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ABSTRACT

An ichthyofaunal survey of the Russell Fork of the Levisa Fork of the Big Sandy River in western Virginia and eastern Kentucky was conducted from May to November 1998. A total of 94 collections was made from 92 sites. A total of 65 species was collected. *Phoxinus oreas* was a new Big Sandy drainage record. *Ichthyomyzon unicuspis* and *Noturus flavus* were new Levisa Fork system records. *Clinostomus funduloides*, *Noturus stigmosus*, and *Stizostedion canadense* were Russell Fork system records. *Etheostoma nigrum* was a new record for the Virginia portion of the Russell Fork. Finally, *Lepomis auritus* was a new record for the Kentucky portion of the Russell Fork. Failure to collect *Ammocrypta pellucida* and *Nocomis micropogon* may indicate their extirpation from the Russell Fork system. Reports by previous investigators of *Ichthyomyzon bdellium*, *Nocomis biguttatus*, *Notropis atherinoides*, *Pimephales promelas*, *Carpiodes velifer*, *Ameiurus nebulosus*, and *Ameiurus melas* were determined to be erroneous. Deletion of these misidentifications, combined with the new records of this study, brought the total number of known fishes in the Russell Fork to 73 species. Fish data indicated that a series of cascades located near the Virginia-Kentucky border act as a barrier to upstream fish dispersal, causing a depauperate fish fauna in the upper portion of the Russell Fork. *Cyprinella galactura* and *Etheostoma simoterum* were hypothesized to be Russell Fork natives transferred via headwater stream capture with the Clinch River. Species of *Etheostoma* in tributaries to the upper Russell Fork exhibit allopatric distributions that are unexplained.

INTRODUCTION

The Russell Fork (Levisa Fork - Big Sandy River drainage) originates in Dickenson County, Virginia, and flows northwestward toward Kentucky. It is joined by the McClure River and the Pound River before entering the 300 m deep Breaks Canyon and dropping 100 m in its final three river kilometers (rkm) in Virginia (Dietrich, 1970). Within this 3 rkm, there are five cascades more than 3 m in height. Two of these cascades, approximately 3 m and 5 m high, are separated by less than 10 m of horizontal flow. The substrate in this area is exclusively boulder and bedrock (personal observation). After exiting Breaks Canyon, the Russell Fork gradient (1.9 m/km) becomes more typical of an Appalachian stream its size (Kirkwood, 1957). The Russell Fork flows 28 rkm in Kentucky before it empties into the Levisa Fork in Pike County, Kentucky, as a sixth order tributary. The system lies within the Central Appalachian Ecoregion and drains all of Dickenson County, Virginia, parts of Buchanan and Wise counties, Virginia, and Pike County, Kentucky (Kentucky Division of Water, 1997; Jenkins and Burkhead, 1993).

Although the first fish collections were made over 100 years ago (Woolman 1892), the Russell Fork system has been poorly sampled by ichthyologists (Robert E. Jenkins pers. comm.). The first known collections in the Russell Fork system were made in Kentucky (Woolman 1892). No additional collecting was done until 1937, when Clark (1941) visited the Kentucky portion of the Russell Fork, and Schultz and Reid visited the Virginia portion (Jenkins and Burkhead, 1993). Approximately five collections were taken from the Russell Fork system between 1938 and 1968 (Jenkins and Burkhead, 1993; Burr and Warren, 1986; Kirkwood, 1957; Turner, 1959, 1961).

More fish data from the Russell Fork system have become available since 1968, but many large tributaries have been poorly sampled or totally unsampled. Jenkins and Burkhead (1993) based their description of the Russell Fork fish fauna in Virginia on data from 41 collection sites spread over a 50-year period. Burr and Warren (1986) cited data from less than ten localities in Kentucky including Woolman (1892), Clark (1941), Kirkwood (1957), Turner (1959, 1961), Evenhuis (1973), Kentucky Nature Preserves Commission (1979), Robinson and Branson (1980), and unpublished records from the Eastern Kentucky University fish collection database.

Since Burr and Warren (1986) and Jenkins and Burkhead (1993), very little work has been done in the Russell Fork system. Kentucky State Nature Preserves Commission personnel made three collections in the Russell Fork system prior to this study. Bay (1986) sampled 14 sites in the Russell Fork mainstem, and Leftwich et al. (1994) sampled nine sites within four reaches of the Russell Fork mainstem. Because many of these more recent collections were made at previously-collected sites, and some collections had inexact locality information, the total number of historical fish collection sites (all sites sampled prior to this study) in the Russell Fork system was approximately 56 (Fig. 1).

A total of 73 fish species was reported from these 56 sites (Table 1). Sixty-seven of the 73 species reported from the Russell Fork system were reported from the Kentucky portion of the drainage. Only 44 species had been reported from the Virginia portion. Jenkins and Burkhead (1993) attributed the low species richness of the Virginia portion of the Russell Fork to degradation of the watershed by logging, mining, and development. However, Leftwich et al. (1994) suggested that a series of cascades located near the state line act as a barrier to upstream fish dispersal.

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Table 1. Species list for watersheds within the Russell Fork system[#]. 1 = lower Russell Fork mainstem and minor tributaries. 2 = Elkhorn Creek. 3 = Grassy Creek. 4 = upper Russell Fork and minor tributaries. 5 = Lick Creek. 6 = McClure River. 7 = Cranes Nest River. 8 = Pound River. G = generally distributed; O = occasional; S = sporadic [from Smith (1965)].

Family / Scientific name	Watershed 1	2	3	4	5	6	7	8
Petromyzontidae								
*Ichthyomyzon bdellium**								
I. unicuspis	S							
Lampetra appendix	S							
Lepisosteidae								
Lepisosteus osseus	O							
Anguillidae								
Anguilla rostrata	S							
Clupeidae								
Dorosoma cepedianum	O	S						
Salmonidae								
Oncorhynchus mykiss	S			S		S	S	S
Salmo trutta	S			S			S	S
Cyprinidae								
Campostoma anomalum	G	G	G	G	G	G	G	G
Clinostomus funduloides			S					
Cyprinella galactura	G	O		G	G	G	O	O
C. spiloptera	G							
C. whipplei	O							
Cyprinus carpio	O			S				
Ericymba buccata	O	O		O		S	S	S
Erimystax dissimilis	O							
Luxilus chrysocephalus	G	G		G	G	G	G	G
Macrhybopsis aestivalis	O							
Nocomis micropogon	S			S				S
*N. biguttatus**								
*Notropis atherinoides**								
N. ludibundus	O	O		O			S	
N. photogenis	G	O						
N. rubellus	G	O		G	O	G	O	O
N. volucellus	G	S						
Phenacobius mirabilis	S	S						
Phoxinus oreas			S					
Pimephales notatus	G	G		G	O	S	S	S
*P. promelas**								
Rhinichthys atratulus	G	G	G	G	O	G	G	G
R. cataractae	S							
Semotilus atromaculatus	G	G	G	G	G	G	G	G
Catostomidae								
Carpiodes cyprinus	O							
*C. velifer**								
Catostomus commersoni	O	G		O	O	S	O	O
Hypentelium nigricans	G	G		G	G	G	G	G
Ictiobus bubalus	S							
Moxostoma anisurum	O							
M. carinatum	O							
M. duquesnei	O							
M. erythrurum	O							
M. macrolepidotum	O							

Family / Scientific name	Watershed 1	2	3	4	5	6	7	8
Ictaluridae								
Ameiurus natalis	S	S		S			S	S
*A. melas**								
*A. nebulosus**								
Ictalurus punctatus	S	S		S				
Noturus eleutherus	S							
N. flavus				S				
N. stigmosus	S							
Pylodictis olivaris	S			S				
Atherinidae								
Labidesthes sicculus	S							
Cottidae								
Cottus bairdi					O	O	S	O
Moronidae								
Morone chrysops								S
Centrarchidae								
Ambloplites rupestris	O	O		G	G	G	S	O
Lepomis auritus	S	S		G	O	O	O	O
L. cyanellus		S		S		S		S
L. macrochirus	S			S			O	G
L. megalotis	S							
L. microlophus				S			S	
Micropterus dolomieu	G	O		G	O	O		S
M. punctulatus	S			S	S	S	S	S
M. salmoides	S	S		S			S	S
Pomoxis annularis	S			S				
P. nigromaculatus								S
Percidae								
Ammocrypta pellucida	S							
Etheostoma blennioides	G	O						
E. caeruleum	G	S		G	G	S		
E. flabellare	S			S	G			
E. nigrum	S	S					G	G
E. simoterum	S			S		G		
E. variatum	G	S						
E. zonale	G	S						
Percina caprodes	O	S						
P. copelandi	S							
P. evides	O							
P. maculata	S							
P. oxyrhyncha	S			O	S	S	S	O
P. sciera	O							
Stizostedion canadense	S							
S. vitreum	S							

[#] based on this study, Jenkins and Burkhead (1993), Leftwich et al.(1994), Bay (1986), Stephens and Prather (1985), Robinson and Branson (1980), Kentucky Nature Preserves Commission (1979), Evenhuis (1973), Turner (1959, 1961), Kirkwood (1957), Clark (1941), Woolman (1892) and collections housed at Eastern Kentucky University, and Kentucky State Nature Preserves Commission.

*erroneously reported, species not found in Russell Fork

Although there were 56 historical collection sites in the Russell Fork, many of the original field data sheets indicated incomplete sampling, many different collecting methods, and imprecise locality information. Therefore, we do not have an adequate knowledge of the Russell Fork fish fauna. Since no comprehensive fish survey of the system has ever been conducted, it is difficult to determine the extent to which human activity has impacted the ichthyofauna of Russell Fork. The primary goal of this study was to conduct the first comprehensive survey of the Russell Fork system. This goal was achieved by accomplishing the following objectives:

1. Resample all historical collection sites on the Russell Fork system;
2. Sample additional sites so that the entire system is well represented;
3. Provide baseline distribution data for future assessments and/or remediation;
4. Note differences between species reported in previous collections and this study, and offer explanations for differences;
5. Identify and explain biogeographic trends in the Russell Fork; and
6. Note unique features that may be in need of protection and/or further study (habitat, unique fauna, etc.).

METHODS

Site Selection

All known historical localities (n = 56) were revisited. Seven historical localities were not resampled due to poor habitat (degradation, small stream size, and/or no fish reported by previous collectors) or proximity to other sites. An additional 36 sites were sampled to insure that representative habitats in all major tributaries of the Russell Fork system were adequately sampled (Fig. 1, Appendix A).

Sampling

Collections were made generally following protocols outlined by Kentucky Division of Water (KDOW) (1993). This required subjective use of seines of various sizes and electrofishing gear in all suitable fish habitats at a given site. Snorkel surveying was also done at Sites 19 and 24 to search for species not likely to be captured by other methods. A trammel net was set at Site 19 and boat electrofishing was done at Sites 4 and 17 to capture larger species that are not likely to be regularly collected by seining. Voucher specimens were retained from each site in approximate proportion to their abundance. Specimens were preserved in 10% formalin for at least one week. The samples were then rinsed in tap water, transferred into 70% ethanol, and identified using Jenkins and Burkhead (1993) and Etnier and Starnes (1993). All voucher specimens were catalogued into the permanent research collection at the Branson Museum of Zoology at Eastern Kentucky University. Original sorting sheets were also stored at the Branson Museum.

Data Analysis

Data analysis was divided into two main components: trends in species presence/absence data and biogeographic trends. The trends in species presence/absence data were analyzed by plotting all historical records against the 1998 data. New records, trends, and omissions were noted and explained in the Results and Discussion. Also, in an effort to be consistent with the most frequently cited publication regarding fishes in Kentucky (Burr and Warren, 1986), each species was identified as being generally distributed, occasional, or sporadic (Table 2) in each subsystem of the Russell Fork system from which it is known following the definitions of Smith (1965) as used by Burr and Warren (1986). The species occurrence index was based upon the proportion of sites in a given subsystem in which the species was found. Only sites containing suitable habitat and sampled with methods appropriate for collecting that species were used to evaluate the species' incidence. Species were determined to be sporadic if collected in less than 1/3 of suitable sites, occasional if taken at 1/3 -2/3 of such sites, and generally distributed if found at more than 2/3 of all suitable sites.

Distribution maps for each species were examined for biogeographic trends. Trends were noted and explained in the results and discussion. Jaccard's coefficients of community similarity (Krebs, 1989) were calculated at four sites adjacent to an hypothesized barrier to fish migration (Leftwich et al., 1994). The coefficients were compared to determine if there were shifts in community similarity at the hypothesized barrier.

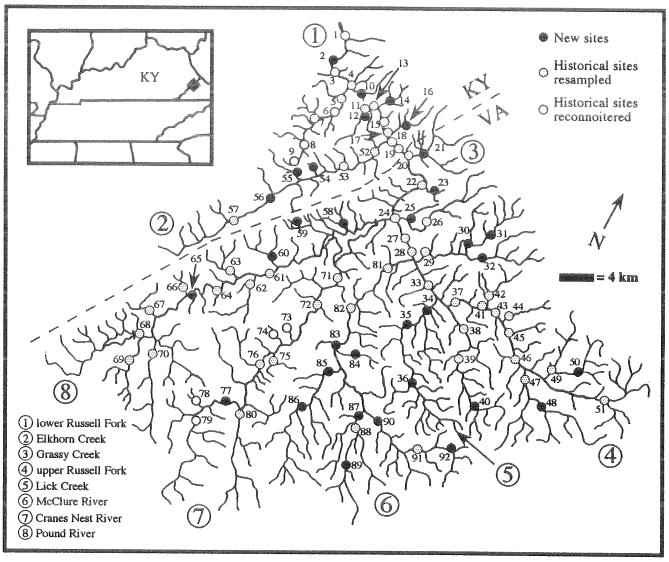

Figure 1. Map of Russell Fork system and all collection sites.

Table 2. Terminology and definitions regarding the distribution of fish species in the Russell Fork system [from Smith (1965) and Burr and Warren (1986)].

Generally distributed - implies that any suitable habitat within the prescribed area should be expected to yield specimens with a reasonably thorough search.
Occasional - implies that suitable-appearing habitat may or may not yield specimens even after prolonged search.
Sporadic - implies that encountering specimens of a given taxon can not be predicted at all.

RESULTS AND DISCUSSION

Sixty-five species were collected in this study. Thirty-eight species were collected from the Virginia portion of the system, while 61 species were collected from the Kentucky portion. The five most generally distributed species were *Campostoma anomalum* (74 sites), *Hypentelium nigricans* (62 sites), *Luxilus chrysocephalus* (53 sites), *Rhinichthys atratulus* (53 sites), and *Semotilus atromaculatus* (48 sites).

Of the 74 fish species previously reported from the Russell Fork, seven are considered probable misidentifications, reducing the total to 67 species known from historical collections in the Russell Fork. Eight of these species were not collected in 1998. However, the collection of six species not previously reported from the Russell Fork system brings the total number known to 73, of which nine were probably introduced and another possibly introduced.

Notable Sites

Forty species, including seven darters and *Noturus stigmosus*, listed as a species of "Special Concern" by Kentucky Nature Preserves Commission (KNPC) (1996), were obtained in two collections made at Site 4. A collection by seining produced 24 species, and a boat electrofishing collection added 16 more species. Site 2 yielded a total of 37 species, including 10 darters, in two collections using seines. Twenty-six species were collected from Site 11, including nine darters and *N. stigmosus*. A total of 25 species, including 10 darters, was collected at Site 18 using seines.

Species Accounts

The following annotations document the occurrence of all species considered to be correctly reported from 92 sites (Fig. 1, Appendix A) in the Russell Fork system. Localities of collections made during this study are in bold. All species are considered native unless otherwise noted.

Petromyzontidae

Ichthyomyzon unicuspis Hubbs and Trautman, silver lamprey. Site **17**. Sporadic in lower Russell Fork. Known only from one specimen. New Levisa Fork system record.

Lampetra appendix (DeKay), American brook lamprey. 1. Sporadic in lower Russell Fork.

Lepisosteidae

Lepisosteus osseus (Linnaeus), longnose gar. **2**, **4**, 13, **17**. Occasional in lower Russell Fork.

Anguillidae

Anguilla rostrata (Lesueur), American eel. 18. Sporadic in lower Russell Fork.

Clupeidae

Dorosoma cepedianum (Lesueur), gizzard shad. 1, **4**, **11**, **17**, 53, **57**. Occasional in lower Russell Fork. Sporadic in Elkhorn Creek.

Salmonidae

Oncorhynchus mykiss (Walbaum), rainbow trout. 18, 20, **22**, 24, **38**, **40**, **49**, **58**, **61**, **75**. Introduced. Sporadic in lower and upper Russell Fork, Cranes Nest, and Pound rivers.

Salmo trutta (Linnaeus), brown trout. 19, 24, 39, **60**, **68**, **72**, **75**. Introduced. Sporadic in lower and upper Russell Fork, and Cranes Nest and Pound rivers.

Cyprinidae

Campostoma anomalum (Rafinesque), central stoneroller. Known from all sites except 6, 8, 9, 15, 25, 26, 54, 59, 73, 74, 78, 79, 83. Generally distributed throughout the Russell Fork system.

Clinostomus funduloides (Girard), rosyside dace. **21**. Possibly introduced due to proximity of bait retailer to collection site and absence from other sites. However, this species is known from other sites in Levisa Fork system. Sporadic. Known only from Grassy Creek. New Russell Fork system record.

Cyprinella galactura (Cope), whitetail shiner. **1**, **2**, **3**, **4**, **10**, **11**, **13**, **18**, **19**, **20**, **22**, **24**, **25**, **27**, **28**, **29**, **33**, **35**, **36**, **37**, **38**, **41**, **42**, **43**, 44, **45**, **46**, **47**, **48**, **49**, **50**, 51, **52**, **53**, **56**, **61**, **64**, **65**, 68, **72**, 74, 75, **76**, **80**, **81**, **82**, **83**, **85**, **86**, **87**, **88**, **90**. Generally distributed in lower and upper Russell Fork, Lick Creek, and McClure River. Occasional in Elkhorn Creek, Cranes Nest and Pound rivers.

Cyprinella spiloptera (Cope), spotfin shiner. **1**, **2**, **3**, **4**, **10**, **11**, **13**, **15**, 17, **18**. Generally distributed in lower Russell Fork.

Cyprinella whipplei Girard, steelcolor shiner. 1, **2**, **3**, **10**, 13, 17, 18, 19. Occasional in lower Russell Fork.

Cyprinus carpio Linnaeus, common carp. 1, **4**, 10, 15, **17**, 18, 19, 41. Introduced. Occasional in lower Russell Fork. Sporadic in upper Russell Fork.

Ericymba buccata Cope, silverjaw minnow. 1, **2**, **3**, **4**, 5, 6, 7, **10**, 15, **18**, **19**, **22**, **24**, **27**, 29, **30**, **32**, 37, **42**, 43, 44, **46**, 47, **53**, **56**, **60**, 61, **66**, **69**, 70, 71, 72, 75, 76, **80**, 82. Occasional in lower and upper Russell Fork and Elkhorn Creek. Sporadic in McClure, Cranes Nest, and Pound rivers.

Erimystax dissimilis (Kirtland), streamline chub. 1, **2**, **3**, **4**, **10**, **11**, 13, 15, 17, 19, 20. Occasional in lower Russell Fork.

Luxilus chrysocephalus Rafinesque, striped shiner. Known from all sites except 6, 7, 8, 9, 10, 12, 14, 21, 23, 26, 39, 40, 48, 49, 51, 54, 55, 58, 59, 63, 66, 73, 78, 79, 83, 84, 86, 89, 91, 92. Generally distributed throughout Russell Fork drainage.

Macrhybopsis aestivalis (Girard), speckled chub. **1**, **2**, **3**, **4**, **10**. Occasional in lower Russell Fork.

Nocomis micropogon (Cope), river chub. 17, 29, 68. Probably extirpated from Russell Fork system.

Notropis ludibundus (Girard), sand shiner. 1, 4, **11**, **13**, **15**, **18**, 19, 20, **22**, **24**, 27, 28, 29, 33, 37, **41**, 42, **43**, **44**, 45, **46**, **52**, 53, **56**, **72**. Occasional in lower and upper Russell Fork and Elkhorn Creek. Sporadic in Cranes Nest River.

Notropis photogenis (Cope), silver shiner. **1**, **2**, **3**, **4**, **10**, **11**, **13**, **15**, **17**, **18**, 52, **53**, **56**. Generally distributed in lower Russell Fork. Occasional in Elkhorn Creek.

Notropis rubellus (Agassiz), rosyface shiner. **1**, **2**, **3**, **4**, **10**, **11**, **12**, **13**, **15**, 17, **18**, **19**, **20**, **22**, **24**, **25**, **27**, **28**, 29, **33**, **34**, **35**, **37**, **38**, **41**, **42**, **43**, 44, **45**, **46**, **47**, **49**, 52, **53**, **56**, **61**, **64**, **65**, **71**, **72**, 74, **81**, **82**, **83**, **85**, **87**. Generally distributed in lower and upper Russell Fork and McClure River. Occasional in Elkhorn and Lick creeks and Pound and Cranes Nest rivers.

Notropis volucellus (Cope), mimic shiner. **1**, **2**, **3**, **4**, **10**, **11**, **13**, **15**, **18**, 19, **53**. Generally distributed in lower Russell Fork. Sporadic in Elkhorn Creek.

Phenacobius mirabilis (Girard), suckermouth minnow. **2**, **3**, **4**, 6, 7, **11**, 52, 53. Sporadic in lower Russell Fork and Elkhorn Creek.

Phoxinus oreas (Cope), mountain redbelly dace. **21**. Probably introduced due to proximity of a bait dealer to collection site and absence from the rest of the Big Sandy drainage. Known only from two specimens taken from Grassy Creek. New Big Sandy drainage record.

Pimephales notatus (Rafinesque), bluntnose minnow. **1**, **2**, **3**, **4**, **10**, **11**, **13**, **15**, 16, 17, **18**, **19**, **20**, **22**, **24**, **25**, **27**, **28**, **29**, **30**, **32**, **33**, **34**, 37, 38, **41**, **42**, **43**, 44, **45**, **46**, **47**, **50**, **52**, **53**, **56**, **57**, **58**, **61**, **64**, **67**, **68**, **71**, **72**, **75**, **76**, 79, **80**, 81, 82, **86**, **88**. Generally distributed in lower and upper Russell Fork and Elkhorn Creek. Occasional in Lick Creek. Sporadic in McClure, Pound and Cranes Nest rivers.

Rhinichthys atratulus (Hermann), blacknose dace. Known from all sites except 1, 2, 3, 9, 10, 12, 13, 15, 16, 17, 18, 28, 30, 34, 36, 41, 45, 53, 59, 61, 64, 65, 71, 73, 78, 82, 83, 85, 87. Generally distributed throughout Russell Fork drainage except for Lick Creek where it is occasional.

Rhinichthys cataractae (Valenciennes), longnose dace. 19. Probably introduced. Known only from lower Russell Fork near the Virginia border.

Semotilus atromaculatus (Mitchill), creek chub. Known from all sites except 1, 3, 10, 11, 13, 15, 17, 18, 24, 27, 28, 29, 30, 34, 37, 38, 39, 41, 43, 45, 48, 51, 52, 53, 65, 73, 81, 82, 83, 85, 86, 90. Generally distributed throughout Russell Fork drainage.

Catostomidae

Carpiodes cyprinus (Lesueur), quillback. 1, **4**, **10**, 13, 15, **17**, 18, **19**. Occasional in lower Russell Fork.

Catostomus commersoni (Lacepede), white sucker. 4, **5**, **7**, **14**, **18**, 20, 22, 24, **25**, **29**, **32**, **36**, **38**, **40**, 42, 51, **52**, **53**, **55**, **56**, **57**, **58**, **60**, 61, **62**, 67, **69**, **70**, 72, 75, 76, **77**, 79, **80**, **91**, **92**. Generally distributed in Elkhorn Creek. Occasional in lower and upper Russell Fork, Lick Creek, and Pound and Cranes Nest rivers. Sporadic in McClure River.

Hypentelium nigricans (Lesueur), northern hogsucker. Known from all sites except 3, 6, 8, 9, 12, 14, 16, 21, 23, 26, 31, 40, 54, 55, 59, 60, 67, 71, 73, 74, 78, 83, 84, 92. Generally distributed throughout the Russell Fork drainage.

Ictiobus bubalus (Rafinesque), smallmouth buffalo. 18. Sporadic in lower Russell Fork.

Moxostoma anisurum (Rafinesque), silver redhorse. **2**, **4**, 13, 15, **17**, 18, 19. Occasional in lower Russell Fork.

Moxostoma carinatum (Cope), river redhorse. **4**, 15, **17**, **19**. Occasional in lower Russell Fork.

Moxostoma duquesnei (Lesueur), black redhorse. 1, **4**, 13, 15, **17**, 18, 19. Occasional in lower Russell Fork.

Moxostoma erythrurum (Rafinesque), golden redhorse. 1, **4**, **5**, **7**, **10**, 13, 15, **17**, 18, 19. Occasional in lower Russell Fork.

Moxostoma macrolepidotum (Lesueur), shorthead redhorse. 1, **4**, **11**, 13, 15, **17**, 18, 19. Occasional in lower Russell Fork.

Ictaluridae

Ameiurus natalis (Lesueur), yellow bullhead. **4**, **5**, 37, 46, **57**, **58**, **64**, **72**. Sporadic in lower and upper Russell Fork, Elkhorn Creek, and Pound and Cranes Nest rivers.

Ictalurus punctatus (Rafinesque), channel catfish. **3**, **4**, 15, **17**, 18, 19, 20, 22, 24, **52**. Sporadic in lower and upper Russell Fork and Elkhorn Creek.

Noturus eleutherus (Jordan), mountain madtom. **2**, **4**. Sporadic in lower Russell Fork.

Noturus flavus Rafinesque, stonecat. **33**, **41**. Sporadic in upper Russell Fork. New Levisa Fork system record.

Noturus stigmosus Taylor, northern madtom. **4**, **11**. Sporadic in lower Russell Fork. New Russell Fork system record.

Pylodictis olivaris (Rafinesque), flathead catfish. **2**, **4**, **17**, 22, **24**. Sporadic in lower and upper Russell Fork.

Atherinidae

Labidesthes sicculus (Cope), brook silverside. 1, **2**, **11**, 17. Sporadic in lower Russell Fork.

Cottidae

Cottus bairdi Girard, mottled sculpin. **36**, **58**, **60**, **61**, **63**, **64**, **66**, 80, **86**, **87**, **88**, **89**, **91**, **92**. Occasional in McClure and Pound rivers. Sporadic in upper Russell Fork and Cranes Nest River.

Moronidae

Morone chrysops (Rafinesque), white bass. Introduced. Known only from North Fork Pound River Reservoir.

Centrarchidae

Ambloplites rupestris (Rafinesque), rockbass. **1**, **2**, **4**, **11**, **18**, **19**, **22**, **24**, 27, **28**, **29**, **31**, **32**, **33**, **34**, **35**, **36**, **37**, **38**, **41**, **42**, **43**, **44**, **45**, 46, **47**, **48**, **49**, **50**, **52**, **53**, 61, **64**, **66**, **67**, **68**, **70**, **80**, **81**, **82**, **83**, **84**, **85**, **87**, **88**, **90**, **91**. Generally distributed in upper Russell Fork, Lick Creek, and McClure River. Occasional in lower Russell Fork, Elkhorn Creek, and Pound River. Sporadic in Cranes Nest River.

Lepomis auritus (Linnaeus), redbreast sunfish. **2**, **20**, **22**, **24**, **27**, 28, **29**, **32**, **33**, **35**, **36**, **37**, **38**, **41**, **43**, **45**, **46**, **47**, **49**, **50**, **52**, **62**, **64**, **65**, **67**, **69**, 70, **72**, **77**, **80**, **81**, **82**, **85**. Introduced. Generally distributed in upper Russell Fork. Occasional in Lick Creek, and McClure, Cranes Nest and Pound rivers. Sporadic in lower Russell Fork and Elkhorn Creek. New Kentucky Russell Fork system record.

Lepomis cyanellus Rafinesque, green sunfish. 22, 52, **53**, **69**, **85**. Sporadic in upper Russell Fork, Elkhorn Creek, and McClure and Pound rivers.

Lepomis macrochirus Rafinesque, bluegill. 13, 15, 18, 19, **29**, 37, 42, 46, **58**, **60**, **61**, **62**, **64**, **68**, **69**, **70**, 71, 72, **75**, **76**, **77**, **80**. Generally distributed in Pound River. Occasional in Cranes Nest River. Sporadic in lower and upper Russell Fork.

Lepomis megalotis (Rafinesque), longear sunfish. 1, **4**, 13, 15, **17**. Sporadic in lower Russell Fork.

Lepomis microlophus (Guenther), redear sunfish. 24, **80**. Introduced. Sporadic in upper Russell Fork and Cranes Nest River.

Micropterus dolomieu Lacepede, smallmouth bass. **2**, **4**, **10**, **11**, 13, 15, **17**, **18**, **19**, **20**, **22**, **24**, **27**, **28**, **29**, **32**, 33, **36**, **37**, **41**, **43**, **44**, **45**, 46, **49**, **52**, **53**, **58**, **81**, **82**, **85**, **87**. Generally distributed in lower and upper Russell Fork. Occasional in Elkhorn and Lick creeks, and McClure River. Sporadic in Pound River.

Micropterus punctulatus (Rafinesque), spotted bass. 1, **2**, **4**, 6, 13, 15, 18, 19, 22, 33, **36**, 37, 41, **43**, 46, **61**, **70**, **72**, **86**. Sporadic in upper and lower Russell Fork, Lick Creek, and McClure, Cranes Nest, and Pound rivers.

Micropterus salmoides (Lacepede), largemouth bass. **1**, **2**, 18, 19, 42, **56**, 64, 70, 71, 72, 76. Sporadic in lower and upper Russell Fork, Elkhorn Creek, Cranes Nest and Pound rivers.

Pomoxis annularis Rafinesque, white crappie. **4**, 18, 19, 22. Sporadic in lower and upper Russell Fork.

Pomoxis nigromaculatus (Lesueur), black crappie. Introduced. Known only from North Fork Pound River Reservoir.

Percidae

Ammocrypta pellucida (Putnam), eastern sand darter. 18. Probably extirpated from Russell Fork system.

Etheostoma blennioides Rafinesque, greenside darter. **1**, **2**, **3**, **4**, **10**, 15, **16**, 17, **18**, **19**, **20**, **52**, **55**, **57**. Generally distributed in lower Russell Fork. Occasional in Elkhorn Creek.

Etheostoma caeruleum Storer, rainbow darter. **2**, **3**, **4**, **10**, **11**, **12**, **13**, **15**, **16**, 17, **18**, **19**, **20**, 22, 24, **25**, 27, **28**, **33**, **34**, **35**, **36**, **37**, **38**, **41**, **42**, **43**, **44**, **45**, **46**, **47**, **48**, **50**, **52**, **81**. Generally distributed in lower and upper Russell Fork and Lick Creek. Sporadic in most downstream reaches of Elkhorn Creek and McClure River.

Etheostoma flabellare Rafinesque, fantail darter. **18**, 19, **33**, **34**, **35**, **36**, **37**. Sporadic in lower Russell Fork. Known only from sites near Lick Creek in upper Russell Fork. Generally distributed in Lick Creek.

Etheostoma nigrum Rafinesque, johnny darter. **2**, **10**, **13**, **18**, 19, 52, **58**, **60**, **61**, **62**, **63**, **64**, **67**, **68**, **69**, **71**, 72, **75**, **76**, **77**, **80**. Sporadic in lower Russell Fork and Elkhorn Creek. Generally distributed in Cranes Nest and Pound rivers. New Virginia Russell Fork system record.

Etheostoma simoterum (Cope), Tennessee snubnose darter. **13**, **18**, **19**, **20**, **22**, **24**, **25**, **27**, **28**, **33**, **81**, **82**, **83**, **85**, **86**, **87**, **88**, **90**, **91**, **92**. Sporadic in lower and upper Russell Fork. Generally distributed in McClure River. Only known Kentucky population of *E. s. simoterum*. All other Kentucky populations of this species are in Cumberland River drainage and typical of *E. s. atripinne* (Burr and Warren, 1986).

Etheostoma variatum Kirtland, variegate darter. **1**, **2**, **3**, **4**, 7, **10**, **11**, **13**, 15, 17, **18**, **19**, **20**, **52**. Generally distributed in lower Russell Fork. Sporadic in Elkhorn Creek. Listed as State Endangered in Virginia (Jenkins and Burkhead, 1993). Not collected within Virginia portion of Russell Fork, but five individuals were collected within 100 m of Virginia border. Therefore, it is likely that there are individuals living in Russell Fork between cascades in the Breaks Canyon and Kentucky border.

Etheostoma zonale (Cope), banded darter. **1**, **2**, **3**, **4**, **10**, **11**, **13**, **15**, 17, **18**, **19**, **20**, **52**. Generally distributed in lower Russell Fork. Sporadic in Elkhorn Creek.

Percina caprodes (Rafinesque), logperch. 1, **2**, **4**, **11**, **13**, 17, **18**, **19**, **20**, **52**. Occasional in lower Russell Fork. Sporadic in Elkhorn Creek.

Percina copelandi (Jordan), channel darter. **2**, **11**, 17. Sporadic in lower Russell Fork.

Percina evides (Jordan and Copeland), gilt darter. **2**, **3**, **4**, **10**, **11**, **13**, **18**. Occasional in lower Russell Fork.

Percina maculata (Girard), blackside darter. **2**, 15, 17, 18, **19**, **20**. Sporadic in lower Russell Fork. Three individuals were collected upstream of the Virginia border, reconfirming Leftwich et al.'s (1994) rediscovery of species in Virginia after nearly 60 year absence (Jenkins and Burkhead, 1993). Only known extant population of *P. maculata* in Virginia.

Percina oxyrhyncha (Hubbs and Raney), sharpnose darter. **11**, 18, **19**, **20**, **22**, **24**, 28, **33**, **35**, **37**, 38, **41**, **43**, **50**, **61**, **65**, **72**, 82. Occasional in upper Russell Fork and Pound River. Sporadic in lower Russell Fork, Lick Creek, and McClure and Cranes Nest rivers.

Percina sciera (Swain), dusky darter. **2**, **3**, **4**, **10**, **11**, **13**, 15, **18**. Occasional in lower Russell Fork.

Stizostedion canadense (Smith), sauger. **4**, **17**. Sporadic in lower Russell Fork.

Stizostedion vitreum (Mitchill), walleye. **17**, **19**, 20. Sporadic in lower Russell Fork.

Species Not Collected

Fifteen species previously reported from the Russell Fork were not collected during this study. Five of these species are considered to represent valid records of native populations, while three species are probably introduced, and seven species are considered misidentifications. Furthermore, two species known from the lower Russell Fork system were erroneously reported from the upper Russell Fork.

Kirkwood (1957) reported *Lampetra appendix* from the Russell Fork. Since lampreys are sometimes difficult to collect even when present, and *L. appendix* is known from other portions of the Big Sandy drainage, their absence from this study does not necessarily indicate extirpation. *Anguilla rostrata* and *Ictiobus bubalus* are large river species that were reported in the Russell Fork by Clark (1941). Their absence from this study also does not indicate extirpation since they are both difficult to collect with conventional methods. They might be collected in future surveys conducted during a different time of year and more intensively using riverine sampling methods (i.e., boat electrofishing, gill/trammel net sampling).

Nocomis micropogon and *Ammocrypta pellucida* were reported in early Russell Fork collections (Jenkins and Burkhead, 1993; Clark, 1941; Turner, 1961; Woolman, 1892). However, *N. micropogon* has not been collected in the Russell Fork since 1960 (Turner, 1961), and *A. pellucida* has not been collected since 1937 (Clark, 1941). Because these are both species that are often collected when present, failure to collect them during this study suggests their extirpation from the Russell Fork system.

Morone chrysops and *Pomoxis nigromaculatus* have only been collected in the North Fork Pound River Reservoir. Both species were stocked as game fish (Jenkins and Burkhead, 1993) and probably rarely leave the impoundment. *Rhinichthys*

cataractae was collected from the Russell Fork, 1.2 km downstream of the Virginia state line (Site 19) in 1984 (Stephens and Prather, 1985). Because fishermen regularly visit the area where *R. cataractae* was collected in 1984, *R. cataractae* was probably a bait bucket transfer that might not have survived in the Russell Fork system.

Ichthyomyzon bdellium (Ohio lamprey) was reported from the Russell Fork by Bay (1986). However, no voucher specimen exists for this collection (Robert T. Bay pers. comm.). Because this is the only record of this species from the entire Big Sandy River drainage, and field identification of lampreys can be difficult, we concluded this record was erroneous. For these same reasons, we would not speculate on the correct identity of this record.

Nocomis biguttatus was reported from the Russell Fork by Turner (1961). Because no voucher specimen exists for the collection, and this record would extend the known range of the species over 150 km (Jenkins and Lachner, 1979), we concluded this record was a misidentified *N. micropogon*.

Notropis atherinoides was reported from two sites in the Russell Fork system. Evenhuis (1973) reported capturing one specimen in Elkhorn Creek near the mouth of Pigeon Creek (Site 57). The stream at this location is approximately three meters wide and 15 cm deep. Based on the lack of appropriate habitat and the fact that no voucher specimen was retained for this collection, we concluded that this record was probably a misidentified *N. rubellus*. The fish collection database from the EKU Branson Museum of Zoology included a record of *N. atherinoides* from the Russell Fork at Elkhorn City (Site 18). We have examined all vouchered specimens from this collection, and all are *N. rubellus*.

Pimephales promelas was reported in the Russell Fork by Leftwich et al. (1994). Leftwich et al. (1994) did not report *P. notatus*. During this study, *Pimephales notatus* was collected, and has been found in many collections from the Russell Fork system. Therefore, we concluded that the report of *P. promelas* was a misidentification of *P. notatus*.

Bay (1986) and Turner (1961) reported *Carpiodes velifer* from the Russell Fork. Voucher specimens do not exist for these records (Robert T. Bay and Jim Axon, KDFWR, pers. comm.). Due to the absence of *C. velifer* from this study and others, and the similarity of *C. velifer* to *C. cyprinus,* we concluded that the report of *C. velifer* from the Russell Fork was erroneous.

Ameiurus nebulosus was reported by Virginia Department of Game and Inland Fisheries personnel from Flannagan and North Fork Pound River reservoirs. Jenkins and Burkhead (1993) treated this record as a misidentified *Ameiurus melas* since no voucher specimens were retained, *A. nebulosus* is normally found in lowland areas (Jenkins and Burkhead, 1993) and this record would have represented a significant range extension for *A. nebulosus* (Burr and Warren, 1986; Jenkins and Burkhead, 1993). Based on the fact that no *A. melas* nor *A. nebulosus* were collected during this study, we concluded that this record was probably misidentified *A. natalis* because several were collected in this area.

The only known record of *Notropis volucellus* in the upper Russell Fork drainage was reported from a tributary to the upper Russell Fork by Bay in 1986 and included in Jenkins and Burkhead (1993). No voucher specimen exists for this record. *Notropis ludibundus* is known from several proximate sites. We concluded that Bay's report of *N. volucellus* was based on a misidentified *N. ludibundus*. Without this record, *N. volucellus* has been found only downstream of Breaks Canyon in the Russell Fork system.

Several records of *Lepomis megalotis* from the upper Russell Fork proper and one from the Pound River were cited in Jenkins and Burkhead (1993). All of the upper Russell Fork records were based on field data sheets from Bay. The Pound River record was collected by Jenkins in 1976 and reported on the field data sheet as "one moderate juvenile". No voucher specimens exist for these collections (Robert T. Bay and Robert E. Jenkins, pers. comm.). We concluded that all of the previously mentioned reports of *L. megalotis* are actually misidentified *L. auritus* for the following reasons: 1) *L. megalotis* and *L. auritus* look superficially similar, especially as juveniles; 2) *L. auritus* were commonly collected in the upper Russell Fork during this study, while no *L. megalotis* were found upstream of Breaks Canyon; 3) Bay misidentified several other species in his work in the Russell Fork (Robert E. Jenkins, pers. comm.); 4) Jenkins collected and identified his "*L. megalotis*" before it was widely known that *L. auritus* had been introduced to the drainage; therefore, he would have expected to find *L. megalotis* in an Ohio River tributary, and not expect to find *L. auritus* which is native to Atlantic drainages (Robert E. Jenkins, pers. comm.).

Biogeographical Analysis

The Breaks as a Barrier

The lower 27 rkm of the Russell Fork and Elkhorn Creek have a distinctly different fauna (68 species) than the Russell Fork upstream of the Breaks Canyon (located at rkm 27) (36 species). The difference in these ichthyofaunal communities is illustrated by Jaccard's coefficients of community similarity calculated using data collected from four sites adjacent to Breaks Canyon. The two sites immediately downstream of the canyon, Sites 19 and 20 (Fig. 1) had a Jaccard's coefficient of 0.75. The two sites immediately upstream of the canyon, Sites 22 and 24 (Fig. 1), had a coefficient of 0.88. The coefficients for Sites 19 and 22 as well as for Sites 19 and 24 were 0.60. The coefficients for Sites 20 and 22 as well as for Sites 20 and 24 were 0.55.

Leftwich et al. (1994) hypothesized that the cascades in the Breaks Canyon impose a hydrologic barrier to species not found upstream, thus explaining the difference in fish communities upstream and downstream of Breaks Canyon illustrated by Jaccard's coefficients. This hypothesis is consistent with hypotheses explaining the depauperate faunas of the upper Kanawha (Hocutt et al., 1986) and the upper Cumberland Rivers (Starnes and Etnier, 1986). Jenkins and Burkhead (1993) noted the swift water and bedrock substrate of this section of the Russell Fork, but argued that the cascades did not provide a barrier to upstream movement based on the "recent" discovery of *Ericymba buccata* and *Notropis ludibundus*, two slow water inhabitants in the upper Russell Fork. They cited siltation as the cause of the depauperate fauna of the upper Russell Fork.

We disagree with Jenkins and Burkhead (1993) and support the hydrologic-barrier hypothesis of Leftwich et al. (1994) for the following reasons. First, the recency of the discovery of

Ericymba buccata and *Notropis ludibundus* can be accounted for by the fact that only three collections were made in the upper Russell Fork prior to 1968 (Jenkins and Burkhead, 1993). Secondly, *E. buccata* is also found in the upper Cumberland and Kanawha rivers (Burr and Warren, 1986; Jenkins and Burkhead, 1993) where there is little doubt that barriers to upstream fish movement occur. Also, Breaks Canyon is entirely forested and surrounded by an interstate park and national forest. There are no apparent sources of heavy silt loads or other pollutants in the immediate area that would cause such a dramatic decrease in species richness. Finally, some of the species conspicuously absent from the Russell Fork upstream of Breaks Canyon are considered moderately tolerant to silt and other pollutants (e.g. *Carpiodes cyprinus, Moxostoma erythrurum*) (KDOW, 1997).

While the River Continuum Concept (Vannote et al., 1980) suggests that species richness increases with stream size, the dramatic shift in Jaccard's coefficient values for sites upstream and downstream of the canyon lend further support to the hypothesis that Breaks Canyon acts as a hydrological barrier to upstream fish movements. This hypothesis was also supported by the collection of *Cyprinella spiloptera, Notropis photogenis, Carpiodes cyprinus, Moxostoma anisurum, M. carinatum, M. duquesnei, M. erythrurum, M. macrolepidotum, Etheostoma blennioides, E. variatum, E. zonale, Percina caprodes , P. evides, P. maculata, P. sciera,* and *Stizostedion vitreum* less than 5 rkm downstream of the final large cascade of the Russell Fork in Breaks Canyon. None of these fishes has been collected upstream of Breaks Canyon despite intense sampling in apparently suitable habitat.

Many of the species conspicuously absent from the upper Russell Fork are generally regarded as larger stream species. Conversely, nearly every inhabitant of the upper Russell Fork system is a species that is commonly found in small streams, including *Notropis ludibundus* and *Ericymba buccata.* This pattern is consistent with that of streams containing recognized hydrologic barriers (Hocutt et al., 1986; Starnes and Etnier, 1986).

Disjunctions

Cyprinella galactura and *Etheostoma simoterum* are of uncertain origin in the Russell Fork. Both species are widespread throughout the Tennessee and Cumberland rivers, but have extremely limited distributions in the Ohio River basin (Burr and Warren, 1986; Etnier and Starnes, 1993; Jenkins and Burkhead, 1993). *Cyprinella galactura* is also found in the White and St. Francis rivers (Pflieger, 1997) in Arkansas and Missouri, a disjunction explained by Pleistocene glaciation (Burr and Page, 1986). Other populations are found in the upland portions of the Santee and Savannah rivers of North Carolina, where its disjunct distribution is considered a stream capture transfer (Menhinick, 1991), and the New River in Virginia (Jenkins and Burkhead, 1993) and West Virginia (Stauffer et al., 1995). Jenkins and Burkhead (1993) considered *C. galactura* to be introduced, but possibly native to the New, while Stauffer et al. (1995) argued that *C. galactura* is probably native, but possibly introduced. This fish was found in small numbers near the mouth of the Russell Fork and became progressively more common upstream until it was one of the dominant cyprinids in the system upstream of Breaks Canyon. Except for the population in the New River, this is the only known population of *C. galactura* in the Ohio River basin. Jenkins and Burkhead (1993) considered *Cyprinella galactura* probably introduced, but possibly native, to the Russell Fork, based on the fact that it is found only in the Russell Fork of the Big Sandy drainage. They believed that at least isolated relictual populations of *C. galactura* would have been found in other Big Sandy tributaries if it were native to the drainage. We disagree with the hypothesized introduction by humans based on the fact that *C. galactura* is abundant in the Russell Fork only upstream of Breaks Canyon, where it is the only species of *Cyprinella.* Downstream of the canyon *C. galactura* may face increasing competition from other *Cyprinella,* until it disappears from the Russell Fork fauna near the mouth, thus prohibiting its dispersal to other Big Sandy tributaries. Furthermore, *C. galactura* is a common fish in the Clinch River (Jenkins and Burkhead, 1993). The interdigitating headwaters of the Russell Fork and Clinch tributaries could have provided several possible theaters for stream capture through which *C. galactura* could have been transferred into the Russell Fork from the Clinch River drainage. Finally, Shultz and Reid (Jenkins and Burkhead, 1993) took *C. galactura* in the very first fish collections made within the Russell Fork drainage in 1937. The probability of introduction prior to 1937 seems low.

Etheostoma simoterum is common and widespread throughout the Tennessee and Cumberland rivers (Etnier and Starnes, 1993; Burr and Warren, 1986), but has been discovered in the Bluestone River (New River tributary) and the Russell Fork only within the last 30 years (Jenkins and Burkhead, 1993). Etnier and Starnes (1993) suggested that both of these populations were introduced based on the recency of their discovery. Stauffer et al. (1995) and Jenkins and Burkhead (1993) stated that the Bluestone River populations of *E. simoterum* were possibly introduced, but probably native, due to a lack of collections in the known range of *E. simoterum* prior to its discovery. *Etheostoma simoterum* was considered probably native, but possibly introduced, to the Russell Fork by Jenkins and Burkhead (1993). Since no sites within the present range of *E. simoterum* were sampled prior to its discovery in 1972, the recency of their discovery is uninformative. It appears logical that *E. simoterum* and *C. galactura* were transferred in stream capture events from the Clinch River. The disappearance of *E. simoterum* from the Russell Fork in its lower reaches may be due to the shift to large river habitat and increased competition by other darters not found in the upper Russell Fork system.

The affinity of the Russell Fork fauna to that of the upper Tennessee could be explained by Jillson's (1927) interpretation of the geologic history of the Big Sandy drainage. Stream-worn, quartzite boulders found in the Licking and Big Sandy rivers indicate that at one time, these two rivers were once part of a larger river system that originated in what is now western North Carolina and southwestern Virginia. This ancient river system had its headwaters pirated by the upper Tennessee and Bluestone Rivers during the middle Tertiary period. Soon after that, the stream was bisected again diverting the headwaters north and forming the present Big Sandy River, and leaving the remaining downstream section as the Licking River. Even though these

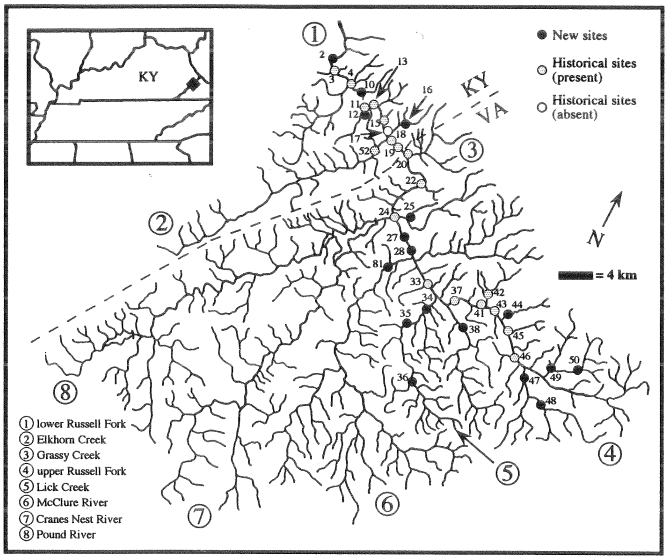

Figure 2. Distribution of *Etheostoma caeruleum* in Russell Fork system.

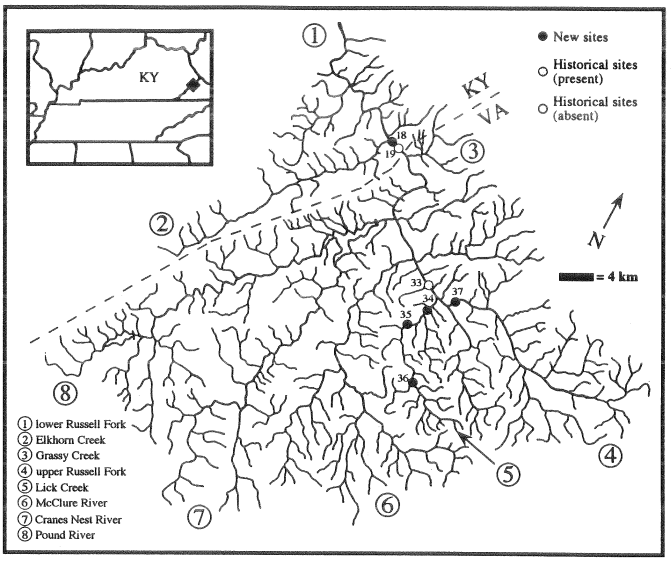

Figure 3. Distribution of *Etheostoma flabellare* in Russell Fork System.

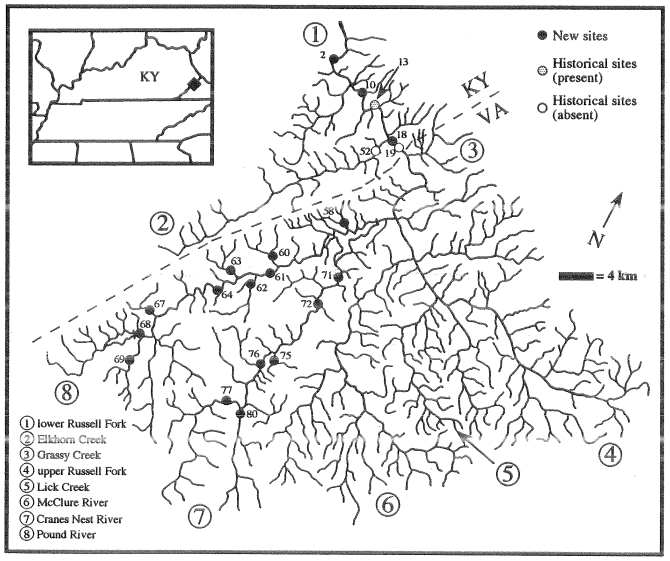

Figure 4. Distribution of *Etheostoma nigrum* in Russell Fork system.

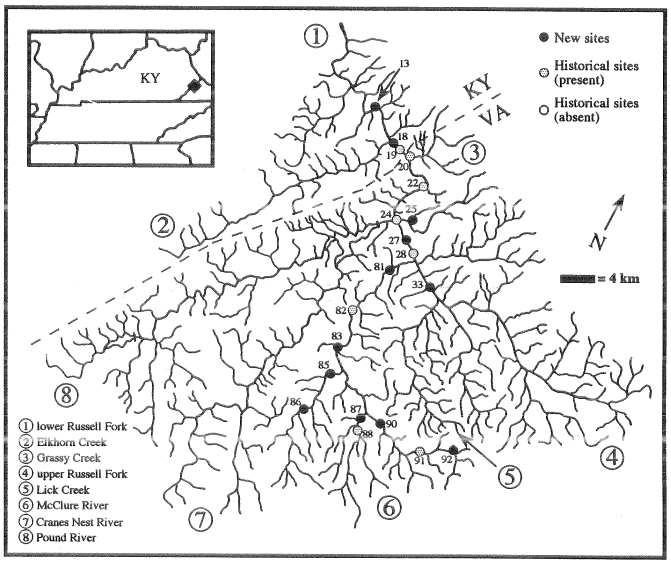

Figure 5. Distribution of *Etheostoma simoterum* in Russell Fork system.

events happened before the appearance of these species, the ancient connections of the main river channels of these rivers left low divides that could have acted as theaters for later stream captures.

Allopatric *Etheostoma*

The distributions of species of *Etheostoma* in the upper tributaries of the Russell Fork also present an interesting biogeographic question. *Etheostoma caeruleum* is common in the Russell Fork proper upstream of its confluence with the McClure River (Fig. 2). However, the only other species of *Etheostoma* inhabiting this area is *E. flabellare*. *Etheostoma flabellare* is largely restricted to Lick Creek in the upper Russell Fork (Fig. 3). *Etheostoma nigrum* is common in the Pound and Cranes Nest rivers and is the only *Etheostoma* known from these two systems (Fig. 4). It has not been collected from any other locality upstream of Breaks Canyon. *Etheostoma simoterum* is common in the McClure River (Fig. 5). No other *Etheostoma* species is known from most of the McClure system. All of these species are found in sympatry in the Russell Fork downstream of Breaks Canyon and throughout a large portion of their ranges (Page, 1983). There are no cascades that could act as a barrier to dispersal in the upper Russell Fork. Ideal habitat for each species appears plentiful throughout all major tributaries of the Russell Fork. The reason for their allopatry in the Russell Fork remains a mystery.

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Appendix A. Site localities and dates sampled of all sites surveyed in 1998.

1. Russell Fork 1 km S Millard at Powell Creek confluence off US Hwy 460. Pike Co., KY. 14 August.
2. Russell Fork at Winwright Station off US Hwy 460. Pike Co., KY. 14 August, 6 November.
3. Russell Fork 3 km NW of Marrowbone at private bridge off US Hwy 460. Pike Co., KY. 13 August.
4[1]. Russell Fork at Marrowbone off US Hwy 460. Pike, Co., KY. 13 August, 24 August.
5. Marrowbone Creek at Marrowbone Fire Dept. off KY Hwy 195. Pike Co., KY. 6 May.
6*. Marrowbone Creek at Dry Fork off KY Hwy 195. Pike Co., KY.
7. Marrowbone Creek at Rockhouse off KY Hwy 195. Pike Co., KY. 6 May.
8*. Marrowbone Creek at Hellier off KY Hwy 195. Pike Co., KY.
9*. Marrowbone Creek at Allegheny off Allegheny Rd. Pike Co., KY.
10. Russell Fork 2 km N Draffin along unmarked dirt road off Pond Creek Rd. Pike Co., KY. 14 August.
11. Russell Fork at Draffin off Pond Creek Rd. bridge. Pike Co., KY. 25 August, 6 November.
12. Pond Creek at Draffin off Pond Creek Rd. bridge. Pike Co., KY. 3 July.
13. Russell Fork 2 km SE Draffin upstream of concrete bridge off US Hwy 460. Pike Co., KY. 13 August.
14. Ferrell Creek 1 km NE Belcher off Old Ferrell Creek Rd. Pike Co., KY. 1 July.
15. Russell Fork at Beaver Bottom off KY Hwy 80. Pike Co., KY. 13 August.
16. Beaver Creek at Beaver Bottom off Beaver Bottom Rd. Pike Co., KY. 16 July.
17[1]. Russell Fork 1 km N Elkhorn City at unnamed dirt road along river. Pike Co., KY. 24 August.
18. Russell Fork at Elkhorn City under KY Hwy 80 bridge. Pike Co., KY. 25 July.
19[2, 3]. Russell Fork 3 km SE Elkhorn City at river access off KY Hwy 80. Pike Co., KY. 14 August, 4 September, 5 September.
20. Russell Fork at VA/KY state line off KY Hwy 80. Pike Co., KY / Dickenson Co., VA. 5 September.
21. Grassy Creek 3 km E Breaks at hiking trail off KY Hwy 80. Buchanan Co., VA. 6 May.
22. Russell Fork at Garden Hole in Breaks Interstate Park off VA Hwy 80. Dickenson Co., VA. 2 October.
23. Camp Branch at Garden Hole Rd. in Breaks Interstate Park off VA Hwy 80. Dickenson Co., VA. 3 July.
24[3]. Russell Fork at Bartlick off Co. Hwy 611. Dickenson Co., VA. 4 September.
25. Barts Lick Creek at Bartlick off Co. Hwy 611. Dickenson Co., VA. 15 May.
26. Barts Lick Creek 2 km S Breaks Interstate Park entrance off Co. Hwy 80. Dickenson Co., VA. 2 July.
27. Russell Fork at Splashdam off Co. Hwy 613. Dickenson Co., VA. 4 September.
28. Russell Fork at Haysi downstream of VA Hwy 63 bridge. Dickenson Co., VA. 4 September.
29. Russell Prater Creek 3 km E Haysi along VA Hwy 83. Dickenson Co., VA. 19 July.
30. Greenbriar Creek 2.5 km NW Vicey at junction of Co. Hwy 611 & 608. Buchanan Co., VA. 2 July.
31. Greenbriar Creek 3 km NE Vicey off Co. Hwy 608. Buchanan Co., VA. 24 July.
32. Russell Prater Creek at Vicey along VA Hwy 83. Buchanan Co., VA. 19 July.
33. Russell Fork 1 km NW Birchleaf off VA Hwy 80. Dickenson Co., VA. 5 September.
34. Lick Creek 1 km SW Birchleaf off Co. Hwy 670. Dickenson Co., VA. 14 May.
35. Lick Creek 5 km SW Birchleaf off Co. Hwy 670. Dickenson Co., VA. 16 July.
36. Lick Creek 2 km NW Aily off Co. Hwy 670. Dickenson Co., VA. 7 November.
37. Russell Fork 3 km SE Birchleaf off Co. Hwy 605. Dickenson Co., VA. 15 May.
38. Fryingpan Creek 2.5 km SE Colley off VA Hwy 80. Dickenson Co., VA. 14 May.
39. Fryingpan Creek 1 km N of Tiny off Co. Hwy 625. Dickenson Co., VA. 2 October.
40. Fryingpan Creek at Bucu off Co. Hwy 600. Dickenson Co., VA. 7 November.
41. Russell Fork 2 km E Cannady off Co. Hwy 605. Buchanan Co., VA. 2 October.
42. Pawpaw Creek at Cannady off Co. Hwy 605. Buchanan Co., VA. 2 July.
43. Russell Fork 2 km SE Cannady off Co. Hwy 605. Buchanan Co., VA. 2 October.
44. Fox Creek 2 km SE Cannady at Co. Hwy 605 bridge. Buchanan Co., VA. 24 July.
45. Russell Fork 2 km NW Murphy off Co. Hwy 605. Buchanan Co., VA. 7 November.
46. Russell Fork 2 km SE Murphy off VA Hwy 80. Buchanan Co., VA. 14 May.
47. Indian Creek 3 km N Duty at Co. Hwy 602 bridge. Buchanan Co., VA. 25 July.
48. Indian Creek 1 km E Duty off Co. Hwy 602. Buchanan Co., VA. 7 November.
49. Hurricane Creek 1 km N Davenport off Co. Hwy 600. Buchanan Co., VA. 25 July.
50. Hurricane Creek 3 km NE Davenport off Co. Hwy 600. Buchanan Co., VA. 7 November.
51. Russell Fork at Council off VA Hwy 80. Buchanan Co., VA. 14 May.
52. Elkhorn Creek 2 km SW Elkhorn City off KY Hwy 197. Pike Co., KY. 18 July.
53. Elkhorn Creek 6 km SW Elkhorn City off KY Hwy 197. Pike Co., KY. 18 July.
54. Ashcamp Branch 1 km N Ashcamp off Ashcamp Branch Rd. Pike Co., KY. 18 July.
55. Sycamore Creek 6 km SW Ashcamp off Sycamore Creek Rd. Pike Co., KY. 3 July.
56. Elkhorn Creek at Hylton off KY Hwy 197. Pike Co., KY. 18 July.

57. Elkhorn Creek 2 km SW Shelby Gap off KY Hwy 197. Pike Co., KY. 18 July.
58. Upper Twin Branch 4 km SW Tivis off Co. Hwy 611. Dickenson Co., VA. 4 June, 18 July.
59. Unnamed tributary to Cane Creek 2 km SW Blowing Rock at Co. Hwy 611 bridge. Dickenson Co.,VA. 17 July.
60. Bearpen Branch at Isom off Co. Hwy 620. Dickenson Co., VA. 17 July.
61. Pound River 1 km SW Isom off Co. Hwy 631. Dickenson Co., VA. 6 September.
62. Georges Fork 3 km NW Clintwood off Co. Hwy 621. Dickenson Co., VA. 1 October.
63. Pine Creek 5 km NW Clintwood along unmarked road off Co. Hwy 631. Dickenson Co., VA. 1 October.
64. Pound River at Norland off Co. Hwy 624 bridge. Dickenson Co., VA. 8 November.
65. Pound River 5 km NE Pound at Co. Hwy 666 bridge. Wise Co., VA. 6 September.
66. Bearpen Creek 5 km NE Pound at Hwy Co. 666 bridge. Wise Co., VA. 6 September.
67. Bad Creek 2 km N Pound off Co. Hwy 630. Wise Co., VA. 8 November.
68. Pound River 2 km W Pound at Water Plant Rd. bridge. Wise Co., VA. 6 September.
69. South Fork Pound River 2 km SW Pound at Co. Hwy 671 bridge. Wise Co., VA. 8 November.
70. Pound River 3 km S Pound at Co. Hwy 689 bridge. Wise Co., VA. 8 November.
71. Cranes Nest River 3.5 km NW Fremont along unmarked gravel road off VA Hwy 83. Dickenson Co., VA. 3 October.
72. Cranes Nest River 4 km SE Clintwood at VA Hwy 83 bridge. Dickenson Co., VA. 6 September.
73*. Unnamed tributary to Cranes Nest River 3 km S Clintwood off Co. Hwy 649. Dickenson Co., VA.
74*. Keel Branch 4 km S Clintwood off Co. Hwy 649. Dickenson Co., VA.
75. Rush Creek 4 km W Fremont off Co. Hwy 649. Dickenson Co., VA. 17 July.
76. Cranes Nest River 2 km E Darwin at Co. Hwy 637 bridge. Dickenson Co., VA. 6 September.
77. Dotson Creek 3 km N Duncan Gap off Co. Hwy 634. Wise Co., VA. 8 November.
78*. Unnamed tributary to Birchfield Creek 7 km S Pound off Co. Hwy 673. Wise Co., VA.
79*. Dotson Creek 3.5 km W Duncan Gap off Co. Hwy 636. Wise Co., VA.
80. Cranes Nest River 5 km S Darwin at VA Hwy 72 bridge. Dickenson Co., VA. 8 November.
81. McClure River 3 km W Haysi off VA Hwy 83. Dickenson Co., VA. 15 May, 5 September.
82. McClure River 1.5 km SW Clinchco off VA Hwy 83. Dickenson Co., VA. 3 October.
83. McClure River at Fremont off VA Hwy 83 bridge. Dickenson Co., VA. 7 November.
84. Big Branch 2 km SE Fremont off Co. Hwy 661. Dickenson Co., VA. 17 July.
85. Caney Creek 1 km SW McClure off Co. Hwy 773. Dickenson Co., VA. 7 May.
86. Caney Creek 6 km W Nora at Hwy Co. 644 bridge. Dickenson Co., VA. 7 November.
87. Open Fork McClure River 2 km SW Nora off Co. Hwy 652. Dickenson Co., VA. 7 May.
88. Middle Fork McClure River 3 km S Nora off Co. Hwy 651 at railroad crossing. Dickenson Co., VA. 26 July.
89. Middle Fork McClure River 5 km S Nora along unmarked road off Co. Hwy 651. Dickenson Co., VA. 7 November.
90. McClure River 2 km SE Nora off VA Hwy 63. Dickenson Co., VA. 26 July.
91. Roaring Fork McClure River 2 km SE Wakenva off Co. Hwy 656. Dickenson Co., VA. 26 July, 7 November.
92. Roaring Fork McClure River 4 km E Wakenva off Co. Hwy 656. Dickenson Co., VA. 7 November.

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* = site reconnoitered only
[1] = boat shocking site
[2] = trammel net site
[3] = snorkel survey site