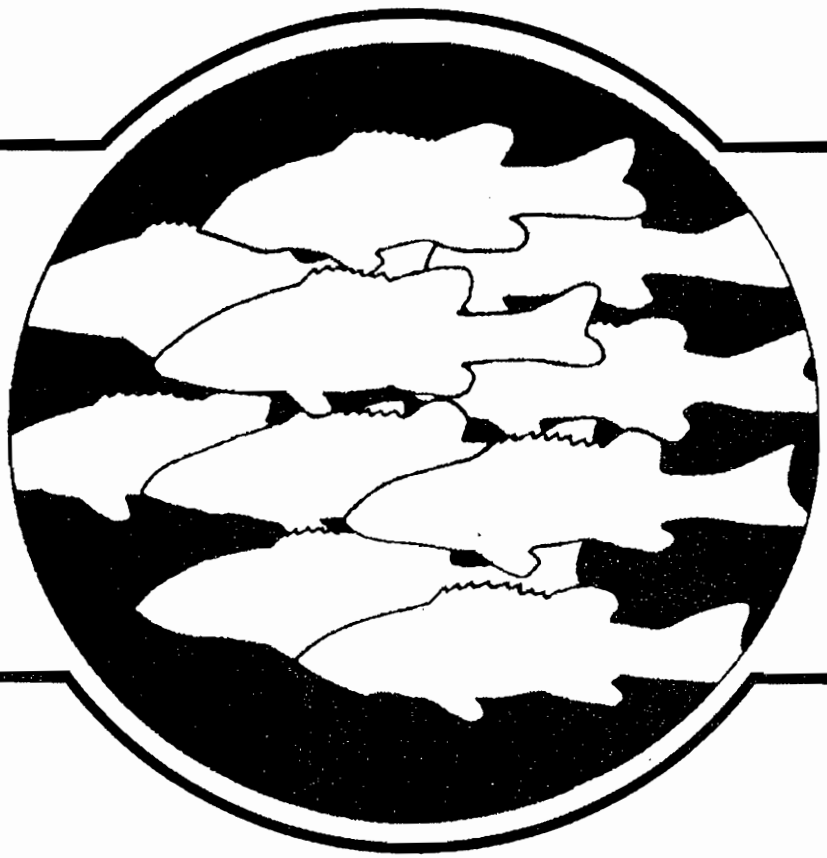

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Evaluation of Brown Trout Introductions in Three Southeastern Kentucky Streams

by

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ABSTRACT

Brown trout fingerlings (3-5 in) were stocked into nine Kentucky streams during 1986-1987 for the purpose of establishing self-sustaining populations capable of supporting a fishery. Previous water quality measurements and habitat assessments indicated that these streams could potentially support brown trout. Bark Camp, Laurel, and East Prong of White Oak creeks were selected from the nine streams to evaluate the success of developing natural populations of brown trout sufficient to create a fishery. Natural reproduction was documented in Bark Camp and East Prong of White Oak creeks, but not in Laurel Creek. Reprodutive success was insufficient to maintain a self-sustaining population of trout. Poor and limited spawning habitat were regarded as the primary factors precluding successful reproduction. Only Bark Camp Creek was selected for future stockings of 8-inch brown trout to provide a put-grow-take fishery.

INTRODUCTION

The Kentucky Department of Fish and Wildlife Resources (KDFWR) examined available coldwater ($\leq 68^{\circ}F$) habitat in the early 1980's to determine management potential for "wild" brown trout (*Salmo trutta*) populations. Self-sustaining brook trout, (*Salvelinus fontinalis*) populations occurred in two streams in eastern Kentucky. Rainbow trout (*Oncorhynchus mykiss*) fisheries were principally put and take fisheries with limited natural reproduction occurring in select streams. Since brown trout reportedly are more tolerant of higher water temperatures (Raleigh et al. 1986) and have become the dominant wild trout in most American trout streams following introductory stockings (MacCrimmon and Marshall 1968; Behnke 1988), their potential was considered for Kentucky streams.

A scoring and rating system was established to evaluate candidate streams for brown trout introductions. During 1986 and 1987, fingerling (3-5 in) brown trout were stocked into nine Kentucky streams. The purpose of this study was to evaluate the success of these stockings in three streams. Initially, the study began with Bark Camp and Laurel creeks; however, sampling in Laurel Creek was discontinued and East Prong of White Oak Creek was added to the study in 1991 following problems in the Laurel Creek watershed.

STUDY AREAS

Bark Camp Creek is an Order IV stream within the Cumberland River drainage. This stream originates near the junction of US 25-W and KY 90 in northwestern Whitley County and flows for a distance of 8.4 miles in a northwesterly direction to its confluence with the Cumberland River, approximately 7 miles downstream of Cumberland Falls. This stream is within the Daniel Boone National Forest. The lower section (6.5 miles) of the stream was determined to contain suitable coldwater habitat for brown trout.

Laurel Creek, a tributary of Marsh Creek, is located in McCreary County. This stream flows for a distance of 8.7 miles from the outflow of the McCreary County Reservoir (a 50-acre impoundment located 2.0 miles ESE of Stearns) to the mouth. Downstream of the reservoir, the stream lies almost entirely within the Daniel Boone National Forest. A total of 5.6 miles of this stream (Mile 3.4 to Mile 9.0) was identified as having suitable coldwater habitat.

East Prong of White Oak Creek is a tributary to White Oak Creek in Laurel County, 1.6 miles south of Bernstadt. This remote stream is located primarily within the Daniel Boone National Forest and was determined to have coldwater habitat in the lower 2.3 miles.

METHODS

Bark Camp Creek, East Prong of White Oak Creek, and Laurel Creek were stocked with 3-5 inch brown trout fingerlings (Plymouth Rock strain) on 01 July 1986 and 30 June 1987. These fish were stocked at rates ranging from 63-185 fish per stream mile (Table 1). The trout were backpacked into remote sections of the streams to equally disperse them throughout stream sections that were determined to be suitable habitat for trout.

Physical/chemical determinations were made at each of the streams during the rating phase and at times following stocking. Water quality parameters of temperature, dissolved oxygen, pH, total alkalinity, turbidity, conductivity, and salinity were recorded for each of the streams. Dissolved oxygen and temperature measurements were determined with a YSI Model 54 oxygen meter. A Hach pocket pH meter was used for pH determinations, while a Hach Model AL-AP test kit was utilized for total alkalinity measurements. Turbidity and conductivity/salinity were determined by a HF Instruments turbidity meter and a YSI-SCT meter, respectively. The water quality criteria used to determine suitable coldwater habitat are shown in Table 2. Water quality parameters were measured at two locations in both Bark Camp and East Prong of White Oak creeks and at four locations at Laurel Creek (Table 3) during the period of 1983-1987. Water temperature was also checked at each of the streams during late October at the onset of the spawning season. The physical characteristics of the aquatic habitat in each stream were also recorded on-site, using visual estimation. Care was taken to note the presence or absence and condition of potential spawning habitat in the remainder of each of the streams outside the stations used to quantify the physical and chemical characteristics.

Benthic macroinvertebrate populations were sampled at two locations at Bark Camp Creek and three locations at Laurel Creek in May 1990 (Table 4). The invertebrates were collected by using the kick method of dislodging benthic organisms from the bottom of a one square-meter area above a D-frame aquatic net. Replicate samples were taken at each sample station. The samples were preserved in ethanol for later identification in the laboratory. Composition, density, diversity, and equitability were determined for each site. Species diversity was calculated by using the modified Shannon-Weaver index (Lloyd et al. 1968), while equitability was determined by utilizing the method described by Lloyd and Ghelardi (1964). Species richness (the total number of taxa) and the EPT (Ephemeroptera/Plecoptera/Trichoptera) index, which is the number of taxa within these three orders, were also calculated for each sample site. Interpretation of the indices follow standards developed by KDEP (1987).

Fish populations were examined in the three streams during the period of 1986-1992 by using a Smith-Root portable backpack electrofishing unit. A single pass was made through all available habitat types and efforts were made to include a minimum of two riffles and two pools at each station sampled. A varying number of stations were sampled in each stream during each year of electrofishing (Table 5). Additional electrofishing was done outside of the regular sample sites to attempt to locate trout. Fish were identified to species, measured to the nearest 0.1 inch, then returned to the stream. For this report, individual station data was combined and presented as yearly data per stream.

RESULTS AND DISCUSSION

Water quality results (Table 6) indicated that each of the three streams met the predetermined water quality requirements (Table 2) to establish self-sustaining populations of brown trout. The water temperature was slightly above optimum at Station 1 in Laurel Creek, due primarily to water being warmed by solar radiation before flowing out of the McCreary County Reservoir, but was not deemed critical for survival. Water temperatures during the period from late-October through mid- November (the spawning period) ranged from 44-46°F, below the critical level suggested by Spencer Turner (Missouri Department of Conservation - personal communication). Elevated fall temperatures (>53°F) due to discharge from natural springs precluded successful egg maturation by brown trout in those systems.

Each of the streams contained sections of physical habitat suitable for brown trout (Table 7). Raleigh et al. (1986) reported that optimum brown trout habitat included: 1) clear, cool to cold water; 2) relatively silt-free rocky substrate in riffle-run areas; 3) 50-70% pool/ 30-50% riffle ratio; 4) streams with areas of slow, deep water; 5) well vegetated, stable stream banks; 6) abundant instream cover; and 7) relatively stable annual water flow and temperature regimes. Raleigh et al. (1986) reported that brown trout require a gravel substrate in riffle-run areas for optimal reproduction to occur. He said that preferred gravel size had a diameter of 1.0-7.0 cm, but trout apparently used gravel ranging in size from 0.3-10 cm. Benson (1953) stated that potential spawning sites are characterized by upwelling of water through the gravel or by the presence of water currents flowing downward into the gravel. Hartzler et al. (1988) stated that trout are rarely found where the substrate is sand, silt, or fines, which damage the habitat and forage base. Lynch et al. (1977) indicated that sediment in spawning areas suffocates eggs and embryos of trout by filling the interstitial spaces in the substrate. As a result of this lack of space, flow of water carrying in oxygen and removing metabolic waste is reduced. The headwater region of Laurel Creek had problems with sedimentation severely degrading the riffle areas. Keith Blair (Kentucky Division of Water - personal communication) stated that a heavy increase in sedimentation in Laurel Creek began in 1987, resulting from high volumes of water discharged from a water treatment plant which eroded the sandy banks of a tributary stream. Any potential gravel riffle-run spawning sites which had existed in this section of Laurel Creek had the interstitial spaces filled in; therefore, any potential for flow of water through the gravel was eliminated. This high flow of water also contained significant concentrations of chlorine (Keith Blair - personal communication), which also impacted the biota. Adequate spawning sites, based on gravel size needed, did not exist in downstream sections of Laurel Creek. Only limited sections in the downstream areas of Bark Camp and East Prong of White Oak creeks contained suitable spawning habitat. MacCrimmon et al. (1988) suggested that suitable conditions for spawning, along with water temperature, were the two primary factors influencing the establishment of self-sustaining brown trout populations in streams.

Wesche et al. (1988) reported that the abundance and distribution of trout are directly correlated to trout cover. He stated that trout cover occurred in three primary components: 1) instream rubble and boulders, 2) overhead cover (undercut banks, overhanging vegetation, logs, and debris jams), and 3) deep pool areas ($\geq$45cm). It was suggested that the overhead cover was the habitat factor most likely to influence the distribution of trout. Laurel Creek and

East Prong of White Oak Creek contained adequate cover/shelter at each of the stations (Table 7). Bark Camp Creek had suitable boulder habitat throughout but sufficient overhead cover occurred only in the lower half of the stream.

The macroinvertebrate population data (Tables 8-12) indicated good water quality in both Bark Camp and Laurel creeks, with the exception of Station 1 (headwater area just downstream of the McCreary County Reservoir) at Laurel Creek, which was degraded due to sedimentation and high chlorine concentrations. The species diversity and equitability values were high (4.27-4.77 and .77-.78, respectively) for all but Station 1 at Laurel Creek and moderate (3.41-4.01 and .48-.83, respectively) at Bark Camp Creek, indicating relatively unpolluted water quality (Wilhm and Dorris 1966). The number of taxa of mayflies, stoneflies, and caddisflies (EPT Index) was good for Bark Camp (19-20) and Laurel creeks (22-28). The species richness values were moderate (29-31) for Bark Camp Creek and high (36-53) for Laurel Creek. Laurel Creek had species richness values which progressively increased downstream. All the macroinvertebrate samples, except at Station 1 at Laurel Creek, were typical for cool, clear, unpolluted streams in the Cumberland Plateau region of southeastern Kentucky.

The total fish population was sampled in the three streams, producing thirty-four taxa (Table 13), and reported as species composition, relative abundance (catch per hour), and length frequency (Tables 14-16). Both Laurel and East Prong of White Oak creeks contained fish assemblages indicative of similar size streams in the upper Cumberland River drainage. However, Bark Camp Creek had a noticeable absence of darters and low numbers of cyprinids presumably due to a barrier (waterfall) near the mouth of the stream. Laurel Creek contained the federally- threatened blackside dace (Phoxinus cumberlandensis) in 1988 and a good population of the johnny darter (Etheostoma nigrum susanae) which is currently under federal review for listing as an endangered or threatened species. The blackside dace was only collected in 1988, a drought year, and apparently migrated from a tributary stream between Stations 1 and 2. The introduced redbreast sunfish (Lepomis auritus) was also collected in Laurel Creek, a product of migration from their initial introduction during 1969 and 1971 in Marsh Creek (Bell et al. 1985), of which Laurel Creek is a tributary.

The length frequency and catch rate of brown trout collected in the three study streams from 1986-1992 are presented in Table 17. Sampling in Laurel Creek was discontinued after 1990 following low catch per unit effort (1987,1988,1990) and water quality and habitat conditions in the headwaters. The highest catch rates for brown trout were in East Prong of White Oak Creek; however, most brown trout were limited to the lowermost station near the mouth. Natural reproduction was documented in both 1990 and 1991 in East Prong of White Oak Creek but was not detected in 1992. Natural reproduction was also detected in Bark Camp Creek during 1988 and 1991, but catch rates declined from 5.6 trout/hour in 1988 to 0.9 trout/hour in 1991.

Both Bark Camp and Laurel creeks were also being stocked with rainbow trout. Laurel Creek was stocked with juvenile rainbow trout during alternate years for a put-grow-take fishery. Bark Camp Creek was stocked with catchable-size (approximately 8-9 inch) rainbow trout during the spring months for a put-take fishery. Competition from "resident" trout may have contributed to the failure of brown trout to establish a significant population in either of these two

streams since Benson (1970) stated that stocking for long-term survival is traditionally more successful when there is minimal competition from resident trout. Swan (1985) found that significant dietary overlap occurred between rainbow trout and longear sunfish in a Tennessee stream; therefore, the presence of redbreast sunfish, a species known to successfully compete with longear sunfish, may be another factor contributing to the lack of success for brown trout in Laurel Creek.

Raleigh et al. (1986) wrote that brown trout, particularly adults, tend to occupy the deeper, lower velocity, warmer, more fertile downstream sections of streams. This was found to be true in both Bark Camp Creek and East Prong of White Oak Creek, as the lower sections of these streams produced both the adults and young-of-year fish. A limited amount of spawning habitat occurs in these two streams in the downstream sections and apparently is responsible for the limited spawning success.

CONCLUSIONS

Natural reproduction of brown trout was documented in Bark Camp and East Prong of White Oak creeks but not in Laurel Creek. Although brown trout succeeded in spawning in the two streams, the density of young-of-year fish was insufficient to create a population level to sustain a fishery. Factors thought to contribute to the failure in establishing self-sustaining populations of brown trout in these streams include: 1) lack of or scarcity of suitable spawning habitat, 2) presence of rainbow trout in two streams, and 3) competition from redbreast sunfish, a predatory species, in one stream. Each of the study streams had one or more of these problems associated with it. The limited amount of suitable spawning habitat is most likely the primary limiting factor in establishing a trout population. Only one other stream of the nine stocked with brown trout in 1986-1987 had minimal reproduction documented - Chimney Top Creek. This stream had good survival and growth of brown trout up to 17.1 inches in 1989 (McLemore et al. 1990). A good population of brown trout has been developed in that stream by stocking 4-inch fish once annually since 1990.

RECOMMENDATIONS

1) Stock 8-inch brown trout in Bark Camp Creek to develop a put-grow-take fishery to supplement the existing rainbow trout fishery. Management for brown trout should occur from the culvert at the USFS Road 193 crossing to the mouth of the stream, a distance of 3.9 miles.

2) Discontinue stocking brown trout in East Prong of White Oak Creek, since access problems preclude development of a put-grow-take fishery.

3) Laurel Creek should not be stocked until such time that the water quality and habitat conditions recover from current disturbances, and then only if studies show that brown trout will not impact populations of the federally threatened blackside dace.

4) Future assessments in potential trout streams should include a survey for threatened and endangered species, and stocking should not be considered until potential impacts are addressed.

5) An evaluation of suitable spawning habitat should occur prior to any stream being stocked with brown trout to ascertain potential for developing a self-sustaining fishery. The presence or absence and condition of spawning habitat should be documented throughout the stream section with coldwater habitat.

6) Future sampling to evaluate stocking success of brown trout in streams should occur for three consecutive years following the second year of stocking. Sampling should occur in representative areas in the upper, middle, and lower regions of the coldwater habitat within the stream.

7) Brown trout should not be stocked to develop a self-sustaining fishery where significant competition from other fish species is probable.

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Table 1. Numbers of brown trout stocked in three southeastern Kentucky streams during 1986 - 1987.

Stream	Year	Size (in)	Number	Number/mile
Bark Camp Creek	1986	4.0 - 5.0	700	108
	1987	3.2 avg	1200	185
Laurel Creek	1986	4.0 - 5.0	350	63
	1987	3.2 avg	800	143
East Prong of White Oak	1986	4.0 - 5.0	300	130
	1987	3.2 avg	400	174

Table 2. Water quality criteria[a] for coldwater habitat suitable for development of wild trout populations in streams.

Water quality parameter	Desirable	Harmful
Temperature (°F)	$\leq$ 68	$\geq$ 78
Dissolved oxygen (mg/l)	$\geq$ 5	< 3
pH	6.5 - 8.2	< 4.7 and > 8.7
Turbidity (NTU)	$\leq$ 10	$\geq$ 90
Salinity (mg/l)	$\leq$ 400 (0.4 ppt)	$\geq$ 2000 (2.0 ppt)
Specific conductance (umhos/cm)	$\leq$ 1000	$\geq$ 4000

[a] Developed by KDFWR from review of literature of coldwater habitat.

Table 3. Sampling stations used to assess water quality and physical habitat at three southeastern Kentucky streams during 1983-1985 and 1987.

Station no.	Location	Date sampled
	Bark Camp Creek	
1	Near Darbs Branch	7-03-85
2	At culvert off USFS Road 193	7-03-85
	Laurel Creek	
1	1.0 mile upstream of Elisha Branch	7-26-84
2	0.25 mile upstream of KY 478 bridge	7-26-84
3*	Just upstream of KY 478 bridge	8-04-83
4*	100 yards upstream of mouth	7-25-84
	East Prong White Oak Creek	
1	Off USFS Road 4107	7-27-87
2	Near the mouth	7-27-87

* Physical habitat characteristics not recorded.

Table 4. Locations of macroinvertebrate sampling stations in Bark Camp Creek and Laurel Creek during May 1990.

Station no.	Location
	Bark Camp Creek
1	Off U.S. Forest Service Road 4186
2	At culvert off USFS Road 193
	Laurel Creek
1	0.1 mile downstream of McCreary County Reservoir dam
2	At upper end of USFS Trail 620
3	Just upstream of KY 478 bridge

Table 5. Sampling stations used to assess the fish population in three southeastern Kentucky streams during 1986-1992.

Station No.	Location	Year sampled					
		86	87	88	90	91	92
	Bark Camp Creek						
1	Off U.S. Forest Service Road 4186					X	
2	Near Spice Mortar Branch	X	X				
3	Near Darbs Branch		X				
4	At mouth of Martin's Fork	X				X	
5	0.5 mile downstream of Martin's Fork		X			X	
6	0.5 mile upstream of USFS Road 193 culvert			X			
7	At culvert off USFS Road 193		X	X	X	X	
8	Near Grassy Branch		X	X		X	
	Laurel Creek						
1	At upper end of USFS Trail 620			X	X		
2	0.25 mile downstream of Station 1			X			
3	Near mouth of Elisha Branch		X	X	X		
4	Just upstream of KY 478 bridge			X			
	East Prong of White Oak Creek						
1	Headwaters - off Hwy 1535					X	X
2	Just upstream of Station 3					X	X
3	Off USFS Road 4107		X			X	X
4	Near the mouth		X			X	X

Table 6. Water quality determinations at three southeastern Kentucky streams during 1983-1987.

Station number	Date	Temperature (°F)	Dissolved oxygen (mg/l)	pH	Total alkalinity (mg/l)	Turbidity (NTU)	Conductivity (umhos/cm)	Salinity (ppt)
				Bark Camp Creek				
1	7-03-85	68	6.5	6.9	34	2	60	0
2	7-23-84	66	10.6	6.6	17	3	30	0
2	7-03-85	68	7.8	7.0	21	2	21	0
				Laurel Creek				
1	7-26-84	71	8.1	7.1	41	12	70	0
2	7-26-84	71	6.7	7.1	27	5	45	0
3	8-04-83	68	7.7	7.8	28	5	80	0
4	7-25-84	68	5.6	6.4	21	3	30	0
				East Prong White Oak Creek				
1	7-27-87	70	7.0	7.2	34	6	60	0
2	7-27-87	69	6.4	7.2	21	5	60	0

Table 7. Physical habitat characteristics of three southeastern Kentucky streams.

Parameter	Bark Camp Creek*		Laurel Creek*		East Prong White Oak*	
	Station no.		Station no.		Station no.	
	1	2	1	2	1	2
Bottom type - pool (%)						
bedrock	10					50
boulder (>12in)	20	10	60	60	40	5
large rubble (6-12in)	30	30	20	20	10	
small rubble (3-6in)	20	20		10	10	10
coarse gravel (1-3in)	10	20	5		5	5
fine gravel (0.1-1in)	10	10			5	
sand		10	15	10	30	30
Bottom type - riffle (%)						
bedrock	10					70
boulder (>12in)	10	30	60	60	50	
large rubble (6-12in)	15	30	20	20	30	10
small rubble (3-6in)	15	20	10	5	5	10
coarse gravel (1-3in)	20	10	5	5	5	5
fine gravel (0.1-1in)	15	10		5	5	5
sand	15		5	5	5	
Pool/riffle ratio						
%pool	40	70	60	30	20	75
%riffle	60	30	40	70	80	25
Fish shelter						
abundant				X		
medium	X	X	X		X	X
Fish shelter type						
undercut banks				X		
boulders	X	X	X	X	X	X
ledges				X		
logs			X	X		X
brush			X	X	X	X
Riparian zone						
>30m	X	X	X	X	X	X
Shade						
75-100%	X		X	X	X	X
50-75%		X				

*Bark Camp Creek(7-3-85), Laurel Creek(7-26-84), East Prong White Oak(7-27-87).

Table 8. List of taxa collected in bottom fauna samples taken from Bark Camp Creek off USFS Road 4186 (Station 1) on May 21, 1990.

Total # of individuals= 329
Species richness= 31
EPT= 19

Diversity= 3.41
Equitability= 0.48

Order	Taxa	Quantitative		Total
		Sample 1	Sample 2	
Decapoda	*Orconectes sp*	1	2	3
Plecoptera	*Allocapnia sp*	1	0	1
	Isoperla sp	2	1	3
	Nemoura venosa	1	1	2
Ephemeroptera	*Attenella attenuata*	1	0	1
	Baetis amplus	2	0	2
	Baetis sp	5	4	9
	Dannella simplex	5	7	12
	Drunnella longicornis	4	1	5
	Epeorus sp	1	0	1
	Ephemerella hispida	10	1	11
	Isonychia sp	11	33	44
	Stenacron interpunctatum	2	8	10
	Stenonema mediopunctatum	44	72	116
	Stenonema puchellum	18	32	50
	Stenonema terminatum	5	6	11
Trichoptera	*Cheumatopsyche sp*	4	2	6
	Chimarra sp	0	1	1
	Glossosoma sp	1	0	1
	Hydropsyche betteni	2	5	7
Megaloptera	*Nigronia serricornis*	6	5	11
Coleoptera	*Ectopria sp*	1	0	1
	Helichus fastigatus	3	1	4
Odonata	*Lanthus albistylus*	1	0	1
Diptera	*Cricotopus tremulus*	1	1	2
	Dubiraphia sp	2	0	2
	Hemerodromia sp		0	2
	Polypedilum convictum	0	1	1
	Rheotanytarsus sp	5	1	6
	Thienemannimyia group sp	0	1	1
	Tipula sp	0	2	2

Table 9. List of taxa collected in bottom fauna samples taken from Bark Camp Creek at USFS Road 193 culvert (Station 2) on May 21, 1990.

Total # of individuals= 361
Species richness= 29
EPT= 20

Diversity= 4.01
Equitability= 0.83

Order	Taxa	Quantitative		Total
		Sample 1	Sample 2	
Decapoda	*Cambarus distans*	2	1	3
Plecoptera	*Acroneuria abnormis*	9	5	14
Ephemeroptera	*Baetis amplus*	3	0	3
	Baetis sp	1	11	12
	Dannella simplex	0	2	2
	Drunnella longicornis	8	15	23
	Epeorus sp	24	22	46
	Ephemerella sp	26	9	35
	Heptagenia sp	14	0	14
	Isonychia sp	33	33	66
	Stenonema mediopunctatum	8	31	39
	Stenonema modestum	9	0	9
	Stenonema puchellum	0	15	15
	Stenonema terminatum	0	8	8
Trichoptera	*Ceratopsyche*	3	0	3
	Cheumatopsyche sp	7	7	14
	Dolophilodes distinctus	8	1	9
	Glossosoma sp	10	1	11
	Hydropsyche betteni	13	0	13
	Neophylax atumnus	1	0	1
	Rhyacophila sp	2	0	2
Megaloptera	*Nigronia serricornis*	3	2	5
Coleoptera	*Psephenus herricki*	1	4	5
	Stenelmis sp 1	2	0	2
	Stenelmis sp 2	1	0	1
Odonata	*Lanthus albistylus*	0	2	2
Diptera	*Eukiefferiella brevicalcar*	1	0	1
	Rheotanytarsus sp	0	1	1
	Tipula sp	0	2	2

Table 10. List of taxa collected in bottom fauna samples taken from Laurel Creek 0.1 mile downstream of McCreary County Reservoir dam (Station 1) on May 22, 1990.

Total # of individuals= 233
Species richness= 10
EPT= 3

Diversity= 0.63
Equitability= 0.20

Order	Taxa	Quantitative		Total
		Sample 1	Sample 2	
Plecoptera	*Acroneuria sp*	1	0	1
Ephemeroptera	*Paraleptophlebia sp*	0	2	2
Trichoptera	*Cheumatopsyche sp*	1	1	2
Megaloptera	*Nigronia serricornis*	1	0	1
Coleoptera	*Helophorus sp*	1	0	1
Oligochaeta	*Lumbriculus sp*	1	0	1
Diptera	*Cardiocladius sp*	3	7	10
	Polypedilum convictum	0	1	1
	Simulium vittatum	36	177	213
	Thienemannimyia group sp	0	1	1

Table 11. List of taxa collected in bottom fauna samples taken from Laurel Creek at upper end of USFS Trail 620 (Station 2) on May 22, 1990.

Total # of individuals= 297
Species richness= 36
EPT= 22

Diversity= 4.27
Equitability= 0.78

Order	Taxa	Quantitative		Total
		Sample 1	Sample 2	
Decapoda	*Orconectes sp*	0	1	1
Plecoptera	*Acroneuria sp*	1	0	1
	Allocapnia sp	6	5	11
	Isoperla sp	13	2	15
	Neoperla clymene	0	2	2
Ephemeroptera	*Baetis amplus*	2	0	2
	Baetis sp	15	9	24
	Dannella simplex	2	2	4
	Ephemera sp	0	1	1
	Ephemerella hispida	4	0	4
	Isonychia sp	2	4	6
	Stenacron interpunctatum	5	1	6
	Stenonema mediopunctatum	38	24	62
	Stenonema puchellum	4	5	9
	Stenonema terminatum	4	5	9
	Stenonema vicarium	0	2	2
Trichoptera	*Cheumatopsyche sp*	9	15	24
	Chimarra sp	11	1	12
	Glossosoma sp	3	0	3
	Hydropsyche betteni	6	1	7
	Hydroptila sp	3	0	3
	Neophylax sp	1	0	1
Megaloptera	*Nigronia serricornis*	20	3	23
Coleoptera	*Anchytarsus sp*	2	1	3
	Promoresia tardella	15	0	15
	Stenelmis sexlineata	4	0	4
	Stenelmis sp	4	1	5
Odonata	*Lanthus albistylus*	2	0	2
Oligochaeta	*Lumbriculus sp*	2	2	4
Diptera	*Atherix sp*	1	0	1
	Hemerodromia sp	3	2	5
	Pedicia sp	2	0	2
	Rheotanytarsus sp	0	1	1
	Simulium vittatum	15	6	21
	Thienemannimyia group sp	1	0	1
	Tipula sp	0	1	1

Table 12. List of taxa collected in bottom fauna samples taken from Laurel Creek just upstream of KY 478 bridge (Station 3) on May 22, 1990.

Total # of individuals= 555
Species richness= 53
EPT= 28

Diversity= 4.77
Equitability= 0.77

Order	Taxa	Quantitative		Total
		Sample 1	Sample 2	
Decapoda	*Orconectes sp*	2	2	4
Gastropoda	*Elimia sp*	4	5	9
Plecoptera	*Acroneuria sp*	8	0	8
	Allocapnia sp	0	5	5
	Isoperla sp	4	7	11
	Nemoura venosa	5	6	11
	Neoperla clymene	3	0	3
Ephemeroptera	*Baetis amplus*	23	8	31
	Baetis sp	13	8	21
	Dannella simplex	6	5	11
	Eoporus sp	1	1	2
	Ephemera sp	0	2	2
	Ephemerella sp	19	12	31
	Isonychia sp	28	13	41
	Serratella serratoides	14	7	21
	Stenonema mediopunctatum	30	15	45
	Stenonema puchellum	3	7	10
	Stenonema terminatum	0	1	1
	Stenonema vicarium	0	1	1
Trichoptera	*Agapetus sp*	1	0	1
	Cheumatopsyche sp	35	15	50
	Chimarra sp	35	19	54
	Glossosoma sp	23	5	28
	Hydropsyche betteni	22	16	38
	Hydroptila sp	3	7	10
	Lepidostoma sp	0	4	4
	Nectopsyche sp	0	1	1
	Neophylax sp	0	2	2
	Polycentropus sp	2	0	2
	Rhyacophila sp	5	0	5
Megaloptera	*Corydalus cornutus*	1	0	1
	Nigronia serricornis	7	1	8

Table 12. (cont)

Order	Taxa	Quantitative		Total
		Sample 1	Sample 2	
Coleoptera	*Anchytarsus sp*	9	4	13
	Cylloepus sp	0	1	1
	Helichus fastigatus	4	2	6
	Promoresia tardella	2	3	5
	Psephenus herricki	13	2	15
	Stenelmis sexlineata	2	3	5
	Stenelmis sp	2	1	3
Odonata	*Argia sp*	0	1	1
	Lanthus albistylus	2	0	2
Lepidoptera	Pyralidae sp	0	1	1
Nematomorpha	*Gordius sp*	1	0	1
Diptera	*Brillia sp*	0	1	1
	Dubiraphia sp	0	2	2
	Eukieferiella sp	2	0	2
	Hemerodromia sp	3	7	10
	Pedicia sp	1	0	1
	Polypedilum sp	0	1	1
	Rheotanytarsus sp	2	0	2
	Simulium vittatum	4	4	8
	Stictochironomus sp	1	0	1
	Thienemannimyia group sp	2	0	2

Table 13. List of fish species collected by electrofishing in three southeastern Kentucky streams during 1986-1992.

Common name	Scientific name*	Bark Camp Creek	Laurel Creek	East Prong White Oak Creek
Rainbow trout	*Oncorhynchus mykiss*	X		
Brown trout	*Salmo trutta*	X	X	X
Rock bass	*Ambloplites rupestris*		X	
Redbreast sunfish	*Lepomis auritus*		X	
Green sunfish	*Lepomis cyanellus*	X		
Warmouth	*Lepomis gulosus*	X		
Bluegill	*Lepomis macrochirus*	X	X	X
Hybrid sunfish	*Lepomis* sp X sp	X		
Smallmouth bass	*Micropterus dolomieu*		X	
Spotted bass	*Micropterus punctulatus*		X	
White sucker	*Catostomus commersoni*	X	X	X
Northern hog sucker	*Hypentelium nigricans*		X	X
Least brook lamprey	*Lampetra aepyptera*		X	X
Central stoneroller	*Campostoma anomalum*		X	
Largescale stoneroller	*Campostoma oligolepis*			X
Spotfin shiner	*Cyprinella spiloptera*		X	
Rosefin shiner	*Lythrurus ardens*		X	X
Striped shiner	*Luxilus chrysocephalus*		X	
Silverjaw minnow	*Notropis buccatus*		X	
Rosyface shiner	*Notropis rubellus*		X	
Mimic shiner	*Notropis volucellus*		X	
Blackside dace	*Phoxinus cumberlandensi*		X	
Southern redbelly dace	*Phoxinus erythrogaster*	X		X
Bluntnose minnow	*Pimephales notatus*	X	X	X
Blacknose dace	*Rhinichthys atratulus*	X		
Creek chub	*Semotilus atromaculatus*	X	X	X
Emerald darter	*Etheostoma baileyi*		X	
Greenside darter	*Etheostoma blennioides*		X	
Fantail darter	*Etheostoma flabellare*			X
Stripetail darter	*Etheostoma kennicotti*		X	
Johnny darter	*Etheostoma nigrum susane*		X	
Arrow darter	*Etheostoma sagitta*		X	
Striped darter	*Etheostoma virgatum*			X
Blackside darter	*Percina maculata*		X	X

*Based on Robins et al. (1991).

Table 14. Species composition, length distribution, and relative abundance of fish collected by electrofishing in Bark Camp Creek during 1986-1991.

Species/Year	Inch class													Total number	Number per hour
	1	2	3	4	5	6	7	8	9	10	11	12	15		
Brown trout															
1987			1	2			1			1				5	2.7
1988			3					3						6	5.6
1990					1									1	1.3
1991			1										1	2	0.9
Rainbow trout															
1987									1					1	0.5
1988								1	1	2	1	2		7	6.5
1990								3	2		1			6	4.6
1991									3					3	1.3
Green sunfish															
1987			1	1										2	2.7
Warmouth															
1991		2												2	1.0
Bluegill															
1987				1										1	0.5
1991		4	5	3										12	6.0
Hybrid sunfish															
1986					3									3	9.3
1987				10	8	4	6	1						29	15.7
White sucker															
1986		1	5		2									8	24.8
1987			6	9	5	7	1							28	15.1
1988			2	12	4		2							20	18.6
1990		2			1									3	7.0
1991	8	1	16	7	19	16	3	2						72	36.0
Southern redbelly dace															
1986		7	4											11	34.1
1987		9	20											29	15.7
1988		5	24	2										31	28.8
1991	1	9	8											18	9.0
Bluntnose minnow															
1986		1												1	3.1
Blacknose dace															
1986	2	6	3											11	34.1
1987	7	61	42	3										113	61.0
1988		6	20	4										30	27.9
1990	14	5	57											76	177.1
1991	14	54	38											106	53.0
Creek chub															
1986	32	60	67	23	8	1		1						192	595.2
1987	2	46	151	94	40	10	5	2						347	187.4
1988		54	120	96	33	2	1	1	1	1	1			310	288.3
1990	16	12	31	21	4	2								86	200.4
1991	61	85	65	76	48	21	12	4	1					373	186.5

Table 15. Species composition, length distribution, and relative abundance of fish collected in Laurel Creek during 1986-1990.

Species/Year	Inch class											Total number	Number per hour
	0	1	2	3	4	5	6	7	8	9	10		
Brown trout													
1987				1	1							2	7.1
Smallmouth bass													
1986				1								1	1.6
Spotted bass													
1986						2		1				3	4.8
Rock bass													
1986				3						1		4	6.4
1987								1	1			2	7.1
1988					1		1	1	1	1		5	5.4
1990					1	1						2	4.3
Redbreast sunfish													
1986		7	4	6	5	2	1	3		1		29	47.0
1987		1	1	1		1						4	14.3
1988				2	2	3	1	1	1			10	10.9
1990								1				1	2.1
Bluegill													
1987				2			1	1				4	14.3
1988					1		1	1				3	3.2
White sucker													
1986			3	10	8	5						26	42.0
1987			8	2	11	13	4	5		1		44	157.1
1988			27	41	48	23	7	4	3			153	164.5
1990		1	1		1	1						4	8.6
Northern hog sucker													
1986				5	1	8	3		1	1		19	31.0
1987					1			1	1			3	11.0
1988			2	3	2	3	1	2	1	1	1	16	17.2
1990			2									2	4.3
Least brook lamprey													
1986					1							1	1.6
1988						3						3	3.2
Central stoneroller													
1986				1	3							4	6.5
1988				4								4	4.3
Spotfin shiner													
1988			1	15	4							20	21.5
Rosefin shiner													
1986		8	9									17	27.4
Striped shiner													
1986						1						1	1.6
Silverjaw minnow													
1986			2	18								20	32.3
1987				2								2	7.1
1988		2	51	69								122	131.2
1990	1		2	1								4	8.6

Table 15. (cont)

Species/Year	Inch class 0	1	2	3	4	5	6	7	8	9	10	Total number	Number per hour
Rosyface shiner													
1988				5	13							18	19.4
Mimic shiner													
1986			23									23	31.7
Blackside dace													
1988			2	5								7	7.5
Bluntnose minnow													
1986		10	24	4								38	61.3
1987			2									2	7.1
1988			2	2	3							7	7.5
Creek chub													
1986		4	25	40	22	4		1		1		97	157.0
1987				3	13	3	3	5	1		1	29	104.0
1988		1	68	60	43	38	7	1	7	1	1	227	244.1
1990		46	33	26	7	4	1					117	254.3
Emerald darter													
1986			4									4	6.5
1988			3									3	3.2
Greenside darter													
1986				1								1	1.6
1988				3	1							4	4.3
Stripetail darter													
1986		2	6	2								10	16.1
1987			2									2	7.1
1988			28	6								34	36.6
1990	1		2	1								4	8.6
Johnny darter													
1986		7	14									21	34.0
1987		1	3									4	14.3
1988		1	36									37	39.8
1990		2	3									5	10.9
Arrow darter													
1986			2	3	1							6	10.0
1987					1							1	3.6
1988			5	7								12	12.9
1990			2	2								4	8.6
Blackside darter													
1986			2									2	3.2
1987				1								1	3.6
1988					1							1	1.1

Table 16. Species composition, length distribution, and relative abundance of fish collected by electrofishing in East Prong of White Oak Creek during 1987-1992.

Species/Year	Inch class														Total number	Number per hour
	0	1	2	3	4	5	6	7	8	9	11	12	13	14		
Brown trout																
1987				1											1	2.2
1990				7							1		1		9	7.7
1991				4	1				1	1					7	5.5
1992									4	3		1		1	9	6.1
Bluegill																
1991			1	3											4	8.9
White sucker																
1987			5	4	16										25	55.6
1991				3	19	22	6	3	1						54	42.2
Northern hog sucker																
1987									1						1	2.2
1991				1				1							2	1.6
Least brook lamprey																
1987					1	1									2	4.4
1991					1	5	1								7	5.5
Largescale stoneroller																
1987			1	8											9	20.0
1991				1	1										2	1.6
Rosefin shiner																
1987				4											4	8.9
Southern redbelly dace																
1987		1	68	14											83	184.4
1991		18	86	2											106	82.8
Bluntnose minnow																
1987				1											1	2.2
Creek chub																
1987		19	17	34	26	5	1								102	226.7
1991	2	38	88	93	62	25	3								311	243.0
Fantail darter																
1987			2												2	4.4
Striped darter																
1987		3	16	11											30	66.7
1991	1	24	44	4											73	57.0
Blackside darter																
1987			2												2	4.4
1991				1											1	0.8

Table 17. Length-frequency and catch rate of brown trout collected by electrofishing in three southeastern Kentucky streams during 1986-1992.

Year	Hours of sampling	Inch class										Total number	Fish per hour
		3	4	5	7	8	9	10	12	14	15		
Bark Camp Creek													
1986	0.32											0	0
1987	1.84	1	2		1			1				5	2.7
1988	1.08	3				3						6	5.6
1990	0.77			1								1	1.3
1991	2.33	1									1	2	0.9
Laurel Creek													
1987	0.28	1	1									2	7.1
1988	0.93					1						1*	1.1
1990	1.68											0	0
East Prong White Oak Creek													
1987	0.45	1										1	2.2
1990	1.17	7							1	1		9	7.7
1991	1.28	4	1			1	1					7	5.5
1992	1.47					4	3		1	1		9	6.1

*Observed but not collected.