A Detailed Investigation of the Sociological, Economic, and Ecological Aspects of Proposed Reservoir Sites in the Salt River Basin of Kentucky

Digital Object Identifier: https://doi.org/10.13023/kwrri.rr.67

Stuart E. Neff  
*University of Louisville*

Louis A. Krumholz  
*University of Louisville*

John R. Baker  
*University of Louisville*

Daryl E. Jennings  
*University of Louisville*

Andrew C. Miller  
*University of Louisville*

Follow this and additional works at: https://uknowledge.uky.edu/kwrri_reports

Part of the [Ecology and Evolutionary Biology Commons](https://uknowledge.uky.edu/evolutionary_biology_cw), [Economics Commons](https://uknowledge.uky.edu/economics_cw), [Sociology Commons](https://uknowledge.uky.edu/sociology_cw), and the [Water Resource Management Commons](https://uknowledge.uky.edu/water_resource_management_cw)

Repository Citation  
https://uknowledge.uky.edu/kwrri_reports/128

This Report is brought to you for free and open access by the Kentucky Water Resources Research Institute at UKnowledge. It has been accepted for inclusion in KWRRI Research Reports by an authorized administrator of UKnowledge. For more information, please contact UKnowledge@lsv.uky.edu.
A DETAILED INVESTIGATION OF THE
SOCIOLOGICAL, ECONOMIC, AND ECOLOGICAL ASPECTS
OF PROPOSED RESERVOIR SITES
IN THE SALT RIVER BASIN OF KENTUCKY

Stuart E. Neff and Louis A. Krumholz
Principal Investigators

John R. Baker, Daryl E. Jennings, Andrew C. Miller,
Jerry S. Parsons, Vincent H. Resh, David S. White
Graduate Research Assistants

Project Number B-022-KY (Completion Report)
Agreement Number 14-31-0001-3286
Period of Project, July 1970-June 1972

University of Louisville Water Resources Laboratory
Louisville, Kentucky

The work on which this report is based was supported in part by funds
provided by the Office of Water Resources Research, United States
Department of the Interior, as authorized under the Water Resources

November 1973
ABSTRACT

Samples of water, bottom fauna, and fishes were collected from 66 stations in the Salt River and one of its principal tributaries, the Beech Fork and its tributary, the Chaplin River, Kentucky. Precipitation ranged from 38.86 inches (1969) to 58.04 inches (1970), an increase of nearly 50 percent with marked fluctuations in discharge. Intensive comparisons of phosphates, sulfates, specific conductance, total alkalinity, total hardness, and turbidity showed the streams to be relatively clean and healthy. Nearly 300 different kinds of benthic organisms and other macroinvertebrates have been collected and identified from the basin. Detailed studies of caddisflies and stream drift are under way along with the development of computer programs for diversity indices of the various organisms. Twenty-eight species of bivalve mussels and representatives of six genera of snails have been collected including the Asiatic clam Corbicula mulleri. Among the vertebrates, 60 species of fishes have been collected and identified along with 22 amphibians and 21 reptiles. Nearly 150 species of birds have been identified in the area.

An economic study of Spencer County revealed that there has been a decrease in the human population along with a general decline in the overall economic picture of the county as indicated by a retarded rate of growth in annual per capita income and a decline in total retail sales within the county over the past decade. The highway system in the county consists of largely Class 4, 5, and 6 roads which, because
of the topography, are generally narrow, crooked, and hilly. However, Spencer County is almost completely encircled by interstate highways within ten miles of its borders.

KEY WORDS: Aquatic habitats, Limnology, Water quality, Environmental effects, Natural resources, Benefits, Planning, Populations, Social adjustment, Economics.
ACKNOWLEDGMENTS

We are most grateful to our graduate students Edmond Bacon, John Baker, Patty Breene, Daryl Jennings, Andrew Miller, Reba Page, Jerry Parsons, Vincent Resh, and David White, and to undergraduates Erika Abner, Kim Haag, Tom Weber, and Bruce Wilson for their assistance in the field and in the laboratory, particularly in collecting and analyzing water samples. For their aid in gathering and analyzing data for the economic phase of the study, we are most grateful to Professor Carl E. Abner and Messrs. Tom Friedlob, William Hord, and Jeffrey Horen. Also, we deeply appreciate the assistance of Shirley Viers, Sharon Pierce, and Patty Vick for the many ways in which they helped, especially in compiling data and typing reports. We are especially grateful to Dr. Robert D. Hoyt, Western Kentucky University, for his invaluable help in collecting, sorting, and identifying fishes and for assistance in the field and in the laboratory.

The following persons from the Neighborhood Youth Corps Summer Programs assisted in the laboratory and field during the summer: Gregory Berry, Marilyn Glenn, Darrell Griffith, Denise Harlan, Michael Jackson, Judy Kinnison, Roosevelt Meyers, Phillip Shoulders, Janet Slack, and George Todd, Jr. We are grateful to the Office of Economic Opportunity for sponsoring these students.

This study could not have been undertaken without the cooperation and financial assistance of the U.S. Department of the Interior, Office of Water Resources Research, afforded through the Water Resources Institute of the University of Kentucky. We extend our gratitude to Dr. Robert A. Lauderdale, Director of the Institute.
INTRODUCTION

The work reported here is an extension of that reported in Project Nos. B-005-KY and B-016-KY for the period from 1 July 1968 through 30 June 1971 (Krumholz 1971, and Krumholz and Neff 1972). In the original proposal for the study of the Salt River basin, it was stated that the U.S. Army Corps of Engineers had planned to impound the main stem of the Salt River about 3 miles upstream from Taylorsville and the Beech Fork about 1 mile upstream from Maud, Kentucky (Fig. 1). Since that time there has been a modification of the program because of incompatibility in the requirements of the Corps with those allowable within the Constitution of the Commonwealth of Kentucky. As a result the construction of the dam for Taylorsville Lake has been postponed until those differences can be ironed out. A further complication resulted from the President's veto of the Omnibus Bill for Public Works on Rivers and Harbors late in 1972.

This study includes data from the main stem of the Salt River as well as from the Beech Fork and its principal tributary, the Chaplin River. In addition, an intensive study has been made of the water chemistry and bottom fauna of Brashears Creek, a principal tributary that enters the Salt Fork at Taylorsville (Woodling 1971). With this background, we undertook to continue to amplify the Salt River Project with the following objectives in mind: 1) to assess the ecological conditions in the areas of the Salt River, Kentucky, which will be subsequently impounded. Physical, chemical, and biological data will be gathered regularly to obtain a baseline, preimpoundment evaluation of conditions. These data will permit an appraisal of changes in the
Fig. 1. Drainage area of the Salt River, Kentucky, showing the principal tributaries and the proposed sites for reservoirs, along with the principal cities and towns. The plans for the Howardstown Reservoir have been set aside for the time being.
water quality and biota of the river following impoundment; 2) to de-
determine the economic status of the urban and agricultural areas of the
Salt River Basin in order to assess the effects of dam construction,
river impoundment, and the changes that occur in the economic and
political structure of the communities in the basin following impound-
ment; 3) to assess the sociological status and attitudes of persons
living in the area and to ascertain their attitudes toward being dis-
placed from their present homes and the adjustments necessary in main-
taining their present status in a new and quite different location.
The third objective listed above has been undertaken by personnel at
the University of Kentucky and their findings will not be included here.

METHODS

Physical and chemical parameters of the waters in the Salt River
and its tributaries were measured according to accepted limnological
procedures. Temperatures were measured with calibrated mercury stem
thermometers and with the thermistor element of a Yellow Springs Model
54 Oxygen Meter. Readings for dissolved oxygen were taken with the
same meter and checked against a standard determined by the Alsterberg
modification of the Winkler method. Total hardness and alkalinity
were determined following procedures described in the 13th Edition of
Standard Methods for Examination of Water and Wastewater (Taras et al.
1971). Alkalinitities were determined also using a Corning Model 10 pH
meter. Major anions were determined using accepted wet chemistry pro-
cedures with colorimetric analyses in a Bausch and Lomb Spectronic 20
spectrophotometer. Major cations were determined with a Perkin-Elmer
Model 303 atomic absorption spectrophotometer.
Benthic samples were collected with Surber samplers, nets, and dredges in an effort to obtain qualitative information as well as sound data on the relative abundance and distribution of the various organisms. Such samples were preserved in ethanol and returned to the laboratory for sorting, identification, and counting. Fishes were collected by electroshocking, netting, seining, and with chemicals. Fishes were fixed in formalin, returned to the laboratory, sorted, identified, weighed, and preserved in ethanol. Whenever possible the stations were visited on several occasions so that any seasonal changes in the various elements of the flora and fauna could be documented. While in the field, records were kept of all amphibians, reptiles, and birds seen in the study area. Preliminary and partial lists of algae, vascular plants, benthic arthropods, and fishes taken from the Salt River or observed in the watershed were provided in the Completion Report for Project B-005-KY (Krumholz 1971) and an annotated list of the fishes was published in the open literature (Hoyt, Neff, and Krumholz 1970). A preliminary list of birds seen in the area was provided in the Completion Report for Project No. B-016-KY (Krumholz and Neff 1972). Included in this report are preliminary lists of aquatic mollusks, amphibians and reptiles, and a more complete list of aquatic bottom organisms. For the fishes, only those species that have been collected from the Salt River, the Beech Fork, and the Chaplin River during Fiscal Years 1971 and 1972 will be listed here. Upon completion of the preimpoundment phase of this study, complete lists of the flora and fauna for the Salt River Basin will be compiled.

Data for the detailed study of the economic base of Spencer County were gathered from professional real estate agents, county tax records,
land owners and tenants, soil conservationists, bankers, and private citizens. Photostatic copies of all plats of land in Spencer County were made and used in studying the relation of proximity to the proposed Taylorsville Lake with any increase in value. Additional data were obtained from the Office of Development Services and Business Research of the University of Kentucky, and from the Kentucky Department of Commerce Handbooks of Kentucky Economic Statistics and Industrial Resources. Other data were supplied by the U.S. Bureau of the Census and by the Office of the County Clerk of Spencer County.

DESCRIPTION OF THE STUDY AREA

The study area under consideration has been described in detail in the Completion Reports for Project Nos. B-005-KY and B-016-KY for the periods 1 July 1968 through 30 June 1969 and 1 July 1969 through 30 June 1971, respectively. Similarly, the permanent collecting stations in the Salt River and its principal tributaries were described in those reports.

Since the areas in the Salt River and its tributaries to be impounded for Taylorsville Lake have been described in previous completion reports (Krumholz 1971, Krumholz and Neff 1972), those descriptions will not be repeated here. However, the areas to be impounded for Camp Ground Lake on the Beech Fork have not been described. The Beech Fork and its principal tributary, the Chaplin River, lie directly south of the proposed Taylorsville Lake and drain portions of Anderson, Boyle, Marion, Mercer, Nelson, and Washington counties (Fig. 1). The dam for Camp Ground Lake is scheduled to be placed just upstream from the town of Maud on the main stem of the Beech Fork about 0.75 mile downstream from the confluence of the Chaplin River with the Beech
Fork with the Rolling Fork. That dam will impound an area of about 5,000 acres in Washington, Nelson, and Anderson counties at seasonal pool and will affect about 22 miles of the Beech Fork and about 45 miles of the Chaplin River.

The Beech Fork rises on west central Boyle County and flows in a generally northwesterly direction for about 60 miles through Marion and Washington counties to where it is joined by the Chaplin River at the Nelson-Washington County line about 6 miles southeast of the town of Bloomfield. From that point it flows in a southwesterly direction forming the boundary between Nelson and Washington counties to the site where it is joined by Hardin Creek. It then flows in a generally westerly course forming the boundary between Nelson and Marion counties to its confluence with the Rolling Fork. The principal tributaries to the Beech Fork, in addition to the Chaplin River, are Long Lick Creek, Mays Creek, Panther Creek, and Pleasant Run. Of those, only portions of Long Lick and Mays creeks will be impounded.

The Chaplin River drains more than twice the area drained by the Beech Fork upstream from the damsite. The Chaplin River rises in central Boyle County about 2 miles west of the source of the Salt River (Fig. 1) and about 5 miles east of the source of the Beech Fork. It flows generally northward for about 50 miles through Boyle and Mercer counties in a quite tortuous channel and then turns westward and southwestward to its union with the Beech Fork. Over the last third of its course, the Chaplin River provides about 25 miles of the boundary between Nelson and Washington counties, and together with its tributaries forms about 20 miles of the boundary between Anderson and Washington
counties. The principal tributaries to the Chaplin River are Beaver Creek, Glens Creek, Sulphur Creek, and Thompson Creek with lesser tributaries of Deep Creek, Doctors Fork, Beech Creek, and Chaplin Creek near the source. Of these, portions of Beaver Creek, Glens Creek, Sulphur Creek, and Thompson Creek will be impounded.

The general aspect of the terrain of the Beech Fork and Chaplin River drainages, and especially the area surrounding the proposed Camp Ground Lake, is quite different than that of the Salt River and Taylorsville Lake. In the area to be impounded, the Beech Fork and Chaplin River flow through much hillier country than does the Salt River. In addition, the stream channels are much narrower and the banks generally steeper. As a result, the shoreline of Camp Ground Lake will be much longer than that of Taylorsville Lake and the outline of the lake will be much more dendritic. Much of the immediate watershed is wooded and there is considerably less fertile bottomland than in the area to be impounded for Taylorsville Lake.

The following stations (Fig. 2) have been established on the Beech Fork and the Chaplin River as collecting sites for water samples, fishes, and invertebrates. For ease in distinguishing these stations from others described in earlier reports, those on the Beech Fork and its tributaries will be designated with a "B" whereas those on the Chaplin River and its tributaries will be designated with a "C".

**Beech Fork**

*Station Bl.* On Beech Fork at Tick Creek, Washington County. The bottom is gravel and mud with deep mud in Tick Creek. The stream is 10-25 ft wide in this area.
Fig. 2. The Salt River, Beech Fork, and Chaplin River showing the locations of the principal collecting sites for water samples, bottom fauna, and fishes.
Station B2. On Beech Fork, 2 miles south of Thompsonville, Washington County, off Highway 152 about 0.2 mile downstream from the gaging station at the mouth of Pleasant Run. The bottom is gravel and mud and the stream is about 15 ft wide.

Station B3. On Beech Fork, 3 miles north of Springfield, Washington County, at the bridge for State Highway 53. The stream in this area is about 50 ft wide and consists of pools and riffles with gravel and rubble on the bottom.

Station B4. On Beech Fork at Litsey, Washington County, at the bridge for State Highway 438. This portion of the stream has a bedrock bottom with some gravel and silt and is about 80 ft wide.

Station B5. On Beech Fork about 2 miles east southeast of Hardesty, Washington County, at the bridge for State Highway 438. Here, the stream is 25-40 ft wide and the bottom is gravel and rubble.

Station B6. On Beech Fork at Steep Hollow Branch about 3 miles east of Mooresville, Washington County. In this area, the stream is 40-60 ft wide with a bedrock bottom covered with gravel and mud.

Station B7. On Beech Fork at the covered bridge about 2 miles north of Mooresville, Washington County, on Highway 431. The stream is 30-60 ft wide with large rocks and rubble on the bottom.

Station B8. On Beech Fork at Walkers Chapel about a mile north of the town of Maud at the bridge for State Highway 55. Here, the stream forms the boundary between Nelson and Washington counties. The stream is about 75 ft wide, the banks are steep and muddy, and there are deep pools with several chutes and riffles. The bottom is covered with large rocks and rubble.
Station B9. On Cartwright Creek, a tributary to Beech Fork several miles downstream from the proposed dam site. A sampling station has been established on Cartwright Creek at the ford off Highway 150 about 2 miles east of Fredericktown to serve as a comparison following impoundment of Camp Ground Lake. The stream is about 40 ft wide with sand and gravel bottom.

Station B10. On Long Lick Creek at bridge for Highway 438 between Polin and Hardesty, Washington County. The stream is about 10 ft wide with sand and gravel bottom.

Station B11. On Long Lick Creek 2.5 miles southwest of Willisburg, Washington County, at bridge for Highway 53. The stream is about 10 ft wide with a sand and gravel bottom.

Chaplin River

Station C1. On Chaplin River at the mouth of Buck Creek, about 1.5 miles south of Perryville, Boyle County. The river is about 25 ft wide and the bottom is bedrock with silt in the still areas.

Station C2. On Chaplin River a half mile north of Perryville, Boyle County, just off Highway 442. The bottom is gravel and rubble with mud in the pools. The stream is 20-30 ft wide.

Station C3. On Chaplin River at the ford a half mile above the confluence of Doctors Fork and 1.5 miles west of State Highway 68, Boyle County. The bottom is bedrock and gravel and the stream is 20-30 ft wide.

Station C4. On Chaplin River at bridge for State Highway 1941, near the confluence of Fallis Run and about 1.5 miles west of Dixville,
Mercer County. The stream is 15-30 ft wide and the bottom is largely gravel with some silt in the pools.

Station C5. On Chaplin River about 7 miles west of Harrodsburg, Mercer County, at the bridge for State Highway 152. The banks of the stream are steep and muddy and the bottom is muddy with some large rocks. The stream is about 50 ft wide.

Station C6. On Chaplin River at the bridge about 1.5 miles east southeast of Cornishville, Mercer County. The stream is about 50 ft wide and the bottom is very rocky with some very large stones.

Station C7. On Chaplin River off State Highway 1941 about half mile southeast of Grapevine Church, Mercer County. The bottom is bedrock with some gravel and mud and the stream is about 50 ft wide.

Station C8. On Chaplin River at the bridge near Pinkston School about a mile southwest of Talow, Washington County. The stream ranges from 25 to 75 ft wide and the bottom is bedrock with gravel and some silt.

Station C9. On Chaplin River about half mile east of Sharpsville, Washington County, at the confluence of Traces Creek. The stream is 60-80 ft wide and the bottom is almost entirely gravel.

Station C10. On Chaplin River about a quarter mile below the bridge at Tatham Springs, Washington County, just upstream from the confluence of Glens Creek. The width of the stream ranges from 10 to 90 ft and the bottom is gravel with no silt.

Station C11. On Chaplin River off Love Ridge at the confluence of Beaver Creek on the Nelson-Washington County boundary. The stream is 25-75 ft wide and the bottom is gravel with some rubble and mud.

Station C12. On Chaplin River at the bridge for State Highway 1754 about 1.5 miles east of Chaplin, on the Washington-Nelson County line. The stream is 10-50 ft wide and the bottom is gravel and rubble with accumulations of silt in the pools.
Station Cl3. On Chaplin River at the confluence of McCan Branch about 2 miles south southeast of Chaplin on the Washington-Nelson County line. The stream is 30-60 ft wide and the bottom is largely gravel with large rocks in the pools.

Station Cl4. On Chaplin River at the site of the covered bridge on State Highway 431 about 1.5 miles south of Chaplin, Washington-Nelson County line, near the mouth of Jessie Run. The bridge was destroyed by fire in 1971 and the stream was diverted and changed by construction of a new bridge. The bottom is bedrock with gravel and the stream is 10-75 ft wide.

Station Cl5. On Beaver Creek, Anderson County, about 1 mile west southwest of Search School at the bridge where Leathers Road crosses the stream. The stream is about 15-18 ft wide with some sand, gravel, and silt on the bottom.

Station Cl6. On Beaver Creek, Anderson County, 0.5 mile south southeast of Searcy School at bridge where Searcy School Road crosses the stream. The stream is about 15 ft wide with sand and gravel bottom.

Station Cl7. On Sulphur Creek at the bridge for Highway 53 on the Anderson-Washington County line, about 0.5 mile north of Kirkland School. The stream is 10-15 ft wide and the bottom is gravelly with some silt in the quiet areas.

Station Cl8. On Thompson Creek, Mercer County, about 0.5 mile east southeast of Duncan and about 0.5 mile above the mouth of Indian Creek. The stream is about 10-12 ft wide with rocky bottom and some sand and silt in the slack water.
PHYSICAL AND CHEMICAL CHARACTERISTICS OF SALT RIVER

Accepted limnological methods, as described in earlier reports (see Krumholz 1971, Krumholz and Neff 1972), were used throughout the study.

Information gathered during this study period confirmed our earlier reports that the Salt River and its tributaries upstream from the proposed Taylorsville Lake is a reasonably clean, healthy stream. There appear to be only two major sources of pollution, the outfall from the sewage disposal plant at Harrodsburg, about 70 miles above the proposed damsite, and the outfall from the sewage disposal plant at Lawrenceburg which empties into Hammonds Creek, which in turn empties into Salt River about 30 miles upstream from the damsite.

In this report, the discussion is concerned primarily with measurements of selected chemical parameters at 10 sampling stations during 1969 and 1970. These data are taken from information to be used as partial fulfillment of the requirements for the degree of Master of Science in Biology by Jerry S. Parsons. Ten stations that bracketed the proposed seasonal pool, and that included 7 stations within the confines of that pool, were selected for intensive study. Those stations were Nos. 14, 15, 16, 17, 18, 20, 23, 26, 24, and 35 (Fig. 2). Of those within the pool, Stations 15, 16, 17, 18, and 20 are in the mainstem of the Salt River and Stations 34 and 35 are on Beech Creek and Little Beech Creek, respectively. Station 14 is upstream from the seasonal pool, Station 23 is downstream from the dam-
site, and Station 26 is on Brashears Creek.

Station 17, at Goodnight Bridge in western Anderson County, was chosen as an index station because the U.S. Geological Survey maintains a permanent water stage recorder there and thus provides daily records of stream discharge. It is important to point out here that that is the only point within the study where such a gage is located.

Stream Discharge

During 1969 and 1970, there were extreme differences in annual precipitation (U.S. Department of Commerce, 1969, 1970). In 1969, the total precipitation recorded at Taylorsville was 38.86 inches, whereas in 1970 the total precipitation at the same station was 58.04 inches, an increase of 49.4 percent that amounted to 900 million cubic feet (6.7 billion gallons) of additional water available to the study area in 1970 over that in 1969. U.S. Geological Survey records (1969, 1970) show an increase in discharge of 82 percent at Goodnight Bridge as against the 49.4 percent increase in precipitation. It is reasonable to expect that, on an annual basis, about a third of the precipitation will become runoff to be measured as discharge in streams. If that figure is assumed, there was a volume increase of 300 million more cubic feet of water in 1970 than in 1969, as shown by the U.S. Geological Survey records. It is noted here that the annual precipitation in 1970 was sufficient to raise the 32-year average discharge of the Salt River at Goodnight Bridge from 236 to 237 cubic feet per second. As a result of the increased rainfall in 1970, there was a marked increase in the lushness of the vegetation over previous years.
Because of the generally impervious nature of the Eden Shale that underlies much of the basin, runoff is rapid. The streams rise very suddenly following spates and fall almost as rapidly. On one occasion, workers in the field noted an increase in depth of the Salt River of about a foot in slightly more than a half hour. That level dropped almost as rapidly when the rain stopped. Accordingly, discharges are positively correlated with rainfall, as the rainfall increases, the discharge increases, and the response to rainfall is very rapid.

Variation in Selected Chemical Parameters

A principal tenet in the study of streams is the inverse relationship between discharge and concentrations of dissolved and suspended materials. In relatively closed systems of uniform stratigraphy and composition, the relationship holds quite closely as in Durum's (1953) mirror-image curves of daily discharge and specific conductance in the Saline River in Kansas. Unfortunately, the Salt River does not follow that rule so precisely. Although many chemical and physical parameters were measured, only 6 were selected for intensive comparisons throughout the stream. They are phosphate (PO$_4$ in mg/l), sulfate (SO$_4$ in mg/l), specific conductance (in µmhos/cm), total alkalinity (in mg/l as CaCO$_3$), total hardness (in mg/l as CaCO$_3$), and turbidity (in mg/l as SiO$_2$). These parameters were chosen on the basis of the numbers of samples available for statistical analysis and on the dependability of the analytical techniques used. The data from each of the other stations under consideration were compared with those of Station 17, and there were no significant differences
at the 0.05 level, although there were some variations among the differ­
ent parameters (Table 1). Such variation probably is normal since the
point sampling error may be great even though at least 3 stations were
sampled in a single day and the discharge rates at Station 17 were applied
to all stations upstream and downstream from the point at which the dis­
charge was measured. These data are useful in showing trends in the water
quality and should hold under similar conditions.

There is a strong positive correlation between turbidity and dis­
charge. This is as it should be since the carrying capacity of the stream
is a direct function of its rate of flow. Accordingly, in the Salt River,
the load of suspended material may be expected to increase proportionately
with discharge.

With each of the other 5 parameters, there were negative correlations
although they were not as strongly negative as might have been expected
when compared with Durum's (1953) results. With total hardness and total
alkalinity, correlation coefficients were approximately -0.5. In these
parameters, concentrations may be expected to be modified inversely with
discharge since they are influenced by the type of substrate and dissolved
gases, but it is unlikely that there is any direct causal relationship.

There were much stronger correlations between hardness and alkalinity with
temperature than with discharge, and the relationships correspond more
closely with seasonal changes than with actual temperature. The solubility
of carbon dioxide is inversely proportional to the temperature of the water,
but it is also evolved in such organic processes as aerobic and anaerobic
respiration which take place in direct proportion to temperature and also
are influenced by diurnal changes in light intensity. These reactions aid
in governing the buffering capacity of the water and hence affect the alka-
Table 1. Group comparison of six parameters between Station 17 and nine other stations in Salt River, 1969-1970.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Calculated t value</th>
<th>Degrees of Freedom</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfates</td>
<td>1.27</td>
<td>135</td>
<td>.20</td>
</tr>
<tr>
<td>Phosphates</td>
<td>0.457</td>
<td>203</td>
<td>.70</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>0.799</td>
<td>210</td>
<td>.50</td>
</tr>
<tr>
<td>Hardness</td>
<td>1.56</td>
<td>197</td>
<td>.20</td>
</tr>
<tr>
<td>Specific conductance</td>
<td>1.12</td>
<td>167</td>
<td>.25</td>
</tr>
<tr>
<td>Turbidity</td>
<td>0.166</td>
<td>150</td>
<td>.85</td>
</tr>
</tbody>
</table>
linity and hardness of the water. Contributions from photosynthesis as well as from the decomposition of leaf fall from riparian vegetation as shown by Liston (Krumholz 1973) play important roles in the contribution of carbon dioxide to the stream ecosystem. Maximum concentrations of alkalinity and hardness occur in the fall with decreased consumption of carbon dioxide in photosynthesis, increased breakdown of allochthonous organic materials, and decreasing temperatures. Another peak occurs in spring when temperatures rise and respiration increases. Minima are reached during late summer when photosynthesis reaches its peak and organic decomposition has fallen off because of a lack of dead organic material. In essence, alkalinity and hardness and their accompanying carbon dioxide relations are influenced greatly by biotic factors that in turn respond directly to physical factors in the environment.

There was a surprisingly low negative correlation (-0.1) with specific conductance. It appears that there is a dilution effect that probably is influenced by the leaching of electrolytes with increased runoff and flow of groundwater. We believe that electrolyte concentrations and discharge are statistically independent. There was much stronger correlation between specific conductance and temperature than with discharge, but here too the correlation was largely on a seasonal basis. In this respect, the data for specific conductance fitted very well with those for hardness and alkalinity, indicating that the major inorganic salts (calcium and magnesium carbonates and sulfates) are the principal electrolytic components of the system and are basically responsible for specific conductance as well as for alkalinity and hardness.

There was a much better negative correlation between sulfates and temperatures than with discharge. Sulfates increased most rapidly follow-
ing dry, fall weather, probably as an indication of the results of extended periods of bacterial activity involved in the breakdown of organic materials in the soil and in the detritus in the stream, particularly in pools at minimal flow. The relatively slow oxidation of organically bound sulfur to sulfate, and its accumulation in soil and bottom sediments during periods of little rainfall accounts for small surges following light rain showers. Gorham (1961) suggested that winter rains account for much of the sulfate content of fresh waters especially in areas where coal is a principal heating fuel. We believe that sulfate concentrations probably are determined by a combination of bacterial activity and rainfall to produce peaks in late fall and early spring. Apparently, sulfate concentrations are independent of discharge in the study area of the Salt River.

Concentrations of phosphates manifested relatively low to medium negative correlations with temperature on a seasonal basis. Unlike other nutrients, phosphates are stored preferentially by plants in excess of their needs, and are taken up particularly rapidly by algae. Because concentrations appear to be independent of discharge and vary on a seasonal basis, there is the suggestion that the principal source of this anion is allochthonous material, either from riparian leaf fall or from application of agricultural fertilizers to neighboring farmlands. Accumulation in plants usually occurs in spring and summer with release into the stream in fall and winter.

In addition to the 6 parameters discussed above, observations on at least 2 other parameters are of interest here. Nitrate nitrogen reached spring and summer peaks probably because of the applications of agricultural fertilizers, and the relatively high winter values probably are related to the degradation of organic materials. Nitrate to phosphate ratios
averaged about 5 to 1, a rather rich medium expected to be conducive to extensive algal blooms. Since no such blooms were observed in the study area, it must be assumed that neither anion serves as a limiting factor for algae in this portion of the Salt River. In a lentic situation, such as an impoundment, such a ratio would tend to promote eutrophication.

Dissolved oxygen concentrations ranged from about 5 to 15 mg/l with saturation values of about 65 to 125 percent. Periods of supersaturation occurred during active photosynthesis, mostly in warmer parts of the year. The Salt River appears to be quite healthy and typical of clean water streams so far as oxygen concentrations are concerned.
BIOLOGICAL DATA

Plants

No aquatic or terrestrial plants different from those listed in the two previous completion reports (Krumholz 1971, Krumholz and Neff 1972) have been observed during this phase of the study.

Bottom Fauna

Nearly 300 different kinds of benthic organisms and other macroinvertebrates have been collected and identified (see appended list). Among those animals are representatives of 80 families of insects, most of which are aquatic. The purely aquatic forms listed are the Plecoptera (stoneflies), Ephemeroptera (mayflies), Odonata (dragonflies and damselflies), Hemiptera (water bugs), Megaloptera (alderflies), Trichoptera (caddisflies), and Diptera (two-winged flies). Of the Coleoptera, the Ditiscidae, Gyrinidae, Haliplidae, Hydrophilidae, Dryopidae, Psephenidae, and Elmidae are aquatic; the others are terrestrial beetles taken in light traps or drift samples. The only aquatic Lepidoptera (butterflies and moths) taken was Parargyraetis fulicalis. None of the Hymenoptera (ants, bees, wasps) are aquatic.

The list referred to does not include the freshwater sponge Spongilla lacustris, reported previously, or an unidentified bryozoan. Further identifications are in progress.

A detailed study of the life histories of caddisflies of the genus Athripsodes in the Salt River Drainage is under way. Such biological features of the immature stages as food and feeding habits, age and growth, case making, emergence, parasitism, and species interaction have
been analyzed since one of the critical factors in aquatic ecological studies has been a lack of association of immature and adult forms of bottom-dwelling insects (Wiggins 1964). It is our intent to use this information to develop a key to the aquatic stages of the different species of *Athripsodes* throughout eastern North America with annotations of tolerances to changes in water quality and the ability to withstand various degrees of pollution.

*Athripsodes* is one of the largest and most widely distributed genera of caddisflies and among the most frequently encountered by hydrobiologists. It is anticipated that this study, along with the associated rearing techniques developed in this laboratory (Resh 1972), that this genus will become, perhaps, the most readily identifiable of the North American caddisflies. This study is being made by Mr. Resh as partial fulfillment of the requirements of the degree of Doctor of Philosophy.

**Invertebrate Drift**

During this period, intensive sampling of invertebrate drift organisms was started. Much effort was expended in attempting to determine the best methods for delineating the periods of peak drift and the time required to obtain statistically significant data. A total of 60 samples were taken over the entire width of the stream and samples were taken over 13 different 24-hour periods. The numbers of organisms collected in those samples approaches one million and the sorting and identification of those organisms constituted a tremendous task. From these preliminary data it was determined that the greatest numbers of organisms were taken just after sundown, and that samples taken for a few minutes provided a much more reliable indication of a peak than did samples taken for as much as a half hour.
Multiple regressions are being used to determine the independent importance of volume, speed of flow, and depth of water on drift abundance. The data are being computerized with the aid of Fortran IV. It should be pointed out that flash flooding and persistent high water has interfered with sampling on a regular basis. Because of these uncontrolled vagaries, it was decided to test the validity of the sampling procedure on a smaller stream (Brashears Creek). Station 28 was chosen for this test because the streambed is wide and relatively flat so that increased volume of flow will not have as drastic an effect on stream depth as occurs in streams with narrow channels.

Mussels

A preliminary study was made of the relative abundance and species composition of mollusks in Salt River. The appended list includes the names of 28 species of clams and snails referable to 8 families. Of those, members of the freshwater clams (Unionidae) are most abundant. It is of interest to note that the Asiatic clam Corbicula mulleri has been collected at several locations in the Salt River and Beech Fork drainages.

Generally speaking, bivalve mussels prefer a muddy substrate and, to a lesser extent sand and gravel, but they tend to avoid fine silt and shifting sand. In the Salt River drainage, mud bottoms are not common, and sand, gravel, and rocky riffles are much more abundant. Most samples were taken from sites where clams were likely to occur. Although the clams are fairly widespread throughout the drainage, it is important to note that they are absent in the areas below the sewage outfall from Harrodsburg and below the mouth of Hammond Creek which receives the sewage effluent from Lawrenceburg. The most abundant species were the
fat mucket *Lampsilis siliquoidea*, the white heelsplitter *Lasmigona complanta*, the three-ridge *Ambloplites plicata*, and the maple leaf *Quadrula quadrula*, but the fat mucket was more numerous in the collections than the other three combined.

Among the fingernail clams, members of the genus *Musculium* are more abundant than those of *Sphaerium*. Specific identifications of those clams will be forthcoming.

Although representatives of six genera of snails referable to five families have been collected, *Physa integra* is by far the most abundant, and may well make up as much as 90 percent of the total snail population.

**Fishes**

Among the vertebrates, the fishes are by far the most abundant and diverse class. During the two-year period, we collected and identified 60 species of fishes along with at least 3 different kinds of hybrid sunfishes. All fishes collected belong to the Class Osteichthyes (bony fishes) and there are representatives of 7 Orders and 12 Families as follows: Clupeiformes—Clupeidae; Cypriniformes—Cyprinidae, Catostomidae; Siluriformes—Ictaluridae; Atheriniformes—Cyprinodontidae, Atherinidae; and Perciformes—Centrarchidae, Percidae, Sciaenidae, Cottidae. This classification follows that of the American Fisheries Society (1970).

All together there were 70 collections of fishes, 14 from the Salt River, 25 from the Beech Fork, and 31 from the Chaplin River and some of their respective tributaries (Table 2). In those collections there were 4,027 individual fishes that weighed 364,988 grams (804.65 pounds), 9,058 specimens from the Salt River that weighed 182.27 pounds, 19,600 individuals from the Beech Fork that weighed 395.92 pounds, and 11,369 from the Chaplin River that weighed 226.46 pounds.
Table 2. Numbers and weights of fishes taken from various streams and their tributaries in the Salt River Basin of Kentucky, 1971-1972. (Numbers of collections: Salt River, 14; Beech Fork, 25; Chaplin River, 31).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lepisosteus osseus</td>
<td>1</td>
<td>463</td>
<td>1</td>
<td>647</td>
<td>2</td>
<td>1,110</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anguilla rostrata</td>
<td>2</td>
<td>794</td>
<td>2</td>
<td>794</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dorosoma cepedianum</td>
<td>5</td>
<td>725</td>
<td>3</td>
<td>734</td>
<td>7</td>
<td>1,243</td>
<td>15</td>
<td>2,702</td>
</tr>
<tr>
<td>Campostoma anomalum</td>
<td>676</td>
<td>3,996</td>
<td>1,663</td>
<td>9,743</td>
<td>1,425</td>
<td>4,403</td>
<td>3,764</td>
<td>18,142</td>
</tr>
<tr>
<td>Cyprinus carpio</td>
<td>5</td>
<td>3,040</td>
<td>3</td>
<td>687</td>
<td>3</td>
<td>2</td>
<td>11</td>
<td>3,729</td>
</tr>
<tr>
<td>Eriophya buccata</td>
<td>39</td>
<td>57</td>
<td>865</td>
<td>1,914</td>
<td></td>
<td></td>
<td>904</td>
<td>1,971</td>
</tr>
<tr>
<td>Hybopsis amblophes</td>
<td>44</td>
<td>67</td>
<td>3</td>
<td>4</td>
<td>47</td>
<td>71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notropis ardens</td>
<td>433</td>
<td>662</td>
<td>355</td>
<td>583</td>
<td>222</td>
<td>384</td>
<td>1,010</td>
<td>1,629</td>
</tr>
<tr>
<td>Notropis boops</td>
<td>117</td>
<td>195</td>
<td>2</td>
<td>4</td>
<td>64</td>
<td>120</td>
<td>183</td>
<td>319</td>
</tr>
<tr>
<td>Notropis buchanani</td>
<td>9</td>
<td>5</td>
<td>43</td>
<td>29</td>
<td>52</td>
<td>34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notropis cornutus</td>
<td>100</td>
<td>717</td>
<td>2,554</td>
<td>19,073</td>
<td>334</td>
<td>1,335</td>
<td>2,988</td>
<td>21,125</td>
</tr>
<tr>
<td>Notropis photogenes</td>
<td>2</td>
<td>7</td>
<td>73</td>
<td>251</td>
<td>75</td>
<td>258</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notropis spilopterus</td>
<td>198</td>
<td>481</td>
<td>58</td>
<td>106</td>
<td>69</td>
<td>169</td>
<td>325</td>
<td>756</td>
</tr>
<tr>
<td>Notropis stramineus</td>
<td>151</td>
<td>209</td>
<td>801</td>
<td>1,360</td>
<td>53</td>
<td>69</td>
<td>1,005</td>
<td>1,638</td>
</tr>
<tr>
<td>Notropis whipplei</td>
<td>49</td>
<td>167</td>
<td>20</td>
<td>59</td>
<td>30</td>
<td>135</td>
<td>99</td>
<td>361</td>
</tr>
<tr>
<td>Phenacobius mirabilis</td>
<td>8</td>
<td>42</td>
<td>6</td>
<td>28</td>
<td>1</td>
<td>2</td>
<td>15</td>
<td>72</td>
</tr>
<tr>
<td>Pimephales notatus</td>
<td>1,631</td>
<td>2,811</td>
<td>5,026</td>
<td>12,261</td>
<td>1,860</td>
<td>2,331</td>
<td>8,517</td>
<td>17,403</td>
</tr>
<tr>
<td>Pimephales promelas</td>
<td>11</td>
<td>29</td>
<td>3</td>
<td>8</td>
<td>8</td>
<td>18</td>
<td>22</td>
<td>55</td>
</tr>
<tr>
<td>Semotilus atromaculatus</td>
<td>126</td>
<td>268</td>
<td>318</td>
<td>2,979</td>
<td>651</td>
<td>2,914</td>
<td>1,095</td>
<td>6,161</td>
</tr>
<tr>
<td>Carpoides carpio</td>
<td>6</td>
<td>576</td>
<td>6</td>
<td>576</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carpiodes cyprinus</td>
<td>23</td>
<td>2,692</td>
<td>23</td>
<td>2,692</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catostomus commersoni</td>
<td>9</td>
<td>1,507</td>
<td>58</td>
<td>3,936</td>
<td>17</td>
<td>1,939</td>
<td>84</td>
<td>7,382</td>
</tr>
<tr>
<td>Hypentelium nigricans</td>
<td>82</td>
<td>4,834</td>
<td>113</td>
<td>8,805</td>
<td>44</td>
<td>5,488</td>
<td>239</td>
<td>19,127</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------</td>
<td>----------------</td>
<td>----------------</td>
<td>----------------</td>
<td>-------------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td><em>Minytrema melanops</em></td>
<td>5</td>
<td>273</td>
<td>33</td>
<td>7,175</td>
<td>15</td>
<td>2,136</td>
<td>53</td>
<td>9,584</td>
</tr>
<tr>
<td><em>Moxostoma duquesnei</em></td>
<td></td>
<td></td>
<td>1</td>
<td>23</td>
<td></td>
<td></td>
<td>1</td>
<td>23</td>
</tr>
<tr>
<td><em>Moxostoma erythrum</em></td>
<td>48</td>
<td>1,266</td>
<td>26</td>
<td>5,525</td>
<td>140</td>
<td>12,256</td>
<td>214</td>
<td>19,047</td>
</tr>
<tr>
<td><em>Moxostoma macrolepidotum</em></td>
<td></td>
<td></td>
<td>6</td>
<td>1,148</td>
<td>6</td>
<td>1,148</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Ictalurus melas</em></td>
<td>6</td>
<td>361</td>
<td>16</td>
<td>1,282</td>
<td>10</td>
<td>354</td>
<td>32</td>
<td>1,997</td>
</tr>
<tr>
<td><em>Ictalurus natalis</em></td>
<td>62</td>
<td>1,279</td>
<td>29</td>
<td>2,121</td>
<td>66</td>
<td>1,798</td>
<td>157</td>
<td>5,198</td>
</tr>
<tr>
<td><em>Ictalurus nebulosus</em></td>
<td>7</td>
<td>1,409</td>
<td>2</td>
<td>304</td>
<td>7</td>
<td>1,094</td>
<td>16</td>
<td>2,807</td>
</tr>
<tr>
<td><em>Ictalurus punctatus</em></td>
<td>12</td>
<td>269</td>
<td>4</td>
<td>966</td>
<td>14</td>
<td>2,025</td>
<td>30</td>
<td>3,260</td>
</tr>
<tr>
<td><em>Noturus eleutherus</em></td>
<td>16</td>
<td>41</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>41</td>
</tr>
<tr>
<td><em>Noturus flavus</em></td>
<td>126</td>
<td>422</td>
<td>33</td>
<td>46</td>
<td>98</td>
<td>670</td>
<td>257</td>
<td>1,138</td>
</tr>
<tr>
<td><em>Noturus gyrinus</em></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Noturus miurus</em></td>
<td>12</td>
<td>31</td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>13</td>
<td>33</td>
</tr>
<tr>
<td><em>Pylodictis olivaris</em></td>
<td>4</td>
<td>53</td>
<td>1</td>
<td>34</td>
<td>5</td>
<td>1,238</td>
<td>10</td>
<td>1,325</td>
</tr>
<tr>
<td><em>Fundulus catenatus</em></td>
<td></td>
<td></td>
<td>1</td>
<td>25</td>
<td>1</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Fundulus notatus</em></td>
<td>5</td>
<td>8</td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>21</td>
<td>28</td>
</tr>
<tr>
<td><em>Labidesthes sicculus</em></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>12</td>
<td>23</td>
<td>13</td>
<td>25</td>
</tr>
<tr>
<td><em>Ambloplites rupestris</em></td>
<td>82</td>
<td>2,792</td>
<td>1</td>
<td>97</td>
<td></td>
<td></td>
<td>83</td>
<td>2,889</td>
</tr>
<tr>
<td><em>Lepomis cyanellus</em></td>
<td>355</td>
<td>7,213</td>
<td>572</td>
<td>20,440</td>
<td>519</td>
<td>14,297</td>
<td>1,446</td>
<td>41,950</td>
</tr>
<tr>
<td><em>Lepomis humilis</em></td>
<td></td>
<td></td>
<td>2</td>
<td>26</td>
<td>2</td>
<td>26</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Lepomis macrochirus</em></td>
<td>180</td>
<td>3,452</td>
<td>668</td>
<td>5,873</td>
<td>199</td>
<td>2,499</td>
<td>1,047</td>
<td>11,824</td>
</tr>
<tr>
<td><em>Lepomis megalotis</em></td>
<td>1,958</td>
<td>33,731</td>
<td>3,278</td>
<td>52,469</td>
<td>1,481</td>
<td>24,229</td>
<td>6,717</td>
<td>110,429</td>
</tr>
<tr>
<td><em>Lepomis microlophus</em></td>
<td>3</td>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>23</td>
</tr>
<tr>
<td><em>Lepomis x Lepomis hybrids</em></td>
<td>2</td>
<td>95</td>
<td>9</td>
<td>294</td>
<td>10</td>
<td>322</td>
<td>21</td>
<td>711</td>
</tr>
<tr>
<td><em>Micropterus dolomieu</em></td>
<td>15</td>
<td>546</td>
<td>2</td>
<td>414</td>
<td>1</td>
<td>42</td>
<td>18</td>
<td>1,002</td>
</tr>
<tr>
<td>--------------------------</td>
<td>---------</td>
<td>---------</td>
<td>----------------</td>
<td>----------------</td>
<td>--------------------</td>
<td>-------------------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>Micropterus punctulatus</td>
<td>17</td>
<td>154</td>
<td>63</td>
<td>6,391</td>
<td>69</td>
<td>6,129</td>
<td>149</td>
<td>12,674</td>
</tr>
<tr>
<td>Micropterus salmoides</td>
<td>12</td>
<td>816</td>
<td>31</td>
<td>7,102</td>
<td>10</td>
<td>533</td>
<td>53</td>
<td>8,451</td>
</tr>
<tr>
<td>Pomoxis annularis</td>
<td>2</td>
<td>55</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>55</td>
</tr>
<tr>
<td>Etheostoma blennioides</td>
<td>302</td>
<td>914</td>
<td>227</td>
<td>650</td>
<td>148</td>
<td>490</td>
<td>677</td>
<td>2,054</td>
</tr>
<tr>
<td>Etheostoma caeruleum</td>
<td>23</td>
<td>40</td>
<td>129</td>
<td>185</td>
<td>97</td>
<td>170</td>
<td>249</td>
<td>395</td>
</tr>
<tr>
<td>Etheostoma flavellare</td>
<td>1,969</td>
<td>1,952</td>
<td>2,518</td>
<td>1,679</td>
<td>3,407</td>
<td>2,725</td>
<td>7,894</td>
<td>6,356</td>
</tr>
<tr>
<td>Etheostoma nigrum</td>
<td>47</td>
<td>19</td>
<td>33</td>
<td>24</td>
<td>25</td>
<td>18</td>
<td>105</td>
<td>61</td>
</tr>
<tr>
<td>Etheostoma spectabile</td>
<td></td>
<td></td>
<td>9</td>
<td>9</td>
<td>9</td>
<td></td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Etheostoma zonale</td>
<td>54</td>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>54</td>
<td>23</td>
</tr>
<tr>
<td>Percina caprodes</td>
<td>4</td>
<td>74</td>
<td>21</td>
<td>214</td>
<td>42</td>
<td>295</td>
<td>67</td>
<td>583</td>
</tr>
<tr>
<td>Percina maculata</td>
<td>10</td>
<td>21</td>
<td>16</td>
<td>39</td>
<td>19</td>
<td>37</td>
<td>45</td>
<td>97</td>
</tr>
<tr>
<td>Percina phoxocephala</td>
<td>2</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td>16</td>
<td>31</td>
<td>19</td>
<td>40</td>
</tr>
<tr>
<td>Aplodinotus grunniens</td>
<td>5</td>
<td>4,898</td>
<td>2</td>
<td>6,583</td>
<td></td>
<td></td>
<td>7</td>
<td>11,481</td>
</tr>
<tr>
<td>Cottus carolinae</td>
<td>23</td>
<td>55</td>
<td>13</td>
<td>12</td>
<td>36</td>
<td></td>
<td>36</td>
<td>67</td>
</tr>
</tbody>
</table>

**TOTALS**                  | 9,058   | 82,676  | 19,600         | 179,591         | 11,369             | 102,721          | 40,027   | 364,988  |
Of the 60 species of fishes and 3 sunfish hybrids collected, there were 48 species from the Salt River, 45 from Beech Fork, and 50 species from Chaplin River as shown in the attached list. Of those 60 species, 5 were taken only in the Salt River and not in the Beech Fork or Chaplin River, 3 species were taken only in the Beech Fork and not in the Salt River or Chaplin, and 5 species were taken only in the Chaplin River and not in either the Salt River or Beech Fork. Also, from these data it is obvious that 10 species were collected from the Salt River and/or Beech Fork but not from the Chaplin River. Similarly, 12 species were taken from the Beech Fork and/or Chaplin River but not from the Salt River, and 15 species were collected from the Salt River and/or the Chaplin River but not from the Beech Fork.

In earlier accounts (Hoyt et al. 1970, Krumholz 1971), it was reported that 5 additional species were taken from the mainstem of the Salt River and its tributaries, but were not taken during the period encompassed by this study. They are: the skipjack herring *Alosa chrysochloris*, the southern redbelly dace *Chrosomus erythrogaster*, the golden shiner *Notemigonus crysoleucas*, the bigmouth buffalo *Ictiobus cyprinellus*, and the sauger *Stizostedion canadense*. Conversely, during this portion of the study, 13 species were taken that were not reported by Hoyt et al. (1970). They are the American eel *Anguilla rostrata*, the ghost shiner *Notropis buchanani*, the silver shiner *N. photogenis*, the river carpsucker *Carpioodes carpio*, the quillback *C. cyprinus*, the black redhorse *Moxostoma duquesnei*, the shorthead redhorse *M. macrolepidotum*, the mountain madtom *Noturus eleutherus*, the tadpole madtom *N. gyninus*, the flathead catfish *Pylodictis olivaris*, the
northern studfish *Fundulus catenatus*, the orangemouth darter *Etheostoma spectabile*, and the slenderhead darter *Percina phoxocephala*.

In such a series of collections, it is expected that some species will be taken in greater numbers and/or in more collections than others. The most numerous fish in these collections was the bluntnose minnow *Pimephales notatus* (8,517 individuals) and was followed in order by the fantail darter *Etheostoma flabellare* (7,893), the longear sunfish *Lepomis megalotis* (6,717), the stoneroller *Campostoma anomalum* (3,764), the common shiner *Notropis cornutus* (2,988), the green sunfish *Lepomis cyanellus* (1,446), the creek chub *Semotilus atromaculatus* (1,095), the bluegill *Lepomis macrochirus* (1,047), the rosefin shiner *Notropis ardens* (1,010), and the sand shiner *N. stramineus* (1,005). These 10 species made up 88.65 percent of the total numbers collected and 64.71 percent of the total weight.

No single species was taken in all 70 collections, but the bluntnose minnow and the longear sunfish were each taken in 69. Only 9 other species were taken in more than half the collections; they are the green sunfish (62 collections), the stoneroller, the rosefin shiner, the bluegill, and the fantail darter (56), the common shiner (54), the creek chub (41), the spotted bass *Micropterus punctulatus* (38), and the hogsucker *Hypentelium nigricans* (36).

Of the 13 species taken during Fiscal Years 1971 and 1972, but not collected previously, 6 were taken in only 1 collection, 3 were taken in 2, 1 was taken in 4 collections, 1 in 8, and 2 in 9 collections. These are annotated below.

*Anguilla rostrata* (Lesueur) – rare. Two specimens were taken in one collection at the lowermost station on the Beech Fork (Station B8, Fig.
1). These were collected in the same pool with the black redhorse. Both specimens escaped while being transferred to the collecting bucket.

*Notropis buchanani* Meek - rare. Fifty-two specimens were taken in 3 collections from the Beech Fork and 5 collections from the Chaplin River. The ghost shiner is present in the lower reaches of both streams especially where there are riffles and chutes.

*Notropis photogenis* (Cope) - rare. Seventy-five specimens were taken in 2 collections from the Beech Fork and 7 collections from the Chaplin River. The silver shiner was taken in the lower reaches of both streams and 1 tributary.

*Carpiodes carpio* (Rafinesque) - rare. One specimen was taken in a collection from the Salt River at the mouth of Hammond Creek and 5 specimens in a collection from the West Fork of Simpson Creek, a tributary to the Salt River downstream from Taylorsville.

*Carpiodes cyprinus* (Lesueur) - rare. Twenty-three specimens were taken in 2 collections from Cartwright Creek, a tributary to the Salt River about 4 miles downstream from the proposed damsite for Camp Ground Lake.

*Moxostoma duquesnei* (Lesueur) - rare. One specimen of black redhorse was taken at Station B8 (Fig. 1) on the Beech Fork. It was collected at the downstream end of a long, deep pool in which the bottom was slightly silted and with many large rocks.

*Moxostoma macrolepidotum* - rare. Six specimens of shorthead redhorse were taken at 2 locations in the lower Chaplin River. They were collected from long, bedrock-bottomed pools below long narrow chutes.

*Noturus eleutherus* Jordan - rare. Sixteen specimens of mountain madtom were collected at the ford downstream from McBrayer, Anderson County (Station 12, Fig. 1), where the bottom is gravel and rubble.
Noturus gyrinus (Mitchill) - rare. A single specimen of tadpole madtom was collected at Station Cl4 (Fig. 1) on the Chaplin River, where it forms the boundary between Nelson and Washington counties. The stream bottom was bedrock and gravel.

Pylodictis olivaris (Rafinesque) - rare. Ten specimens were taken in 4 collections: 4 specimens in a collection from the Salt River about 15 miles downstream from Taylorsville, 1 individual from the Beech Fork at Station BB (Fig. 1) on separate occasions.

Fundulus catenatus (Storer) - rare. A single specimen of the northern studfish was taken at Station Cl (Fig. 1) within a mile of the source of the Chaplin River. In that area, the creek is intermittent and the fishes were concentrated in small pools below cataracts.

Etheostoma spectabile (Agassiz) - rare. Like the northern studfish, a single specimen of the orangethroat darter was taken at Station Cl (Fig. 1) near the source of the Chaplin River.

Percina phoxocephala (Nelson) - rare. Nineteen specimens of the slenderhead darter were taken in 9 collections: 2 specimens in 1 collection from the Salt River about 15 miles downstream from Taylorsville, 1 specimen from the Beech Fork at Station BB (Fig. 1), and 16 specimens in 7 collections from the lowermost reaches of the Chaplin River. This species was taken near the upper ends of pools below long riffles or chutes in moderately swift current.

Since Taylorsville Lake and Camp Ground Lake will lie in two distinct subdrainages of the Salt River Basin, differences in the fish fauna of the two areas should be pointed out. Using the data from the Salt River reported previously by Hoyt et al. (1970) and Krumholz (1971)
along with those of this report, there are 10 species taken in the
collections from the Salt River but not from the Beech Fork and its
principal tributary, the Chaplin River. They are: *Alosa chrysochloris*,
*Chrosomus erythrogaster*, *Notemigonus crysoleucas*, *Carpiodes carpio*,
*Ictiobus cyprinellus*, *Noturus eleutherus*, *Lepomis microlophus*, *Pomoxis
annularis*, *Etheostoma zona*, and *Stizostedion canadense*. At the same
time, there were 9 species taken from the Beech Fork and Chaplin River
but not from the Salt River, as follows: *Anguilla rostrata*, *Notropis
buchanani*, *Notropis photogenis*, *Carpiodes cyprinus*, *Moxostoma duquesnei*,
*Moxostoma macrolepidotum*, *Noturus gyrinus*, *Fundulus ctenatus*, and
*Etheostoma spectabile*. It is difficult to provide conclusive evidence
of why these differences in the collections have occurred. Samples
were taken at the same time of the year by the same methods and with
the same gear by the same persons. In some instances, samples from
the two subdrainages were taken on the same day by the same crew. Per­
haps the most reasonable explanation, as well as the simplest, is that
the fishes not collected didn’t happen to be in the locality sampled
when the collection was made. In spite of these differences in species
composition in the samples collected from the different streams and
their tributaries, it is likely that each species listed in Table 2
and probably other species as well, are present in at least limited
numbers at some location in each of the stream systems.

Average estimates for standing crops of fishes from the main stems
of the Beech Fork and Chaplin River are about 32 and 37 pounds per acre,
respectively, compared with an average of about 90 pounds per acre for
the Salt River (Hoyt et al. 1970). As in the Salt River, the standing
crops were not the same in all parts of the streams. In the tributaries
to the Beech Fork and Chaplin River, the standing crops averaged about 20 pounds per acre. In the mainstem of the Beech Fork, the standing crops ranged from 2.4 to 107.6 pounds per acre, while in the Chaplin River they ranged from 4.9 to 178.0 pounds per acre. These figures fall in line with those reported by Hoyt et al. (1970) for the Salt River where the estimates ranged from 4.7 to 217.8 pounds per acre. In all streams, the conditions of the stream and the method of sampling have a profound effect on the kind and numbers of fishes taken in a collection. The greatest numbers collected usually followed treatment with chemicals that were not selective or when the discharges were very low and the fishes were concentrated in isolated pools.

**Amphibians and Reptiles**

Although no special effort was expended, 43 specimens of amphibians and reptiles were collected during routine field trips: 5 ambystomatid, 7 plethodontid, and 1 proteid salamanders; 4 ranid and 3 hylid frogs; 2 toads; 2 chelydrid, 4 emydid, and 2 trionychid turtles; 1 iguanid and 1 scinicid lizard; and 10 colubrid snakes and 1 viper (see attached list). Of these, the most common along the banks of the streams were the frogs, particularly the cricket frog, although the bullfrog was fairly common throughout the stream system. The commonest toad is Fowler's toad. Painted turtles were common in most areas, particularly where there were long, slowly moving pools, and snapping turtles and softshell turtles were seen occasionally. Box turtles were common in the fields and were seen frequently crossing roads. The queen snake was the most frequently seen snake, along with an occasional water snake. Other snakes were seen in the fields and on the highways.
Birds

An additional 45 species of birds have been added to the list of 100 included in the report by Krumholz and Neff (1972), making a total of 145 species observed in the Salt River area. The additional species are included at the end of this report. In all probability, other species will be added in future years of study. Nomenclature follows Mengel (1965).

Computer Analysis

Extensive computer analysis has been used in an attempt to better analyze the potential use of the data from both the fish and benthic collections. A computer model for single species production and population dynamics has been developed based on estimates of standing crop from over 1700 square meter samples from the Salt River drainage. The unique biological features of the animal chosen for this work, *Athripsodes anaylus*, suggests that the variation of population and production based on habitat and substrate in this model, may typify that of a secondary producer. The analysis of physical factors in this model such as substrate size, current and water depth are exceptionally valuable in a preimpoundment survey.

For each of the 116 fish collections from the Salt River, the following measures of community organization and interrelationship of species were made for both numbers and biomass: species diversity Peilou (1966), theoretical maximum diversity, theoretical minimum diversity, redundancy (Wilhm and Dorris 1968) and Margalef's diversity (Margalef 1958). These are widely used measures of the biological assessment of water quality. Produced moment and canonical correlations of these indices and other population and standing crop parameters show extremely high significance levels ($\alpha = .01$). The potential use of these
diversity measures as predictors of fish production is currently being examined. Preliminary results indicate that a mathematic quality-quantity relationship, such as species diversity, may prove to be a valuable intermediate in predicting the relationship between number of species, number of individuals and fish production yield in pounds per acre.
ECONOMIC BASE STUDY OF SPENCER COUNTY

During the study period we completed a detailed study of the economic base of Spencer County, Kentucky, which included gathering and compiling data on (1) the population of the county including employment and income, (2) the extent of retail trade and selected services, (3) the transportation network, and (4) the values of various parcels of land.

In 1970, the population of Spencer County was 5,488 persons, a decrease of 192 (3.4%) from 1960 (Table 3), and was the only county, when compared with its contiguous counties, to show such a decrease. This is rather remarkable in light of the 14.4 percent growth in the surrounding counties. The rather phenomenal growth in Bullitt County (65.9%) may be accounted for by its proximity to Louisville and the tendency toward suburban living. The decrease in population of Spencer County since 1960 is likely due primarily to the lack of diversification in the local economy which has not afforded broad opportunities of the younger people. As a result, they have sought employment outside the county. This situation is particularly evident among the young males, many of whom leave the county shortly after finishing high school. This is borne out by the census data for 1970 which shows that 52.1 percent of the population under 20 years of age was males whereas between the ages of 20 and 24, inclusive, only 46.3 was males. The average for the entire population of the county was 50.7 percent males. Of equally great importance, however, was the fact that less than 10 percent of the entire county population consisted of young men and young women between the ages of 18 and 25.

Of the entire population of Spencer County there were 243 blacks (4.4%) and a single other nonwhite (Table 4). For the population of the entire area contiguous to and including Spencer County, which included
Table 3. Populations of Spencer County, Kentucky, and the counties contiguous to it based on the 1960 and 1970 censuses, showing the percentage changes during that decade. Data from U.S. Department of Commerce, Bureau of the Census.

<table>
<thead>
<tr>
<th>County</th>
<th>1960</th>
<th>1970</th>
<th>Percentage change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spencer</td>
<td>5,680</td>
<td>5,488</td>
<td>-3.4</td>
</tr>
<tr>
<td>Anderson</td>
<td>8,618</td>
<td>9,358</td>
<td>8.6</td>
</tr>
<tr>
<td>Bullitt</td>
<td>15,726</td>
<td>26,090</td>
<td>65.0</td>
</tr>
<tr>
<td>Jefferson</td>
<td>610,947</td>
<td>695,055</td>
<td>13.8</td>
</tr>
<tr>
<td>Nelson</td>
<td>22,168</td>
<td>23,477</td>
<td>5.9</td>
</tr>
<tr>
<td>Shelby</td>
<td>18,493</td>
<td>18,999</td>
<td>2.7</td>
</tr>
<tr>
<td>Total</td>
<td>681,632</td>
<td>778,467</td>
<td>14.2</td>
</tr>
</tbody>
</table>
Table 4. Populations of Whites, blacks, and others in Spencer County, Kentucky, and the counties contiguous to it based on the 1970 census. The figures in parentheses are percentages. Data from U.S. Department of Commerce, Bureau of the Census.

<table>
<thead>
<tr>
<th>County</th>
<th>White</th>
<th>Black</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spencer</td>
<td>5,244 (95.6)</td>
<td>243 (4.4)</td>
<td>1 (0)</td>
</tr>
<tr>
<td>Anderson</td>
<td>8,895 (95.1)</td>
<td>450 (4.8)</td>
<td>13 (0.1)</td>
</tr>
<tr>
<td>Bullitt</td>
<td>25,644 (98.3)</td>
<td>435 (1.6)</td>
<td>11 (0.1)</td>
</tr>
<tr>
<td>Jefferson</td>
<td>597,735 (86.0)</td>
<td>95,762 (13.8)</td>
<td>1,558 (0.2)</td>
</tr>
<tr>
<td>Nelson</td>
<td>21,646 (92.2)</td>
<td>1,804 (7.7)</td>
<td>27 (0.1)</td>
</tr>
<tr>
<td>Shelby</td>
<td>16,555 (87.1)</td>
<td>2,423 (12.8)</td>
<td>21 (0.1)</td>
</tr>
<tr>
<td>Total</td>
<td>675,719 (86.8)</td>
<td>101,117 (13.0)</td>
<td>1,631 (0.2)</td>
</tr>
</tbody>
</table>
778,467 persons (Table 3), there were 101,117 blacks (13.0%) and 1,631 other nonwhites (2.1%), most of whom (12.3% blacks and 2.0% other) lived in Jefferson County in and around Louisville. Thus, only 0.7% of the blacks and 0.1 percent of the other nonwhites lived in the essentially rural counties. From these data, it is obvious that the populations of the area contiguous to Spencer County are dominated by the city of Louisville and Jefferson County.

During 1969, the unemployment rate in Spencer County was 3.3 percent, or 0.3 percent lower than the state average, 1.4 percent lower than that in Bullitt County, and 5.0 percent lower than that in Nelson County. It may appear at first glance that an unemployment rate of 3.3 percent is not an unhealthy economic indicator for Spencer County. However, several factors lead to the conclusion that such is not the case. For example, Spencer County is the only county in the trade area that is almost solely dependent on agriculture, which has the effect of severely limiting the availability of other kinds of employment. Furthermore, although Spencer County has not experienced the trend of consolidation of farms into large "conglomerates," they have turned increasingly to replacing labor with capital equipment thereby reducing the number of jobs available. The low employment rate may be accounted for by (1) the reduction in the size of the overall population which may well have been caused by the lack of opportunities for employment, and (2) approximately 300 members of the labor force (about 16.8%) were employed outside the county, thereby reducing the unemployment rate within the county.

Perhaps the greatest deterrent to employment within Spencer County was the lack of diversification in the local economy. There was essentially no manufacturing of any kind other than in food and kindred products and
the printing and publishing of the local newspaper. All together, those industries employed no more than 25 persons in 1969. In the surrounding counties, on the other hand, particularly in Jefferson County and Louisville, there was great diversification of industry and a wide variety of opportunities for employment.

The average annual per capita income for residents of Spencer County in 1968 was $1,912, $730 less than the average for the Commonwealth of Kentucky and $1,509 less than the national average. The percentage of income from agriculture was greater in Spencer County than in any of the surrounding counties, but this is as expected with the lack of diversification of the economy. Still, the percentage increase in annual per capita income during the immediately preceding decade was lower in Spencer County than in any of the contiguous counties, and was nearly 14 percent less than for the area as a whole during that period (Table 5). This retarded rate of growth in income for the residents of Spencer County is directly attributable to its agriculturally based economy and failure of the county to diversify at the same time its neighbors were doing so.

In recent years there has been a national trend toward an increase in population, a larger disposable income, and more leisure time. This has not been the case in Spencer County, and the plight of the economy is rather indicative of the woes that face the small farmer on a national scale. Farmers in Spencer County have been faced with rapidly rising costs of production coupled with diminishing returns on his investments, and have been forced to spend increasingly greater percentages of their incomes to maintain their living standards.

The retail trade in Spencer County functions almost solely to support county residents. There is essentially no regional interchange even
Table 5. Per capita income for Spencer County, Kentucky, and counties contiguous to it in 1959 and 1968, showing the percentage increases during that period. Data from Office of Development Services and Business Research, University of Kentucky, Lexington, Kentucky.

<table>
<thead>
<tr>
<th>County</th>
<th>1959</th>
<th>1968</th>
<th>Percentage change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spencer</td>
<td>1,259</td>
<td>1,912</td>
<td>51.9</td>
</tr>
<tr>
<td>Anderson</td>
<td>1,319</td>
<td>2,307</td>
<td>74.9</td>
</tr>
<tr>
<td>Bullitt</td>
<td>1,335</td>
<td>2,540</td>
<td>90.3</td>
</tr>
<tr>
<td>Jefferson</td>
<td>2,360</td>
<td>3,588</td>
<td>52.0</td>
</tr>
<tr>
<td>Nelson</td>
<td>1,220</td>
<td>1,946</td>
<td>59.5</td>
</tr>
<tr>
<td>Shelby</td>
<td>1,514</td>
<td>2,664</td>
<td>75.9</td>
</tr>
</tbody>
</table>
though the surrounding counties are more affluent (Table 5). The statistics for retail sales (Table 6) indicate that there was a decrease of 21.8 percent in the dollar volume of sales in the decade immediately preceding the beginning of this study (1968). The only other county in the area to suffer a loss was Anderson County with a decrease of 5.0 percent. Still, the overall gain for the six counties was 52.3 percent. Here, again, the proximity of Bullitt County to suburban Louisville is reflected in the inordinate increase in sales in that county. Again, it should be pointed out that the principal reason for the decrease in Spencer County is the lack of diversification in its economic base.

In considering the different segments of the retail trade during the 1958 to 1967 decade, it is apparent that certain kinds of merchandising, such as the advent of the "big store" and the gradual elimination of the small neighborhood stores, played an important role. There was a decrease in the number of stores handling general merchandise in all counties with the single exception of Bullitt County, where the number remained the same; those decreases were 40.0 percent in Spencer County, 37.5 percent in Anderson, 18.3 percent in Jefferson, 20.0 percent in Nelson, and 7.6 percent in Shelby. Food stores also underwent consolidation, but not to the extent of the general merchandising stores. Those businesses that dealt in building materials, hardware, furniture, and home equipment thrived in the area. This was particularly true in Spencer County where the J.A. Bennett Company in Taylorsville dominated the county largely by underselling its competitors. Dealers in farm equipment also fared well, but as mentioned earlier, that capital investment in machinery led to a decrease in opportunities for employment in Spencer County.

A sort of paradox existed in the sales of automobiles when compared
Table 6. Total retail sales in thousands of dollars in Spencer County, Kentucky, and counties contiguous to it in 1958 and 1967, along with the percentage changes during that period. Data from the U.S. Department of Commerce, Bureau of the Census.

<table>
<thead>
<tr>
<th>County</th>
<th>1958</th>
<th>1967</th>
<th>Percentage change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spencer</td>
<td>5,448</td>
<td>4,259</td>
<td>-21.8</td>
</tr>
<tr>
<td>Anderson</td>
<td>10,065</td>
<td>9,566</td>
<td>-5.0</td>
</tr>
<tr>
<td>Bullitt</td>
<td>7,417</td>
<td>13,218</td>
<td>78.2</td>
</tr>
<tr>
<td>Jefferson</td>
<td>716,827</td>
<td>1,099,218</td>
<td>53.3</td>
</tr>
<tr>
<td>Nelson</td>
<td>15,041</td>
<td>23,242</td>
<td>54.5</td>
</tr>
<tr>
<td>Shelby</td>
<td>18,174</td>
<td>27,794</td>
<td>52.9</td>
</tr>
<tr>
<td>Total</td>
<td>772,972</td>
<td>1,177,297</td>
<td>52.3</td>
</tr>
</tbody>
</table>
with the sales of gasoline and automotive equipment by service stations. Automobile sales were up, but the sale of gasoline declined by about 42 percent during the 1958-1967 decade. The most plausible explanation of this apparent paradox is that persons from outside Spencer County purchased automobiles there, probably because of reduced overhead costs and resultant lowered prices, while the residents of the county, because of their reduced income, bought less gasoline and other automotive supplies.

Spencer County has undergone a healthy growth in the area of selected personal and business services during the 1958-1967 decade with an increase of 36.3 percent in the number of service establishments and a concomitant increase of 68.2 percent in receipts. Although the growth in Spencer County was not as great as that in Anderson, Bullitt, and Nelson counties, it is, nevertheless, significant in light of the marked decrease in the areas of retail and wholesale trade.

Perhaps the most dramatic trend in the economy of Spencer County is the almost total decline in amusement and recreational facilities. The movie theater is closed, and other places of amusement are negligible. There is no hotel or motel facility in or near Taylorsville, nor are there any tourist or camping facilities. Such a decrease in places of amusement and recreation was highly predictable in light of the marked decrease in annual per capita income.

Up to the time of this report there has been little federal highway construction in Spencer County. The only federal highway is U.S. 31E-150, and it extends for 2.4 miles through the extreme southwest corner of the county. That section of highway is classified by the Kentucky Highway Department as a major rural collector. Spencer County lies about 7 miles south of Interstate 64, the principal east-west artery between Louisville
Blue Grass Parkway, a toll road between Lexington and Elizabethtown that connects with Interstate 64 to the east and the Western Kentucky Parkway to the west. About 15 miles west of Spencer County is the Kentucky Turnpike (Interstate 65), the principal north-south artery through Louisville.

The state highway system within Spencer County may be classified into two subsystems: (1) the rural minor arterials and (2) the collector-distributor system. The rural minor arterials provide the fastest movement to the principal points within the county, handle the largest numbers of cars per day, and move those vehicles with greater efficiency than other roads in the county. Those roads are classified as Class 4 roads having an average pavement width of about 20 feet and an average daily traffic volume of fewer than 400 vehicles. There are state highways that provide residents of Taylorsville ready north-south and east-west access to the principal federal highway systems. State Highway 55 connects Taylorsville with Interstate 64 and the Blue Grass Parkway. State Highway 44 allows direct connection with U.S. Highway 31E-150 and Interstate 65, and a few miles east of Taylorsville, State Highway 248 intersects Highway 44, and together the two provide the easterly access to Lawrenceburg, Frankfort, and Lexington.

The second subsystem, the collector-distributor network, collects traffic from minor roads, such as farms and residences, and feeds it into the minor arterials and disperses traffic from the minor arterials to all parts of the county. These roads are classified as Class 5 or Class 6 roads having pavement widths of 18 and 16 feet, respectively, and that are capable of carrying respective traffic volumes of 100-250 and fewer than 100 vehicles daily. In the western part of the county, this system is comprised of State Highways 1319, 1060, and 623 which serve as collectors.
and feeders to Highways 155, 44, and 48, which in turn serve as collector-feeders for the Blue Grass Parkway. Other such highways in the central part of the county are 1169 and 652, which, along with 1066, provide access facilities in that area. In the northeastern part of the county, there are three main collector-distributor routes, Highways 1795, 1416, and 636, which provide access to and from the smaller communities. Of course, there are other lesser roads throughout the county. A good many of the Class 5 and Class 6 roads throughout the county are relatively narrow, hilly, and crooked so that the traffic capabilities are not great. In many places it is virtually impossible to pass a loaded farm vehicle, and when meeting one on the road it may be necessary to pull off to the side to let it pass by. Passing distances usually are not adequate because of the topography of the land and the manner in which the roads were laid out originally.

As mentioned in an earlier report (Krumholz and Neff 1972), 135 farms were selected in different parts of the county from the tax rolls to sample changes in value from January 1966 through July 1969. Each farm was readily accessible to the proposed reservoir and was chosen on the basis that its actual value could be determined. The average values of those lands ranged from $200 to $280 per acre, with the lands northwest of the proposed lake (toward Louisville) having the highest value. Lands with the lowest value were in southeastern Spencer County, the greatest distance from any large center of population. We have gathered information on each parcel of land in Spencer County along with its evaluation in 1970 when the assessments were raised an average of about 15 percent. There is no reason to believe that the values of those lands will change substantially until there is a firm commitment by the U.S. Army Corps of Engineers that the dam will be built and the lake impounded.
Preliminary List of
Bottom Fauna and Macroinvertebrates
of the Salt River Basin

Gordiida species

Oligochaeta
Tubificidae
  Branchiura sowerbyi
  Limnodrilus sp.
  Tubifex sp.

Ostracoda species

Isopoda
Asellota
  Lirceus sp.
  Asellus militaris

Amphipoda
Gammaridae
  Gammarus sp.
  Crangonyx sedactylus
  C. rivularis

Decapoda
  Reptantia
  Orconectes sp.

Hydracarnia
  Sperchon sp.

Plecoptera

Perlidae
  Neoperla olymene
  Perlesta placida
  Acronoera arida

Perlodidae
  Isoperla burksi
  I. clio
  I. nana

Nemouridae
  Allocapnia forbesi
  A. vivipara
  Taeneopteryx parvula
  T. burksi
  Brachyptera fasciata
  Neomoura nigrita
Ephemeroptera

Ephemeraeidae
  *Potamantnthus sp.*
  *Ephoron leukon*
  *Hexagenia sp.*
  *H. limbia*

Caenidae
  *Caenis sp.*
  *C. simulans*
  *C. anceps*
  *C. diminuta*

Ephemerellidae
  *Ephemerella sp.*

Leptophlebiidae
  *Leptophlebia sp.*
  *Paraleptophlebia volitans*

Baetidae
  *Baetis sp.*
  *Isonychia sp.*
  *Pseudocloeon dubium*
  *Neocloeon sp.*
  *N. alemance*

Heptageniidae
  *Stenonema sp.*
  *S. canadense*
  *S. pulchellum*
  *S. nr tripunctatum*
  *S. nr interpunctatum*

Odonata

Arionidae
  *Ayrion sp.*
  *A. aequabile*
  *Argia sp.*
  *A. violacea*

Calopterygidae
  *Calopteryx sp.*
  *C. maculata*
  *Hetaerina sp.*
  *H. americana*

Gomphidae
  *Gomphus sp.*

Lestidae
  *Lestes sp.*
Hemiptera
Corixidae group
*Trichocorixa* sp.

Veliidae
*Rhagouelia* sp.
*R. obesa
Microvelia* sp.

Gerridae
*Trepobates* sp.
*Metrobates* sp.
*Gerris remigis*

Notonectidae
*Notonecta* sp.

Belostomatidae
*Belostoma*

Nepidae
*Nepa apiculata*

Megaloptera
Corydalidae
*Corydalus* sp.
*C. cornutus*

Sialidae
*Sialis* sp.
*S. infumata*

Trichoptera
Rhyacophilidae
*Rhyacophila lobifera
R. ledra
Protoptila maculata*

Philopotamidae
*Chimarra obscura*

Psychomyiidae
*Polycentropus cinereus
Polycentropus remotus*

Hydropsychidae
*Cheumatopsyche* sp.
*C. analis
C. spectosa
C. compyla*
Hydropsyche betteni
H. dicantha
H. valanis
H. incommoda
H. orris
H. simulans
Macronemum sebratum
Potamyia flava

Hydroptilidae
Hydroptila ajax
H. angusta
H. armata
H. consimilis
H. hamata
H. perdita
H. waubesiiana
Ithytricia mason
Neotrichia okopa
Ochrotrichia spinosa
O. tarsalis
O. xena
Orthotrichia americana
O. cristata
Oxythera pallida
Staetobiella palmata

Phryganeidae
Phryganea sayi

Limnephilidae
Neophylax nacatus
N. concinnus
Pycnopsyche guttifer
Ironquia punctatissima
Limnophilus sp.

Leptoceridae
Athripsodes ancyclus
A. angustus
A. cancellatus
A. resurgens
A. nr senilis
A. tarsipunctatus
A. transversus
Leptocella candida
L. exquisita
Ocetetis inconspicua
O. Nocturna
O. ditissa
O. persimilis
Triaenodes tarda
T. cornata

Helicopsychidae
Helicopsyche borealis

Lepidoptera
Nymphalidae
Lycaenidae
Pieridae
Hesperiidae
Papilionidae
Satyridae
Danaidae
Pyralidae
Paragyna austalis fulicalis
Geometridae
Tineidae
Noctuidae
Sphingidae
Manduca sp.
Sphinx sp.

Arctiidae
Haploa clymene

Lithosiidae
Hypoprepia sp.

Yponomeutidae
Atteva aurea

Coleoptera
Carabidae
Bambidion chalcem
B. nr affine
Tachys species
T. scitus
Schizagenius lineolatus
Clivina impressifrons
C. bipustula
C. dentipes
Aspidoglossa subangulate
Dyschiriia haemorroidalis
Arilatoma viridis
Agyonum placidum
Stenolophus ochropeatus
Agonoderus lecontei
Anisodactylus (Pseudamphasis) sericeus
Lebia atriventris  
L. analis  
L. viridis  
Gallerita janus  
Brachinus cyanipennis

Dytiscidae  
Laocophilus maculosus  
L. maculosus

Gyrinidae  
Dineutes assimilis  
D. homi  
Gyrinus analis

Haliplidae  
Pettodytes species  
Haliplus sp.

Hydropsychidae  
Helophorus lineatus  
Berosus sp.  
B. fraternus  
B. exigus  
B. pugnax  
B. panterinus  
B. aculeatus  
B. perigrinus  
B. striatus  
B. infuscatus  
Tropisternus lateralis  
T. natator  
T. collaris striolatus  
Enochrius pygmaeus

Silphidae  
Microphorus orbicollis  
Silpha surinamensis

Pselaphidae  
Bryaxis illinoiensis

Staphylinidae  
Staphylinidae species

Scarabaeidae  
Aphodius lividus  
A. ruricola  
A. stercorosus  
Ataenius gracilis  
Trox monachus  
Phylophaga rugosa  
P. futilis  
P. hirticula  
P. crenulata  
P. implicata  
Pelicnota punctata
Heteroceridae
  *Heterocernus brunneus*
  *H. undatus*
  *H. pusillos*

Dryopidae
  *Helicus sp.*

Psephenidae
  *Eubrianax sp.*
  *Psephenus herricki*

Elmidae
  *Stenelmis sexalineata*
  *S. sexvittata*
  *Maoronychus glabratus*
  *Dubiraphia quadranotata*
  *Ancyronyx varigatus*

Buprestidae
  *Argilus obsoletoguttata*
  *Melanophila sp.*

Elateridae
  *Megapenthes insignis*

Helodidae
  *Prinocyphon sp.*

Lanpyridae
  *Photuris versicolor*

Cantharidae
  *Chauliognathus marginatus*
  *Podabrus rugosus*
  *Cantharis sp.*

Melyridae
  *Attalus sp.*

Anthididae
  *Sapintus caudatus*
  *Anthicus cervinus*

Pedilidae
  *Pedilus labiatus*

Cucujidae
  *Telephorus velox*

Mordellidae
  *Mordellistena species*

Phalacridae
  *Achyronemus ergot*
Coccinellidae
- Scymnus terminatus
- Cyloneda sanguinea
- Ceratomegilla maculata

Erotylidae
- Ischyrus quadripunctatus

Cerambycidae
- Typocerus aoutidauda
- Neoclytus aasminatus
- Eupogonius tomentosus

Chrysomelidae
- Paria thoracica
- Gastroides ayanea
- Acalymma vittata
- DiSEMBLIGA glabrata
- Diabrotica decimpunctata
- Altica ignita
- Agrionota bivittata
- Chirida guttata
- Metriona bicolor

Curculionidae
- Thodobaenus trideimpunctatus var. pulchellus

Diptera
Chironomidae
- Pentaneura sp.
- P. flavifrons
- Clinotanypus sp.
- Procladius sp.
- Glyptotendipes sp.
- Nanocladius sp.
- Orthocladius sp.
- Trichocladius sp.
- Corynoneura sp.
- Chironomus attenuatus
- C. staegeri
- Dicrotendipes modestus
- Xenochironomus scoepula
- X. xenolabis
- Microtendipes pedellus
- Pseudochironomus richardsoni
- Stichtochironomus sp.
- Tanytarsus (Rheotanytarsus) sp.

Simulidae
- Prosimulium sp.
- Simulium sp.
- S. vittatum
Ephydridae group
Tabanidae
 Tabanus sp.
 Chrysops sp.

Tipulidae
 Tipula sp.
 Hexatoma sp.
 H. megacera

Culicidae
 Culex pipens
 Culex restuans
 Aedes vexans
 A. triseriatus
 Psorophora sp.
 P. ciliata
 P. cinifinis
 Anopheles punctipennis
 Culiseta inornata

Empididae
 Hemerodromia sp.
 Roederiodes sp.

Ceratopogonidae
 Stilobezzia sp.
 Bezzia sp.

Hymenoptera
 Evanidae
 Barconidae
 Cucutidae
 Sphecidae
 Vespidae
 Bombidae
 Apidae
 Apis mellifera
Preliminary List of Mollusks from Salt River Basin

Unionidae
- Tritogonia verrucosa
- Lampsilis siliquoidea
- Plagiola sp.
- Leptodea fragilis
- Proptera alata
- Lasmigona complanata
- Truncilla truncata
- Lasmigona costata
- Anodonta grandis
- Alasmidonta calceolus
- Quadrula quadrula
- Fusconata undata
- Quadrula nodulata
- Ambleo plicata
- Quadrula pustulosa
- Megalonaiæ gigantea
- Lampsilis ovata ventricosa
- Crenodonta costata
- Ptychobranchus fasciolaris

Sphaeriidae
- Sphaerium spp.
- Musculium sp.

Cyrenidae
- Corbicula mülleri

Physidae
- Physa integræ

Pleuroceridae
- Goniobasis ? livescens

Planorbidae
- Helisoma trivolvis
- Cyraulus sp.

Viviparidae
- Campeloma ? decisum

Ancylidae
- Ferrissia sp.
A Preliminary List of the
Amphibians and Reptiles of
The Salt River Basin

Amphibia
Caudata
Ambystomatidae
Ambystoma jeffersonianum (Green), Jefferson's Salamander
Ambystoma texanum (Matthes), Small-mouthed Salamander
Ambystoma opacum (Gravenhorst), Marbled Salamander
Ambystoma maculatum (Shaw), Spotted Salamander
Ambystoma tigrinum (Green), Tiger Salamander

Plethodontidae
Desmognathus fuscus (Rafinesque), Dusky Salamander
Plethodon dorsalis (Cope), Zig-zag Salamander
Plethodon glutinosus (Green), Slimy Salamander
Pseudotriton ruber (Latreille), Red Salamander
Eurycea bislineata (Green), Two-lined Salamander
Eurycea longicauda (Green), Long-tailed Salamander
Eurycea lucifuga (Rafinesque), Cave Salamander

Proteidae
Necturus maculosus (Rafinesque), Mudpuppy

Anura
Ranidae
Rana catesbeiana Shaw, Bullfrog
Rana clamitans melanota (Rafinesque), Green Frog
Rana pipiens pipiens Schreber, Leopard Frog
Rana sylvatica sylvatica LeConte, Wood Frog

Bufonidae
Bufo americanus americanus Holbrook, American Toad
Bufo woodhousei fowleri Hinckley, Fowler's Toad

Hylidae
Acris crepitans blanchardi Harper, Blanchard's Cricket Frog
Hyla crucifer crucifer Wied, Spring Peeper
Hyla versicolor versicolor LeConte, Grey Treefrog

Reptilia
Testudinata
Chelydridae
Chelydra serpentina serpentina (Linnaeus), Snapping Turtle
Sternotherus odoratus (Latreille), Stinkpot

Emydidae
Terrapene carolina carolina (Linnaeus), Eastern Box Turtle
Terrapene ornata ornata (Agassiz), Western Box Turtle
Chrysemys picta marginata Agassiz, Painted Turtle
Chrysemys scripta elegans (Weid), Red-eared Turtle

Trionychidae
Trionyx muticus muticus Lesueur, Smooth Softshell Turtle
Trionyx spinifer spinifer Lesueur, Spiny Softshell Turtle

Squamata (Sauria)
Iguanidae
Sceloporus undulatus hyacinthinus (Green), Northern Fence Swift

Scincidae
Eumeces fasciatus (Linnaeus), Five-lined Skink

Squamata (Serpentes)
Colubridae
Carphophis amoenus helenae (Kennicott), Midwest Work Snake
Diadophis punctatus edwardsi (Merrem), Northern Ringneck Snake
Coluber constrictor constrictor Linnaeus, Northern Black Racer
Elaphe obsoleta obsoleta (Say), Black Rat Snake
Thamnophis sirtalis sirtalis (Linnaeus), Eastern Garter Snake
Lampropeltis doliata triangulum (Lacépède), Eastern Milk Snake
Storeria dekayi dekayi (Holbrook), Dekay's Snake
Heterodon platyrhinos Latreille, Hognose Snake
Regina septemvittata septemvittata (Say), Queen Snake
Natrix sipedon sipedon (Linnaeus), Northern Common Water Snake

Viperidae
Agkistrodon contortrix mokeson (Daudin), Northern Copperhead
Additional birds observed in the Salt River Basin between 1 July 1970 and 30 June 1972. See Krumholz and Neff (1972) for previous list.

**Ardeidae**

- *Florida caerulea*  
  Little blue heron  
- *Casmerodius albus*  
  Common egret

**Anatidae**

- *Branta canadensis*  
  Canada goose  
- *Anas discors*  
  Blue-winged teal

**Accipitridae**

- *Accipiter cooperii*  
  Cooper's hawk  
- *Circus cyaneus*  
  Marsh hawk

**Rallidae**

- *Fulica americana*  
  American coot

**Scolopacidae**

- *Phalaropus minor*  
  American woodcock  
- *Actitis macularia*  
  Spotted sandpiper

**Tytonidae**

- *Tyto alba*  
  Barn owl

**Strigidae**

- *Nyctea scandiaca*  
  Snowy owl  
- *Asio flammeus*  
  Short-eared owl

**Tyrannidae**

- *Epidonax flaviventris*  
  Yellow-bellied flycatcher  
- *Epidonax traillii*  
  Traill's flycatcher  
- *Nuttallornis*  
  Olive-sided flycatcher

**Sittidae**

- *Sitta canadensis*  
  Red-breasted nuthatch

**Troglocyrtidae**

- *Hylocichla ustulata*  
  Winter wren  
- *Hylocichla minima*  
  Bewick's wren

**Turdidae**

- *Hylocichla fuscescens*  
  Swainson's thrush  
- *Hylocichla canadensis*  
  Gray-cheeked thrush  
- *Veery*
Sylviidae

Regulus satrapa
Regulus calendula

Vireonidae

Vireo philadelphicus

Parulidae

Mniotilta varia
Helmitheros vermivorus
Vermivora peregrina
Vermivora ruficapilla
Dendroica tigrina
Dendroica pensylvanica
Dendroica pinus
Dendroica palmarum
Seiurus aurocapillus
Seiurus noveboracensis
Opocornis formosus
Wilsonia canadensis

Icteridae

Icterus spurius
Icterus galbula

Thraupidae

Piranga rubra

Fringillidae

Pheucticus ludovicianus
Spiza americana
Hesperiphona vespertina
Loxia leucoptera
Spizella arborea
Melospiza lincolnii

Golden-crowned kinglet
Ruby-crowned kinglet

Philadelphia vireo

Black-and-white warbler
Worm-eating warbler
Tennessee warbler
Nashville warbler
Cape May warbler
Chestnut-sided warbler
Pine warbler
Palm warbler
Ovenbird
Northern waterthrush
Kentucky warbler
Canada warbler

Orchard oriole
Baltimore oriole

Summer tanager

Rose-breasted grosbeak
Dickcissel
Evening grosbeak
White-winged crossbill
Tree sparrow
Lincoln's sparrow
LITERATURE CITED


