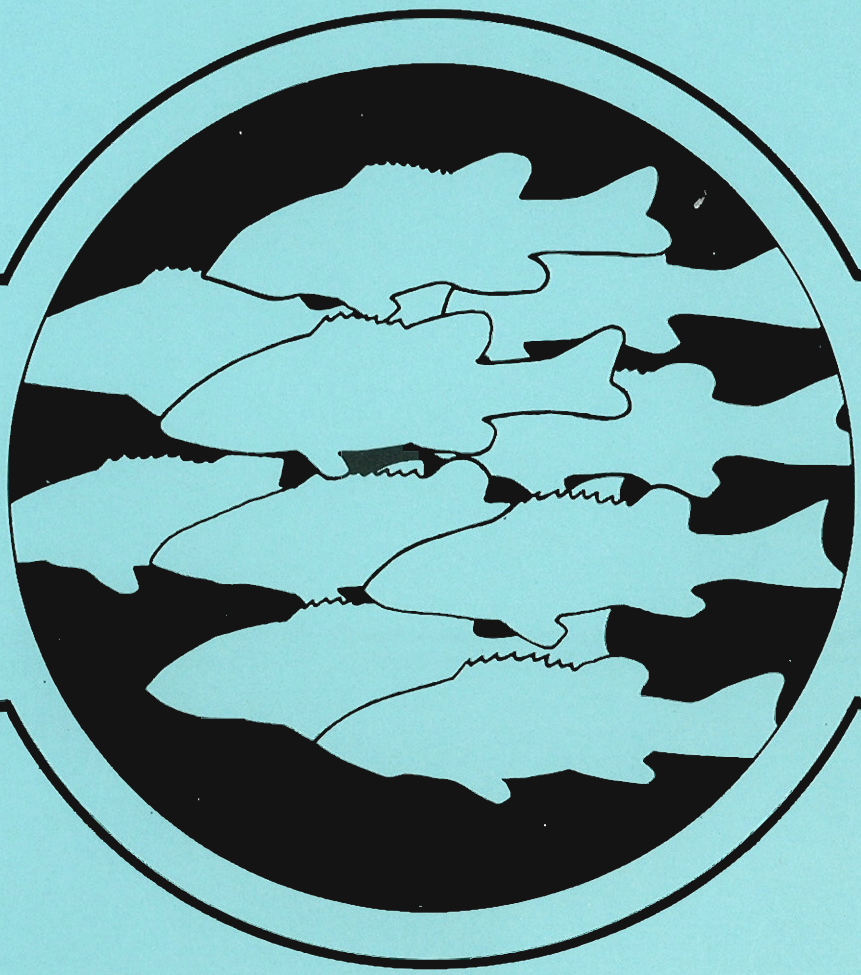

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Muskellunge Streams Investigation in the South Fork Kentucky River Drainage

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CONTENTS

ABSTRACT. 1

INTRODUCTION. 2

METHODS 5

RESULTS AND DISCUSSION. 10

Water Quality 16

Benthic Macroinvertebrates. 17

CONCLUSIONS 20

RECOMMENDATIONS 21

ACKNOWLEDGEMENTS. 22

REFERENCES. 23

ABSTRACT

In order to determine the present status of the muskellunge populations in streams and to determine the potential for enhancing the muskellunge fisheries, studies of the biologiccal, chemical and physical characteriscis were conducted in six streams of the South Fork Kentucky River drainage in 1981 and 1982. The fish population was sampled with an electrofishing unit. Water quality characteristics and the bottom fauna were sampled seasonally. A total of 46 muskellunge were taken from the South Fork Kentucky River drainage during the 2 years of study. Six muskellunge were taken from South Fork Kentucky River, 3 from Sexton Creek, 7 from Redbird River, 18 from Goose Creek, and 12 from Collins Fork. No muskellunge were taken from Little Goose Creek. The catch per unit of electrofishing effort was 0.4 muskellunge per hour in this drainage. The highest concentrations were in Collins Fork (0.9 muskellunge per hour) and Goose Creek (0.8 muskellunge per hour). Muskellunge grew to a total length of 10.2 inches at age 1, 15.6 in at age 2, 20.1 in at age 3, 24.6 in at age 4, 30.3 in at age 5, and 31.4 in at age 6. The fish species most often associated with muskellunge populations was golden redhorse and muskellunge were most often taken in pools where fallen trees were abundant. The strongest year classes of muskellunge were 1978, 1979, and 1980. Stockings of fingerling-size muskellunge evidently strengthened the year class for the year stocked. It is recommended that an annual stocking of muskellunge fingerlings be conducted on streams in the South Fork Kentucky River drainage.

INTRODUCTION

The muskellunge Esox masquinongy is native to a number of Kentucky streams, most of which are in the eastern section of the state. Clay (1962) reported that musky were present in the Kentucky, Licking, and Green River systems as well as Kinniconick Creek and Tygarts Creek. Axon and Kornman (in press) stated that musky ranged throughout more than 700 miles of 18 streams in Kentucky.

Prior to 1967, little fish management work had been done on muskellunge populations within Kentucky. From 1967-1972, muskellunge studies (D-J Project F-31-R) were conducted by Brewer (1980). A recommendation was made by Brewer to supplementally stock one large fingerling muskellunge per 2 acres of pool habitat in selected native muskellunge streams in order to replace the number of young-of-year muskellunge being lost due to adverse environmental conditions (i.e., high discharge rates and low temperatures) occurring during the spawning season in most years. Brewer also recommended the supplemental stocking be evaluated to determine the stocking success.

A fingerling muskellunge (6-9 in) stocking program was carried out on 17 streams from 1973 through 1979. Stocking at South Fork Kentucky River Drainage streams is shown in Table 1. In 1980, a muskellunge stream study was initiated as part of the Dingell-Johnson Project Number F-50. In 1981, this study was expanded to include studies on six streams in the South Fork Kentucky River drainage. These studies were designed to determine the: (1) fish population structure in muskellunge streams, (2) age and growth of muskellunge, (3) exploitation rate and harvest of muskellunge, (4) contribution of muskellunge stockings to the population, (5) population of benthic

macroinvertebrates, (6) water quality conditions, and (7) management potential for developing the muskellunge fisheries in native muskellunge streams.

Study Sites

The South Fork Kentucky River watershed lies in southeastern Kentucky. This mountainous area is characterized by high and steep hills. The ridges are narrow and often capped with sandstone ledges. The surface rocks are sandstone and shale. Common soil types are muskingum stony loam, shaly loam, sandy loam, and silt loam of brownish to yellowish gray color. The watershed covers an area of 735 mile^2. It lies from approximately 640 to 2200 msl with considerable area above 1,000 ft.

South Fork Kentucky River begins with the confluence of Redbird River and Goose Creek at Oneida, Kentucky. It flows to the north through Owsley County for 40.38 mi to join the Kentucky River at Beattyville. The elevation where South Fork is formed is 760 ft msl; the elevation at Booneville (Hwy 30) is 660 ft msl. The stream gradient is 3.3 ft/mi in this portion where muskellunge are most prevalent. The lower 12 mi from Booneville to the mouth has a mean gradient of slightly less than 2 ft msl. The mean gradient for the entire stream is 2.9 ft msl.

Sexton Creek rises in southeastern Jackson County and flows east and north through northern Clay County to join South Fork Kentucky River in Owsley County. This stream is 24 mi long and has an average gradient of 18.5 ft/mi. The headwater elevation is about 1,100 ft msl; the elevation where it enters the South Fork Kentucky River is about 700 ft msl. The mean gradient is about 7.8 ft/mi within the lower 12

mi that is considered muskellunge range (Table 2). Approximately 75% of Sexton Creek is bordered by pasture and crop fields (corn and tobacco). The hills around this bottom land are primarily wooded. Strip mining for coal in this watershed has resulted in acid-mine water entering the stream and causing periodic fish kills.

Redbird River rises in northern Bell County and flows north-northwest to join Goose Creek where the two streams form South Fork Kentucky River at Oneida. This stream is approximately 41 mi long and has an average gradient of 22.5 ft/mi. The headwater elevation is about 1,680 ft msl. The elevation where it enters South Fork Kentucky River is about 760 ft msl. The mean gradient where muskellunge habitat occurs is approximately 4.2 ft/mi. The headwater of this watershed is characterized by steep hills and a narrow valley. In the lower half of this watershed, the valley is wider, with small fields on either side of the river, some of which are used for crops. Practically the entire shoreline is lined with trees. This stream has been affected to a limited extent by silt from stripmine operations in the headwater section.

Goose Creek rises in southern Clay County and flows north-northwest to Manchester, where it takes a northeast course to join Redbird River. Goose Creek is 42 mi long, with a mean gradient of 16.3 ft/mi. The lower 20 mi, which is considered muskellunge habitat, has a mean gradient of 3.0 ft/mi.

Collins Fork rises in northern Knox County and flows northwest to join Goose Creek near Bluehole in Clay County. This stream is 20 mi long and has an average gradient of 13 ft/mi. The headwater elevation is about 1,100 ft msl; the elevation where it

enters Goose Creek is about 840 ft msl. The mean gradient within the lower 15 mi, which is considered muskellunge range, is about 5.3 ft/mi. Collins Fork is bordered by pasture and crop fields in the bottomland, while the hills are primarily wooded. There is some strip-mining for coal in this watershed.

Methods

Fish sampling stations were selected according to accessability and were only those pools known as muskellunge habitat by the local conservation officer. The range of muskellunge habitat in Redbird River, Goose Creek, and Collins Fork was determined by use of topographic maps with aid of Conservation Officer Joe Burchell. Muskellunge range on South Fork Kentucky River and Sexton Creek was obtained from Brewer (1980). Location and statistics on each pool sampled can be found in Table 2. The range of muskellunge in each stream is listed in Table 3.

The fish populations of study streams were sampled for 2 consecutive years with the use of a boat-mounted electrofishing unit. This unit consisted of a 16-ft aluminum boat containing a 5,000 watt, 180 HZ generator with an Chenault box to control the power output. The AC output was usually 5-9 amps at 240 volts.

The fish populations were sampled on six South Fork Kentucky River streams during 1981. Studies were conducted from April 14 - September 30 in a total of 35 pool areas. During 1982, the fish populations were sampled in 34 pools on the same six streams from May 4 through November 2.

The entire shoreline of each sampling site was electrofished at least one time. If more than one muskellunge were taken during the first trip around a study pool, a repeated trip was made in an effort

to ascertain recapture data. All efforts to collect recapture data proved to be unsuccessful; therefore, the Peteson method could not be used as an estimate of the total muskellunge population. According to Robson and Regier (1964), population estimates were found to be highly inaccurate when fewer than four recaptures were made. Therefore, catch per unit effort (CPUE) by electrofishing in each stream was used for estimating the population density of muskellunge.

The total fish population was sampled during part of the first round of electrofishing. These fish were identified and measured. Fish that could not be identified in the field were preserved in formalin and identified later in the laboratory. Fish were identified using fish keys by Clay (1975), Eddy (1957), and Pfleiger (1975). Scientific and common names were assigned according to Robins et al. (1980).

Captured muskellunge were measured to the nearest 0.1 in and weighed to the nearest 0.01 lb. Muskellunge under 30 in long were marked by clipping one of the pelvic fins to enable determination of possible recapture. Fish $\geq$30 in long were tagged with a monel self-piercing jaw tag on the anterior, basal edge of the dorsal fin. Tags where numbered and identified as belonging to the Kentucky Department of Fish and Wildlife Resources. Scale samples were taken from each muskellunge.

Age and growth determinations were made by reading scales which had been cleaned, dampened, mounted between glass slides, and projected by a Bausch and Lomb Tri-Simplex microprojector. Back-calculations of growth were determined by utilizing a modification of the Lee Method (Lagler 1956, Everhart and Youngs 1981), using a correction factor determined by Brewer (1980). The correction factor

was determined by extrapolation of the regression line represented by plotting the scale measurement against body length. The body-scale relationship determined by Brewer was based on 152 muskellunge collected from nine streams in eastern Kentucky. The relationship between body length and scale length, as determined by Brewer, was expressed in the equation L = 4.5 + 3.65, which has a correction factor of 4.5 in. Brewer's correction factor was substituted into the formula $L' = C + \frac{S'}{S}(L-C)$ where:

L' = length of fish at annulus

C = correction factor

S' = length of scale radius at annulus

S = length of total scale radius

L = total length of fish at capture

Pool dimensions were measured by using topographic maps and a cartometer, along with a tape measure for width. Sounding was done to determine the depth. Gradient was determined by measuring mileage and reading elevations from topograhpic maps.

Water quality parameters were taken seasonally during the spring, summer, and fall at a total of nine locations in the South Fork Kentucky River drainage. These stations were as follows: Little Goose Creek (Hwy 687 bridge), Sexton Creek (mouth of Anglin Branch), Collins Fork (between Rock House and Cool Springs), Redbird River (Bullskin Branch), Goose Creek (Sutton Branch), and Severe Branch, and the South Fork of the Kentucky River (Teges, Upper Wolf, and Meadow Creek). Parameters taken were temperature, dissolved oxygen, total alkalinity, turbidity, pH, and specific conductivity. All parameters were determined by standard procedures. Water temperature and

dissolved oxygen concentrations were determined with a YSI Model 54 oxygen meter. Total alkalinity was determined using brom cresol green-methyl red as an indicator and titrating with 0.02 N sulfuric acid. Hydrogen ion concentration and turbidity (NTU) were measured with a Hach OR-E2-5 portable water analysis kit. Specific conductivity was determined with a YSI Model 33 S-C-T meter.

Bottom fauna samples were taken at eight locations within the South Fork Kentucky River drainage. Samples were taken from a single location on each of the following streams: Little Goose Creek (Hwy 687 bridge), Sexton Creek (mouth of Anglin Branch), Collins Fork (between Rock House and Cool Springs), and Redbird River (Bullskin Branch). Macroinvertebrates were taken from both an upstream and downstream section of Goose Creek (Severe Branch and Sutton Branch, respectively) and the South Fork of the Kentucky River (Teges and Meadow creeks, respectively).

The "kick" method was utilized to collect the benthic macroinvertebrates. The invertebrates were dislodged from the substrate in riffle areas and collected with a D-framed aquatic net within a sample area of 1 square meter at each of two locations at each sampling station. Each station was sampled during the spring (May), summer (July), and fall (October). After collecting, the specimens were preserved in 80% ethanol and later sorted and identified in the laboratory. Keys and other manuals used to identify the organisms to species, whenever possible, included Brigham et al. (1982), Lehnkul (1979), Pennak (1978), and Unsinger (1956).

The collection of macroinvertebrates at each of the sample locations was envisioned to serve as a method to evaluate the level of

degradation, if any, of each of the streams studied. Diversity indices ($\bar{d}$) were calculated by using the Lloyd, Zar, and Karr (1968) machine formula of the Shannon-Weaver (1949) equation $\bar{d} = C/N(N\log_{10}N - E^{n}i\ 1^{o}g_{10}ni)$ where C is a constant (3.321928), N is the total number of individuals, and ni is the total number of individuals in the ith species. Wilhm (1970) stated that the diversity index ($\bar{d}$) had values generally between 3 and 4 in unpolluted water and less than 1 in polluted water. Values between the upper and lower limits express conditions of moderate pollution.

Research conducted by U.S. Environmental Protection Agency biologists has shown that $\bar{d}$ lacks the sensitivity to demonstrate differences between slight to moderate degradation. Therefore Lloyd and Ghelardi (1964) developed an equation that compares $\bar{d}$ with the type of distribution frequently found in natural situations, that of a few relatively abundant species and numerous species represented by only a few individuals. This formula (e=S'/S) compares the number of species in a sample (S) with the number of species expected from natural communities (S') based upon tabulated values of $\bar{d}$. Equitability (e) has been found to be sensitive to slight levels of degradation. Values for equitability range from 0 for polluted conditions to 1 for clean water, except for the cases where there are relatively few specimens with several taxa represented (Weber 1973). A situation such as that described could result in values greater than 1. Equitability (e) was not found to be below 0.5 in southeastern streams unaffected by oxygen-demanding wastes. Southeastern streams usually range from 0.6-0.8. Studies have shown that even the slightest degradation can result in equitability dropping to values between 0.0-0.3.

RESULTS AND DISCUSSION

Muskellunge Population Characteristics

South Fork Kentucky River

In 1981, four muskellunge were taken during 33 hours and 16 minutes of electrofishing for a capture rate of 0.1 muskellunge per hour of electrofishing. One muskellunge was captured per 20 acres (2.19 mi). An area of 80.2 acres (8.8 mi) was sampled out of a total of 509 acres (32 mi) of muskellunge habitat in pools (Table 4). In 1982, two muskellunge were taken during 9 hours and 40 minutes of electrofishing at eight pools. The capture rate was 0.2 muskellunge per hour. One muskellunge was taken in every 41.2 acres (3.7 mi) of muskellunge pool habitat sampled. The mean capture rate for both years was 0.1 muskellunge per hour and 0.4 muskellunge per mile (Table 3). No legal-size muskellunge were taken in this stream.

Muskellunge were taken each year from pool numbers 1 (river mile 37-39) and 4 (river mile 23). One muskellunge was sighted but not collected in pool number 2 (river mile 29.3-30.2) in 1981 and two muskellunge were sighted but not taken in pool number 1 during 1982. No muskellunge were taken below the mouth of Sexton Creek. This apparent concentration of muskellunge in the upper section of South Fork Kentucky River could have been influenced by the fact that the lower section had high water temperatures in the summer. Also, the efficiency of capture by electrofishing was very likely reduced by the wider pools in the downstream section.

Sexton Creek

Sexton Creek had one of the highest population densities of

muskellunge of all South Fork Kentucky River streams. Three muskellunge wer taken during 2 hours and 45 minutes of electrofishing at three pools on Sexton Creek in 1981; one of these fish was legal size (Table 4). An area of 4.3 acres (0.8 mi) was sampled out of a total area of 28 acres (4 mi) of muskellunge habitat in this stream. In 1982, no muskellunge were taken during 1 hour and 40 minutes of electrofishing at three pools on this stream. The mean capture rate for 2 years of sampling was 0.7 muskellunge per hour and 1.9 muskellunge per mile. Muskellunge were taken from the upper and lower pools, while none were taken from the middle pool.

Redbird River

Four muskellunge were captured from three of seven pools and 4.4 miles of Redbird River in 1981. Two muskellunge were collected from two of seven pools and 4.4 miles of pool habitat in 1982 (Table 4). Muskellunge were captured at a rate of 0.5 fish per hour and 0.9 fish per miles in 1981. In 1982, muskellunge were captured at a rate of 0.4 fish per hour and 0.7 fish per mile. The mean rate of capture from both years of electrofishing wa 0.5 muskellunge per hour and 0.8 muskellunge per mile. This represented the lowest catch rate of muskellunge from the five streams where muskellunge were taken in the South Fork Kentucky River drainage. Muskellunge were taken from three of five pools sampled from mile 17.4 downstream to mile 4.5.

Goose Creek

Muskellunge were taken from seven of the nine pools sampled on Goose Creek in 1981 and 1982. In 1981, 11 muskellunge were taken during 15 hours and 15 minutes of electrofishing for a capture rate of 0.7

muskellunge per hour of electrofishing. One muskellunge was captured per 2.85 acres (3 mi). An area of 31.4 acres (4.75 mi) of habitat was sampled out of a total of 102 acres of muskellunge habitat. In 1982, seven muskellunge were taken during 7 hours and 45 minutes of electrofishing at eight pools. The capture rate was 0.9 muskellunge per hour. One muskellunge was taken in every 5.1 acres (0.74 mi) of pool habitat sampled. A total of 3 legal-size and 15 sub-legal muskellunge were taken during both years of sampling. The mean capture rate for both years of sampling was 0.8 muskellunge per hour and 1.6 muskellunge per mile.

Little Goose Creek

No muskellunge were taken from Little Goose Creek during 1981 or 1982. Electrofishing studies were conducted on two pools in 1981 and one pool in 1982.

Historically, this stream was affected by acid drainage from deep mining from coal. In 1969, the pH range was between 5.1 and 5.9 (Brewer 1980). In 1982 and 1983, the pH ranged between 7.2 and 7.6. This dramatic improvement in the pH has resulted in a better fish population in Little Goose Creek; however, muskellunge apparently inhabit only the lower section of this stream during the period of spawning.

Collins Fork

In 1981, six muskellunge were taken during 9 hours and 40 minutes of electrofishing at seven pools for a capture rate of 0.6 muskellunge per hour of electrofishing. One muskellunge was captured per 1.6 acres (0.35 mi). An area of 9.8 acres (2.10 mi) of habitat was sampled out of a total of 24.0 acres (3.5 mi) of suitable habitat. In

1982, six muskellunge were taken during 4 hours of electrofishing at nine pools. The capture rate was 1.5 muskellunge per hour. One muskellunge was taken in every 2 acres (0.54 mi) of muskellunge pool habitat sampled. The mean capture rate for both years of sampling was 0.9 muskellunge per hour and 2.5 muskellunge per mile. This represented the highest population density of muskellunge from the six streams sampled on the South Fork Kentucky River drainage during 1981-1982. One legal-size muskellunge was taken on this stream in 1981. Muskellunge were taken from 8 of the 10 pools sampled from the mouth upstream to mile 11.6, indicating good distribution of the muskellunge population in Collins Fork.

The total number of muskellunge captured in the South Fork Kentucky River drainage in 1981-1982 was 46 fish (Table 5). An additional 13 fish escaped capture. The efficiency of capture was 78%. Eleven percent of the number of captures was of legal size ($\geq$30 in). This compares to 24% at Tygarts Creek and 59% at Kinniconick Creek during 1980-1981 studies (Kornman 1983).

The greatest number of legal-size and sub-legal size fish were captured in Goose Creek. The catch rate for muskellunge in Goose Creek was second best at 0.8 fish per hour, nearly the same as at Collins Fork (0.9 fish/hr). The mean catch rate for all streams in the drainage was 0.4 muskellunge per hour. Only Little Goose Creek and South Fork were below the mean.

The growth of muskellunge was very similar at the five streams that this species was captured (Table 6). When compared to growth of muskellunge in all other streams studied since 1980 by Kornman and Prather, fish in the South Fork Kentucky River drainage streams grow slower (Axon and Kornman, in press). This might be due to the lower alkalinity and more acidic conditions in this drainage as discussed later.

Muskellunge were captured that belonged to each year class from 1975 through 1981. Muskellunge were stocked in the South Fork drainage each year except in 1975 and 1977. It is difficult to determine if stockings strengthened any year classes from observing this data. However, there was a greater number of fish collected from the 1978 year class compared to 1977. Muskellunge were stocked in 1978, but not in 1977.

During 1981 and 1982 studies, a total of eight muskellunge were tagged that were 29 inches or longer. As of this writing, only one tag has been returned from an angler. This muskellunge was captured and tagged at Goose Creek on 16 June 1981 at an age of 5+; the total length was 29.5 in (6.0 lb). This fish was creeled in Collins Fork on 20 March 1984 at a total length of 31.5 inches.

Mail-in survey returns of creeled muskellunge during 1981-84 were from fish belonging to the following year classes: 1976(2), 1977(1), and 1978(3). Five of these fish were creeled in South Fork Kentucky River. Four of the five fish were creeled within 2 miles of the mouth of Sexton Creek. Conservation Officers Joe Burchell and Ted Marcum (personal communication 1983) reported a harvest of at least 60 muskellunge during February-April 1983 from near Booneville (stream mile 11) in South Fork Kentucky River upstream into Goose Creek, Redbird River, and Collins Fork. Most of these fish were creeled at three locations: the mouth of Sexton Creek, Longhole (River mile 37-39), and the mouth of Little Goose Creek. Based on angler returns and size of muskellunge creeled, most of these fish were probably from the strong year class of 1978.

Species of fish captured in the South Fork Kentucky River in

1981-1982 are in Table 8. The most abundant species of fish captured from every stream in the drainage was golden redhorse (Moxostoma erythrurum)(Table 9). This species may be an indicator species for muskellunge habitat and is likely the primary forage of muskellunge. A total of 64 species of fish were taken from the six study streams on the South Fork Kentucky River drainage (Table 8). Most of these species have been taken from this drainage before. Jones (1971) had previously collected all of these species except for muskellunge, redfin shiner Notropis umbratilis, and bigeye shiner Notropis boops. The following species were captured from South Fork Kentucky River drainage in 1981-1983 that were not taken during the previous studies: black bullhead Ictuluvus melas, black redhorse Moxostma duquesnei, bigeye chub Hybopsis amblops, blotched chub Hybopsis insignis, river shiner Notropis blennius, silver shiner Notropis photogenis, steelcolor shiner Notropis whipplei, eastern sand darter Ammocrypta pelluvida, and variegate darter Etheostoma zonale. Most of the fishes collected by Jones (1971) were with the use of rotenone.

The species most often taken in pools were golden redhorse and longear sunfish (93% of the study pools), spotted bass and bluntnose minnow (77%), northern hog sucker and striped shiner (57%), smallmouth bass (53%), and bluegill (50%).

Spotted bass was the dominant black bass species taken in all studies combined. However, studies on Redbird River revealed that the smallmouth bass population was equal to the spotted bass population. In Collins Fork, largemouth bass was the most abundant black bass species. These differences in the black bass populations in Redbird River and Collins Fork are due to the differences of habitat. Redbird River has more smallmouth bass habitat in the form of longer riffles

with large rubble and many pools containing large boulders, while Collins Fork has more aquatic vegetation, primarily found in shallow pools, in the form of spatterdock Nuphar sp.

Most every muskellunge captured or sited was near fallen trees in each study stream. In fact, the order of the streams based on amount of fallen trees is the same as the order of streams according to the population density of muskellunge. This type of habitat appears to be very important to the production of muskellunge in streams. The larger muskellunge (age 2+) were most often taken where large logs or three branches were providing instream cover. The younger muskellunge were primarily taken along the bank in brush or weeded areas. Fallen trees were more prevalent in Collins Fork and Goose Creek than in other study streams. These streams were where most of the muskellunge (30 of the 46 muskellunge captured) were taken and where the catch per unit effort was greatest. Other factors such as mean depth and gradient likely influenced where muskellunge were taken. Axon and Kornman (1984) determined that muskellunge most often occurred in pools where mean depths were 3.5 to 4.0 ft and the gradient was between 3.0 and 6.9 ft/mile.

Water Quality

Results of the water quality data are shown in Table 10. The entire drainage system of the South Fork Kentucky River lies in relatively unpopulated areas of eastern Kentucky. The major problems with the degradation of water quality in the drainage comes from the presence of coal mining. Acid drainage contaminates many areas and affects most of the streams to some degree. Siltation from these mines has also created problems in some sections of the streams, especially the downstream

reaches.

Another characteristic of the streams in this area is the lower pH values. The values tend to be at or below neutral. This results from the streams containing a substrate of sandstone rather than limestone. This fact also accounts for the low alkalinity levels present in the streams. Tygarts and Kinniconick creeks in northeastern Kentucky have markedly higher total laklinity levels than do the streams in the South Fork Kentucky River drainage (Kornman 1983). These values may very well contribute to the slower qrowth rate of muskellunge in the South Fork Kentucky River drainage when compared to streams such as Tygarts and Kinniconick creeks.

Benthic Macroinvertebrates

Very little information is available on the benthic macroinvertebrates in the South Fork Kentucky River drainage. Harker et al. (1979) conducted a water quality and benthic macroinvertebrate survey at Goose Creek, which will be discussed later in this section. Findings from the seasonal macroinvertebrate sampling are shown in Tables 11-19.

Little Goose Creek

This study was performed at the Hwy 687 bridge over Little Goose Creek. The density of macroinvertebrates was highest in the summer, followed by fall and spring, respectively. The low density in the spring sample was also expressed by a lower diversity index value. The diversity indices and equitability values indicated a relatively unpolluted situation for all three seasons sampled, although the diversity index was slightly lower in the spring. Tables 11 and 19 present the results of the seasonal sampling during 1982.

Sexton Creek

The results of the macroinvertebrate sampling on Sexton Creek is shown in Tables 12 and 19. A riffle location at the mouth of Anglin Creek was chosen for this survey. The density of macroinvertebrates was greatest in the summer, followed by fall and spring, respectively. The diversity index and equitability were very high in the spring sample. This is misleading, however, due to the low number of individuals with several taxa represented. The equitability value was low during the summer, indicating somewhat degraded conditions at this time. The high density during the summer is also misleading since there was a lower diversity and equitability. This can be explained by the majority of individuals being included in the fairly pollution tolerant taxa of Isonychia, Cheumatopsyche, Hydropsyche, and Chimarra. Diversity and equitability also show relatively unpolluted water present during the fall sample.

Collins Fork

The results of the seasonal invertebrate sampling at Collins Fork are presented in Tables 13 and 19. The sample area was located between Rock House and Cool Springs. Macroinvertebrate density was uniform during all three seasons sampled. Diversity and equitability values indicated unpolluted conditions during the spring and fall with somewhat degraded conditions during the summer.

Redbird River

Results of data collected at Bullskin Branch on Redbird River can be found in Tables 14 and 19. The density of macroinvertebrates was high during all seaons but was greater than doubled during the summer. This large increase in numbers resulted from a large increase in species

such as Isonychia, Stenelmis, and Gooniobasis. Diversity and equitability values suggested slightly degraded conditions in the summer and fall with relatively unpolluted conditions in the spring.

Goose Creek - Sutton Branch

Tables 15 and 19 presents the data from Goose Creek near the mouth of Sutton Branch during 1982. The number of taxa remained relatively constant during all three seasons, while the density was highest in the summer followed by fall and spring, respectively. Diversity and equitability values showed very good, unpolluted conditions in the spring, moderately degraded conditions in the summer, and slightly degraded conditions in the fall.

A survey by Harker et al. (1979) also showed a marked decrease in diversity and equitability values from May to October. Their study showed that an increase in numbers of individuals during the October sample was due directly to an increase of the more pollution tolerant species - Cheumatopsyche, Isonychia, and Stenonema vicarium. This present study further confirms their findings.

Goose Creek - Severe Branch

This survey was conducted near the mouth of Severe Branch on Goose Creek above the confluence of Collins Fork. The results can be found in Tables 16 and 19. Density was highest during the spring, followed by the summer and fall, respectively. Equitability values show moderately degraded conditions during all seasons. The numbers of taxa were also highest during the spring.

South Fork Kentucky River

Results from both the upper and lower sections sampled can be

found in Tables 17-19. The upper locations was near the mouth of Teges Creek and the lower station was located near the mouth of Meadow Creek in Booneville. The number of taxa present at both stations was highest in the spring. Density at the upper station was highest in the summer, followed by the spring and fall, respectively. Diversity was also highest in the spring, followed by the fall and summer, respectively. The decrease in diversity and increase in density during the summer sample can be explained by the increase in the more pollution tolerant species of Isonychia, Baetis, Stenonema mediopunctatum, and Cheumatopsyche.

The diversity and equitability at the lower station (Meadow Creek) was also the lowest during the summer, suggesting moderate degradation of the quality of the water. Densities and the number of taxa were greatest during the spring sample, followed by summer and fall, respectively. The low diversities and equitabilities at both locations on the South Fork of the Kentucky River during the summer result from lower flows and the magnification of the siltation problems from upstream reaches.

CONCLUSIONS

Sexton Creek, Goose Creek, and Collins Fork are considered to be high quality muskellunge streams. Historically, these streams have been affected to some degree by surface mining for coal. However, the water quality has improved when compared to findings by Brewer. The muskellunge habitat of Little Goose Creek has been eliminated due to sedimentation in most of the pools.

The most important need in managing the native muskellunge fisheries in these streams is to assure the integrity of stream habitat. These natural muskellunge streams should be protected from

any future land use practices that are known to have a negative impact on the fish habitat. Some of the most common limiting factors that are now negatively affecting the muskellunge fisheries in the South Fork Kentucky River drainage are acidic water, low total alkalinity, and the illegal harvest of fish.

Two management practices that can enhance the muskellunge fisheries are stricter law enforcement to curb the illegal harvest of fish and the supplemental stocking of muskellunge in streams where habitat is available and the recruitment from natural reproduction is too low to maintain a desirable fishable population of muskellunge. It was apparent that strong year classes of muskellunge were influenced by stockings during the year of stocking.

RECOMMENDATIONS

The supplemental stocking of muskellunge should be continued in South Fork Kentucky River, Collins Fork, Goose Creek, Redbird River, and Sexton Creek to insure that the muskellunge population is maintained at or near carrying capacity. The year classes of muskellunge were stronger during those years when muskellunge fingerlings were stocked. Therefore, it is recommended that an annual stocking rate of one fingerling-size muskellunge per 2 acres of muskellunge pool habitat or a minimum of 25 fish per stream be followed on these streams. At this rate, the annual stocking would be 250 fish in South Fork Kentucky River, 50 in Goose Creek, 25 in Redbird River, 25 in Collins Fork and 25 in Sexton Creek. Stricter law enforcement should be applied to reduce the illegal harvest of muskellunge below the minimum lenth limit of 30 in and the harvest of fish by use of illegal fishing gear.

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Table 1. Muskellunge stocked in the South Fork Kentucky River drainage from 1974-1980.

Stream	1974		1976		1978		1979		1980	
	No.	Length (in)	No.	Length (in)	No.	Length (in)	No.	Length (in)	No.	Length (in)
South Fork Kentucky River	510	5-9	1,018	5-9	8,000	<1	0	0	523	5-9
Goose Creek	130	5-9	224	5-9	0	0	215	5-9	0	0
Collins Fork	0	0	0	0	31	5-9	0	0	25	5-9
Sexton Creek	30	5-9	56	5-9	0	0	28	5-9	0	0

Table 2. Muskellunge range and pool habitat in streams of the South Fork Kentucky River drainage.

Stream	Muskellunge range (stream mi)	Miles of pool habitat	Mean width (ft)	Acreage of pool habitat
South Fork Kentucky River	0 - 40	32.0	130	509
Sexton Creek	0 - 12	4.0	60	28
Redbird River	0 - 27	9.2	50	56
Goose Creek	0 - 30	8.8	90	98
Little Goose Creek		1.8	28	4
Collins Fork	0 - 10	3.5	58	24
Total		59.3		719

Table 3. Length frequency and catch rate of muskellunge captured by electrofishing a total of 103.8 hours on six streams in the South Fork Kentucky River drainage during 1981 and 1982.

Stream	Inch group																				Number of captured muskellunge	Fish/hour
	10	12	13	14	15	16	17	18	20	21	23	24	25	27	28	30	31	32	33	34		
South Fork Kentucky River				1	1	1					1	1		1							6	0.1
Sexton Creek			1								1							1			3	0.7
Redbird River		1	1			1		1			1		2								7	0.5
Goose Creek	1				2		1		2	1		1	2	3	1	1	1		1	1	18	0.8
Collins Fork	1	3						2	2					2	1		1				12	0.9
Little Goose Creek																					0	0.0
Total	3	4	2	1	3	2	1	3	4	1	3	2	4	6	2	1	1	1	1	1	46	
Mean																						0.4

Table 4. Muskellunge captured at study sites and pool characteristics at South Fork Kentucky River study streams.

Sample site (stream mi)	River mile	Gradient (ft/mi)	Mean depth (ft)	Length (mi)	Mean width (ft)	Acres	Length (inch group) captured muskellunge 1981	1982
South Fork Kentucky River								
1. Long Hole	37.2 - 39.2	2.8	7.0	2.0	70	17.0	15,24	27
2. Newfound	29.3 - 30.2	2.4	4.0	0.9	70	7.6		
3. Road Run	24.6 - 25.6	2.0	6.0	1.0	120	14.6		
4. Sexton Creek Mouth	22.8 - 23.7	2.0	6.0	0.9	100	10.9	16,14	23
5. Taft	22.5 - 22.7	2.0	6.0	0.2	90	2.2		
6. Hacker Branch	21.5 - 22.5	2.0	5.0	1.0	100	12.1		
7. Indian Creek	16.2 - 16.7	1.6	3.0	0.5	100	6.0		
8. Cow Creek	13.7 - 14.6	1.6	2.5	0.9	110	12.0		NS
8/9 Meadow Creek	6.8 - 8.4	1.6		1.6	110	21.33		NS
Sexton Creek								
1. Cool Springs	7.0 - 7.5	7.8	4.5	0.5	40	2.4	25,32	
2. Spivey	5.7 - 5.8	7.8	3.0	0.1	50	0.6		
3. Burgen Branch	3.6 - 3.8	7.8	4.0	0.2	55	1.3	13	
Redbird River								
1. Elisha Creek	25.7 - 26.4	9.0	3.5	0.7	40	3.4		
2. Peabody (upper)	17.4 - 17.5	4.6	5.5	0.1	60	0.7		
3. Peabody (lower)	16.9 - 17.4	4.6	5.5	0.5	60	3.6	13,16	25
4. Big Creek	14.2 - 14.9	4.0	4.0	0.7	60	5.1		
5. Spurlock (school)	8.8 - 9.4	4.0		0.6	60	4.3	12	23
6. Spurlock (post office)	7.6 - 8.8	4.0	4.0	1.2	60	8.8		
7. Bullskin Branch	4.5 - 5.1	4.0	4.0	0.6	70	5.1	25	
Goose Creek								
1. Goose Rock School	30.3 - 30.4	6.0		0.2	25	0.6	15	
2. Granny Branch	29.8 - 29.8	5.4		0.1	30	0.2		
3. Park Way (upper)	23.5 - 24.2	4.0	3.5	0.8	50	4.8	NS	20
4. Manchester	22.0 - 23.5	4.0	4.0	1.5	50	9.1	12,25,30, 31,33	34

Sample site (stream mi)	River mile	Gradient (ft/mi)	Mean depth (ft)	Length (mi)	Mean width (ft)	Acres	Length (inch group) captured muskellunge 1981	1982
5. Island Creek	16.3 - 17.2	2.6	4.0	0.9	50	5.5	17	24
6. Laurel Creek	9.2 - 9.7	2.4	3.0	0.5	70	4.2		27,27
7. Beech Creek	8.5 - 8.9	2.4	5.0	0.4	70	3.4	20,21,	25
8. Little Wildcat (Laurel Branch)	7.4 - 8.2	3.6		0.8	50	4.8	27,28	
9. Gas Pump Hollow	1.6 - 1.9	3.6	3.0	0.3	100	3.6		10
Collins Fork								
1. Fount	12.0 - 12.2	6.4		0.2	25	0.8		NS
2. Farmers	11.2 - 11.6	6.4	4.5	0.2	35	0.6	NS	20
3. Farmers		6.4	4.0	0.5	40	2.4	NS	20
4. Dissappointment	10.5 - 10.8	6.4		0.3	40	1.5		NS
5. Wollum	10.0 - 10.2	6.0	4.0	0.2	45	1.1	12	
6. Antioch (upper)	8.7 - 9.0	6.0	3.5	0.2	35	1.0	31	28
7. Antioch (lower)		6.0	2.5	0.2	35	1.0	NS	
8. Cool Springs	8.1 - 8.3	6.0	3.0	0.2	50	1.2	10,12	
9. Balls Branch	5.4 - 5.8	6.0	4.0	0.4	50	2.4	10,12	18
10. Engine	1.2 - 1.7	4.0	3.5	0.5	30	1.8		
11. Collins Fork mouth	0.0 - 0.4	4.0	3.0	0.2	30	0.9		27,27
Little Goose Creek								
1. Hacker School	4.4 - 5.4	5.6	3.0	0.8	35	3.4		NS
2. Stone Cole mouth	2.2 - 2.5	5.6		0.3	25	0.9		NS

NS = not sampled.

Table 5. Number of sub-legal (<30 in) and legal-size (≥30 in) muskellunge captured by electrofishing in the study streams of the South Fork Kentucky River drainage.

Stream (year)	Number captured		Number sighted	
	Legal	Sub-legal	Legal	Sub-legal
South Fork Kentucky River				
1981		4		1
1982		2	1	1
Sexton Creek				
1981	1	2		
1982				
Redbird River				
1981		4		
1982		3		
Goose Creek				
1981	2	9		2
1982	1	6		3
Collins Fork				
1981	1	5		2
1982		6		3
Total	5	41	1	12

Table 6. Mean annual length of muskellunge captured at each stream in the South Fork Kentucky River drainage in 1981-1982.

Stream	No. of fish	Age					
		1	2	3	4	5	6
South Fork KY River	6	10.6	16.6	20.4	24.0		
Sexton Creek	3	9.1	13.2	19.6	23.8	30.4	
Redbird River	6	11.0	15.9	20.8	22.2		
Goose Creek	18	10.4	15.8	20.1	24.7	29.7	32.0
Collins Fork	11	9.8	14.4	19.2	23.1	27.0	30.7

Table 7. Number of muskellunge from each year class that were captured at streams in the South Fork Kentucky River drainage in 1981-1982.

Stream	Year class						
	1975	1976	1977	1978	1979	1980	1981
South Fork Kentucky River				1	2	3	
Sexton Creek		1	1			1	
Redbird River				2	2	2	
Goose Creek	1	2	3	5	4	2	1
Collins Fork	1			3	4	3	
Total	2	3	4	11	12	11	1

Table 8. Species and length distribution of fish taken by electrofishing from six South Fork Kentucky River Drainage streams during 1981-1982.

Species	Inch group																															Number of fish	Percent
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	27	28	29	30	31	32	33	34	40		
Muskellunge										2		3	2	1	3	2	1	3		4	1		2	2	5	6	2		1	2	1	1	1		45	1
Largemouth bass					2	1	1		1	5	4	1	5		2	2	1			2														27	t
Spotted bass		6	15	19	27	34	43	33	24	16	13	6	3							1														240	4
Smallmouth bass		1	3	9	7	4	18	16	14	14	3	6	4	2	2	3	3			1														110	2
Rock bass		1	4	6	7	16	16	9	9																									68	1
White bass								1			1																							2	t
Black crappie				1				2																										3	t
White crappie		2	7					1			1																							11	t
Bluegill	3	24	36	16	13	8	6																											106	2
Longear sunfish	16	91	142	139	117	31	1																											537	10
Green sunfish			1	2	2	3																												8	t
Warmouth			3	2	1	4	3	1	1																									15	t
Hybrid sunfish	1	5	17	16	6		1																											46	1
Channel catfish							1	6	5	11	8	21	19	11	13	12	14	9	4	4	4	2	1		2									149	3
Flathead catfish				1			2	3	9	2	4	9	4	3	1	2	2	2		1	1		1			1				1				47	1
Yellow bullhead									2																									2	t
Freshwater drum											2	4	3	2	2	3	1						1				1	1		1				21	t
Carp								1												1				1	1	1								5	t
Longnose gar											1		2	3	1	2	7	6	5	6	5		2	1					1					42	1
Smallmouth buffalo																							1											1	t
Golden redhorse		5	103	127	254	305	301	228	179	187	128	94	59	25	10	4			1		1													213	38
River redhorse						1			1				1					1																	4	t
Shorthead redhorse			1	1	15	10	12	8	5	5	3	1	1																					62	1
Northern hogsucker		1	33	38	40	16	16	15	7	2	5	5	10	1																				189	3
White sucker		1	18	7		1	5	4	2	2																								40	1
Spotted sucker		1	10	3	6	8	17	9	9	8	13	3	4	2		1																		94	2
Gizzard shad										2	1	1	3	1																				8	t
American eel																																	1	1	t
Chestnut lamprey								1																										1	t
American lamprey						2																												2	t
Eastern brook lamprey					1	1																												2	t
Notropis sp.	49	129	49	9			1																											236	4
Bluntnose minnow	18	152	76	12																														258	5
Brook silverside		41	100	2																														143	2
Creek chub		1		3	2	1	1																											8	t

Species	Inch group																																Number of fish	Percent
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	27	28	29	30	31	32	33	34	40		
River chub					2																												2	t
Streamline chub			8	2																													10	t
Spotted chub			11	1																													12	t
Striped shiner	4	168	86	49	20	6	9																										342	6
Emerald shiner	1	34	11	3																													49	1
Bigeye shiner	1	52	14	11																													78	1
Popeye shiner	7	121	100	30																													253	5
Mimic shiner	3	13																															16	t
Spotfin shiner			2																														2	t
Redfin shiner		2	1																														3	t
Roseyface shiner*		6																															6	t
Sand shiner	4	1																															5	t
Rosefin shiner		2	2																														4	t
Logperch		3	15	21	6																												45	1
Johnny darter	2	5																															7	t
Blackside darter		24	16	1																													41	
Greenside darter		2																															2	t
Bluestripe darter		3	1																														4	t
Fantail darter*	4																																4	t
Rainbow darter*	3																																3	t
Bluebreast darter*	1	1																															2	t
Highfin carpsucker															1																		1	t
Rainbow trout									1																								1	t
Silverjaw minnow		2	1																														3	t
Banded sculpin		1																															1	t
Stoneroller		1	1			1																											3	t
Brindled madtom*	1		1																														2	t
Stonecat	1																																1	t
Banded darter*	1	4																															5	t
Total																																	5,570	

*Species taken in 1983.

Table 9. The three most abundant species of fish captured from each of the study streams in the South Fork Kentucky River drainage in 1981-1982.

Stream	Species		
South Fork Kentucky River	Golden redhorse (46)	Bigeye shiner (11)	Longear sunfish (10)
Sexton Creek	Golden redhorse (39)	Spotted bass (7)	Striped shiner (6)
Redbird River	Golden redhorse (50)	Longear sunfish (11)	Striped shiner (8)
Little Goose Creek	Golden redhorse (31)	Spotted bass (6)	Striped shiner (4)
Goose Creek	Golden redhorse (38)	Longear sunfish (13)	Striped shiner (8)
Collins Fork	Golden redhorse (20)	Striped shiner (12)	Longear sunfish (8)

Table 10. Water quality determinations from six streams on the South Fork Kentucky River drainage during 1982 and 1983.

		South Fork Kentucky River			Sexton Creek	Redbird River	Goose Creek (Sutton Branch)	Goose Creek (Severe Branch)	Little Goose Creek	Collins Fork
		Booneville	Upper Wolf	Teges						
					Temperature (F)					
1982	May	67	66	61	62	68	60	65	62	63
	Jul	81	83	75	79	77	79	74	75	75
	Oct	50	58	48	48	52	55	54	54	55
1983	May	61	59	59	59	59	59	61	63	62
	Jul	81	88	79	82	80	75	75	74	81
	Oct	64	70	66	64	70	66	63	61	68
					Dissolved oxygen (mg/l)					
1982	May	10.7	11.1	11.4	11.3	11.0	10.6	11.6	11.0	11.2
	Jul	7.5	9.0	7.0	7.6	6.0	8.0	8.0	8.0	8.0
	Oct	12.0	11.0	10.0	10.0	10.2	9.8	10.0	10.5	11.0
1983	Jul	5.6	10.0	8.2	9.0	8.0	10.0	6.1	9.6	6.5
	Oct	6.1	7.4	7.4	5.5	7.9	7.4	5.8	7.8	8.0
					Total alkalinity					
1982	May	26	27	23	19	30	27	27	36	22
	Jul	45	42	49	30	61	46	63	58	35
	Oct	5	50	50	60	50	50	60	40	40
1983	May	ND	27	ND	27	55	ND	27	ND	ND
	Jul	41	55	48	48	82	41	62	48	44
	Oct	ND	ND	61	54		54	68	68	55
					Turbidity (NTU)					
1982	May	5	2	6	2	1	3	3	10	8
	Jul	12	11	4	7	4	7	30	26	6
	Oct	12	12	10	10	10	9	20	10	12
1983	May	20	22	22	22	14	16	12	12	19
	Jul	12	9	22	12	12	54	53	50	14
	Oct	19	28	7	8	32	60	23	22	8

		South Fork Kentucky River			Sexton Creek	Redbird River	Goose Creek (Sutton Branch)	Goose Creek (Severe Branch)	Little Goose Creek	Collins Fork
		Booneville	Upper Wolf	Teges						
					pH					
1982	May	6.3	6.4	6.4	6.4	6.0	7.2	7.0	7.4	6.2
	Jul	7.2	7.5	7.0	6.5	7.2	7.0	7.0	7.5	7.3
	Oct	6.6	6.5	6.5	6.5	7.0	7.0	6.5	7.5	6.5
1983	May	7.6	7.7	7.6	7.6	7.6	7.5	7.5	7.6	7.8
	Jul	7.6	8.8	7.6	7.7	7.7	7.5	7.4	7.5	6.5
	Oct	7.1	7.8	7.5	7.1	7.7	7.2	7.1	7.2	7.9
					Specific conductiviety (umhos/cm)					
1983	May	110	110	125	70	110	145	70	220	50
	Jul	400	350	295	190	800	295	165	505	120
	Oct	510	480	490	180	410	460	230	600	170

ND = not determined.

Table 11. Number of individuals per taxa, composition, density, diversity ($\bar{d}$), and equitability (e) values for benthic macroinvertebrates collected seasonally in Little Goose Creek (Hwy 687 bridge) in 1982.

	May 4	Jul 15	Oct 21
Ephemeroptera			
Baetidae, *Baetis* sp.		35	5
Pseudocleon sp.			1
Baetiscidae, *Baetisca* sp.	1		13
Caenidae, *Caenis* sp.	2	19	22
Ephemerellidae, *Drunella* sp.		5	
Ephemerella sp.	5		
Heptageniidae, *Heptagenia* sp.			2
Stenacron interpunctatum		15	4
Stenonema vicarium		47	43
Stenonema sp.	23	3	
Oligoneuridae, *Isonychia* sp.	2	60	29
Tricorythidae, *Tricorythodes* sp.		8	
Odonata			
Gomphidae, *Lanthus* sp.		7	
Unidentified species	1		
Plecoptera			
Chloroperlidae, *Hastaperla* sp.		5	1
Heteroptera			
Hebridae, *Hebrus concinnus*		27	
Veliidae, *Microvelia* sp.		14	
Unidentified species		1	
Megaloptera			
Corydalidae, *Chauliodes* sp.		1	
Corydalus cornutus	2	3	2
Nigronia sp.		8	
Trichoptera			
Hydropsychidae, *Cheumatopsyche* sp.	12	88	28
Hydropsyche sp.		40	
Polycentropodidae, *Polycentropus* sp.			2
Coleoptera			
Elmidae, *Stenelmis* sp.	3	25	27
Gyrinidae, *Dineutus* sp.		1	
Diptera			
Athericidae, *Atherix* sp.		1	
Chironomidae, Sp. A	1	4	2
Sp. B		1	
Culicidae, Sp. A		1	
Empididae, Sp. A		1	
Simulidae, *Simulium* sp.		1	
Tipulidae, *Hexatoma* sp.	2	2	2
Tipula sp.			6
Unidentified species		1	
Unidentified species		2	

	May 4	Jul 15	Oct 21
Oligocheata			
Species A		1	4
Decapoda			
Orconectes sp.	3	3	
Pelecypoda			
Sphaeriidae, *Sphaerium* sp.			6
Water mites			2

Table 12. Number of individuals per taxa, composition, density, diversity ($\bar{d}$), and equitability (e) values for benthic macroinvertebrates collected seasonally in Sexton Creek (mouth of Anglin Branch) in 1982.

	May 5	Jul 16	Oct 22
Ephemeroptera			
Baetidae, *Baetis* sp.	10	86	1
Ephemerellidae, *Drunella* sp.	2		
Heptageniidae, *Stenacron interpunctatum*	1	4	6
Stenonema exiguum		3	53
Stenonema sp.	14	3	
Oligoneuridae, *Isonychia* sp.	3	264	23
Siphlonuridae, *Ameletus* sp.	11		
Baetiscidae, *Baetisca* sp.			9
Canenidae, *Caenis* sp.	7	1	95
Odonata			
Gomphidae, *Gomphus* sp.			1
Lanthus sp.			5
Unidentified species		2	
Coenagrionidae, *Argia* sp.			4
Plecoptera			
Nemouridae, *Amphinemura* sp.	3		
Perlidae, *Acroneuria* sp.	4		
Neoperla sp.	2		23
Perlodidae, *Isoperla* sp.	4	1	
Heteroptera			
Rhagovelia sp.		1	
Megaloptera			
Corydalidae, *Corydalus cornutus*	1	26	2
Chauliodes sp.		11	
Nigronia serricornis			1
Sialidae, *Sialis* sp.			1
Trichoptera			
Hydropsychidae, *Cheumatopsyche* sp.	2	107	1
Hydropsyche sp.	21	179	14
Unidentified species	1		
Philopotamidae, *Chimarra* sp.	5	145	8
Coleoptera			
Elmidae, *Stenelmis* sp.	2	28	28
Psephenidae, *Psephenus herricki*	3		1
Diptera			
Athericidae, *Atherix* sp.	2		
Chironomidae, Sp. A	2	19	6
Sp. B	1	2	3
Culicidae, Sp. A	6		
Simuliidae, *Simulium* sp.		2	
Tabanidae, *Tabanus* sp.		1	4
Unidentified species	6		
Tipulidae, *Hexatoma* sp.	1	5	6
Tipula sp.	1		

	May 5	Jul 16	Oct 28
Oligocheata			
Species A			21
Decapoda			
Orconectes sp.	8	3	1
Gastropoda			
Goniobasis sp.	2	12	3
Pelecypoda			
Corbiculidae, *Corbicula* sp.			1
Sphaeriidae, *Sphaerium* sp.	1	18	

Table 13. Number of individuals per taxa, composition, density, diversity ($\bar{d}$), and equitability (e) values for benthic macroinvertebrates collected seasonally in Collins Fork (between Rock House and Cool Springs) in 1982.

	May 6	Jul 15	Oct 21
Ephemeroptera			
Baetidae, *Baetis* sp.	11		
Baetiscidae, *Baetisca* sp.			5
Caenidae, *Caenis* sp.		1	7
Ephemerellidae, *Drunella* sp.	11		4
Ephemerella sp.	10	8	
Ephemeridae, *Ephemera* sp.			13
Heptageniidae, *Stenacron interpunctatum*	1	3	64
Stenonema ares		8	
S. bipunctatum		134	
S. exiguum			4
S. tripunctatum		22	
S. vicarium			55
S. sp.	63		
Oligoneuridae, *Isonychia* sp.	55	48	21
Siphlonuridae, *Ameletus* sp.		2	
Odonata			
Gomphidae, *Gomphus* sp.	1		
Lanthus sp.			18
Unidentified species		8	
Plecoptera			
Nemouridae, *Amphinemura* sp.	11		
Perlidae, *Acroneuria* sp.	1		
Neoperla sp.	3		
Perlodidae, *Isoperla* sp.	2		
Yugus sp.	2		
Heteroptera			
Gerridae, *Gerris* sp.		4	
Unidentified species		1	
Megaloptera			
Corydalidae, *Corydalus cornutus*	15	1	1
Trichoptera			
Hydropsychidae, *Cheumatopsyche* sp.		6	30
Hydropsyche sp.	8	5	12
Philopotamidae, *Chimarra* sp.	73	5	3
Coleoptera			
Elmidae, *Stenelmis* sp.		7	3
Psephenidae, *Psephenus* sp.	1		8
Diptera			
Chironomidae, Sp. A	11	3	3
Sp. B		2	
Culicidae, Sp. A		1	
Simulidae, *Simulium* sp.	22		
Tabanidae, *Tabanus* sp.			4

	May 6	Jul 15	Oct 21
Tipulidae, *Antocha* sp.	1		
Hexatoma sp.		2	
Tipula sp.	2		1
Unidentified species		1	
Oligocheata			
Species A			2
Decapoda			
Orconectes sp.		27	9
Gastropoda			
Goniobasis sp.		1	1
Physa sp.		1	11
Pelecypoda			
Corbiculidae, *Corbicula* sp.		1	

Table 14. Number of individuals per taxa, composition, density, diversity ($\bar{d}$), and equitability (e) values for benthic macroinvertebrates collected seasonally in Redbird River (Bullskin Branch) in 1982.

	May 5	Jul 16	Oct 22
Ephemeroptera			
Baetidae, Baetis sp.	16	61	
Cleon sp.		1	
Baetiscidae, Baetisca sp.	2		15
Caenidae, Caenis sp.	98	28	7
Ephemerellidae, Drunella sp.	2		4
Ephemerella sp.	50		1
Ephemeridae, Ephemera sp.	1	2	2
Heptageniidae, Heptagenia sp.	46		49
Stenonema exiguum		17	
S. mediopunctatum	43	84	116
S. vicarium	8	3	22
Oligoneuridae, Isonychia sp.	22	344	69
Odonata			
Aeshnidae, Boyeria sp.			5
Coenagrionidae, Argia sp.	4		
Gomphidae, Lanthus sp.	4	18	
Plecoptera			
Perlidae, Acroneuria sp.	2		
Perlodidae, Isoperla sp.	1		1
Heteroptera			
Gerridae, Gerris sp.		1	
Veliidae, Microvelia sp.		6	
Unidentified species		1	
Megaloptera			
Corydalidae, Corydalus cornutus	7	37	4
Trichoptera			
Hydropsychidae, Cheumatopsyche sp.	5	73	8
Hydropsyche sp.		18	
Philopotamidae, Chimarra sp.	3	8	1
Polycentropodidae, Polycentropus sp.			1
Coleoptera			
Elmidae, Macronychus sp.		2	
Optioservus sp.	1		1
Stenelmis sp.	4	103	1
Gyrinidae, Gyrinus sp.		10	
Psephenidae, Psephenus sp.	2		
Diptera			
Empididae, Sp. A	2		
Chironomidae, Sp. A	7	10	
Sp. B	3	1	
Sp. C	5		
Simuliidae, Simulium sp.		1	
Tabanidae, Tabanus sp.	1		

	May 5	Jul 16	Oct 22
Tipulidae, *Tipula* sp.	4		
Unidentified species	12		
Oligocheata			
Species A	3		
Decapoda			
Orconectes sp.		7	3
Gastropoda			
Goniobasis sp.	19	90	
Pleurocera sp.			6
Pelecypoda			
Corbiculidae, *Corbicula* sp.	49	72	56
Sphaeriidae, *Sphaerium* sp.			20

Table 15. Number of individuals per taxa, composition, density ($\bar{d}$), and equitability (e) values for benthic macroinvertebrates collected seasonally in Goose Creek (Sutton Branch) in 1982.

	May 5	Jul 15	Oct 21
Ephemeroptera			
Baetidae, Baetis, sp. A	15	204	2
Baetis, sp. B		1	
Baetiscidae, Beatisca sp.			9
Caenidae, Caenis sp.	38	2	170
Ephemerellidae, Drunella sp.	1		3
Ephemerella sp.	20	3	
Ephemeridae, Ephemera sp.			4
Heptageniidae, Heptagenia sp.	8		1
Stenacron interpunctatum	2		6
Stenonema exiguum		11	37
S. mediopunctatum		7	11
S. vicarium	23	79	77
Oligoneuridae, Isonychia sp.	28	364	24
Odonata			
Coenagrionidae, Argia sp.			3
Gomphidae, Lanthus sp.		1	
Plecoptera			
Perlidae, Acroneuria sp.	1		
Perlodidae, Isoperla sp.	2	2	
Taeniopterygidae, Taeniopteryx sp.	1		
Megaloptera			
Corydalidae, Corydalus cornutus	8	21	
Trichoptera			
Hydropsychidae, Cheumatopsyche sp.	10	124	3
Hydropsyche sp.		36	4
Philopotamidae, Chimarra sp.		1	
Coleoptera			
Elmidae, Stenelmis sp.		3	3
Gyrinidae, Gyrinus sp.		1	
Psephenidae, Psephenus sp.	1		
Diptera			
Chironomidae, Sp. A	19	4	6
Sp. B	25	6	1
Sp. C	9		
Sp. D	6		
Stratiomyidae, unidentified species		1	
Tipulidae, Hexatoma sp.		2	3
Tipula sp.	1	4	
Unidentified species		4	

	May 5	Jul 15	Oct 21
Oligocheata			
Sp. A	7		2
Decapoda			
Orconectes sp.		6	7
Gastropoda			
Ferrisia sp.			9
Goniobasis sp.	12	11	40
Pelecypoda			
Corbiculidae, Corbicula sp.	13		1
Sphaeriidae, Sphaerium sp.		3	43

Table 16. Number of individuals per taxa, composition, density, diversity ($\bar{d}$), and equitability (e) values for benthic macroinvertebrates collected seasonally in Goose Creek (Severe Branch) in 1982.

	May 4	Jul 15	Oct 21
Ephemeroptera			
Baetidae, *Baetis* sp.	49	2	
Cleon sp.	1		
Baetiscidae, *Baetisca* sp.			3
Caenidae, *Caenis* sp.	1		1
Ephemerellidae, *Drunella* sp.	18		
Ephemerella sp.	273		
Ephemeridae, *Ephemera* sp.		1	
Heptageniidae, *Heptagenia* sp.	1	22	
Stenacron interpunctatum			6
Stenonema vicarium	59	91	56
Oligoneuridae, *Isonychia* sp.	37	7	8
Siphlonuridae, *Siphlonurus* sp. A	2		
sp. B	2		
Odonata			
Gomphidae, *Lanthus* sp.		6	
Plecoptera			
Capniidae, *Nemocapnia* sp.		1	
Perlidae, *Acroneuria* sp.	6	1	
Neoperla sp.			1
Perlodidae, *Diploperla* sp.	1		
Isoperla sp.	9	4	
Remenus sp.	1		
Taeniopterygidae, *Taeniopteryx* sp.	5		
Megaloptera			
Corydalidae, *Corydalus cornutus*	2	2	
Heteroptera			
Gerridae, *Gerris* sp.			1
Veliidae, *Microvelia* sp.		1	
Trichoptera			
Hydropsychidae, *Cheumatopsyche* sp.	18	18	23
Rhyacophilidae, *Rhyacophila* sp.	1	1	2
Unidentified species	1		
Coleoptera			
Dryopidae, *Helichus* sp.	8	1	
Elmidae, *Stenelmis* sp.	10	9	5
Diptera			
Athericidae, *Atherix* sp.	3		
Chironomidae, Sp. A	26	4	
Sp. B	9		
Culicidae, Sp. A	4	2	
Sp. B	8		
Sp. C	13		
Sp. D	14		
Sp. E	8		

	May 4	Jul 15	Oct 21
Unidentified adult	2		
Empididae, Sp. A		2	
Tabanidae, *Tabanus* sp.			5
Tipulidae, *Hexatona* sp.	2	5	3
Longurio sp.	1		
Oligocheata			
Species A			4
Decapoda			
Orconectes sp.	2	10	3
Pelecypoda			
Sphaeriidae, *Sphaerium* sp.	15	7	8

Table 17. Number of individuals per taxa, composition, desnity, diversity ($\bar{d}$), and equitability (e) values for benthic macroinvertebrates collected seasonally in South Fork Kentucky River (Teges) in 1982.

	May 5	Jul 16	Oct 22
Ephemeroptera			
Baetidae, *Baetis* sp.	18	130	2
Ephemerellidae, *Drunella* sp.	6		1
Heptagenniidae, *Heptagenia* sp.	108	33	
Stenacron interpunctatum	1		
Stenonema exiguum			28
S. mediopunctatum	9	149	44
S. vicarium	2	21	3
Oligoneuriidae, *Isonychia* sp.	19	164	31
Leptophlebiidae, unidentified sp.	1		
Ephemeridae, *Ephemera* sp.	4		
Caenidae, *Caenis* sp.	116	4	20
Baetiscidae, *Baetisca* sp.	1		2
Odonata			
Aeshnidae, *Boyeria* sp	1		
Gomphidae, *Lanthus* sp.	1	7	
Coenagrionidae, *Argia* sp.	15		11
Plecoptera			
Chloroperlidae, *Hastaperla* sp.	1		
Perlidae, *Acroneuria* sp.	1		2
Perlodidae, *Isoperla* sp.	5	3	
Heteroptera			
Gerridae, *Gerris* sp.			1
Veliidae, *Microvelia* sp.		3	
Megaloptera			
Corydalidae, *Corydalus cornutus*	1		4
Nigronia sp.		3	
Trichoptera			
Hydropsychidae, *Cheumatopsyche* sp.	16	350	35
Philopotamidae, *Chimarra* sp.	3	2	
Rhyacophilidae, *Rhyacophila* sp.	1	5	
Coleoptera			
Elmidae, *Optioservus* sp.	1		
Stenelmis sp.	4	7	1
Gyrinidae, *Gyrinus* sp.		5	
Diptera			
Ceratopogonidae, *Atrichopogon* sp.	1		
Chironomidae, Sp. A	18	9	1
Sp. B	2	7	3
Culicidae, Sp. A			1
Empididae, Sp. A	1		2

	May 5	Jul 16	Oct 22
Simuliidae, *Simulium* sp.	6		
Tabanidae, *Tabanus* sp.	1		
Tipulidae, *Hexatoma* sp.	1		
Longurio sp.		1	
Tipula sp.	2		
Unidentified species	12	1	
Oligocheata			
Species A	8		
Species B		12	36
Decapoda			
Orconectes sp.	3	3	5
Gastropoda			
Ferrisia sp.			3
Goniobasis sp.	12	29	13
Pleurocera sp.	8		
Pelecypoda			
Corbiculidae, *Corbicula* sp.	4	3	17
Sphaeriidae, *Sphaerium* sp.	3	11	
Unionidae, *Elliptio crascidens*	1		

Table 18. Number of individuals per taxa, composition, density ($\bar{d}$), and equitability (e) values for benthic macroinvertebrates collected seasonally in South Fork Kentucky River (Meadow Creek) in 1982.

	May 5	Jul 16	Oct 22
Ephemeroptera			
Baetidae, Baetis sp.	34	58	2
Cleon sp.	2		
Ephemerellidae, Drunella sp.			6
Ephemerella sp.	38		
Heptageniidae, Heptagenia sp.	3	2	
Stenacron interpunctatum	1		3
Stenonema mediopunctatum	5	3	
S. vicarium	10	10	23
Oligoneuridae, Isonychia sp.	146	147	
Tricorythidae, Tricorythodes sp.			5
Ephemeridae, Ephemera sp.			4
Caenidae, Caenis sp.	5	6	
Baetiscidae, Baetisca sp.			2
Odonata			
Gomphidae, Lanthus sp.			1
Plecoptera			
Chloroperlidae, Hastaperla sp.	1		
Perlidae, Acroneuria sp.	2	2	
Perlodidae, Isoperla sp.	5	2	
Taeniopterygidae, Taeniopteryx sp.	8		
Unidentified - early instar			2
Megaloptera			
Corydalidae, Corydalus cornutus	7	3	
Nigronia sp.		5	
Trichoptera			
Hydropsychidae, Cheumatopsyche sp.	5	29	
Hydropsyche sp.			5
Philopotamidae, Chimarra sp.	8	1	
Coleoptera			
Dryopidae, Helichus sp.	2		
Elmidae, Macronychus sp.			1
Stenelmis sp.	2	4	3
Psephenidae, Psephenus sp.		1	
Diptera			
Chironomidae, Sp. A	15	4	1
Sp. B	2		
Simuliidae, Simulium sp.	1	1	
Tipulidae, Hexatoma sp.			1
Tipula sp.			1

	May 5	Jul 16	Oct 22
Oligocheata			
Species A	1		5
Decapoda			
Orconectes sp.			1
Gastropoda			
Goniobasis sp.	8	6	1
Pelecypoda			
Corbiculidae, *Corbicula* sp.	8	3	
Sphaeriidae, *Sphaerium* sp.			14

Table 19. Summary of the number of individuals per taxa, composition, density, diversity diversity (d), and equitability (e) values for benthis macroinvertebrates collected seasonally in the South Fork Kentucky River drainage in 1982.

	Number of individuals			Number of taxa			Diversity ($\bar{d}$)			Equitability (e)		
	May	Jul	Oct	May	Jul	Oct	May	Jul	Oct	May	Jul	Oct
Little Goose Creek	59	428	201	13	30	19	2.86	3.77	3.40	0.78	0.66	0.80
Sexton Creek	126	923	321	28	23	26	4.34	3.01	3.45	1.06	0.49	0.62
Collins Fork	304	302	280	20	25	23	3.24	2.96	3.59	0.67	0.44	0.76
Redbird River	426	998	392	30	25	21	3.75	3.30	3.12	0.65	0.56	0.59
Goose Creek (Sutton Branch)	250	895	470	22	24	25	3.89	2.59	3.17	0.98	0.36	0.51
Goose Creek (Severe Branch)	612	197	129	34	21	15	3.26	2.96	2.82	0.40	0.52	0.66
South Fork Kentucky River (Teges)	419	984	266	40	26	23	3.88	2.94	3.63	0.54	0.41	0.78
South Fork Kentucky River (Meadow Creek)	339	287	81	24	18	19	3.42	2.41	3.49	0.63	0.40	0.85