. F. and Phillippi. 1980. A vegetation study of Bad Branch. Unpublished data. Kentucky State Nature Preserves Commission, Frankfort, Kentucky, USA.

Harker, D. F., L. R. Phillippe, R. R. Hannan and R. S. Caldwell. 1979. Eastern Kentucky coal field: preliminary investigations of natural features and cultural resources. Volume II. Ecology and ecological features of eastern Kentucky. Technical report. Kentucky State Nature Preserves Commission, Frankfort, Kentucky, USA.

Harker, D. L., Jr., M. L. Warren, Jr., K. E. Camburn, S. M. Call, G. J. Fallo and P. Wigley. 1980a. Aquatic biota and water quality survey of the upper Cumberland River basin. Technical Report. Kentucky State Nature Preserves Commission, Frankfort, Kentucky, USA.

Harris, R. C. and W. R. Buck. Unpublished draft. Lichens collected at Bad Branch Nature Preserve below Bad Branch Falls. New York Botanical Garden, Bronx, New York, USA.

Hartman, L. A., H. R. Freilich and H. K. Cordell. 1988. Trends and current status of participation in outdoor recreation. Pages 147-166 *in* A. H. Watson, compiler. Outdoor recreation benchmark 1988: Proceedings of the national outdoor recreation forum. Southeastern Forest Experiment Station, Asheville, North Carolina, USA.

Henderson, G. 1989. Unpublished trip reports from archaeological surveys of Bad Branch State Nature Preserve. Kentucky State Nature Preserves Commission, Frankfort, Kentucky, USA.

Hubricht, L. 1985. The distributions of the native land mollusks of the eastern United States. Fieldiana 24:1-191.

Karan, P. P. and C. Mather, editors. 1977. Atlas of Kentucky. University Press of Kentucky, Lexington, Kentucky, USA.

Kartesz, J. T. and R. Kartesz. 1980. A synonymized checklist of the vascular flora of the United States, Canada and Greenland. The University of North Carolina Press, Chapel Hill, North Carolina, USA.

Keck, L. 1971. A recreation and tourism plan for Letcher County Kentucky. Kentucky River Area Development District, Hazard, Kentucky, USA.

Kentucky Natural Heritage Program. 1991. Kentucky State Nature Preserves Commission, Frankfort, Kentucky, USA.

Kentucky State Nature Preserves Commission. 1991. Endangered, threatened, and special concern plant and animal species of Kentucky. Kentucky State Nature Preserves Commission, Frankfort, Kentucky, USA.

Leist, D. W., F. Quinones, D. S. Mull, and M. Young. 1982. Hydrology of area 15, eastern coal province, Kentucky and Tennessee. Open-file Report 81-809, United States Geological Survey, Louisville, Kentucky, USA.

Niquette, C. M. and A. G. Henderson. 1984. Background to the historic and prehistoric resources of eastern Kentucky. Prepared by Environment Consultants, Incorporated for the United States Department of Interior, Bureau of Land Management, Alexandria, Virginia, USA.

Patrick, R., and C. W. Reimer. 1966. The diatoms of the United States. Volume 1. Monograph No. 13. Academy of Natural Sciences of Philadelphia, Philadelphia, Pennsylvania, USA.

Plafkin, J. L., M. T. Barbour, K. D. Porter, S. K. Gross, and R. M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers. Benthic macroinvertebrates and fish. EPA/444/4-89-001. Office of Water, United States Environmental Protection Agency, Washington, District of Columbia, USA.

Pollack, D., editor. 1990. The archaeology of Kentucky: past accomplishments and future directions. State historic preservation comprehensive plan report No. 1. Vol. 1 and 2. Kentucky Heritage Council, Frankfort, Kentucky, USA.

Price, W. E. Jr., D. S. Mull and C. Kilburn. 1962. Reconnaissance of ground water resources in the eastern coal field region Kentucky. Geological survey water-supply paper 1607. Washington, District of Columbia, USA.

Purrington, B. L. 1967a. Excavations in the Carr Fork Reservoir, Knott County, Kentucky. Manuscript on file, Museum of Anthropology, University of Kentucky, Lexington, Kentucky, USA.

Purrington, B. L. 1967b. Prehistoric horizons and traditions in the eastern mountains of Kentucky. Thesis. University of Kentucky, Lexington, Kentucky, USA.

Rice, C. L. and D. E. Wolcott. 1973. Geologic map of the Whitesburg Quadrangle, Kentucky-Virginia and part of the Flat Gap Quadrangle, Letcher County, Kentucky. United States Geological Survey, Washington, District of Columbia, USA.

Risk, A. Unpublished draft. A preliminary report on the mosses of the Bad Branch Nature Preserve, Letcher County, Kentucky. Submitted to the Kentucky State Nature Preserves Commission, Frankfort, Kentucky, USA.

Rolingson, M. A. 1974. Paleo-Indian culture in Kentucky. Studies in anthropology No. 2. University of Kentucky Press, Lexington, Kentucky, USA.

Sandidge, V., T. Craighead, J. Barker, B. Renaker, B. Chandler and L. Creech. 1989. Assessment and policy for outdoor recreation. Commonwealth of Kentucky, Frankfort, Kentucky, USA.

Trewartha, G. T. 1954. An introduction to climate. McGraw-Hill Book Company, New York, New York, USA.

United States Bureau of the Census. 1940. Census. United States Bureau of the Census, Washington, District of Columbia, USA.

United States Bureau of the Census. 1990. Census. United States Bureau of the Census, Washington, District of Columbia, USA.

United States Department of Commerce. 1989. County Business Patterns. United States Department of Commerce, Washington, District of Columbia, USA.

United States Fish and Wildlife Service. 1990. Endangered and threatened wildlife and plants; review of plant taxa for listing as endangered or threatened species; notice of review. Federal Register 54:554-579.

United States Fish and Wildlife Service. 1991. Endangered and threatened wildlife and plants; animal candidate review for listing as endangered or threatened species, proposed rule. Federal Register 56:58804-58836.

White, J. 1978. Illinois natural areas inventory technical report. Volume I: survey methods and results. Illinois Natural Areas Inventory, Urbana, Illinois, USA.

Whitesburg Mountain Eagle. 1992. Tall tale from Letcher County concerns famous hole. The Kentucky Explorer 6(7):58.

APPENDIX

COMMENTS ON THE ENVIRONMENTAL INVENTORY AND MANAGEMENT PLAN

The appendix includes comments on the plan and responses to these comments.

Ray Barry
3415 Snaffle Rd.
Lexington, KY 40513

SIERRA CLUB Kentucky Chapter
Bluegrass Group

August 21, 1992

Robert W. Ware, Manager
Water Quality Branch, Division of Water
Department for Environmental Protection
14 Reilly Road
Frankfort, KY 40601

Dear Mr. Ware,

I am responding to the Draft Management Plan for the Bad Branch Wild River on behalf of the Bluegrass Group of the Sierra Club centered in Lexington, KY. I was not able to attend the July 23 hearing in Whitesburg, but I have reviewed the plan and would like to enter some comments into the record.

First, let me congratulate the authors on a fine job of compiling the data and assessing the situation in the Bad Branch corridor. In my role of environmental advocate it is refreshing to see strong support of the environmental principles for which we must usually fight.

Our group supports the management plan set forth in as much as it seeks to achieve the following goals:

1. Protection of the entire watershed, whether or not officially designated as part of the corridor. This is a fundamental issue in protecting against non-point source pollution. It is too often ignored in management plans because the political boundaries do not follow watershed boundaries. Bad Branch is a near ideal location to apply this practice and can set an example for other areas.

2. To be a truly wild river, the corridor should be returned as closely as possible to it's pre-logging state. There is almost no virgin forest left in the eastern part of the U.S., this area represents a chance to recapture a small resemblance of such.

3. Biodiversity is an important element already existing in the corridor and essential to any truly wild area. It is also necessary for a healthy, self-sustaining ecosystem. Maintenance for a diversity of communities as well as a diversity of organism should be a priority of the maintenance plan.

4. Recreation is not the primary purpose of designating the corridor wild. Protection of this valuable resource takes priority over any recreational uses. The current use by horses, ATV's, rock climbers, and trout fishermen is inappropriate for this area.

5. The number of rare and endangered species is one of the most valuable and unique attributes of this area. Protection of sensitive biological assets is important not just on a local scale, but also in the global (world-wide) perspective.

6. Detailed monitoring of the flora, fauna, water quality, and surrounding influences is required to fill gaps in the existing database and to determine future management strategies and tactics.

We also support many of the strategies recommended to achieve these goals. In particular:

1. All remaining privately owned land in the watershed should be purchased when it becomes available, and added to the wild river corridor for protection.

2. Hiring a full time manager would make it more feasible to limit banned activities and provide additional resource to help monitor the water quality and biological assets.

3. All stretches of trail that threaten water quality and rare or endangered species should be re-routed. The trail system should be cut back to one remaining loop trail, all other trails closed and returned to a natural state, including roads. Trails should be maintained in a manner that discourages horse and ATV travel. As long as the existence of the water fall is known it will attract visitors, wether or not there is a trail to it. Therefor, a trail to the falls will be necessary to prevent damage from uncontrolled or unguided traffic. However, it may require special construction and/or devices to reduce the impact of visitors if the area usage becomes too high.

4. The impoundment on the easternmost branch of the stream should eventually be drained and carefully returned to it's original form as noted in the report. Although it should be purchased at the first opportunity, an agreement with the current owner should be pursued, in order to begin the work sooner. Non-chemical means should be sought for eliminating the non-native fish.

5. Active management of the rare and endangered species by monitoring status, diagnosing problems, researching solutions, and carefully testing remedies before full implementation provides the best chance for survival of these species.

6. Brook trout, a non-native species, should be discouraged as it upsets the normal ecological balance of the stream and attracts fisherman who cause soil erosion, water pollution, and trample sensitive plants. Non-chemical means should be sought for achieving this.

7. The management responsibilities of DOW, KSNPC, and TNC should be clearly set forth in a written document so there will be no future problems with deciding which organization has decision making power and specific management responsibilities.

There are only a few recommendations in the report we do no support.

1. We do not support involving the chamber of commerce or development district in any way with the Bad Branch corridor. We have nothing against these organizations, it is simply that their goals and priorities are economic development. Achievement of their goals necessarily involves publicizing, and drawing visitors to the area. Even with a full time manager, increased traffic cannot help but place additional stress on the area. While it may be a tempting source of money to help fund a full time manager, it could be very damaging. Once publicity on the area is released, it is impossible to recall. Also, dependence on these organizations for management funds will give them implicit, if not explicit, leverage in the management decisions. They are going to want to see some kind of payback for their investment, and the managers are going to want to retain their funding. Any reference to such arrangements should be stricken from the plan.

2. We do not consider the preservation of old still sites to be consistent with the other goals of the plan. These should be cleaned up and allowed to return to their natural state the same as other intrusions into this area such as logging roads, impoundments, camp sites, etc.

We find missing from the plan an ordering of priorities. Some of the management goals could prove to be conflicting (such as endangered species located in an archeological site.) An order of priorities should be established to guide conflict resolution and management decisions for which the plan does not give specific instruction.

Although we agree that TNC, KSNPC, and DOW should keep in contact with DOT regarding the proposed improvements to US 119, we are uncomfortable with the informal arrangement. We would like to see the force of law placed behind some type of provision to keep the DOT from doing anything in the corridor without approval of all three organizations.

Finally, we suggest that symbiotic alliances with state Universities could be established. The universities could use the preserve for research and gather some of the data necessary for the biological inventories, water quality studies, etc. for little or no cost.

We would like to thank you for the opportunity to comment and express our willingness to work with you in the future on this and other projects.

Sincerely,

Ray Barry

Ray Barry

PHILLIP J. SHEPHERD
SECRETARY

BRERETON C. JONES
GOVERNOR

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
FRANKFORT OFFICE PARK
18 REILLY ROAD
FRANKFORT, KENTUCKY 40601

November 4, 1992

Ray Barry
Sierra Club - Bluegrass Group
3415 Snaffle Road
Lexington, Kentucky 40513

Dear Mr. Barry:

Thank you for your interest in the Bad Branch Wild River draft management plan, and for your support for the majority of the provisions of the plan. We would like to respond to the recommendations that you stated you did not support.

1. Regarding the possible involvement of the Chamber of Commerce and/or the local development district on the promotion of Bad Branch and as a possible source of funding, these were listed as two possible sources of such assistance. Bad Branch is a well known community resource, and these agencies have in the past indicated a keen interest in the protection of the area. The area has been used by local and regional residents for many years and will continue to be used as such, regardless of any promotional activities which may be undertaken. The Wild Rivers statutes and regulations and the Kentucky State Nature Preserves statutes outline the appropriate level of management and use of the area. Any agreements negotiated with any agency would be subject to the conditions and restrictions of these regulations. As stated in the management plan, all growth will be carefully controlled and monitored so that nothing interferes with the protection of the watershed and the rare species found there. The integrity of the area will in no way be compromised by the managing agencies, regardless of any agreements which may be negotiated with any entity, whether locally or state based.

2. Regarding the appropriateness of protecting old still sites, the state Antiquities Act, KRS 164.705-.735 protects the cultural resources of the Commonwealth. According to the Kentucky Heritage Council, the sites in question, because of their age, are considered an

archaeological resource. As such, they must either be maintained as historic sites, or carefully documented to determine their historical significance before being dismantled. The managing agencies intend to maintain these sites in such a way that no further impact to the natural environment of Bad Branch occurs.

3. In reference to your statement that an ordering of priorities is missing from the plan, the highest priorities of all agencies concerned is to protect the biodiversity of the area and the management plan reflects this. The three agencies have no conflicts in regards to the management plan as presented, and if any conflicts arise in the future, they will be addressed at that time.

4. Regarding the Sierra Club's concerns with the possibility of the proposed improvement to US 119 causing any disruption to the Bad Branch Wild River Corridor, the Kentucky State Nature Preserves statutes prohibit the construction of any roads within the Nature Preserve, and the Wild Rivers regulations mandate that any construction of a state or county road within a wild river corridor require full environmental review by the Division of Water and any other appropriate state natural resource agencies prior to any construction activity. Therefore, it is apparent that the "force of law" is already placed behind the requirement that the Department of Transportation gain approval for any activities they may wish to undertake in the Bad Branch corridor.

5. As to your suggestion that symbiotic alliances with state universities be established, the Kentucky State Nature Preserves Commission has been working for some time to investigate and possibly establish just such alliances.

Again, thank you for your comments and interest in the Bad Branch draft management plan. We will send you a copy of the final plan when it is available.

Sincerely,

Robert W. Ware, Assistant Director
Division of Water

RWW:MOJ:mw

Summary of Oral Comments Received at Public Hearing on Draft Bad Branch Management Plan, July 23, 1992

L. M. Mike Caudill, Whitesburg, Kentucky:
Representing himself, and the Line Fork Fish and Game Club

- Has been a visitor to Bad Branch both before and after acquisition by the Nature Conservancy.
- Much of the wildlife in the area is a result of license fees paid by sportsmen.
- Trout were stocked by Kentucky Dept. of Fish and Wildlife Resources.
- Wild Turkey were stocked by Kentucky Dept. of Fish and Wildlife Resources.
- Wild bear spotted in area were probably stocked by the West Virginia or Virginia Fish and Game Departments.
- Concerned that the plan speaks of hunting and fishing in negative.
- Plan makes no provision for these activities to continue, when sportsmen's dollars created the attraction, as far as fish and wildlife are concerned.
- Plan is very thorough, well-written and impressive.
- There is no reason why the area should not be utilized for hunting and fishing in a responsible manner, to allow return of sportsmen's dollars already invested in the area.
- Disagrees with portion of report that speaks of fishing in a derogatory manner - fishing can be done in a way so as not to degrade water quality or the natural environment.
- Recognizes that threatened and endangered plants and animals need to be protected - plan makes provisions for this.
- In summary, the no hunting/no fishing policy is not good; the plan should consider whether these activities can take place in a responsible manner, without degrading the natural environment and still meeting the goals and objectives set out in the plan.
- Noted that hunting was not mentioned in the list of prohibited activities, when it was apparently intended to be included.

Response to comments from L. M. Caudill

The Articles of Dedication prohibit hunting and fishing. Other nearby areas are available for hunting and fishing.

Frank Majority, Whitesburg, Kentucky:

- The Indians say this area is where the three great rivers begin: the Cumberland, Kentucky and Big Sandy Rivers all arise near here.
- When he was a child, lots of people walked through Bad Branch and near High Rock to go to Whitesburg.
- The area is very historic.
- Area is also an Indian warpath trail.
- Many stories about the area were handed down from parents to their children.
- Lots of berry picking occurred - blueberries and huckleberries.
- In his opinion, this was the most beautiful place in eastern Kentucky.
- He is proud of the area and proud of efforts to protect it.