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**Muskellunge Streams Investigation in  
Little Sandy River and Salt Lick Creek**

by  
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## ABSTRACT

*The main stem of Little Sandy River below Grayson Lake was part of a muskellunge streams investigation study in 1986 and 1987. This study was initiated to determine the range and population status of the muskellunge, the success of past muskellunge stockings, management needs for the muskellunge fishery, and to document all fish species collected within the study sites. Pertinent physical features were noted at each study site and water quality was gathered seasonally at four locations both years. A total of 11.4 miles, representing 5 pools, of the Little Sandy River was electrofished each year. In all, 21.6 h was spent electrofishing these five pools and 19 muskellunge were captured that were 9-42 in long; another 18 muskellunge were sighted, but not captured. The total catch rate for captured muskellunge was 0.9 fish/h - 0.9 fish/h in 1986 and 0.8 fish/h in 1987. This compares favorably to the average of 0.6 fish/h reported from 14 eastern Kentucky streams with muskellunge populations. Muskellunge range throughout the 51 mi of Little Sandy River below Grayson Lake. Based on back-calculated lengths from 17 muskellunge, legal harvest length of 30 in was reached at age 4+. A total of 72 species of fish were recovered while electrofishing and/or seining within Little Sandy River during this study, bringing the total of known species to over 90; several species had not been reported from Little Sandy River prior to this survey. Golden redhorse, gizzard shad, and emerald shiner were the three most abundant species sampled based on CPUE. Golden redhorse was the most abundant species in 11 of 15 muskellunge streams previously studied. Low alkalinity, turbidity, sedimentation, and riparian habitat loss are some of the limiting factors associated with Little Sandy River. Little Sandy River was found to have enough adequate habitat to support annual stockings of 400 9-inch muskellunge, twice what had previously been stocked (200 fish).*

*Salt Lick Creek was sampled due to reports of an occasional muskellunge being harvested. This stream is not stocked with muskellunge by Kentucky Department of Fish and Wildlife Resources (KDFWR). Only one pool was accessible to electrofishing at Salt Lick Creek. This sample site was from the mouth upstream 0.8 mi and was sampled in 1986 and 1987. A 29-in muskellunge was captured during this time. A total of 37 species of fish were sampled from Salt Lick Creek; most were new locality records. Based on catch rates, the three most abundant species collected electrofishing were gizzard shad, longear sunfish, and emerald shiner. Muskellunge habitat is limited in this relatively small stream and the muskellunge that might be found within the stream are probably stragglers.*

## INTRODUCTION

Kentucky is fortunate in having 18 streams (nearly 700 miles) inhabited by native muskellunge *Esox masquinongy*. Most of these streams have been surveyed since 1967, starting with Brewer's investigations. Brewer (1980), Kornman (1983, 1985, and 1989), Jones and Stephens (1984), Prather (1985), and Axon and Kornman (1986) report the status of muskellunge streams from surveys conducted by the Kentucky Department of Fish and Wildlife Resources (KDFWR). Bonny Laflin (pers. comm. and Annual Performance Reports) investigated Barren and Green River drainages and Albert Surmont (in preparation) surveyed muskellunge populations in Fox Creek and Triplett Creek.

Muskellunge investigations were initiated in 1980 under Sport Fish Restoration Project F-50. Project goals were to determine: (1) the size and structure of the muskellunge population and the fish population in selected streams, (2) the relative success of muskellunge stockings based on Brewer's (1980) recommendations, (3) certain physical and chemical characteristics of each study stream, and (4) the management potential for sustaining and improving the muskellunge fisheries in these streams. The primary goal was to determine stocking success and any changes since Brewer's (1980) investigations, and to sample streams with known muskellunge populations that had not previously been sampled.

Included in this report are results of electrofishing and seining surveys in 1986 and 1987 from five sites on Little Sandy River below Grayson Lake dam, which is 51.2 miles upstream from the stream's confluence with the Ohio River. One site was electrofished in 1986 and 1987 at Salt Lick Creek. Brewer (1980) determined that muskellunge ranged from the mouth to Grayson Lake dam within the Little Sandy River and mi 0 – mi 7 in Salt Lick Creek. Figure 1 shows the locations of the study streams and sampling sites. Table 1 presents the numbers of muskellunge which have been stocked into Little Sandy River; Salt Lick Creek was never stocked.

Turner (1962) conducted a 2.16-acre rotenone study in the Little Sandy River and Brewer electrofished a 1.2-mi section; they collected no muskellunge from either of these samples. None of the investigations from past studies within the Little Sandy River drainage sampled muskellunge within this stream, including Woolman (1892), Clark (1941 a and b), Carter (1970), Evenhuis (1972), and Branson et al. (1981). Few fisheries investigations have been carried out in Salt Lick Creek.

## STUDY AREA

### Little Sandy River

This study was confined to the main stem of Little Sandy River below Grayson Lake (mi 0-51.2). The average gradient within this section is 1.7 ft/mi (Table 2). Brewer (1980) determined that the muskellunge generally ranged from mi 0 – 50, and there were approximately 30 mi of muskellunge pool habitat (roughly 400 acres) within this section. This section is characterized by pools of slow-moving water and as one moves downstream, the number of riffles decrease and the stream's width and average depth increases.

Little Sandy River drains most of Elliott County and portions of Carter and Greenup counties (Figure 1) as it flows toward the Ohio River, entering at Greenup, KY (Ohio River mi 337.6). The river flows in a northeasterly direction for approximately 87 mi and drains roughly 724 mi<sup>2</sup>. Elevations within the headwaters are 1,050 ft and those at the mouth are around 515 ft for an average gradient of 6.5 ft/mi. A flood control dam was constructed by the Corps of Engineers at mi 51.2 to form Grayson Lake in 1968. The

headwaters lie within the Unglaciaded Allegheny Plateau Section of Appalachian Plateaus Province. Most of the tributary streams are upland with moderate to high gradients, numerous riffles, bedrock, and large boulders. Throughout the Little Sandy River basin and its major tributary system to the west, the lower section of the valley walls are near vertical outcrops of sandstone (COE 1975). The overall topography of the drainage is of moderate to strong relief; there is little flat or undulating land, except near the mouth. The river itself is fairly clean swept with numerous sand bars, hence the name Little Sandy. Major tributaries to Little Sandy River below Grayson Lake are East Fork Little Sandy River, Little Fork, and Big Sinking Creek.

Hankla et al. (1992) assessed several resource categories within the 51 mi section of Little Sandy River below Grayson Lake and assigned a value class for each: 1 = superior, 2 = highly significant, 3 = significant. Categories and ratings for Little Sandy River were: Cultural Resources - 3, Botanical Resources - 3, Fish Resources - 1, Water quality - 2 at mi 13-51.0, and Wildlife Resources - 2. Within river mi 36.6-39.2, basically the Grayson, KY vicinity, a Corridor Character – Urban Rivers category was given a class value of 2.

### Salt Lick Creek

Located in northwestern Lewis County, Salt Lick Creek flows for 10.7 mi from the confluence of Big and Little Branch before entering the Ohio River at ORM 378.3 at Vanceburg, KY (Figure 1). The gradient within this 10.7 mi section averages 5.6 ft/mi (Table 2). The gradient within the 0.8 mi study area was 3.2 ft/mi. The stream had well-established riffles, relatively short pools and narrow stream width that offers good canopy. Salt Lick Creek lies within the Blue Grass Section, Northeastern Blue Grass Subsection. This area is considered to be in either the Knobs Region or the Unglaciaded Allegheny Plateau. The topography lies on shale and sandstone of the Mississippi and Devonian Age. As the stream name implies, early settlers traveled to the area to obtain salt from salt laden springs found within the Salt Lick Creek basin. Bryan (1988) discussed salinity levels within a reconstructed wetland adjacent to Salt Lick Creek. Few fishery investigations have included Salt Lick Creek. Brewer (1980) determined that muskellunge ranged from mi 0 – mi 7 within Salt Lick Creek, that the stream supported a very small muskellunge population, and it was used by muskellunge primarily for spawning.

## **METHODS**

Five pools were electrofished for muskellunge in Little Sandy River and one in Salt Lick Creek in 1986 and 1987; several riffle areas were also seined in both streams. Study pools were chosen on the basis of their accessibility and were delineated by an upper and lower riffle in most cases. Access to Little Sandy River with the electrofishing boat was extremely limited and only one site was accessible at Salt Lick Creek. Both shorelines of each study pool were sampled unless the pool was of such a length that only portions of the pool could be sampled effectively. Captured muskellunge were measured and weighed, and scale samples were taken for age and growth determinations. The muskellunge were also marked so they would be recognized if recaptured. In order to better determine the species composition from each stream, all fish collected during a timed sample period were identified, measured, and released. Additional fish species not picked up during this timed period were identified and noted separately. Unidentified fish were preserved for later identification. Selected riffle habitats were seined for further fish species composition.

Water quality determinations were taken from four stations in Little Sandy River during July and October 1986 and April, July, and October 1987. Water quality was

taken from only one station in Salt Lick Creek in August and October 1986 and May, July, and October 1987. Water quality parameters included stream temperature, dissolved oxygen, total alkalinity, turbidity, pH, salinity, and specific conductivity. Physical parameters such as pool depth, width, and length were measured at each station.

## RESULTS AND DISCUSSION

### *Muskellunge Population Characteristics*

#### Little Sandy River

A total of 19 muskellunge were captured while sampling five pools (Table 3) representing 11.4 stream mi within Little Sandy River in 1986 and 1987. In 1986, 10 muskellunge were captured and six others observed but not captured in 10.7 h of electrofishing. During 1987, within the same area, nine muskellunge were collected in 10.9 h of sampling; an additional 12 muskellunge were sighted. As previously mentioned, no muskellunge had reportedly been collected from Little Sandy River by other investigators. The CPUE for muskellunge captured was 0.9 fish/h in 1986 and 0.8 fish/h in 1987, which can be compared to values recorded from other streams in northeastern Kentucky (Appendix A). Table 4 shows the lengths and weights of muskellunge sampled by pool, date, and sampling effort during 1986 and 1987. Of the 19 muskellunge captured in 1986 and 1987, only 3 fish were of a legal creel length (30 in long or greater). Muskellunge captured in 1986 ranged from 15.7 (1.08 lb) to 29.1 (5.78 lb) in long; in 1987, they ranged from 9.0-42.0 (15.5 lb) in long. A 31.1 in long muskellunge, which was captured, tagged and released at Station 5 in June 1987, was caught by an angler at 38 in long within the Grayson Lake tailwater area in May 1989.

Scale samples were used to age muskellunge for this study. The use of cleithra for age and growth studies have been shown to be a more reliable method of age determination in esocides, particularly for older fishes. However, Johnson (1971) found age 1-9 muskellunge could be fairly accurately determined from the use of scale or fin section methods. He also found scale samples to be more reliable for back calculations of growth. Harrison and Hadly (1979) also found that fishes older than age 9+ could not be aged from scales. They did report 87% agreement when comparing age and growth determinations from cleithra to similar scale analysis. Out of 10 cleithra collected by Monaghan (1985), only one disagreement was found between readings from scales and cleithra. Muskellunge captured in this study were considered too valuable to sacrifice in order to obtain their cleithra. All of these fish were also less than age 9.

Results of muskellunge age and growth determinations from Little Sandy River are shown in tables 5 and 6. Back-calculated lengths from the 17 muskellunge shown in tables 5 and 6 (combined) was: 10.9, 16.9, 21.5, 26.8, 33.2, 36.6, and 40.4 in (for ages 1-8). Muskellunge reached legal length of 30 in long between ages 4 and 5. Age 1-4 muskellunge grew at a rate similar to those found in 13 other eastern Kentucky streams. Beyond age 4, they grew somewhat faster in Little Sandy River; however, the sample size for age 5+ fish was small. Also, some degree of muskellunge reproduction must be taking place, as several fish were captured that were aged to be from years in which muskellunge were not stocked into the river.

Little information regarding the muskellunge fishery in Little Sandy River was available; thus, letters were mailed in 1988 to several well-known muskellunge anglers within the region to ask for their knowledge regarding Little Sandy River muskellunge. Mr. Elmer Claxon was one of the individuals who responded, an individual who was recommended by several muskellunge anglers to interview. Mr. Claxon said his father caught muskellunge in the river back in the 1890's, usually on a "trout line". He said that

only 2-3 fish were caught in a year's time, until the stocking program began, particularly in the upper sections. Within the lower section, he said muskie fishing became better after Greenup L&D was built on the Ohio River in 1964, which backed slack water up into the Little Sandy for about 13 mi to near Argillite, KY. He felt that this section is some of the best muskie fishing in the state.

A letter from Mr. James Woods stated that he didn't think many people fished Little Sandy River prior to the mid-1980's, when the muskellunge stocking program began in earnest. He said he started fishing there in 1982. He had caught 10 "keeper" muskellunge from 1982-1988; the largest fish was 43.5 in long. He rarely saw another angler until the mid to late 1980's.

### Salt Lick Creek

In 1986, the only site accessible in Salt Lick Creek was sampled for 0.8 h and one muskellunge was captured. This fish was 29.3 in long and weighed 5.89 lb. Back-calculated age-growth information revealed that the fish was from the 1982 year class and grew at the following rate: age 1 – 11.9, 2 – 18.4, 3 – 23.6, and 4 – 27.9 in. Salt Lick Creek is not stocked with muskellunge. Muskellunge occasionally enter this stream from the Ohio River, perhaps from other nearby streams stocked with muskellunge such as Kinniconick and Tygarts creeks. Brewer (1980) reported this stream might be used as a spawning area for muskellunge. During 1987 sampling, no muskellunge were collected or observed.

### Fishes Collected From Little Sandy River

The fishes within the Little Sandy River drainage, based on ichthyofaunal habitat classification, are of the Upland Stream and River Subsystem. Combined studies from numerous investigations, including and compared to findings from this study and other KDFWR reports (Table 7), collectively report 101 fish species from Little Sandy River (Table 8). After eliminating old and/or doubtful records and introduced fishes, close to 90 native fish species dwell within the river's drainage system.

As mentioned, numerous studies have been carried out by the KDFWR in tributary streams within the drainage. Locations and fishes reported are shown in Appendix G and H (compare with tables 7 and 8). Personnel from KDFWR have collected 77 fish species from Little Sandy River drainage. Bowfin (a second record from the river was caught in the tailwater below Grayson Lake, 05 September 1996, was witnessed by the author), quillback, bigmouth buffalo, and northern pike are reported for the first time from this drainage. Several fish species collected by us were reported by Burr and Warren (1986); they included goldfish, golden shiner, river carpsucker, smallmouth buffalo, river redhorse, black bullhead, flathead catfish, brown trout, white bass, pumpkinseed, warmouth, black crappie, yellow perch, and freshwater drum. Those underlined were only recovered near, or at the mouth of, Little Sandy River.

Fishes collected from each study pool electrofished and those sampled from riffle sites by seine are shown in Table 9. A total of 69 species of fishes representing 15 fish families were sampled. An additional three species were collected since 1987 for a total of 72 fish species reported from the main stem by us. Appendices B-F list the fishes collected during a timed period from electrofishing stations 1-5, along with their length distribution, total numbers collected, and catch rates. Although varying in abundance by station, the three most abundant species sampled (based upon % composition), in order of abundance, were golden redhorse (20.4%), gizzard shad (17.4%), and emerald shiner (11.8%). The golden redhorse was the most abundant species collected from 11 of 14 streams that supported muskellunge (Axon and Kornman 1986).



Of the black bass species, no smallmouth bass were sampled from the main stem during this investigation. Largemouth bass were well represented at Station 1, with a good population of 12-in or longer fish. Elsewhere in the Little Sandy River, spotted bass were predominant, representing close to 90% of the black bass captured. Other fishes often sought by anglers that occur within the river are sauger, rock bass in the upper sections, channel and flathead catfish, and bluegill. White crappie and white bass are present, but in lesser numbers. Rainbow trout are stocked in the tailwater below Grayson Lake. A 32-in northern pike was caught in 1988 near Pactolis and yellow perch were captured in 1979 by KDFWR at the mouth.

Several species of fish have been introduced by the KDFWR into Grayson Lake in the past, but were not sampled in the Little Sandy River during this study. These fishes include smallmouth bass, black crappie, and threadfin shad, which no longer exists in the lake. Rainbow trout are stocked in Grayson Lake tailwater, upper East Fork Little Sandy River, Big Caney Creek, Laurel Creek, and Greenbo Lake, an impoundment on Claylick Creek. All these sites are within the Little Sandy River drainage. The first brown trout stocked into Kentucky waters took place in Laurel Creek in 1980. This species is stocked annually in Laurel Creek and nearby Big Caney Creek. However, these two streams drain into the upper reaches of Grayson Lake. Brown trout were stocked into Big Sinking Creek in 1988-1990, but this has since been discontinued. In light of all of these trout stockings, no trout were collected during this study.

During the mainstem study in 1986-1987, numerous fish species were sampled by electrofishing that were not collected with a seine. Species of fishes collected by seine that were not collected by electrofishing were: redbfin shiner, speckled chub, yellow bullhead, greenside darter and fantail darter. A few fish species have been collected in KDFWR studies from tributary streams that were not collected from the main stem. They include rosyzide dace, southern redbelly dace, black bullhead, brown trout, mottled sculpin, and rainbow darter.

Hankla et al. (1992) assigned the Little Sandy River to Class Value 1 (superior) for Fish Resources, which represents systems with Federal listed species and/or Kentucky Academy of Science/Kentucky State Nature Preserves Commission (KAS-KSNPC) listed species of endangered, threatened, and rare animals in Kentucky; high quality, coldwater streams; or streams with potentially unique native populations of muskellunge or walleye. From the author's experience, Little Sandy River fits all three. Five fish species are listed as being endangered, threatened, or rare by KAS-KSNPC (1996, Table 10). Cicerello et al (1991) also lists one endangered, two threatened, and one special concern freshwater unionid from a total of 22 reported from the river (Appendix I).

#### *Fishes Collected from Salt Lick Creek*

Salt Lick Creek is classified within the Upland Stream and River Subsystem ichthyofaunal habitat. The fish fauna within the region drained by Salt Lick Creek is strongly allied to both the Plateau and members of the Blue Grass fauna (Burr and Warren 1986). Twenty-five species of fishes were collected by electrofishing in this stream within this area (tables 11-12). Sizes and numbers of fish species sampled and catch rates (CPUE) can be found in Appendix J. Spotted bass was the most frequently collected black bass species. One smallmouth bass was seined from Station 3. All of the bass sampled were less than 12 in long, except for one 12 in largemouth bass. Other fishes within lower Salt Lick Creek of sport fish value are sauger, channel and flathead catfishes, and bluegill.

Since this is one of the few studies ever carried out within this stream, many of the fishes listed in Table 12 represent new distribution records. The blackstripe topminnow represents the easternmost drainage record for this fish in Kentucky. It has been reported farther east within the Ohio River drainage, being reported from the Scioto River drainage in Ohio (Trautman 1981).

In all, 37 fish species were collected during this study, with a total of 45 species reported by KDFWR (Table 12). Based on percent composition, both years combined, gizzard shad (18.9%), longear sunfish (14.1%) and emerald shiner (9.7%) were the most abundant fishes sampled.

The KDFWR conducted a 0.2-acre rotenone study on 29 July 1978 about 8.3 mi upstream from the mouth of Salt Lick Creek. In this study, several species of fish were sampled that were not collected in 1986 or 1987. These fishes were fathead minnow, white sucker, northern hog sucker, brindled madtom, grass pickerel, green sunfish, and greenside darter. The Kentucky Department of Transportation, while seining (1986) in Salt Lick Creek, collected brindled madtom, a species not collected during our sampling. The KY DOT and Balke Engineers also did some sampling in an old oxbow wetland (as part of AA Highway mitigation) just west of Vanceburg adjacent to Salt Lick Creek (field notes and Bryan 1988). In this wetland, they found two species of fish not previously reported – river shiner and white crappie. Although these fish were not found in Salt Lick Creek, proper, both species would be expected to enter the lower reaches of Salt Lick Creek from the Ohio River. The river shiner is primarily a big river species.

#### *Physical – Chemical Determinations*

##### Little Sandy River

Physical parameters of the pools measured within the five sampling stations averaged 2.3 mi long, 91.5 ft wide, 4.2 ft deep, and 25.3 acres in size (Table 13). Size and depths of pools decreased from stations 1-5. Fish sampling stations 1-3 were basically within the backwater influence of the Ohio River. The first riffle found in Little Sandy River was at stream mi 13.0, the head of Station 3. The average gradient for stations 1-3 was 0.4 ft/mi. Compared to pools within other muskellunge streams studied, Station 1 had atypical muskellunge habitat, yet three muskellunge were sampled here. Atypical muskellunge habitat consisted of long, sluggish pools (all 5), excessive stream widths (particularly within the lower reaches) which offered little shade, increased sedimentation, and few fallen trees which offer habitat for muskellunge (and other fishes).

Large, sometimes shallow, sediment deposits were found at Station 1 along with intermittent beds of submergent and emergent aquatic vegetation that were particularly abundant in the lower reaches of this station, chiefly water milfoil (*Myriophyllum* spp.) along with Eurasian milfoil and *Najas* spp. No aquatic vegetation was observed at Station 2. At Station 3, there were a few stands of waterwillow (*Justicia americana*) and pondweed (*Potamogeton* spp). Cover in the form of logs and brush was abundant. Waterwillow was found growing in association with riffle areas at Station 4 and there was an abundance of logs and brush. In Station 5, there was good cover in the form of logs and brush, but no aquatic vegetation was observed. This was probably due to the fact that most of the bottom within the shallow areas was of sand, which often is washed away and offers an unstable substrate.

Axon and Kornman (1986) found that muskellunge tended to prefer pools with a mean depth of 3.5-4.0 ft, a gradient of 3.0-6.9 ft/mi, a mean width >25 ft, a total length of 1.8 mi or less, and the presence of fallen trees.

Water quality determinations taken during this study indicated no major problem (tables 14 and 15) and met parameters for warmwater aquatic life (Appendix L). However, alkalinity values taken in 1987 tended to be somewhat low and the pH was slightly below the preferred range of 6.5-8.2 during July of both 1986 and 1987 and October 1986. Water quality determined by the Kentucky Division of Water in 1985-1988 at Argillite in the Little Sandy River showed an increasing trend in D.O., specific conductance, pH, and total zinc, and a decreasing trend in suspended solids and total phosphorous.

Following are some activities that occur within the Little Sandy River drainage that may, on occasion, negatively influence the stream's water quality. Coal strip mines, many abandoned, are found within the drainage. These may contribute to sedimentation and pH problems. Oil wells, many abandoned as well, also occur within the drainage. Problems in the past with oil and salt brines have been encountered in the Sandsuck Creek drainage (enters Little Sandy at ca mi 18.0). Several discharges from the Grayson vicinity may also occasionally pollute the river. During the early 1990's, Cooks Family Foods (Grayson) waste facility was rarely in compliance. Increased development is occurring in Grayson; much of it is close to the river. Also, much development is occurring within the East Fork Little Sandy River drainage, which may contribute to increased sedimentation and potential waste problems within the drainage.

Despite the above, water quality assessment for Little Sandy River (mi 13.0-15.0) by Hankla et al. (1992) resulted in a Class Value of 2, indicating a highly significant rating.

#### Salt Lick Creek

Only one pool (0.8 mi long) was sampled within Salt Lick Creek and it was created entirely from the Ohio River backwater. Vanceburg lies along the northeastern side of the creek adjacent to a portion of the study pool. There was 75-100% shade created by the narrow riparian zone along this relatively narrow stream (<70 ft) (Table 16). No aquatic vegetation was observed within this section, but fish shelter was abundant in the form of fallen logs and brush. Several exposed shale (which may depress pH) cuts were created by Salt Lick Creek where hillsides appeared adjacent to the creek.

Water quality values determined in 1986 and 1987 (Table 17) revealed no long term problems. However, turbidity was above 200 NTU in July 1987, probably due to the increased silt load associated with the construction of the AA Highway taking place along the Salt Lick Creek watershed. A bridge for this highway was eventually constructed over Salt Lick Creek at stream mi 4.2. The pH was depressed in August 1986 and July 1987.

### **RECOMMENDATIONS**

Little Sandy River probably never had as large a muskellunge population as nearby Kinniconick or Tygarts creeks prior to being stocked, but muskellunge were occasionally caught by anglers. Since KDFWR began stocking Little Sandy River, a much better fishery has developed and more anglers are traveling to this stream to fish (personal communication from local muskie anglers). Based on the findings from this study, Little Sandy River can support a stocking rate as high as one muskellunge per acre of pool habitat (or 400 muskellunge) based on abundant instream habitat and population density; this began in 1994 (Table 1). Salt Lick Creek should not be stocked with muskellunge due to its limited muskellunge habitat.

Protection of the vegetation in the riparian zone is very important to these (and all) streams and their aquatic life. The reason for this is that streamside vegetation helps

filter sediments and absorb contaminants, provides shade from the trees, maintains bank stabilization, and provides a supply of woody debris in the form of fallen trees that has been found to be important habitat for muskellunge (and other fishes) and also serves as macroinvertebrate substrate. Root wads also provide habitat for fishes and other aquatic life. Vegetation along the stream is also important for insect life that provide food for certain fishes.

Any discharge into the Little Sandy River, particularly from Grayson and Greenup, should be strictly enforced to meet water quality standards and to help protect the stream's fisheries. Much development exists, and more is occurring, in Boyd County along East Fork Little Sandy River and in Grayson adjacent to Little Sandy River. Thus, monitoring and enforcement of water quality regulations are important here as well. Stream water quality and riparian zone protection remain requisites to maintain the muskellunge fishery in Little Sandy River. Good watershed practices should be promoted and enforced. Better awareness and enforcement need to be made regarding the regulations in protecting what enters our waterways (no matter their size) in order to have healthy stream ecosystems and fisheries (such as muskellunge) within the Commonwealth.

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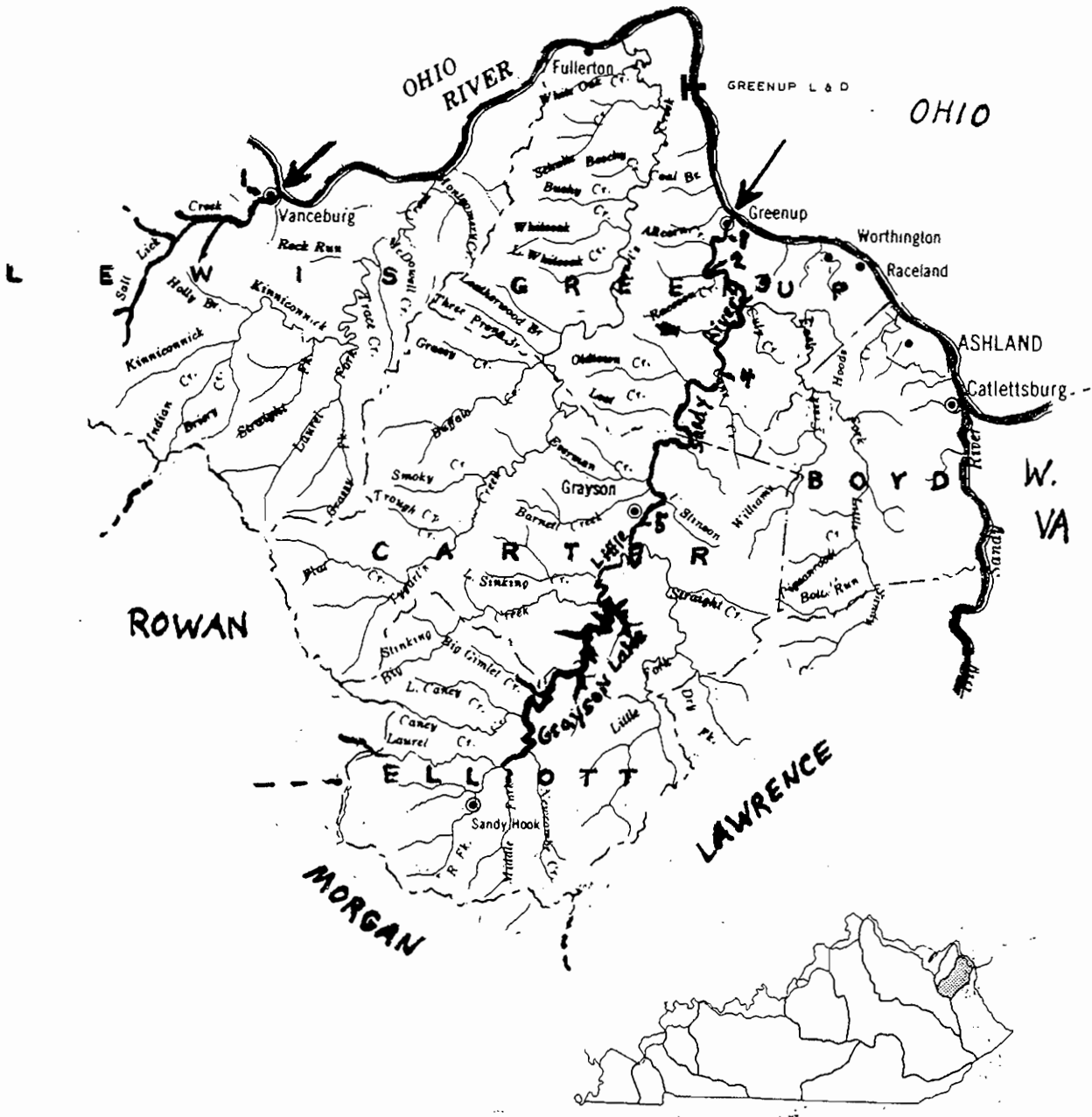


Figure 1. Little Sandy River and Salt Lick Creek drainage.

Table 1. Muskellunge stocked into Little Sandy River.

Year	Number	Average length (in)	Date stocked
1976	800	6.5	12 Jul
1979	400	8.3	24 Jul
1984	500	8.7	31 Jul
1985	535	9.0	01 Aug
1987	410	8.4	05 Aug
1988	300	9.3	03 Aug
1989	200	8.8	02 Aug
1990	211	9.0	02 Aug
1991	200	8.7	07 Aug
1993	200	9.7	11 Aug
1994	403	8.5	10 Aug
1995	200	8.9	09 Aug
	105	12.9	01 Nov
1996	204	13.9	10 Oct
1997	400	9.4	07 Aug

Table 2. Stream miles, gradient, corresponding sampling stations, and number of muskellunge captured or observed.

Stream mile	Miles	Elevation msl (ft)	Drop (ft)	Gradient (ft/mi)	Sample station within this range	No. of muskellunge
Little Sandy River below Grayson Lake						
0-14.2	14.2	515-520	5	0.4	1,2,3	24
14.2-26.1	11.9	520-540	20	1.7	4	4
26.1-35.0	8.9	540-560	20	2.2		
35.0-48.0	13.0	560-580	20	1.5	5	9
48.0-51.0 <sup>a</sup>	3.0	580-600	20	6.7		
Salt Lick Creek						
0-1.6	1.6	495-500	5	3.2	1	1
1.6-4.0	2.4	500-520	20	8.3		
4.0-7.2	3.2	520-540	20	6.3		
7.2-10.7 <sup>b</sup>	3.5	540-555	15	4.3		

<sup>a</sup>Grayson Lake dam - average gradient mi 0-51.0 = 1.7 ft/mi.

<sup>b</sup>Confluence of Big and Little Branch - average gradient mi 0-10.7 = 5.6 ft/mi.

Table 3. Locations of electrofishing and riffle-seine (S) sampling sites in Little Sandy River during 1986 and 1987.

Station	Location
1	Greenup County - from just below US 23 bridge crossing, USCE boat ramp, upstream 2.1 mi. River mi 0.4-2.5, 08 Sep 1986. River mi 0.2-2.5, 17 Aug 1987. Portions of river mi 0.2-2.5, 02 Jun and 11 Jun 1987. Greenup, KY-OH Quad.
2	Greenup County - from Raccoon Creek confluence (KDFWR boat ramp at St Rt 2 bridge crossing), upstream 2.0 mi. River mi 6.3-8.3, 25 Aug 1986 and 18 Aug 1987. Greenup, KY-OH Quad.
3	Greenup County - from Odett Run confluence, upstream 3.2 mi to just below St Rt 1 bridge crossing (vicinity Argillite, KY). River mi 9.8-13.0, 14 Aug 1986 and 28 Jul 1987. Greenup, KY-OH and Argillite, KY Quads.
S1	Greenup County - below St Rt 1 bridge crossing (vic Argillite), ca river mi 13.0, 14 Aug 1986. Argillite, KY Quad.
S2	Greenup County - vicinity Long Branch confluence (Forbes Park), ca river mi 18.0, 13 August 1986. Argillite, KY Quad.
4	Greenup County - from Long Branch confluence, upstream 2.0 mi. River mi 18.0-20.0, 13 Aug 1985 and 27 Jul 1987. Argillite, KY Quad.
S3	Greenup County - below Oldtown covered bridge (just upstream of Frazer Branch confluence), 0.5 air mi SE of Oldtown, KY, ca river mi 23.4, 14 Aug 1987. Oldtown, KY Quad.
S4	Greenup County - just downstream of Cane Creek confluence, off of St Rt 1 at Hopewell, KY, ca river mi 25.6, 14 Aug 1987. Oldtown, KY Quad.
S5	Carter County - just downstream of Scott Branch confluence, 1.5 road mi S of Carter/Greenup county line on St Rt 1, ca river mi 31.0, 14 Aug 1987. Oldtown, KY Quad.
5	Carter County - from just downstream of Dark Hollow confluence (Grayson, KY filtration plant intake), upstream 2.1 mi (to just downstream of St Rt 773 bridge crossing). River mi 39.4-41.5, 12 Aug 1986 and 01 Jun 1987. Grayson, KY Quad.
S6	Carter County - below St Rt 773 bridge (0.2 mi downstream of Little Fork Little Sandy River confluence), ca river mi 41.5, 12 Aug 1986. Grayson, KY Quad.
S7	Carter County - mid-way between spillway basin (Grayson Lake tailwater) and Big Sinking Creek confluence, ca river mi 50.5, 14 Aug 1987. Grayson, KY Quad.

Table 4. Sampling effort and muskellunge captured while electrofishing Little Sandy River in 1986 and 1987.

Station	Date sampled	Total hours electrofished	Subsample time (h)	Length of sample pool (mi)	Muskellunge captured		No. of muskellunge observed (approximate length)
					Length (in)	Weight (lb)	
1	08 Sept 1986	2.0	1.1	2.1	23.5	2.56	
					23.5	2.62	
					24.0	2.68	
	02 Jun 1987	2.5	1.8	2.5	-	-	
2	25 Aug 1986	2.1	2.1	2.0	16.6	0.79	
	18 Aug 1987 <sup>a</sup>	2.0	2.0	2.0	27.4	4.08	
3	14 Aug 1986	2.0	1.5	3.2	15.7	1.08	
					29.1	5.78	
					22.2	1.91	
	24.2	2.72	2 (28 & 33 in)				
	25.7	3.59					
	38.8	15.50					
4	13 Aug 1986	2.2	1.0	2.0	19.5	1.19	3 (20, 23 & 40 in)
	27 Jul 1987	2.0	1.0	2.0	-	-	
5	12 Aug 1986	2.4	1.0	2.1	25.2	2.94	4 (25-30 in)
					26.9	3.84	
					27.6	4.37	
					31.1	8.92	
Total	1986	10.7	6.7	11.4	10		7
	1987	10.9	8.0	11.8	7		11

<sup>a</sup>Two additional recently stocked (05 Aug) muskellunge (9 and 10 in) were captured, bringing the 1987 total to 9.

Table 5. Mean back calculated lengths (in) at each annulus for muskellunge collected from the Little Sandy River during August-September 1986, including 95% confidence intervals (CI) for each mean length per age group.

Year class	No.	Age			
		1	2	3	4
1985	2	9.8			
1984	1	12.0	15.7		
1983	5	10.7	16.3	21.1	
1982	2	10.2	15.5	20.7	25.4
Mean		10.5	16.1	21.0	25.4
Number	10	10	8	7	2
Smallest		9.6	15.2	19.6	25.3
Largest		12.0	17.8	23.2	25.4
Std error		0.22	0.32	0.43	0.05
95 CI ( $\pm$ )		0.4	0.6	0.8	0.1

Intercept value = 4.5

Table 6. Mean back calculated lengths (in) at each annulus for muskellunge collected from the Little Sandy River during June-August 1987, including 95% confidence intervals (CI) for each mean length per age group.

Year class	No.	Age							
		1	2	3	4	5	6	7	8
1985	1	10.6	18.9						
1984	2	11.3	17.0	21.5					
1983	1	9.8	13.4	18.2	23.6				
1982	1	12.0	16.4	21.7	27.5	29.7			
1980	1	12.8	19.3	23.3	29.8	34.1	36.3	37.7	
1979	1	11.4	18.4	22.8	26.9	31.8	36.3	38.3	40.4
Mean		11.3	17.2	21.5	26.9	31.9	36.3	38.0	40.4
Number	7	7	7	6	4	3	2	2	1
Smallest		9.8	13.4	18.2	23.6	29.7	36.3	37.7	
Largest		12.8	19.3	23.3	29.8	34.1	36.3	38.3	
Std error		0.37	0.78	0.79	1.28	1.29	0.01	0.31	
95% CI ( $\pm$ )		0.7	1.5	1.5	2.5	2.5	0.0	0.6	

Intercept value = 4.5. Two other muskellunge were collected from the 1987 year class stocking.

Table 7. List of investigations which included Little Sandy River drainage; use with annotated list of fishes (Table 8).

Order	Investigations
A	Woolman, A.J. 1892. Reported specimens collected by C.H. Gilbert and J.A. Henshall in 1888; specific sampling sites not provide. Everman, B.W. 1918. Simply repeats above; will not be considered further.
B	Clark, M.E. 1941a. List of fishes repeats Gilbert and Henshall data, but also provides fishes he collected; only his collection is referred to here. Clark, M.E. 1941b. Provides historical information and some fish records; in some instances it was difficult to know for sure which species of fish he was describing; however, most of his accounts were very astute.
C	Turner, W.R. 1962. In this pre-impoundment study, two sites, Big Sinking Creek and Little Sandy River at mouth of Greenbrier Creek were sampled. The Greenbrier site is now inundated by Grayson Lake; Big Sinking Creek is just downstream from the dam. Unfortunately, fish records from the sites were not separated within the report.
D	Carter, J.P. 1970. Surveyed one of the tributaries to Little Sandy River – Big Caney Creek (Rowan and Elliott counties); a tributary to Grayson Lake.
E	Evenhuis, B.L. 1972. Reported fishes collected from three tributaries: East Fork Little Sandy River (Boyd County), Little Fork Little Sandy River (Carter and Elliott counties), and big Sinking Creek (Carter County).
F	Kentucky Nature Preserves Commission. 1979. Sampled fishes from four tributaries: East fork Little Sandy River (Boyd County), Little fork Little Sandy River (Elliott County), Big Sinking Creek (Carter County), and Ruin Creek (tributary to Grayson Lake – Elliott County).
G	Branson, B.A., D.L. Batch, and S. Rice. 1981. Reported fishes from sampling five sites on Little Sandy River below Grayson Lake, one site above Grayson Lake, and three tributary streams.
H	Kentucky Department of Fish and Wildlife Resources. 1986 and 1987. This study, main stem Little Sandy River below Grayson Lake.
I	Kentucky Department of Fish and Wildlife Resources. Various years, tributary sampling: Left Fork of Middle Fork (Elliott County – 1975), Big Sinking Creek (Elliott County – 1981, 1987), Little Sandy River (Greenup County at mouth – 1982), Big Caney Creek (Elliott County – 1983, 1990, 1995), Laurel Creek (Elliott County – 1982, 1991, 1995), East Fork Little Sandy River (Boyd County – 1987, 1989). See Appendix G and H.
J	Burr, B.M. and M.L. Warren. 1986. Fishes known (or have been reported, some pre-1920) to occur in Little Sandy River drainage (this list obtained from species and map accounts within text).
K	Mills, M.R. 1988. Fish collections by the Kentucky Division of Water from five tributary streams in Elliott County upstream of Grayson Lake.
L	Fishes collected from Grayson Lake (various methods and years) by Kentucky Department of Fish and Wildlife Resources.
M	Fishes collected from Greenbo Lake (by KDFWR), an impoundment on Claylick Creek – Greenup County (various methods and years)

Table 8. List of fishes reported from the Little Sandy River drainage. See Table 7 for list of investigations reporting these fishes. ( y = mainstem, x – tributary only (or not known), \* - both, ✓ - impoundment).

Species	Investigations												
	A	B	C	D	E	F	G	H	I	J	K	L	M
Northern brook lamprey <sup>a</sup>						x <sup>b</sup>				+			
Least brook lamprey							y	y	x	+			
American brook lamprey <sup>a</sup>					x					+			
Longnose gar	x	x				x	y	y		+			
Bowfin								y					
American eel		x						y		+			
Skipjack herring	x							y		+			
Gizzard shad	x	x		x	x			y	x	+		✓	
Threadfin shad										+		✓ <sup>c</sup>	
Central stoneroller	x		x	y	x	x	*	y	x	+	x		
Goldfish								y		+			
Rosyside dace <sup>d</sup>		x	x			x	x		x	+	x		
Grass carp													✓ <sup>c</sup>
Spotfin shiner			x				y	y		+			
Steelcolor shiner	x	x						y		+			
Common carp					x			y	x	+		✓	✓
Mississippi silvery minnow	x									+ <sup>f</sup>			
Striped shiner		x	x	x	x	x	*	y	x	+	x		
Rosefin shiner <sup>g</sup>		x		x	x		y						
Redfin shiner		x	x			x		y	x	+			
Speckled chub							y	y		+			
Silver chub	x						y	y		+			
River chub		x	x		x	x	*	y		+			
Golden shiner								y		+		✓ <sup>h</sup>	
Bigeye chub		x								+			
Emerald shiner	x		x		x		y	y		+			
River shiner	x									+			
Silverjaw minnow	x	x	x	x	x	x	*	y	x	+	x		
Silver shiner		x	x	x		x	y	y	x	+			
Rosyface shiner	x		x	x		x		y		+			
Sand shiner	x	x					y	y	x	+			
Mimic shiner		x	x	x		x		y		+			
Suckermouth minnow			x										
Southern redbelly dace				x		x			x	+			
Bluntnose minnow	x	x	x	x	x	x	*	y	x	+	x	✓	
Fathead minnow						x	x			+	x	✓	
Bullhead minnow	x	x						y		+			
Blacknose dace			x		x	x	x	y	x	+	x		
Creek chub		x	x	x	x	x	*	y	x	+	x		
River carpsucker								y		+			
Quillback								y					
Highfin carpsucker	x									+			
White sucker		x	x	x	x	x	x	y	x	+	x	✓	



Table 8 continued.

Species	Investigations												
	A	B	C	D	E	F	G	H	I	J	K	L	M
Northern hog sucker		x	x	x	x	x	*	y	x	+	x		
Smallmouth buffalo								y		+			
Bigmouth buffalo								y		+			
Spotted sucker			x		x			y	x	+		✓	
Silver redhorse	x		x					y	x	+		✓	
River redhorse								y		+			
Black redhorse	x	x	x			x				+			
Golden redhorse		x	x		x		*	y	x	+		✓	
Shorthead redhorse	x						x	y		+			
White catfish										+			i
Black bullhead									x	+		✓	✓
Yellow bullhead			x		x	x		y	x	+		✓	✓
Blue catfish		x											
Channel catfish	x	x			x			y	x	+		✓	✓ <sup>c</sup>
Elegant madtom <sup>j</sup>										+			
Stonecat			x					y		+			
Brindled madtom	x	x	x	x	x	x	y	y	x	+	x	✓	
Freckled madtom		x								+		✓	
Flathead catfish								y		+		✓	
Grass pickerel					x	x	y	y	x	+			
Northern pike <sup>k</sup>													
Muskellunge								y		+			
Rainbow trout <sup>l</sup>				x	x	x			x	+			✓
Brown trout <sup>m</sup>									x	+			
Trout-perch <sup>d</sup>		x	x	x		x	y	y	x	+		✓	
Brook silverside	x					x		y	x	+	x	✓	
Mottled sculpin			x	x		x			x	+			
Banded sculpin <sup>n</sup>					x								
White bass								y	x	+		✓	
Rock bass	x	x	x	x	x	x	*	y	x	+	x	✓	
Green sunfish			x		x	x	y	y	x	+		✓	✓
Pumpkinseed								y		+			✓
Warmouth								y	x	+		✓	
Orangespotted sunfish <sup>p</sup>			x						x				
Bluegill	x	x	x	x	x	x	*	y	x	+	x	✓	✓
Longear sunfish	x	x	x	x	x	x	*	y	x	+	x	✓	✓
Redear sunfish <sup>o</sup>										+			
Smallmouth bass	x	x	x	x					x	+		✓ <sup>c</sup>	✓ <sup>c</sup>
Spotted bass		x	x	x	x	x	y	y	x	+	x	✓	
Largemouth bass	x	x	x					y	x	+		✓	✓
White crappie	x	x			x		y	y	x	+		✓	✓
Black crappie									x	+		✓ <sup>c</sup>	✓
Eastern sand darter <sup>d</sup>	x				x		y	y		+			

Table 8 continued.

Species	Investigations												
	A	B	C	D	E	F	G	H	I	J	K	L	M
Greenside darter		x	x	x	x	x	*	y	x	+			
Rainbow darter		x	x	x	x	x	x		x	+	x		
Fantail darter		x	x	x	x	x	*	y	x	+	x	✓	
Johnny darter	x	x	x	x	x	x	*	y	x	+	x	✓	
Orangethroat darter		x											
Variegated darter			x	x	x	x		y	x	+			
Banded darter	x	x	x			x	*	y	x	+	x		
Yellow perch <sup>p</sup>										+			
Logperch			x	x	x	x	*	y	x	+		✓	
Blackside darter		x	x	x	x	x	y	y	x	+		✓	
Dusky darter	x	x	x			x	y	y	x	+			
River darter <sup>d</sup>										+			
Sauger	x	x						y	x	+		✓	
Walleye	x	x								+			
Freshwater drum								y	x	+			

<sup>a</sup>KSNPC (1996) considers this species threatened in Kentucky.

<sup>b</sup>Warren (1981) new distribution record for Little Sandy River.

<sup>c</sup>Introduced by KDFWR, threadfin shad did not survive.

<sup>d</sup>KSNPC (1996) considered this species of special concern.

<sup>e</sup>Introduced – triploid (KDFWR).

<sup>f</sup>Burr and Warren (1986) report this species has not been reported from the Ohio River upstream of the falls since the late 1800's.

<sup>g</sup>Redfin shiner (*Lythrurus umbratilis*) is the species now believed to occur in Little Sandy River drainage. Earlier rosefin shiner (*L. ardens*) records are probably this species.

<sup>h</sup>Probably introduced by anglers.

<sup>i</sup>Clay (1975) reported that it was introduced once into Greenbo Lake, never collected by NEFD, stocking records to 1956 do not indicate this species having been stocked.

<sup>j</sup>Bauer and Branson (1979) from Ruin Creek in Elliott County, Burr and Warren (1986) considered the record doubtful.

<sup>k</sup>Caught 07 Jul 88 by angler near Pactolus, the 32-in long fish was brought to the author, photo and article appeared in "The Muskie Line", a newsletter of the Kentucky Silver Muskie Club (Vol. 21, No. 3 – Summer 1988).

<sup>l</sup>Stocked annually by KDFWR into Grayson Lake tailwater, Big Caney Creek, East Fork Little Sandy River, Laurel Creek, and Greenbo Lake.

<sup>m</sup>Stocked annually by KDFWR into Big Caney Creek and Laurel Creek. Were stocked into Big Sinking Creek 1988-1990.

<sup>n</sup>Probably mis-identified.

<sup>o</sup>Reported from mouth of Little Sandy River by R. Jackson (pers. comm. 1982 – KDFWR Ohio River Biologist). Author took pumpkinseed at this site. Redear sunfish were stocked into Greenbo Lake in 1956; since that time, none have been collected, only pumpkinseed sunfish (rarely).

<sup>p</sup>Collected at the mouth of Little Sandy River 12 Sept 79 (voucher specimen in NEFD collection).

<sup>q</sup>Warren and Cicerello (1983) report it from Little Sandy River near Argillite.

Table 9. Distribution of fishes, by station, collected while electrofishing or seining in Little Sandy River (Carter and Greenup counties) in 1986-1987, this study.

Species	Station <sup>a</sup>												
	1	2	3	S1	S2	4	S3	S4	S5	5	S6	S7	
Lamprey ammocoetes						x				x			
Least brook lamprey										x			
Longnose gar	x									x			
Bowfin	x												
American eel			x			x							
Skipjack herring	x	x											
Gizzard shad	x	x	x			x				x			
Central stoneroller				x	x	x		x	x	x	x		
Goldfish	x												
Spotfin shiner	x	x	x			x			x	x			
Steelcolor shiner				x	x	x		x	x				
Common carp	x	x	x			x				x			
Striped shiner			x	x	x	x	x	x	x	x	x	x	
Redfin shiner												x	
Speckled chub								x					
Silver chub	x					x							
River chub				x	x	x	x	x	x	x	x		
Golden shiner	x												
Emerald shiner	x	x	x	x	x	x	x	x	x	x			
Silverjaw minnow					x	x		x			x		
Silver shiner										x	x		
Rosyface shiner			x	x					x	x	x	x	
Sand shiner		x		x							x	x	
Mimic shiner	x					x							
Bluntnose minnow	x	x	x		x	x	x	x	x	x	x	x	
Bullhead minnow	x	x	x		x	x	x	x	x	x			
Blacknose dace						x							
Creek chub				x	x		x		x	x	x		
River carpsucker	x		x			x				x			
Quillback	x		x			x				x			
White sucker	x					x							
Northern hog sucker			x		x	x		x	x	x	x		
Smallmouth buffalo	x	x											
Bigmouth buffalo	x	x											
Spotted sucker	x	x	x			x				x			
Silver redhorse	x	x	x			x				x			
River redhorse			x			x				x			

Table 9 continued.

Species	Station <sup>a</sup>											
	1	2	3	S1	S2	4	S3	S4	S5	5	S6	S7
Golden redhorse	x	x	x	x		x	x		x	x		
Shorthead redhorse		x	x			x				x		
Yellow bullhead							x		x			
Channel catfish	x	x	x			x	x			x	x	
Stonecat							x	x		x		
Brindled madtom							x	x	x	x	x	x
Flathead catfish	x	x	x			x				x		
Grass pickerel	x	x	x			x	x		x			
Muskellunge	x	x	x			x				x		
Rainbow trout <sup>b</sup>												
Trout-perch			x			x				x		
Brook silverside	x	x			x		x		x	x		x
White bass	x									x		
Rock bass						x	x		x	x		
Green sunfish			x			x	x		x	x		
Pumpkinseed	x											
Warmouth	x					x						
Bluegill	x	x	x			x	x		x	x		
Longear sunfish	x	x	x			x	x		x	x		
Hybrid sunfish	x											
Spotted bass	x	x	x			x			x	x		x
Largemouth bass	x	x	x							x		
White crappie	x					x						
Eastern sand darter			x	x		x		x			x	
Greenside darter					x		x	x	x			
Fantail darter					x				x		x	
Johnny darter	x		x	x	x	x	x		x	x	x	x
Variegated darter							x			x	x	
Banded darter			x	x	x	x	x	x	x		x	x
Yellow perch	x											
Logperch	x	x	x		x	x						
Blackside darter			x		x	x			x	x		
Dusky darter	x		x			x	x	x	x	x		
Sauger	x	x	x			x				x		
Freshwater drum	x	x	x			x				x		

<sup>a</sup>See Table 3 for station locations.

<sup>b</sup>Stocked annually in Grayson Lake tailwater but not collected during this study.

Table 10. Endangered, threatened, and rare fishes known to occur in the Little Sandy River drainage.

Species	Status	
	KAS-KSNPC <sup>a</sup>	Federal
Northern brook lamprey <sup>b</sup>	T	
American brook lamprey <sup>c</sup>	T	
Rosyside dace <sup>d</sup>	S	
Trout-perch <sup>e</sup>	S	
Eastern sand darter <sup>f</sup>	S	C2

<sup>a</sup>1996.

<sup>b</sup>Warren (1981)

<sup>c</sup>Evenhuis (1972).

<sup>d</sup>Clark (1941), Turner (1962), KSNPC (1979), Branson et al. (1981), Mills (1988), this study.

<sup>e</sup>Clark (1941), Turner (1962), Carter (1970), KSNPC (1979), Branson et al. (1981), this study.

<sup>f</sup>Woolman (1892), Evenhuis (1972), Branson et al. (1981), Rice et al. (1983), this study.

T - threatened.

S - special concern.

C2 - ...conclusive data on biological vulnerability and threat are not available to support proposed rules....USFWS (1985).

Table 11. Location of sample sites from Salt Lick Creek, Lewis County.

Station	Location
1	From confluence with Ohio River, upstream 0.8 mi to just below St Rt 10 bridge, Vanceburg, KY. Creek mi 0-0.8. 08 Aug 1986 and 19 Aug 1987. Vanceburg, KY-OH Quad. Electrofishing.
S1	Seined riffle just upstream from St Rt 10 bridge crossing. 08 Aug 1986.
S2	Seined riffle ca 1.5 mi above confluence with Ohio River. 14 Aug 1987.
A	Rotenone (0.2 acre, 250 ft length of stream) ca 8.3 mi upstream from confluence with Ohio River. 29 Jun 1978 (Fisheries Annual Performance Report 1978, NEFD - B. Chitwood).

Table 12. List of fishes sampled from Salt Lick Creek.

Species	Sample sites			
	I	S1	S2	A
Longnose gar	x			
Skipjack herring	x			
Gizzard shad	x			
Central stoneroller		x	x	x
Spotfin shiner	x	x	x	
Steelcolor shiner	x	x		
Common carp	x			
Striped shiner		x	x	x
River chub		x		
Emerald shiner	x	x	x	
Mimic shiner	x			
Suckermouth minnow		x		
Bluntnose minnow	x	x	x	x
Fathead minnow <sup>a</sup>				x
Bullhead minnow	x			
Creek chub		x		
River carpsucker	x			
White sucker				x
Northern hog sucker				x
Smallmouth buffalo	x			
Bigmouth buffalo	x			
Spotted sucker	x			x
Golden redhorse	x		x	x
Yellow bullhead				x
Channel catfish	x			
Brindled madtom				x
Flathead catfish	x			
Grass pickerel				x
Muskellunge	x			
Blackstripe topminnow			x	x
Brook silverside			x	
Green sunfish				x
Bluegill	x			
Longear sunfish	x		x	x
Smallmouth bass			x	
Spotted bass	x		x	x
Largemouth bass	x			
Greenside darter				x
Rainbow darter		x	x	
Fantail darter		x	x	x
Johnny darter		x	x	x
Logperch	x		x	x
Blackside darter			x	x
Sauger	x			
Freshwater drum	x			

<sup>a</sup>Identification questionable.

Table 13. Physical characteristics from each electrofishing station pool during 1986 and 1987 in Little Sandy River below Grayson lake.

Station	No. muskellunge	Stream mi <sup>a</sup>	Pool length (mi)	Average pool width (ft)	Est. acreage	Mean depth (ft)	Maximum depth (ft)	Est. shade (%)	Pool/riffle (%)
1 <sup>b</sup>	3	0-2.1/2.5	2.1/2.5	n/d	n/d	n/d	n/d	5-25	100-0
2	10	6.3-8.3	2.0	125.9	32.0	7.9	24.0	25-50	100-0
3	11	9.8-13.0	3.2	96.7	23.4	4.8	21.0	25-50 (lower) 75-100 (upper)	100-0
4	4	18.0-20.0	2.0	74.1	28.7	2.4	8.5	75-100	90-10
5	9	39.4-41.5	2.1	69.2	16.8	1.6	n/d	75-100	60-40
Total	37		11.4						
Mean			2.3	91.5	25.2	4.2			

<sup>a</sup>Mile 0 at confluence with Ohio River at ORM 336.4.

<sup>b</sup>Widths and depths not determined due to extreme widths and much sedimentation that frequency fluctuates depths.

Table 14. Water quality sample site locations in Little Sandy River in 1986 and 1987.

Station	Location
1	Greenup County - at COE boat ramp, between C&O railroad crossing and US 23 bridge crossing, just upstream of confluence with Ohio River, Greenup, KY-OH Quad.
2	Greenup County - near Long Branch confluence, ca river mi 18.0, Argillite, KY Quad.
3	Carter County - at St Rt 1910 crossing at Pactolus, ca river mi 33.8, Grayson, KY Quad.
4	Carter County - between Big Sinking Creek confluence and Grayson Lake dam spillway basin, ca river mi 50.5, Grayson, KY Quad.

Table 15. Water quality determinations from the Little Sandy River below Grayson Lake.

	1986 stations <sup>a</sup>				1987 stations <sup>b</sup>			
	1	2	3	4	1	2	3	4
Water temperature (°C)								
Apr					13.0	11.0	10.0	9.0
Jul	26.0	23.0	23.5	22.0	25.6	22.8	22.2	22.2
Oct	17.0	12.0	12.0	13.5	17.2	12.8	12.5	15.6
Dissolved oxygen (mg/l)								
Apr					9.3	10.6	11.6	11.8
Jul	5.9	7.0	5.9	7.9	5.0	7.5	8.0	8.2
Oct	8.4	9.8	9.2	8.9	8.6	7.9	6.0	10.0
Total alkalinity (mg/l)								
Apr					51	51	26	43
Jul	68	86	86	51	51	51	68	26
Oct	68	77	86	60	68	68	51	51
Turbidity (NTU)								
Apr					52	21	18	14
Jul	85	31	49	5	100	90	76	6
Oct	22	20	17	5	32	5	5	6
pH								
Apr					7.5	7.7	7.5	6.9
Jul	6.4	6.4	6.3	6.3	6.4	6.9	6.6	6.5
Oct	4.1	6.8	6.5	6.6	7.6	7.4	7.4	7.6
Salinity (ppt)								
Apr					0	0	0	0
Jul	0	0	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0
Conductivity (umhos/sec)								
Apr					149	135	135	132
Jul	235	230	280	240	210	175	199	172
Oct	282	210	220	245	260	200	210	175

<sup>a</sup>1986 - 07 Jul, 17 Oct.

<sup>b</sup>1987 - 14 Apr, 15 Jul, 20 Oct.



Table 16. Physical characteristics from the study pool electrofished during 1986-1987 in Salt Lick Creek.

Stream mi <sup>a</sup>	Pool length (mi)	Average pool width (ft)	Est. acreage	Mean depth (ft)	Maximum depth (ft)	Est. % shade	Pool/riffle (%)
0-0.8	0.8	68.2	6.6	3.8	16.0	75-100	90-10

<sup>a</sup>Mile 0 at confluence with Ohio River at ORM 378.5.

Table 17. Water quality determinations from Salt Lick Creek during 1986 and 1987 taken at the access ramp near Vanceburg between the mouth and St Rt 8 bridge.

	1986		1987	
	Temperature (°C)			18 May
	08 Aug	26.5	15 Jul	21.7
	17 Oct	17.1	20 Oct	17.0
Dissolved oxygen (mg/l)			May	7.1
	Aug	8.9	Jul	6.6
	Oct	8.2	Oct	7.5
Total alkalinity (mg/l)			May	102.6
	Aug	85.5	Jul	94.1
	Oct	94.1	Oct	68.4
Turbidity (NTU)			May	14.0
	Aug	21.0	Jul	200.0+
	Oct	20.0	Oct	12.0
pH			May	7.4
	Aug	6.1	Jul	6.3
	Oct	6.8	Oct	7.4
Salinity (ppt)			May	0
	Aug	0	Jul	0
	Oct	0	Oct	0
Conductivity (umhos/cm)			May	335
	Aug	375	Jul	250
	Oct	310	Oct	300

Appendix A. Catch-per-unit-effort for muskellunge captured (all sizes) from study streams within the Northeastern Fishery District<sup>a</sup>.

Stream	Year sampled	CPUE (fish/hour)
Kinniconick Creek	1980	0.5
	1981	0.5
Tygarts Creek	1980	1
	1981	1.7
Red River	1982	0.4
	1983	0.2
Station Camp Creek	1982	0.7
	1983	0.8
Sturgeon Creek	1982	0
	1983	0.4
Licking River	1983-1986	0.2
Little Sandy River	1986	0.9
	1987	0.8
Salt Lick Creek	1986	1.2
	1987	0
Fox Creek <sup>b</sup>	1987	7.2
	1988	6.4
Triplett Creek <sup>b</sup>	1986	1.7
	1987	0.6

<sup>a</sup>x CPUE for 12 Kentucky muskellunge streams was 0.6 fish/hour (Axon and Kornman 1986).

<sup>b</sup>Surmont (KDFWR Fisheries Bulletin in preparation) - Licking River tributaries.

Appendix B. Fishes collected and length distribution while electrofishing Little Sandy River at Station 1.<sup>a</sup> x represents species taken but not during a timed subsample, or it was not measured.

Species	Year	Inch group																									Total	Fish/ hour	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25			26
Longnose gar	1987																											x	
Bowfin	1986																											x	
Skipjack herring	1987																											x	
Gizzard shad	1986		1	3	17	72	45	4	2	14	5	2	1		2													168	152.7
	1987			138	175	10	16	16	18	7	26	13	4	4	1													428	237.8
Goldfish	1987																											x	
Spotfin shiner	1987																											x	
Common carp	1986													1				1		2	2	3	1	2				12	10.9
	1987					2			1									1	1	1						1	2	9	5.0
Silver chub	1986		2	3																								5	4.5
	1987			2																								2	1.1
Golden shiner	1986				1	1	1	1																				4	3.6
	1987																											x	
Emerald shiner	1986	50	55	3																								108	98.2
	1987	2	2																									4	2.2
Mimic shiner	1986	1	2																									3	2.7
Bluntnose minnow	1986	1	2																									3	2.7
	1987		1	1																								2	1.1
Bullhead minnow	1986		10																									10	9.1
	1987		2																									2	1.1
River carpsucker	1986							1	1					3	1			1			1							8	7.3
	1987			4	1		2	1	1		2	2	1	1						1								16	8.9
Quillback	1987				2			2		1				2														7	3.9
White sucker	1987																											x	
Smallmouth buffalo	1986									1	2	2		1	1		1											8	7.3
	1987					1		1	1					1			1											5	2.8
Bigmouth buffalo	1986																											1	0.9
	1987												1													1		1	0.6
Spotted sucker	1986				9								2				1											12	10.9
	1987				1		3		1		1			3	2		1	1										13	7.2
Silver redhorse	1986																		1									2	1.8
Golden redhorse	1987						1																					2	1.1
Channel catfish	1986																											x	
Flathead catfish	1986																											1	0.9
	1987										1			1				1	1									4	2.2
Grass pickerel	1986																											x	
	1987																											x	
Muskellunge	1986																									3		3	1.5
Brook silverside	1986		2	3																								5	4.5
White bass	1986					2	1																					3	2.7
	1987					2																						2	1.1
Pumpkinseed	1986			2	3																							5	4.5
	1987				2	1	1																					4	2.2

## Appendix B continued.

Species	Year	Inch group																								Total	Fish/ hour		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			25	26
Warmouth	1986																											x	
	1987				1		2																					3	1.7
Bluegill	1986	3	21	10	20	10	6																					70	63.6
	1987	3	21	5	9	18	6	1																				63	35.0
Longear sunfish	1986		20	6	8																							34	30.9
	1987		18	14	4	6																						42	23.3
Hybrid sunfish	1987				1	1																						2	1.1
Spotted bass	1986		3	9	8																							20	10.0
	1987		1	2	1		2		1		1																	8	3.2
Largemouth bass	1986					6	4		1	8	2	4	4			1												31	15.5
	1987			1	5	6	3	3	3	8	5	5	8	6	2	1	1			1	1							59	23.6
White crappie	1986																											1	0.9
Johnny darter	1986		1																									1	0.9
Logperch	1986			3																								3	2.7
	1987		1	1																								2	1.1
Dusky darter	1986		1																									1	0.9
Sauger	1986				1	1	1																					3	2.7
	1987				1																							1	0.6
Freshwater drum	1986			11	2	1		1																				15	13.6
	1987		1	2	2					1					1	1												9	5.0

<sup>a</sup>In appendices B-F, sampling effort for black bass and muskellunge (and from 1986 and 1987) may vary from that for other species.

Appendix C. Fishes collected and length distribution while electrofishing Little Sandy River at Station 2. x represents fishes observed and not collected or collected and not measured.

Species	Year	Inch group																												Total	Fish/ hour
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	27	28	30		
Skipjack herring	1986							1																					1	0.5	
	1987					1																								1	0.5
Gizzard shad	1986																													x	
	1987							2		1																				3	1.5
Spotfin shiner	1986			1																										1	0.5
Common carp	1986															1				3	1		1		1	1		1	1	10	4.8
	1987																			1			1							2	1.0
Emerald shiner	1986	12	20	4																										36	17.1
	1987	2	1	2																										5	2.5
Sand shiner	1987			1																										1	0.5
Bluntnose minnow	1986	3	3	1																										7	3.3
Bullhead minnow	1986	4	10	1																										15	7.1
Smallmouth buffalo	1986																											1	1	1	0.5
Bigmouth buffalo	1986																													1	0.5
	1987				1																									1	0.5
Spotted sucker	1986			2																										2	1.0
	1987					1																								1	0.5
Silver redhorse	1986															1	1	1	1											5	2.4
Golden redhorse	1986								1	2			1	1	1															6	2.9
	1987												1		1															2	1.0
Shorthead redhorse	1986				1				1																					2	1.0
Channel catfish	1986		1																											1	0.5
Flathead catfish	1986																		1	1										2	1.0
	1987													1																1	1.0
Grass pickeret	1986					1			1																					2	1.0
Muskellunge	1986																1													1	0.5
	1987										1	1																		3	1.5
Brook silverside	1986		2	1																										3	1.4
Bluegill	1986	2		17		3	6																							29	13.8
Longear sunfish	1986	1	1	9	5	3																								19	9.0
	1987				2																									2	1.0
Spotted bass	1986	1				2	2	1																						6	2.9
	1987				1	1				1																				3	1.5
Largemouth bass	1986				1				1				1																	3	1.4
Logperch	1986		2	2																										4	1.9
Sauger	1986					2																								2	1.0
	1987					1										1														2	1.0
Freshwater drum	1986														1															3	1.4
	1987			1																										1	0.5



## Appendix D continued.

Species	Year	Inch group																				Total	Fish/ hour									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			21	22	23	24	26	29	39	42	
Spotted bass	1986		3	1	1		1	2	2																						10	5.0
	1987	1	1				1	1		1																				5	2.2	
Largemouth bass	1986												1	1																2	1.0	
Eastern sand darter	1986		1																											1	0.7	
Johnny darter	1987		1																											1	0.6	
Banded darter	1987																													x		
Logperch	1986		1																											1	0.7	
	1987				1																									1	0.6	
Blackside darter	1986		5																											5	3.3	
	1987			1																										1	0.6	
Dusky darter	1986			1																										1	0.7	
	1987			2	1																									3	1.9	
Sauger	1986									1																				1	0.7	
	1987								1						1															2	1.2	
Freshwater drum	1986			1					2						1		1				1	1								7	4.7	
	1987			2									1																	3	1.9	

Appendix E. Fishes collected and length distribution while electrofishing Little Sandy River at Station 4; x represents species taken but not during a timed period or collected but not measured.

Species	Year	Inch group																				Total	Fish/ hour					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			22	23	35		
American eel	1986																								1	1	1.0	
Gizzard shad	1986							4	18	2	5	9	6	2	2												48	48.0
	1987						1		6	25	7	2		1												42	42.0	
Central stoneroller	1986		7		1																					8	8.0	
	1987		1		2																					3	1.5	
Spotfin shiner	1987				2																					2	1.0	
Steelcolor shiner	1986				2																					2	2.0	
Common carp	1986										1															1	1.0	
	1987																						1			1	1.0	
Striped shiner	1986	1	1																							2	2.0	
Silver chub	1986					1																				1	1.0	
River chub	1986				1	2	2	1																		6	6.0	
Emerald shiner	1986	1	5	22	5																					33	33.0	
	1987	12	6	24																						42	21.0	
Silverjaw minnow	1986		1																							1	1.0	
	1987		4																							4	2.0	
Mimic shiner	1986		1																							1	1.0	
	1987	2																								2	1.0	
Bluntnose minnow	1986		2	2																						4	4.0	
	1987	1	8	4																						13	6.5	
Bullhead minnow	1986		1	1																						2	2.0	
	1987		4	1																						5	2.5	
Blacknose dace	1987		1																							1	0.5	
River carsucker	1986															1									1	2	2.0	
	1987														2	1								1			4	4.0
Quillback	1986												1													1	1.0	
White sucker	1986		1																							1	1.0	
Northern hog sucker	1986		2	1				2																		5	5.0	
	1987				1	1	1			1																4	4.0	
Spotted sucker	1986		1	1				3		1																6	6.0	
	1987					1	1	1					1													4	4.0	
Silver redhorse	1986											3	6	4	4	3	3									23	23.0	
	1987								1	1	1	1	6	3		2	1									16	16.0	
River redhorse	1986																									2	2.0	
	1987																					1	2			3	3.0	
Golden redhorse	1986		2	1	2	2	5	15	29	32	41	50	11	3	1											192	192.0	
	1987			2	2	2		1	8	26	27	35	12	1												116	116.0	
Shorthcad redhorse	1986										1		3	2	2												8	8.0
	1987									1				3													4	4.0
Channel catfish	1986		1																							1	1.0	
	1987													1			1										2	2.0
Flathead catfish	1986															1										1	1.0	
	1987															1										1	1.0	



## Appendix E continued.

Species	Year	Inch group																				Total	Fish/ hour			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			22	23	35
Grass pickerel	1986					2	1																		3	3.0
	1987																								x	
Muskellunge	1986																			1					1	0.5
	1987																								x	
Trout-perch	1986			1																					1	1.0
Rock bass	1986				1			1																	2	2.0
	1987																								x	
Green sunfish	1986																								x	
Warmouth	1987																								x	
Bluegill	1986		3	20	2		2																		27	27.0
	1987			4	4	1																			9	9.0
Longear sunfish	1986			1	3	3																			7	7.0
	1987		3	2	3	1	1																		10	10.0
Spotted bass	1986		2	1		1		1	1	2		1													9	4.1
	1987	1	1		1		1		2	3	2		1												12	6.0
White crappie	1986																								x	
Eastern sand darter	1987		1																						1	0.5
Johnny darter	1986		1																						1	1.0
Banded darter	1986		1																						1	1.0
	1987	1	1																						2	1.0
Logperch	1986				1																				1	1.0
	1987				1																				1	0.5
Blackside darter	1986		1																						1	1.0
	1987		1	2																					3	1.5
Dusky darter	1986		2	2	1																				3	1.5
	1987		8	1																					9	4.5
Sauger	1986												1						1	1					3	1.4
	1987																1								1	0.5
Freshwater drum	1986							1	3	1	2			2		1			1						11	11.0
	1987							1	5			1													7	7.0

Appendix F. Fishes collected and length distribution while electrofishing Little Sandy River at Station 5.

Species	Year	Inch group																															Total	Fish/ hour
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	27	28	30	31				
Least brook lamprey	1987					2	1																										3	1.9
Longnose gar	1986																								1							1	2	2.0
Gizzard shad	1986							1	36	11		3	4																				55	55.0
	1987						1		1	8	1	1	1																				13	8.1
Central stoneroller	1986		5	1																													6	6.0
Spotfin shiner	1987		1																														1	0.6
Common carp	1986																		2		3	2	1	1			1					10	10.0	
	1987																		4	1		3	1	1	1	1	1	1			1	14	8.7	
Striped shiner	1986		3			1																											4	4.0
	1987		1	2																													3	1.9
River chub	1986	1			4	1		1																									7	7.0
	1987					2			1																								3	1.9
Emerald shiner	1986			10																													10	10.0
Silver shiner	1986				2																												2	2.0
	1987				3																												3	1.9
Rosyface shiner	1987		1																														1	0.6
Bluntnose minnow	1986		1	4																													5	5.0
	1987		2																														2	1.2
Bullhead minnow	1987			1																													1	0.6
Creek chub	1986		1																														1	1.0
River catsucker	1987																1																1	0.6
Quillback	1986												1	3																			4	4.0
	1987													1	1																		2	1.2
Northern hog sucker	1986			8	1	5	4	3	1																								22	22.0
	1987				2	6		2			1																						11	6.9
Spotted sucker	1986		2	7		1				2	1	1																					14	14.0
	1987			1	3		1			1	1																						7	4.4
Silver redhorse	1986					1	1			1	4	22	21	11	3	5																	70	70.0
	1987				3			1		1	1	8	11	5	5	2																	37	23.1
River redhorse	1986											1																					1	1.0
Golden redhorse	1986				1	1	2	3	10	16	13	32	6	3																			87	87.0
	1987			1	4			1	10	15	13	20	18	6	1																		89	55.6
Shorthead redhorse	1986													1	3	1	1																6	6.0
Channel catfish	1986																																1	1.0
Stonecat	1986					1																											1	1.0
Brindled madtom	1986				2																												2	2.0
	1987			1																													1	0.6
Flathead catfish	1986																																1	1.0
Muskellunge	1986																																1	1.0
	1987																																1	1.0
Trout-perch	1986		8	14	1																												23	23.0
	1987				1																												1	0.6
Brook silverside	1987			1																													1	0.6

## Appendix F continued.

Species	Year	Inch group																														Total	Fish/ hour
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	27	28	30	31			
White bass	1987							2																							2	1.2	
Rock bass	1986				2																										2	2.0	
	1987					1	3																								4	2.5	
Green sunfish	1987				1																										1	0.6	
Bluegill	1986			1			1																								2	2.0	
	1987			1		1	7	1																							10	6.2	
Longear sunfish	1986		4	1	3	2																									10	10.0	
	1987		1	2	6	6																									15	9.4	
Spotted bass	1986		2		1	1	4			1	1				1																11	11.0	
	1987			3	1		2	2		1	2		1																		12	7.5	
Largemouth bass	1987						1																								1	0.6	
Johnny darter	1986		1																												1	1.0	
	1987		1																												1	0.6	
Varicgate darter	1986	1																													1	1.0	
Blackside darter	1986		6	1																											7	7.0	
	1987			2																											2	1.2	
Dusky darter	1986			2	1																										3	3.0	
	1987			1																											1	0.6	
Sauger	1986												1					1													2	2.0	
	1987								1								1														2	1.2	
Freshwater drum	1986								1	2			1		1					1											6	6.0	
	1987											1	2	1								1									5	3.1	

\*Ammocoetes.

Appendix G. Kentucky Department of Fish and Wildlife Resources sample site locations from Little Sandy River tributary studies; use with Appendix H.

Study	Location
A	Left Fork of Middle Fork. Elliott Co., 27 Oct 1975. Five sites from just downstream of Sheepskin Branch, upstream to just downstream of Right Fork of Middle Fork confluence (Isonville Quad). Fish kill investigation T. Crowell and C. Boggs.
B	Big Sinking Creek, Carter Co., 2.0 air mi SE of Grahn, KY, 04 May 1981 (seine); 01 Oct 1987 (backpack electrofishing); 04 Apr 1992 (seine) 1.9 air mi SE of Grahn (Grahn Quad).
C	Big Caney Creek, Elliott Co., 15 Sept 1983, 28 Aug 1990 and 26 Jul 1995, 1.6 mi E of Ordinary, KY (St Rt 32) N on Frank Conn Rd (Binion Ford Rd); backpack electrofishing vic low wter ford (Ault Quad). 01 Aug 1995 upstream and downstream of Wimberly Br. Confl. (Ault and Bruin Quad).
D	Laurel Creek, Elliott Co., 15 Sep 1983, 22 Jul 1991 and 08, 25 and 28 Aug 1995, 0.9 mi E of Ordinary (St Rt 32), S on Big Stone Rd to low water concrete bridge, backpack electrofishing up-and-down-stream from this point (Ault Quad). 07 Sep 1995, up-and-down-stream of old "ford" located vic Rocky Ck confl. (Ault and Sandy Hook Quad).
E	East Fork Little Sandy River, Boyd Co, 30 Sep 1987, ca 0.4 mi downstream of Laurel Ck confl., ca 1.1 air mi N of Navity, KY (backpack electrofishing - Boltsfork Quad).
F	East Fork Little Sandy River, Boyd Co., 11 Aug 1989, fish kill investitation up-and-down-stream of Shope Branch confl., ca 0.5 mi SE of Meads, KY (Ashland Quad).

Appendix H. Species of fish collected from Little Sandy River tributaries by KDFWR-NEFD personnel, from locations described in Appendix G.

Species	Location					
	A <sup>a</sup>	B	C	D	E	F <sup>b</sup>
Least brook lamprey		x			x	
Lamprey ammocoetes		x	x	x	x	
Gizzard shad	x					x
Central stoneroller	x	x	x	x	x	x
Rosyside dace		x	x	x		
Common carp	x					x
Striped shiner	x	x	x	x	x	x
Redfin shiner					x	
Silverjaw minnow		x		x	x	
Silver shiner		x	x	x		
Sand shiner		x				
Southern redbelly dace		x				
Bluntnose minnow		x	x	x	x	x
Blacknose dace		x	x	x		
Creek chub	x	x	x	x	x	
White sucker	x	x	x	x	x	x
Northern hog sucker	x	x	x	x	x	x
Spotted sucker	x					x
Silver redhorse	x					x
Golden redhorse	x	x			x	x
Black bullhead	x					x
Yellow bullhead	x		x			
Channel catfish						x
Brindled madtom						x
Grass pickerel	x	x			x	x
Rainbow trout		x	x	x		
Brown trout		x	x	x		
Trout-perch	x	x	x	x	x	x
Brook silverside		x				
Mottled sculpin		x	x	x		
White bass						x
Rock bass	x	x	x	x	x	x
Green sunfish	x			x		
Warmouth						x
Orangespotted sunfish <sup>c</sup>	x					
Bluegill	x		x	x		x
Longear sunfish	x	x	x	x	x	x
Smallmouth bass				x		x
Spotted bass	x	x	x	x	x	
Largemouth bass	x		x	x		

Appendix H continued.

Species	Location					
	A <sup>a</sup>	B	C	D	E	F <sup>b</sup>
White crappie	x			x		x
Black crappie						x
Greenside darter		x	x	x	x	
Rainbow darter		x	x	x		
Fantail darter		x	x	x	x	
Johnny darter		x	x	x	x	
Variegated darter		x				
Banded darter		x			x	
Logperch			x	x		x
Blackside darter		x	x	x	x	
Dusky darter				x		
Sauger						x
Freshwater drum						x

<sup>a,b</sup>Most lampreys, shiners, and darters counted were not identified to species.

<sup>c</sup>Indicated on data sheet; probably mis-identified.

Appendix I. Freshwater unionids identified from Little Sandy River (Cicerello et al. 1991) and their status.

Scientific name	Common name	Status <sup>a</sup>	
		KSNPC	U.S.
<i>Alasmidonta marginata</i>	Elktoe	T	
<i>Amblema p. plicata</i>	Threeridge		
<i>Anodonta grandis</i>	Giant floater		
<i>Elliptio crassidens</i>	Elephant-ear		
<i>E. dilatata</i>	Spike		
<i>Fusconaia flava</i>	Washbash pigtoe		
<i>Lampsilis cardium</i>	Plain pocketbook		
<i>L. Siliquoidea</i>	Fatmucket		
<i>Lasmigona c. complanata</i>	White heelsplitter		
<i>L. compressa</i>	Creek heelsplitter	E	
<i>L. costata</i>	Fluted-shell		
<i>Leptodea fragilis</i>	Fragile papershell		
<i>Obovaria subrotunda</i>	Round hickorynut		
<i>Potamilus alatus</i>	Pink heelsplitter		
<i>Ptychobranchus fasciolaris</i>	Kidneyshell		
<i>Quadrula p. pustulosa</i>	Pimpleback		
<i>Q. quadrula</i>	Mapleleaf		
<i>Simpsonaias ambigua</i>	Salamander mussel	T	C2
<i>Strophitus undulatus</i>	Squawfoot		
<i>Toxolasma parvus</i>	Lilliput		
<i>Tritogonia verrucosa</i>	Pistolgrip		
<i>Villosa lienosa</i>	Little spectaclecase	S	

<sup>a</sup>KSNPC (1994).

Appendix J. Fishes collected and length distribution while electrofishing Salt Lick Creek at its mouth. All fishes were collected during 0.8 hour each year in 1986 and 1987.

Species	Year	Inch group																													Total	Fish/ hour
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	29	31						
Longnose gar	1986																												1	1	1.2	
	1987																													x		
Skipjack herring	1987												1																	1	1	1.2
Gizzard shad	1986			1				2	2	1			1																	7	8.7	
	1987							4	9	6	12	7	1		1															40	50.0	
Spotfin shiner	1986		3	5																										8	10.0	
	1987		1	1																										2	2.5	
Steelcolor shiner	1987			1																										1	1.2	
Common carp	1986																													x		
	1987																													x		
Emerald shiner	1986		3	1																										4	5.0	
	1987	1	19																											20	25.0	
Mimic shiner	1986		1																											1	1.2	
Bluntnose minnow	1986	2	1																											3	3.7	
Bullhead minnow	1986		1																											1	1.2	
River carpsucker	1986																2													2	2.5	
	1987																			1										1	1.2	
Smallmouth buffalo	1986																1				2	3		1	1					8	10.0	
	1987												1				1			1										3	3.7	
Bigmouth buffalo	1987																													1	1.2	
Spotted sucker	1986												1	2	1															4	5.0	
	1987											1	1				3	1												6	7.5	
Golden redbhorse	1986				2	1			4	1																				8	10.0	
	1987			1			1				1	2	1		1	1														8	10.0	
Channel catfish	1986															1														1	1.2	
Flathead catfish	1987							1																						1	1.2	
Muskellunge	1986																													1	1.2	
Bluegill	1986	7	1						1																					9	11.2	
	1987		1	1	1																									3	3.7	
Longear sunfish	1986			13	4	5	1																							23	28.7	
	1987		7	1	1																									9	11.2	
Spotted bass	1986		2	3	1	1		1	1	1	2																			12	15.0	
	1987			1				1	2				1																	5	6.2	
Largemouth bass	1986			1	1							1		1																4	5.0	
	1987				1						1																			2	2.5	
Logperch	1986		2	1																										3	3.7	
	1987		2	1																										3	3.7	
Sauger	1986										2				1															3	3.7	
	1987																1													1	1.2	
Freshwater drum	1986		1									2			1	1				1										6	7.5	
	1987										1	2		2	1	1														8	10.0	

x - observed, not collected.



Appendix K. List of scientific names of fishes discussed within this report (Robins et al. 1991).

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*PETROMYZONTIDAE*

<i>Ichthyomyzon fossor</i>	Northern brook lamprey
<i>Lampetra aepyptera</i>	Least brook lamprey
<i>Lampetra appendix</i>	American brook lamprey

*LEPISOSTEIDAE*

<i>Lepisosteus osseus</i>	Longnose gar
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*AMIIDAE*

<i>Amia calva</i>	Bowfin
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*ANGUILLIDAE*

<i>Anguilla rostrata</i>	American eel
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*CLUPEIDAE*

<i>Alosa chrysochloris</i>	Skipjack herring
<i>Dorosoma cepedianum</i>	Gizzard shad
<i>Dorosoma petenense</i>	Threadfin shad

*CYPRINDAE*

<i>Camptostoma anomalum</i>	Central stoneroller
<i>Carassius auratus</i>	Goldfish
<i>Clinostomus funduloides</i>	Rosyside dace
<i>Ctenopharyngodon idella</i>	Grass carp
<i>Cyprinella spiloptera</i>	Spotfin shiner
<i>Cyprinella whipplei</i>	Steelcolor shiner
<i>Cyprinus carpio</i>	Common carp
<i>Hybognathus nuchalis</i>	Mississippi silvery minnow
<i>Luxilus chrysocephalus</i>	Striped shiner
<i>Lythrurus ardens</i>	Rosefin shiner
<i>Lythrurus umbratilis</i>	Redfin shiner
<i>Macrhybopsis aestivalis</i>	Speckled chub
<i>Macrhybopsis storeriana</i>	Silver chub
<i>Nocomis micropogon</i>	River chub
<i>Notemigonus crysoleucas</i>	Golden shiner
<i>Notropis amblops</i>	Bigeye chub
<i>Notropis atherinoides</i>	Emerald shiner
<i>Notropis blennioides</i>	River shiner
<i>Notropis buccatus</i>	Silverjaw minnow
<i>Notropis photogenis</i>	Silver shiner
<i>Notropis rubellus</i>	Rosyface shiner
<i>Notropis stramineus</i>	Sand shiner
<i>Notropis volucellus</i>	Mimic shiner

*Phenacobius mirabilis*  
*Phoxinus erythrogaster*  
*Pimephales notatus*  
*Pimephales promelas*  
*Pimephales vigilax*  
*Rhinichthys atratulus*  
*Semotilus atromaculatus*

Suckermouth minnow  
Southern redbelly dace  
Bluntnose minnow  
Fathead minnow  
Bullhead minnow  
Blacknose dace  
Creek chub

#### CATOSTOMIDAE

*Carpionodes carpio*  
*Carpionodes cyprinus*  
*Carpionodes velifer*  
*Catostomus commersoni*  
*Hypentelium nigricans*  
*Ictiobus bubalus*  
*Ictiobus cyprinellus*  
*Minytrema melanops*  
*Moxostoma anisurum*  
*Moxostoma carinatum*  
*Moxostoma duquesnei*  
*Moxostoma erythrurum*  
*Moxostoma macrolepidotum*

River carpsucker  
Quillback  
Highfin carpsucker  
White sucker  
Northern hog sucker  
Smallmouth buffalo  
Bigmouth buffalo  
Spotted sucker  
Silver redhorse  
River redhorse  
Black redhorse  
Golden redhorse  
Shorthead redhorse

#### ICTALURIDAE

*Ameiurus catus*  
*Ameiurus melas*  
*Ameiurus natalis*  
*Ictalurus furcatus*  
*Ictalurus punctatus*  
*Noturus elegans*  
*Noturus flavus*  
*Noturus miurus*  
*Noturus nocturnus*  
*Pylodictis olivaris*

White catfish  
Black bullhead  
Yellow bullhead  
Blue catfish  
Channel catfish  
Elegant madtom  
Stonecat  
Brindled madtom  
Freckled madtom  
Flathead catfish

#### ESOCIDAE

*Esox americanus vermiculatus*  
*Esox lucius*  
*Esox masquinongy*

Grass pickerel  
Northern pike  
Muskellunge

#### SALMONIDAE

*Oncorhynchus mykiss*  
*Salmo trutta*

Rainbow trout  
Brown trout

*PERCOPSIDAE*

*Percopsis omiscomaycus* Trout-perch

*CYPRINODONTIDAE*

*Fundulus notatus* Blackstripe topminnow

*ATHERINIDAE*

*Labidesthes sicculus* Brook silverside

*COTTIDAE*

*Cottus bairdi* Mottled sculpin

*Cottus carolinae* Banded sculpin

*PERCICHTHYIDAE*

*Morone chrysops* White bass

*CENTRARCHIDAE*

*Ambloplites rupestris* Rock bass  
*Lepomis cyanellus* Green sunfish  
*Lepomis gibbosus* Pumpkinseed  
*Lepomis gulosus* Warmouth  
*Lepomis humilis* Orangespotted sunfish  
*Lepomis macrochirus* Bluegill  
*Lepomis megalotis* Longear sunfish  
*Lepomis microlophus* Redear sunfish  
*Micropterus dolomieu* Smallmouth bass  
*Micropterus punctulatus* Spotted bass  
*Micropterus salmoides* Largemouth bass  
*Pomoxis annularis* White crappie  
*Pomoxis nigromaculatus* Black crappie

*PERCIDAE*

*Ammocrypta pellucida* Eastern sand darter  
*Etheostoma blennioides* Greenside darter  
*Etheostoma caeruleum* Rainbow darter  
*Etheostoma flabellare* Fantail darter  
*Etheostoma nigrum* Johnny darter  
*Etheostoma spectabile* Orangethroat darter  
*Etheostoma variatum* Variegated darter  
*Etheostoma zonale* Banded darter  
*Perca flavescens* Yellow perch  
*Percina caprodes* Logperch  
*Percina maculata* Blackside darter  
*Percina sciera* Dusky darter

*Percina shumardi*  
*Stizostedion canadense*  
*Stizostedion vitreum*

River darter  
Sauger  
Walleye

*SCIAENIDAE*

*Aplodinotus grunniens*

Freshwater drum

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Appendix L. Water quality criteria for warmwater fish habitat.

Parameter	Preferred	Harmful
Temperature (°F/°C, summer)	>68/20 and <89/31.7	>95/35
Dissolved oxygen (mg/l)	≥5	<2
Total alkalinity (mg/l)	≥100	
Turbidity (NTU)	≤200	≥20,000
pH	6.5 - 8.2	<4.7 and >9.0
Salinity (mg/l)	≤400 (0.4 ppt)	≥2,000 (2 ppt)
Conductivity (umhos/cm)	<1,000	≥4,000