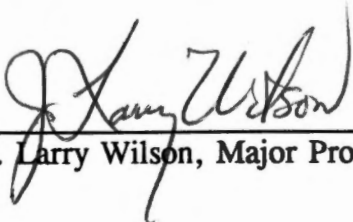
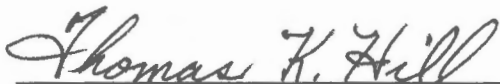
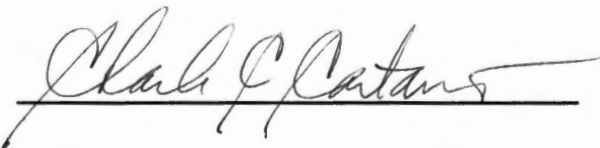


To the Graduate Council:

I am submitting herewith a thesis written by Paul E. Stodola entitled "Movements and Life History of Sauger in Douglas Reservoir, Tennessee." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Wildlife and Fisheries Science.

  
\_\_\_\_\_  
J. Larry Wilson, Major Professor

We have read this thesis  
and recommend its acceptance:

  
\_\_\_\_\_  
  
\_\_\_\_\_

Accepted for the Council:

  
\_\_\_\_\_  
Associate Vice Chancellor  
and Dean of The Graduate School

**MOVEMENTS AND LIFE HISTORY  
OF SAUGER  
IN DOUGLAS RESERVOIR, TENNESSEE**

**A Thesis  
Presented for the  
Master of Science  
Degree  
The University of Tennessee, Knoxville**

**Paul E. Stodola**

**August 1992**

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THESIS

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## ABSTRACT

A total of 30 externally-fixed transmitters were placed on 26 sauger and 4 saugeye (sauger x walleye hybrid) in Douglas Reservoir, TN. Eight sauger were tagged in December 1990, fourteen (one probably a saugeye) in February and March 1991, and eight (4 sauger and 4 saugeye) in June and July 1991. Scales were taken from 56 untagged sauger collected in 1991 for age and growth analysis.

Catch per unit effort (CPUE) for sauger caught in experimental and standard gill nets from 24 November 1990 to 13 July 1991 was 0.14 fish/hour (433.35 net hours). CPUE and TWRA cove rotenone data indicated that sauger are continuing to decline in Douglas Reservoir. The highest CPUE for sauger was recorded at French Broad River Mile (FBRM) 71-71.3, later confirmed as a spawning site. Saugeye made up at least 36% of the total number of Stizostedion sp. captured and over 50% in identified spawning areas. The presence of a large number of saugeye at the spawning ground may affect sauger reproductive success. Gill net mortality was relatively high (sauger=25%; saugeye=47%) during June and July. No net mortality was recorded in winter and spring.

One sauger was tracked through Douglas Dam in January, 1991. This fish passed through one of the turbine intakes (sluice gates were not open at this time) and survived.

Male sauger radio-tagged in February 1991 moved upstream, showing a strong affinity for the old river channel, and were found in a shoal at FBRM 69 between March 26 and 30, 1991. Spawning was documented at FBRM 69 and FBRM 71 by the

collection of eggs between March 26 and April 15.

Sauger and saugeye tagged in June and July exhibited less movement than fish tagged in winter and spring and showed a strong preference for cove habitat. Fish tagged with temperature-sensing transmitters were found in 25-28.5 C water. All fish tagged in June and July were presumed dead in August and September due to lack of movement.

Relative weights ( $W_r$ ) were calculated for prespawn ( $W_r=114$ ), spawning ( $W_r=93$ ), and postspawn ( $W_r=98$ ) adult sauger. Relative weight values for age one ( $W_r=82$ ), age two ( $W_r=96$ ), age three ( $W_r=101$ ), and age four ( $W_r=104$ ) sauger were also calculated. Relative weights of Douglas Reservoir sauger are "typical" or show normal fluctuations according to season or year class. Growth rate comparisons were made using back-calculated lengths. Growth rates compare favorably to northern sauger and are similar to previous records from Douglas Reservoir. However, back-calculated lengths are below average for sauger from other TVA storage reservoirs.

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## CHAPTER 1

### INTRODUCTION

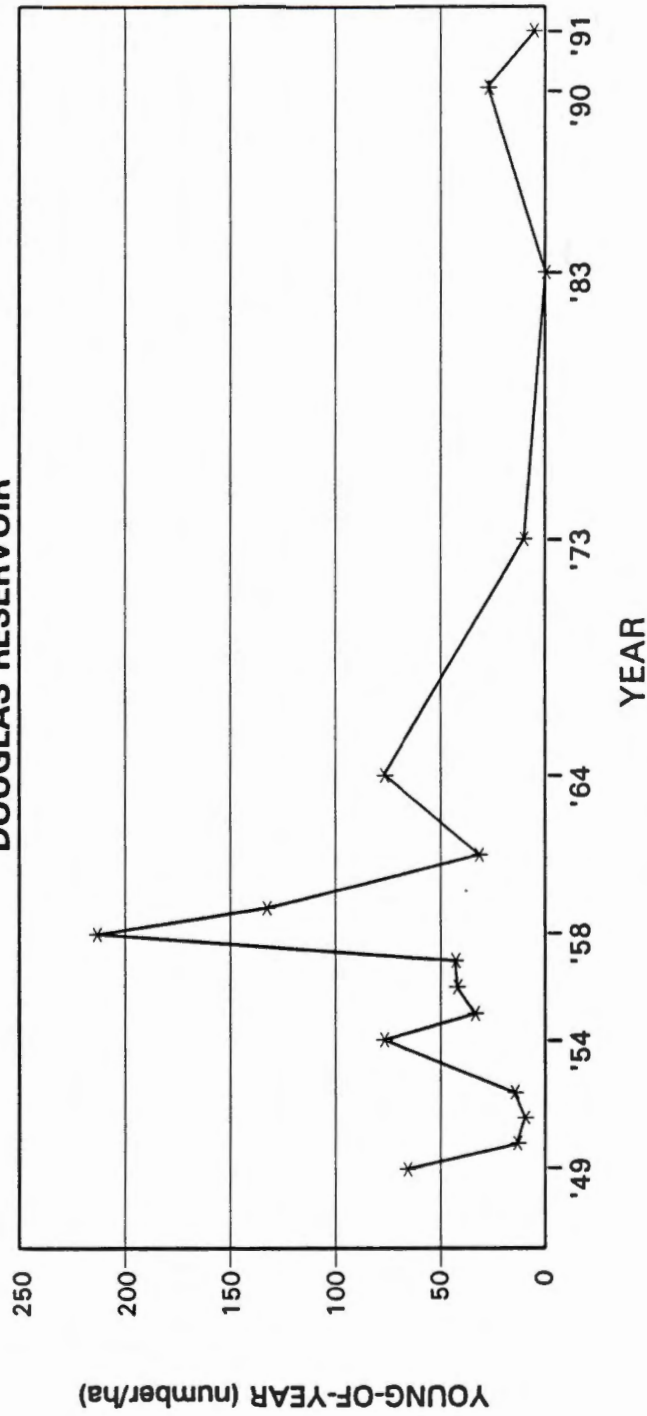
Sauger (Stizostedion canadense) comprise the largest percid fishery in the southeastern United States. This important fishery is found in mainstream as well as two tributary reservoirs of the Tennessee and Cumberland River systems (Hackney and Holbrook 1978). Typically, sauger fishing becomes popular in the spring when they concentrate in tailwaters of mainstream dams and the headwaters of tributary reservoirs (Walburg 1972). These concentrations occur when sauger migrate upstream in search of spawning sites. Indeed, sauger may constitute the dominant fishery of some Tennessee impoundments at this time of the year (Hackney and Holbrook 1978).

Sauger populations, throughout the Tennessee River system, have shown a high degree of instability since 1979 (Hevel 1988). The species has declined in Chickamauga Reservoir and the Watts Bar tailwater based on catch per unit effort (CPUE) results and creel data (Hevel 1988; Hickman et al. 1989). All mainstream reservoirs, with the possible exceptions of Pickwick and Kentucky Reservoirs, have shown a decrease in sauger populations (Hevel 1988).

Sauger have shown an even more dramatic decline in tributary reservoirs. The species once occurred in Cherokee Reservoir (Netsch and Turner 1964) but has disappeared. Norris Reservoir once supported a strong sauger population (Fitz and Holbrook 1978) but now they are relatively scarce (Hackney and Holbrook 1978). Similarly, sauger were once abundant in Douglas Reservoir and its tailwaters but since the mid-to late-1960's have declined. Both young-of-the-year sauger ( Figure 1) and

# **YOUNG-OF-YEAR SAUGER (1949-1991)**

**DOUGLAS RESERVOIR**



(Source: TWRA Cove Rotenone)

Figure 1. Young-of-year sauger collected in cove rotenone studies by TWRA from Douglas Reservoir.

numbers of sauger fishermen on Douglas Reservoir have decreased. In 1986 the Tennessee Wildlife Resources Agency (TWRA) stocked 172,089 sauger fingerlings in Douglas Reservoir, 100,000 in 1987, and in excess of 54,000 in 1992 to improve the fishery (Schacher 1988).

Causes for the decline of sauger are unclear. Walburg's (1972) sauger study on Lewis and Clark Lake, South Dakota, suggested year class strength was related to water level change over the spawning ground, June reservoir water temperature, and reservoir water exchange rate. He noted other factors such as food abundance for larval fish (primarily zooplankton) and current velocities could be important. Nelson (1968 and 1969), Busch et al. (1975), and Saylor et al. (1983) suggested water temperature, flow velocity, water level fluctuations, and substrate type during spawning may influence sauger year class strength. Possible causes for the decline of sauger in Douglas Reservoir and its tailwaters include toxins or some other water quality conditions affecting reproduction, competition or predation by an expanding white bass population, and a change in minimum pool level of 280.4 to 286.5 m which may affect water level and flow in the headwaters during the critical spawning time (Schacher 1988).

Numerous researchers have studied sauger to find out why the species is declining in the Tennessee River system (Ridley 1980; Saylor et al. 1983; Hevel 1988; Woodward et al. 1988; Hickman et al. 1989; St. John 1990; Medlin 1990; and Brown 1990). All of these studies dealt with the species in mainstream reservoirs. The objectives of this study were to concentrate on tributary reservoirs and: (1) characterize seasonal movement patterns and associated habitats of sauger via telemetry, and (2) to assess age and growth

of Douglas Reservoir sauger populations. Data obtained during the course of this study will help formulate strategies to conserve Douglas Reservoir sauger as well as evaluate their general growth and condition compared to other populations of this species.

## CHAPTER 2

### DESCRIPTION OF THE STUDY AREA

Douglas Reservoir (Figure 2) is located on the French Broad River in Cocke, Jefferson, and Sevier counties of east central Tennessee. This impoundment was created by the Tennessee Valley Authority (TVA) primarily for flood control and hydro-electric power. The reservoir was filled in 1943 upon the completion of Douglas Dam at French Broad River Mile (FBRM) 32.3. (With the exception of river miles all units are in metric). The dam has a height of 61.6 m, with a maximum pool elevation of 304.8 m above mean sea level (msl) and a minimum pool of 286.5 m msl. The impoundment is 12,300 hectares in size and has an annual average retention time of 42 days. The French Broad River has an area watershed drainage of 1,176,119 hectares at Douglas Dam. Douglas Reservoir extends upstream from the dam 66.8 km to the confluence of the Pigeon and French Broad Rivers at FBRM 73.8. These rivers, as well as the Nolichucky River, make up the three major tributaries to Douglas Reservoir (TVA 1985).

The French Broad is formed by the confluence of the North, West, Middle, and East Forks of the river near Rosman, NC. In North Carolina, the French Broad flows primarily northeastward and is impounded forming three small reservoirs in Buncombe and Madison Counties. The river enters Cocke County, Tennessee and flows north by northwest, with an average gradient of 1.2 m/km, and a mean annual discharge of 78.3 m<sup>3</sup>/sec at Newport. Industrial and domestic pollution, siltation, and turbidity on the main French Broad River and some tributaries have been of special concern. Soil erosion, along with additional runoff due to tributary channelization have transformed the French

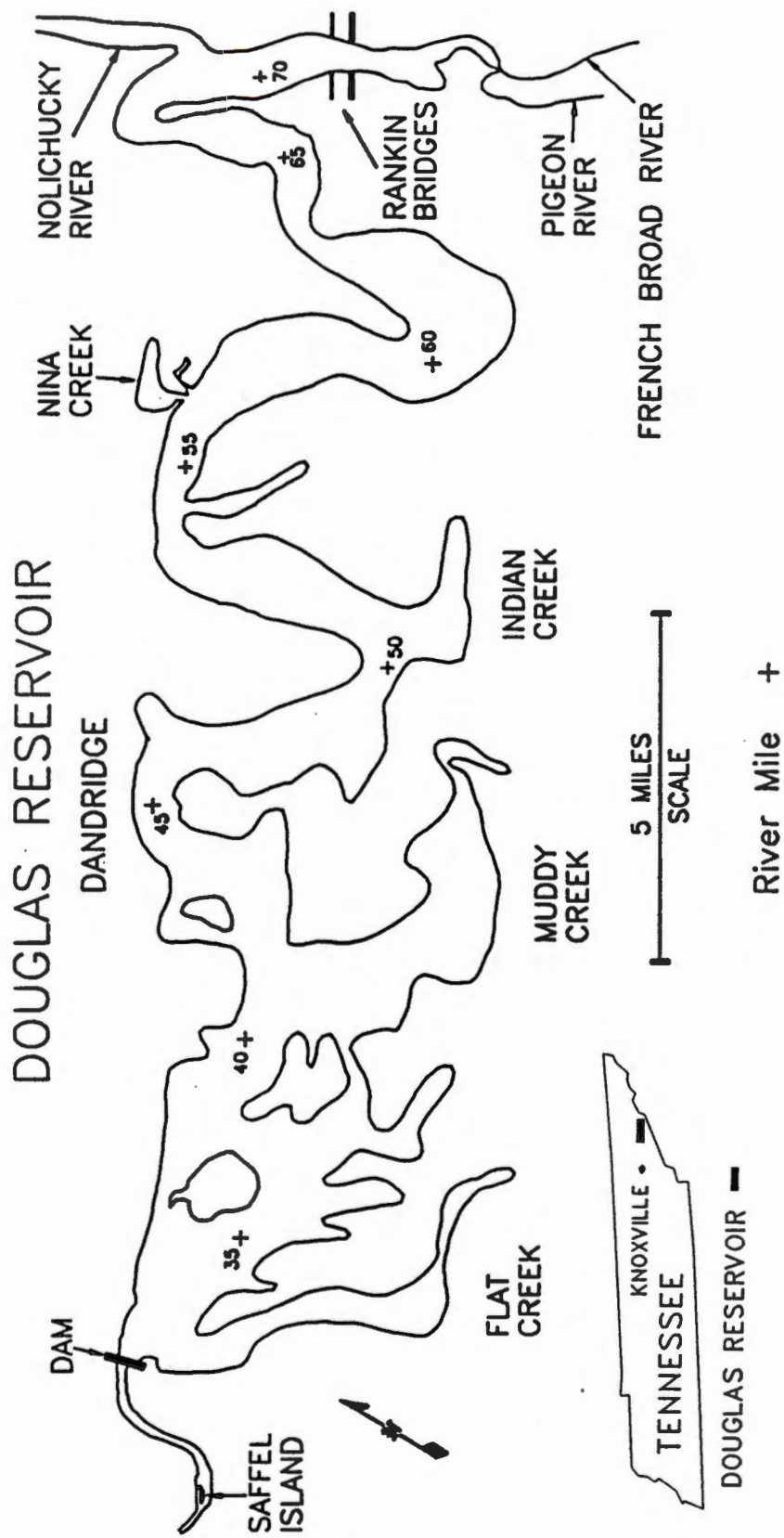


Figure 2. Map of Douglas Reservoir showing location of dam, city of Dandridge, Rankin Bridges and major embayments.

Broad into a turbid, big river habitat (Harned 1979). Index of Biotic Integrity (IBI) fisheries surveys were conducted on the French Broad (FBRM 8.5 and 78.0) in 1991 by TVA. IBI is a method introduced by Karr (1981) for obtaining a general assessment of environmental quality at a given site. The French Broad received a score of 34 or "poor" (C. Saylor, TVA, 1992, personal communication). The French Broad River is used for domestic water supply, industrial use, recreation, irrigation, fish and aquatic life, livestock watering and wildlife as stated by the Tennessee Water Quality Control Board (Schacher 1988).

The Pigeon River originates in North Carolina and is classified as ecologically capable of supporting a brown trout and smallmouth bass fishery upstream of the Champion International Corporation paper mill in Canton, NC (Keup and Stewart 1966; Fish 1968). Water quality, aquatic plant communities, benthic macroinvertebrates and fish populations have been severely degraded downstream of Canton by the effluent discharged by the Champion mill (Schacher 1991). IBI fisheries surveys were conducted on the Pigeon River (PRM 8.2 and 16.4) in 1991 by TWRA and TVA and the river received a score of 38 or "poor" (C. Saylor, TVA, 1992, personal communication).

The Nolichucky River originates at the confluence of the Cane and North Toe Rivers in North Carolina. This river has been severely degraded by silt and sediment coming from abandoned mine sites in Avery, Mitchell, and Yancy counties, NC. IBI fisheries surveys were conducted on the Nolichucky River (NRM 8.5) in 1991 by TVA with the river receiving a score of 46 or "fair +" (C. Saylor, TVA, 1992, personal communication). The Nolichucky adversely impacts the water quality of Douglas

Reservoir and is responsible for the annual loss of  $2.5 \times 10^6 \text{ m}^3$  of water due to sedimentation, three times the rate of any other TVA tributary reservoir (Schacher 1991).

## CHAPTER 3

### METHODS

Sauger were collected for tagging with radio transmitters in Douglas Reservoir, from November 24, 1990, to July 13, 1991. Scale samples were taken from sauger not tagged with transmitters for age and growth analysis.

#### Sauger Collection

Sauger were captured with standard and experimental gill nets and by electrofishing. The three standard gill nets used measured 80.8 x 6.1 m with 76.2-mm bar mesh (two nets) and 61.0 x 2.4 m with a 51.0-mm bar mesh. Six experimental gill nets were used and measured 30.5 x 2.4 m. Four of these nets consisted of 6.1-m panels of 76.2, 64.0, 51.0, 38.0, and 25.4-mm bar mesh. The other two experimental gill nets had 6.1-m panels of 64.0, 51.0, 38.0, 25.4, and 19.0-mm bar mesh. The nets were constructed from monofilament line with the exception of the two larger standard gill nets which were made of nylon. All nets had float and lead lines attached.

Netting occurred at 4 primary and 18 secondary sites (Figure 3). Primary sites had higher catch per unit effort (CPUE) results and were used more often. Four secondary sites from mid-to upper-Douglas Reservoir were used during late November and early December 1990. At the advice of TVA biologists, gill netting efforts were moved to a cove near French Broad River Mile (FBRM) 34.5, opposite Cowboy's Restaurant (Primary Site 1). Efforts were concentrated at this site from December 15, 1990, to February 4, 1991, and March 4, May 30, and June 18, 1991. Nets were set on the bottom perpendicular to shore, anchored (<5 kg), and floats attached at both

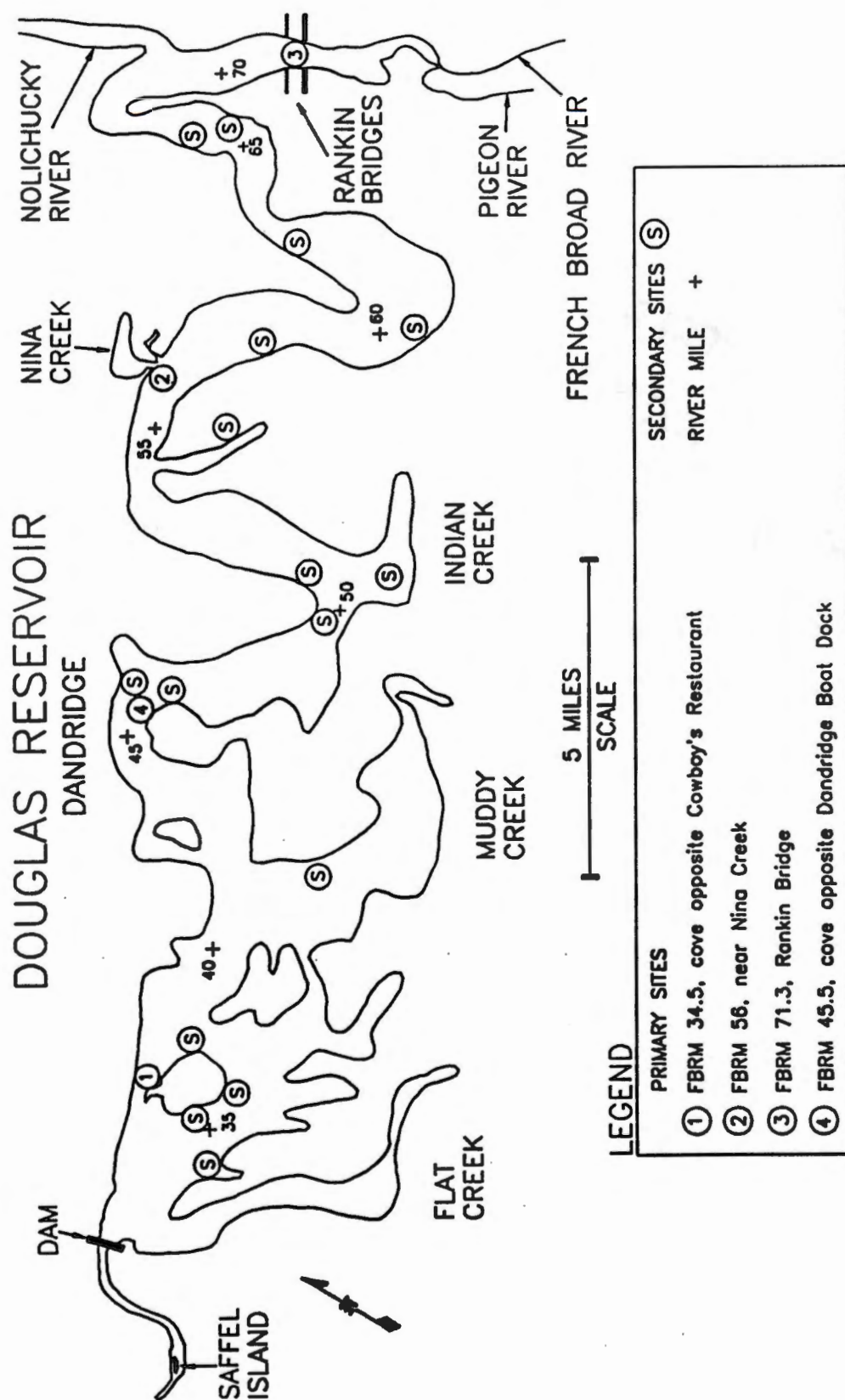


Figure 3. Map of primary and secondary gill netting sites on Douglas Reservoir from November 24, 1990, to July 13, 1991.

ends. Gill nets were set no earlier than 1600 hours and run no later than 2400 hours because sauger are most active at night (Cobb 1960; Kithchell et al. 1977; Ridley 1980). Nets were checked every 1 to 2 hours during this time period.

At the advice of TWRA biologists, gill netting efforts were concentrated near Nina Creek from February 1 to March 2, 1991, between FBRM 55 and 56 (Primary Site 2). Nets were set perpendicular to the bank, anchored to the bottom, and run in a similar fashion to the FBRM 34.5 site.

From March 26 to April 11, 1991, gill nets were used to collect sauger from FBRM 69 to 71, near the Rankin Bridge (Primary Site 3). Flows were much greater at this site so nets were placed parallel to the bank and larger anchors (20 to 25 kg) used to keep them on the bottom. Nets were still swept slowly downstream. Due to trash build up and fish capture, nets were run approximately every 30 minutes.

Gill netting for sauger resumed on May 30 and continued through July 13, 1991. Efforts were concentrated at the mouth of a cove near FBRM 45.5 across from the Dandridge Boat Dock (Primary Site 4). Nets were placed perpendicular to the bank and on the bottom. Due to the higher water temperature and increased stress on captured fish, nets were checked every 20 to 30 minutes.

Electrofishing was used at Primary site #3 and Nolichucky River Mile 1.4 between April 4 and April 18, 1991. Equipment consisted of a boat fitted with two booms and a 230-V AC generator (Homelite model #190HY50-1, Charlotte, NC). On each shocking run the boat was moved upstream, put into neutral, and allowed to drift downstream while discharging an electrical current into the water. Stunned

sauger/saugeye were collected with dip nets. Fish collected by electro-shocking were used in CPUE analysis, sexed, and a scale sample taken for age and growth analysis. No fish obtained by electro-shocking were tagged with radio transmitters.

At each capture site the following information was recorded: date, time, number of nets used, species, number captured, and location. CPUE was calculated for all species collected at each primary site and all sites combined. Habitat characteristics were described at each site where sauger were collected. Water depth at site of capture was obtained by using a weighted measuring line or Eagle Mach I (Eagle Electronics, Inc., Catoosa, OK) depth finder. Water temperature and dissolved oxygen (ppm) were measured at the surface of each capture site using YSI (Yellow Springs Instruments, Yellow Springs, OH) Models 51 B and 58 meters. Substrate was determined for all sites when reservoir height reached its minimum level. Current velocity was calculated using a flow meter (General Oceanics, Inc., Miami, FL).

Captured sauger and saugeye were weighed to the nearest gram using a triple beam balance. A measuring board was used to obtain total length to the nearest millimeter. Sex identification was attempted by holding the fish ventral side up and applying pressure along the abdomen towards the tail. During the period from Feb. 1 to April 18, this technique produced a flow of milt or eggs from the urogenital opening. It was not possible for us to sex sauger or saugeye at other times. Cannulation was performed on certain female sauger by inserting a 10-cm hollow glass tube with a 2-mm diameter into the urogenital opening to obtain an egg sample. Photographs showing the ventral aspect were taken of sauger when the above techniques failed. These slides were

shown to TWRA biologists in an attempt to make a sex identification based upon body conformation and weight.

### Radio Telemetry

Radio telemetry was used to characterize annual movements of adult sauger in Douglas Reservoir. Equipment consisted of 30 transmitters, a Challenger Programmable Scanning Receiver (Model R-2000) with headphones, and a loop antennae (Advanced Telemetry Systems (ATS), Inc., Bethel, Minnesota).

Each transmitter had a unique frequency between 48.590 and 49.450 MHz. Winter et al. (1978) found that lower MHz signals (53 MHz) were attenuated less in water than higher MHz signals (164 MHz). In approximately 50% of the transmitters a stronger signal could be received if the frequency designated on the receiver was increased by 1 to 3 KHz. Transmitters were powered by lithium batteries with a life expectancy of 120 days. Four transmitters were equipped with a temperature-sensing device. The transmitter's signal, i.e., the number of pulses or "beeps" per time interval, would increase as temperature increased. These transmitters were calibrated in a water bath from 10 to 31 C, at 3 degree intervals. ATS technicians suggested counting number of pulses in 20 second intervals to obtain the water temperature where the fish was located. Temperature transmitters ranged in weight from 15.0 to 15.5 grams and averaged 15.2 grams in air.

The 26 transmitters not equipped with temperature-sensing devices ranged in weight from 13.5 to 16.0 grams, averaging 14.6 grams in air, and approximately 5 to 6 grams in water. All transmitters measured 7 cm in length with a 29.5-cm whip

antennae attached.

Radio signals were picked up by a programmable scanning receiver. Every frequency of tagged fish was programmed into the receiver which automatically scanned each setting at any desired time interval between 2 seconds and 16 minutes per frequency. A loop antennae measuring 56 cm in width by 61 cm in height was used to locate fish. The loop antennae was more convenient than a larger, more cumbersome Yagi antennae, and fully capable of locating tagged fish.

#### Transmitter Attachment

Radio transmitters were attached externally according to methods described by Winter (1983) and Woodward et al. (1988). The sauger were placed in a water-filled container 1.0 x 0.5 x 0.5 m after removal from the gill net. Transmitters were attached to fish that weighed more than 750 grams and could hold themselves upright. ATS recommended that the weight of the transmitter not exceed 2% of the fish's weight. TWRA suggested using potassium permanganate ( $\text{KMnO}_4$ ) as a topical antiseptic treatment during tagging in June and July. Aeration and ice were also used at this time since the fish were more stressed due to higher water temperatures. TVA, in previous sauger tracking projects, found that anesthetics were not necessary.

Transmitters were attached adjacent to the spiny-rayed dorsal fin (Figure 4). A 14-gauge hypodermic needle was inserted through the tissue just under the anterior edge of the spiny-rayed dorsal fin and between the proximal pterigophores. The anterior wire of the transmitter was placed through the beveled tip of the needle. The needle was then removed leaving the wire under the fin ray. The second, posterior wire was attached the

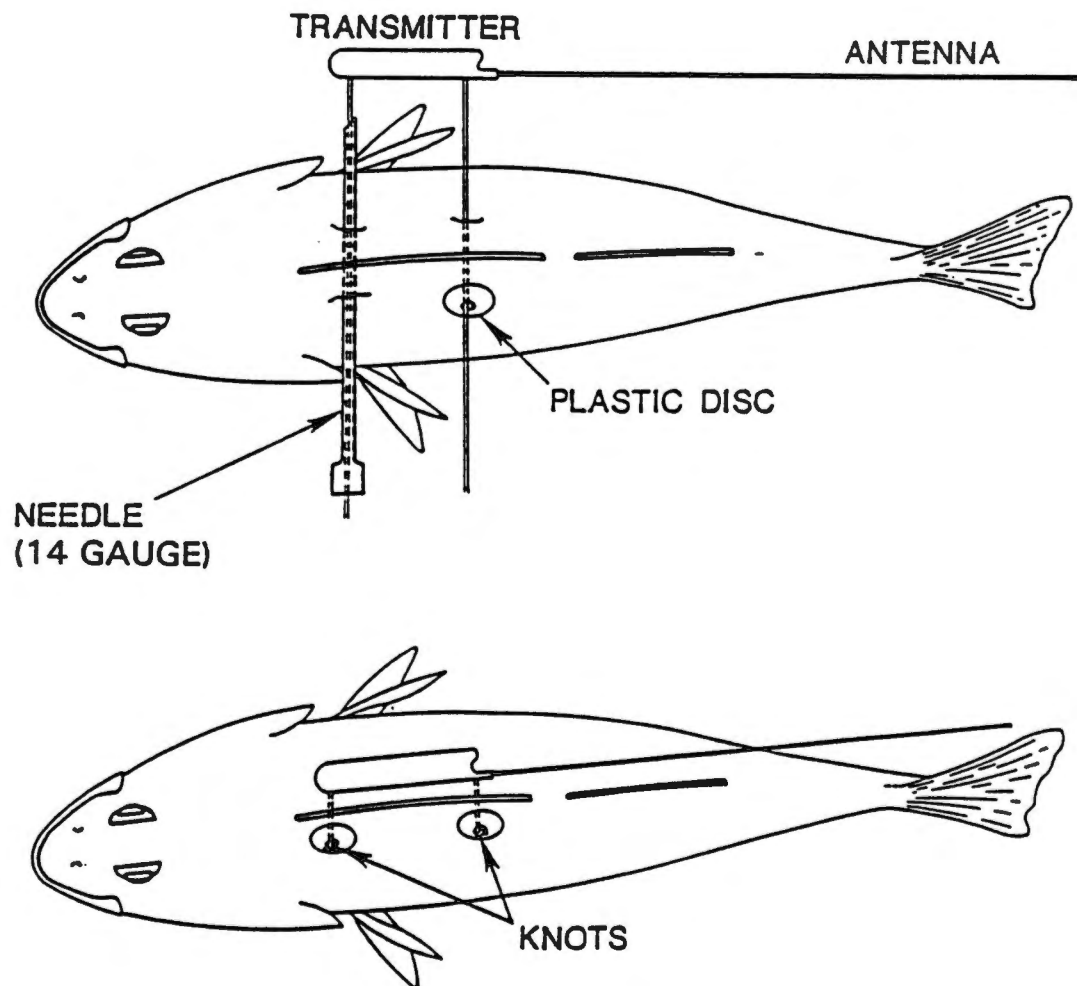


Figure 4. Attachment of externally placed radio transmitters (Source: Hevel 1988).

same way. Plastic washers were slipped over each wire. Knots were tied on the outside of each disc while making sure the transmitter was snugly resting against the side of the fish. The whip antennae was positioned upwards to avoid contact with the caudal fin. Any part of the whip antennae extending beyond the caudal fin was removed. The fish was observed for stress and released if it could maintain itself upright (Woodward et al. 1988).

A total of 30 radio transmitters were used between December 1990 and July 1991 to document yearly movements of sauger. Eight sauger were captured at FBRM 34.5, opposite Cowboy's Restaurant, and tagged with radio transmitters during December, 1990. Fourteen additional sauger, including 6 males and 7 females, were tagged between January 30 and March 4, 1991. Three of these fish were collected across from Cowboy's Restaurant and the other 11 near Nina Creek. One of the fish tagged at Nina is believed to be a saugeye. It is also possible that some other saugeye may have been mistaken for sauger and radio-tagged in December and February. Four sauger and 4 saugeye were tagged in June and July, 1991, at FBRM 45.5 in a cove across from the Dandridge Boat Dock. Saugeye were deliberately tagged at this time due to the difficulty in obtaining sauger and the interest in comparing sauger and saugeye movements. Data obtained for each radio-tagged sauger and saugeye included tagging date, transmitter frequency number, weight, total length, and sex and is summarized in Table 1.

#### Tracking Procedure

Radio-tagged sauger were located by boat or airplane 1 to 2 days per week from December, 1990, to March 1, 1991, 2 to 3 days per week during March and April,

Table 1. Summary of telemetry data associated with the thirty radio-tagged sauger or saugeye collected in Douglas Reservoir, 1990/1991.

| Species      | Transmitter<br>Frequency<br>Number | Total<br>Length<br>(mm) | Weight<br>(g) | Sex<br>(p)(f)(c)* | Tagging<br>Date | Capture<br>Site<br>(FBRM) |
|--------------|------------------------------------|-------------------------|---------------|-------------------|-----------------|---------------------------|
| Sauger       | 48.830                             | 480                     | 1070          | ?**               | 12/16/90        | 34.5                      |
| Sauger       | 48.660                             | 460                     | 1130          | ?                 | 12/16/90        | 34.5                      |
| Sauger       | 48.700                             | 480                     | 1270          | ?                 | 12/16/90        | 34.5                      |
| Sauger       | 48.640                             | 500                     | 1290          | ?                 | 12/19/90        | 34.5                      |
| Sauger       | 48.720                             | 460                     | 1089          | ?                 | 12/19/90        | 34.5                      |
| Sauger       | 48.910                             | 480                     | 1018          | ?                 | 12/19/90        | 34.5                      |
| Sauger       | 48.590                             | 460                     | 998           | ?                 | 12/29/90        | 34.5                      |
| Sauger       | 48.960                             | 535                     | 1759          | ?                 | 12/29/90        | 34.5                      |
| Sauger       | 49.150                             | 480                     | 1120          | ?                 | 01/30/91        | 34.5                      |
| Sauger       | 48.930                             | 430                     | 1043          | m(f)              | 02/01/91        | 56.0                      |
| Sauger       | 48.950                             | 420                     | 821           | f(p)              | 02/01/91        | 56.0                      |
| Sauger       | 48.990                             | 420                     | 838           | m(f)              | 02/01/91        | 55.0                      |
| Sauger       | 49.250                             | 490                     | 1357          | f(p)              | 02/01/91        | 55.0                      |
| Sauger       | 49.200                             | 450                     | 1023          | f(p)              | 02/01/91        | 55.0                      |
| Sauger       | 48.860                             | 420                     | 874           | m(f)              | 02/01/91        | 55.0                      |
| Sauger       | 48.970                             | 470                     | 1169          | f(p)              | 02/01/91        | 55.0                      |
| Sauger       | 48.840                             | 440                     | 998           | m(p)              | 02/04/91        | 34.5                      |
| Sauger       | 48.820                             | 465                     | 1158          | f(p)              | 02/04/91        | 34.5                      |
| Sauger(eye?) | 48.790                             | 440                     | 860           | m(f)              | 02/13/91        | 56.0                      |
| Sauger       | 48.880                             | 480                     | 1260          | f(c)              | 02/13/91        | 56.0                      |
| Sauger       | 48.810                             | 470                     | 1240          | f(c)              | 02/13/91        | 56.0                      |
| Sauger       | 48.890                             | 420                     | 770           | m(f)              | 03/04/91        | 34.5                      |
| Saugeye      | 49.400                             | 520                     | 1702          | ?                 | 06/27/91        | 45.5                      |
| Saugeye      | 48.830                             | 478                     | 1135          | ?                 | 07/01/91        | 45.5                      |
| Sauger       | 49.300                             | 460                     | 908           | ?                 | 07/03/91        | 45.5                      |

(cont.)

Table 1. Summary of telemetry data associated with the thirty radio-tagged sauger or saugeye collected in Douglas Reservoir, 1990/1991. (cont.)

| Species | Transmitter<br>Frequency<br>Number | Total<br>Length<br>(mm) | Weight<br>(g) | Sex<br>(p)(f)(c)* | Tagging<br>Date | Capture<br>Site<br>(FBRM) |
|---------|------------------------------------|-------------------------|---------------|-------------------|-----------------|---------------------------|
| Saugeye | 48.870                             | 499                     | 1362          | ?                 | 07/03/91        | 45.5                      |
| Sauger  | 49.450                             | 484                     | 1090          | ?                 | 07/07/91        | 45.5                      |
| Saugeye | 48.910                             | 494                     | 1407          | ?                 | 07/10/91        | 45.5                      |
| Sauger  | 49.350                             | 455                     | 885           | ?                 | 07/13/91        | 45.5                      |
| Sauger  | 48.850                             | 460                     | 908           | ?                 | 07/13/91        | 45.5                      |

\* (p)=sex identification by photo, (f)=flowing (milt), (c)=sex identification  
by cannulation

\*\* ?=undetermined sex

1991, and 1 to 2 days per week from May 1 to October, 1991. Fish were tracked using a 6-m flat-bottomed boat powered by a 70 hp Evinrude outboard motor. Resistor plugs were used to cut down on the static produced by the motor. Static was also decreased by holding the loop antennae in front of the boat with the flat, open side down. Also, static increased as speed of the boat increased. Generally, two people were used to track by boat. One person would drive the boat while the other listened for signals using the radio telemetry equipment. A special bracket was designed to hold the antennae on the boat's front railing, which enabled one person to do the tracking. It was impossible to search the entire reservoir by boat in a single day. Boat tracking was typically restricted to that part of the reservoir where fish were last located. An approximate location was determined by triangulation or simply moving towards the signal until no null could be heard. Date, time, river mile (RM), landmark, and comments were recorded. Observed locations were plotted on a Douglas Reservoir map. Maps found in Appendix A were created with the computer program Autocad (Version 11).

Two to three times per month tagged fish were located by airplane. Two single prop planes, courtesy of TVA, were used for tracking. One was equipped with wing struts allowing us to attach the loop antennae by means of a special bracket. The antennae was carried inside the cockpit of the other plane which had no wing struts. This cut down the range by approximately 50%. The entire reservoir could be searched in less than 2 hours by plane. Fish that could not be found by boat were often relocated by aircraft. On some days, signals were picked up 3.2 km away in the airplane (antenna on wing strut) versus 1.6 km or less by boat. The approximate location of the

transmitter was determined by circling the aircraft.

### Age and Growth Analysis

Back-calculated lengths and relative weight were calculated for sauger not tagged with radio transmitters in 1991. A total of 56 sauger were used from gill netting, electro-shocking, and TWRA cove rotenone sampling. Scales were taken from the left pectoral area and the left pelvic fin was clipped to avoid repeat sampling during netting or electro-shocking. Samples were placed in scale envelopes with species name, total length, weight, sex, location, date, and fish number written on each envelope.

Scales were brought back to the lab, cleaned in water, and pressed onto cellulose acetate slides. A microfiche copying machine was used to project an enlarged image (28x) and produce a photocopy of the scale. Annuli were identified according to techniques established by Jearld (1983). Three people, on separate occasions, looked at the photocopies or acetate impressions. If different ages were determined the slide or photocopy was read again and a final decision made.

### **Back-Calculated Lengths**

A table of back-calculated lengths (calculated length of fish at each annulus) was created using the computer program DISBCAL. DISBCAL was created in 1989 by the Biometrics Unit of the Missouri Department of Conservation. It was also used to perform a regression analysis of the data producing a model describing how fish length changes with annulus distance.

The Oak Ridge National Laboratory (ORNL) provided the necessary software, manual, and computer hardware to run DISBCAL. The photocopy of the enlarged scale

was placed on the digitizer and the focus, annuli, and edge of the scale were entered into the computer. The standard intercept of scale radius for sauger was not found in DISBCAL's directory, but a value of 24.3 was obtained from Carlander (1950). Back calculated lengths were compared to sauger from other reservoirs.

### **Relative Weight ( $W_r$ )**

Relative Weight was calculated using FISHCALC, the sister program to DISBCAL. Relative weight, as described by Anderson (1980), is based on a percentage comparison of the observed weight per unit length with an accepted standard weight per unit length. It is given by the following formula:

$$W_r = W/W_s \times 100$$

where  $W$  is the observed weight and  $W_s$  equals the standard weight.

A value for standard weight had to be determined first and is given by the following formula:

$$W_s = a \times L^b$$

where  $a$  and  $b$  are coefficients and  $L$  is length. The  $a$  and  $b$  coefficients for sauger were not found in FISHCALC's directory. They were obtained from Guy et al. (1990) who developed the following  $W_s$  equation for sauger:

$$\log_{10} W_s = -5.446 + 3.157 \log_{10} L$$

where  $W_t$  is the weight in grams and  $L$  is total length in millimeters. The value -5.446 was converted to its antilog, 0.000003581 as required by FISHCALC.

## CHAPTER 4

### RESULTS AND DISCUSSION

#### Netting Results and Catch Per Unit Effort

Experimental and standard gill nets were fished a total of 433.35 net hours between November 24, 1990, and July 13, 1991. Tagging-size sauger were caught in 51.0, 38.0, and 25.4-mm bar mesh nets. Fish of this size were more commonly caught in 38.0-mm mesh of the experimental nets. Cobb (1960), Hevel (1988), and St. John (1990) also reported 38.0-mm mesh as the optimum size for capturing tagging size sauger. Most sauger in this study were caught in the lower half of the net as Haslbauer (1945) also observed. Some yearling sauger were caught in 25.4-mm mesh.

Sauger (or saugeye) was the fifth most caught species of a total of 25 species and 1,626 fish that were gill-netted during the course of this study (Table 2). The catch per unit effort (CPUE), or fish per hour, for sauger from primary and secondary netting sites combined was 0.14. Gizzard shad, with a CPUE of 2.34 fish/hour, was the most commonly caught species followed by freshwater drum, carpsucker species, white bass, and then sauger.

The CPUE for sauger at Primary Netting Site 1 (FBRM 34.5) was also 0.14 (Table 3). Sauger were caught at this site between December 15, 1990, and February 4, 1991, and on March 4, 1991. Netting success was greatest between 1730 and 1930 hours. Sauger were caught in depths ranging from 3 to 6 m. This site was located in a cove opposite Cowboy's Restaurant and had a substrate consisting of clay and silt, with exposed outcroppings of shale. Water temperatures ranged from 8-11 C on dates when

Table 2. Total catch and catch per unit effort (fish/hour) of each fish species collected in Douglas Reservoir (all netting sites combined, FBRM 34 to 71.3). The fish were primarily collected using experimental gill nets and occasionally standard gill nets. Gill netting began November 24, 1990, and ended on July 13, 1991, for a total of 433.35 net hours.

| Common Name        | Scientific Name                          | Total Catch | Number of Fish/Hour |
|--------------------|------------------------------------------|-------------|---------------------|
| Gizzard shad       | <u>Dorosoma cepedianum</u>               | 1013        | 2.34                |
| Freshwater drum    | <u>Aplodinotus grunniens</u>             | 94          | 0.22                |
| Carp sucker        | <u>Carpionodes</u> sp.                   | 91          | 0.21                |
| White bass         | <u>Morone chrysops</u>                   | 78          | 0.18                |
| Sauger             | <u>Stizostedion canadense</u>            | 61          | 0.14                |
| White Crappie      | <u>Pomoxis annularis</u>                 | 61          | 0.14                |
| Carp               | <u>Cyprinus carpio</u>                   | 49          | 0.11                |
| Saugeye            | <u>S. canadense</u> x <u>S. vitreum</u>  | 36          | 0.08                |
| Channel catfish    | <u>Ictalurus punctatus</u>               | 36          | 0.08                |
| Smallmouth buffalo | <u>Ictiobus bubalus</u>                  | 27          | 0.06                |
| Black crappie      | <u>Pomoxis nigromaculatus</u>            | 21          | 0.05                |
| Largemouth bass    | <u>Micropterus salmoides</u>             | 18          | 0.04                |
| Bluegill           | <u>Lepomis macrochirus</u>               | 10          | 0.02                |
| Blue catfish       | <u>Ictalurus furcatus</u>                | 7           | 0.02                |
| Shortnose gar      | <u>Lepisosteus platostomus</u>           | 6           | 0.01                |
| Striped bass       | <u>Morone saxatilis</u>                  | 3           | 0.01                |
| Walleye            | <u>Stizostedion vitreum</u>              | 3           | 0.01                |
| Goldfish           | <u>Carrassius auratus</u>                | 3           | 0.01                |
| Flathead catfish   | <u>Pylodictus olivaris</u>               | 2           | 0.005               |
| Longnose gar       | <u>Lepisosteus osseus</u>                | 2           | 0.005               |
| Yellow bullhead    | <u>Ictalurus natalis</u>                 | 1           | 0.002               |
| Mooneye            | <u>Hiodon tergisus</u>                   | 1           | 0.002               |
| Redhorse           | <u>Moxostoma</u> sp.                     | 1           | 0.002               |
| Golden shiner      | <u>Notemigonus crysoleucas</u>           | 1           | 0.002               |
| Hybrid bass        | <u>M. chrysops</u> x <u>M. saxatilis</u> | 1           | 0.002               |
| 1626               |                                          |             |                     |

Table 3. Total catch and catch per unit effort (fish/hour) of each fish species collected in a cove, opposite Cowboy's Restaurant, on Douglas Reservoir (Primary Netting Site 1, FBRM 34.5). The fish were primarily collected using experimental gill nets and occasionally standard gill nets. Gill netting occurred from December 15, 1990, to February 4, 1991, and March 4, May 30, and June 18, 1991, for a total of 116.21 net hours.

| Common Name     | Scientific Name                         | Total Catch | Number of Fish/Hour |
|-----------------|-----------------------------------------|-------------|---------------------|
| Gizzard shad    | <u>Dorosoma cepedianum</u>              | 425         | 3.66                |
| Carp sucker     | <u>Carpionodes</u> sp.                  | 30          | 0.26                |
| Black crappie   | <u>Pomoxis nigromaculatus</u>           | 20          | 0.17                |
| Sauger          | <u>Stizostedion canadense</u>           | 16          | 0.14                |
| Carp            | <u>Cyprinus carpio</u>                  | 9           | 0.08                |
| Largemouth bass | <u>Micropterus salmoides</u>            | 8           | 0.07                |
| White bass      | <u>Morone chrysops</u>                  | 7           | 0.06                |
| Freshwater drum | <u>Aplodinotus grunniens</u>            | 6           | 0.05                |
| Channel catfish | <u>Ictalurus punctatus</u>              | 6           | 0.05                |
| Saugeye         | <u>S. canadense</u> x <u>S. vitreum</u> | 3           | 0.03                |
| Goldfish        | <u>Carrassius auratus</u>               | 3           | 0.03                |
| Longnose gar    | <u>Lepisosteus osseus</u>               | 2           | 0.02                |
| White crappie   | <u>Pomoxis annularis</u>                | 2           | 0.02                |
| Bluegill        | <u>Lepomis macrochirus</u>              | 2           | 0.02                |
| Blue catfish    | <u>Ictalurus furcatus</u>               | 2           | 0.02                |
| Shortnose gar   | <u>Lepisosteus platostomus</u>          | 1           | 0.01                |
| Striped bass    | <u>Morone saxatilis</u>                 | 1           | 0.01                |
| Walleye         | <u>Stizostedion vitreum</u>             | 1           | 0.01                |
|                 |                                         | 544         |                     |

sauger were captured.

The CPUE for sauger at Primary Netting Site 2 (FBRM 55-56) was 0.69 fish/hour (Table 4). Sauger was the most commonly caught species at this site. They were caught in this area between February 1 and March 2, 1991, with netting success being highest from 1630 to 2000 hours. Sauger were captured in depths ranging from 1.5 to 5.5 m. This site was primarily located within the old river channel, just downstream from Nina Creek, and had a substrate consisting of clay and silt with exposed outcroppings of shale. Water temperatures ranged from 5.5-8 C on dates when sauger were caught.

The CPUE for sauger at the third primary netting site (FBRM 71-71.3) was only 0.19 fish/hour (Table 5). However, netting efforts were extremely impaired by rapid flows, rock hazards, and trash. Electro-shocking proved to be a better capture method at this site. The CPUE for sauger collected with electro-shocking equipment was 1.47 fish/hour (including a gravid female sauger caught on April 13, 1991). This CPUE value would have been even higher if all stunned sauger/saugeye were recovered but they were not due to rapid flows and rock hazards. Nevertheless, sauger densities were higher here than any other site, which along with other data, indicated that this was a spawning area. More saugeye than sauger (Tables 5 and 6) were collected with gill nets and electro-shocking equipment at this site. Sauger were collected here between April 5 and 18, 1991, with capture success being equally distributed from 1900 to 2300 hours. The depth of this area ranged from approximately 0.5 to 1.5 m deep. This site was located in a shoal just downstream of Rankin Bridge and had a substrate consisting of boulder,

Table 4. Total catch and catch per unit effort (fish/hour) of each fish species collected at the mouth of Nina Creek in Douglas Reservoir (Primary Netting Site 2, FBRM 55-56). The fish were primarily collected using experimental gill nets and occasionally standard gill nets. Gill netting occurred on November 24, 1990, and February 1 thru March 2, 1991, for a total of 33.23 net hours.

| Common Name      | Scientific Name                         | Total Catch | Number of Fish/Hour |
|------------------|-----------------------------------------|-------------|---------------------|
| Sauger           | <u>Stizostedion canadense</u>           | 23          | 0.69                |
| Freshwater drum  | <u>Aplodinotus grunniens</u>            | 21          | 0.63                |
| Gizzard shad     | <u>Dorosoma cepedianum</u>              | 17          | 0.51                |
| Carp             | <u>Cyprinus carpio</u>                  | 13          | 0.39                |
| Largemouth bass  | <u>Micropterus salmoides</u>            | 6           | 0.18                |
| Bluegill         | <u>Lepomis macrochirus</u>              | 6           | 0.18                |
| Carp sucker      | <u>Carpionodes</u> sp.                  | 3           | 0.09                |
| Saugrey          | <u>S. canadense</u> x <u>S. vitreum</u> | 3           | 0.09                |
| White bass       | <u>Morone chrysops</u>                  | 1           | 0.03                |
| Channel catfish  | <u>Ictalurus punctatus</u>              | 1           | 0.03                |
| Flathead catfish | <u>Pylodictis olivaris</u>              | 1           | 0.03                |
| Yellow bullhead  | <u>Ictalurus natalis</u>                | 1           | 0.03                |
| Mooneye          | <u>Hiodon tergisus</u>                  | 1           | 0.03                |
|                  |                                         | 97          |                     |

Table 5. Total catch and catch per unit effort (fish/hour) of each fish species collected near the Rankin Bridge (Primary Netting Site 3, FBRM 71-71.3). The fish were collected using experimental gill nets. Gill netting occurred on April 10 and 11, 1991, for a total of 5.18 net hours.

| Common Name     | Scientific Name                                   | Total Catch | Number of Fish/Hour |
|-----------------|---------------------------------------------------|-------------|---------------------|
| White Bass      | <u>Morone chrysops</u>                            | 13          | 2.51                |
| Saugeye         | <u>Stizostedion canadense</u> x <u>S. vitreum</u> | 6           | 1.16                |
| Carp sucker     | <u>Carpiodes</u> sp.                              | 4           | 0.77                |
| Channel Catfish | <u>Ictalurus punctatus</u>                        | 3           | 0.58                |
| Sauger          | <u>Stizostedion canadense</u>                     | 1           | 0.19                |
| Gizzard Shad    | <u>Dorosoma cepedianum</u>                        | 1           | 0.19                |
|                 |                                                   | 28          |                     |

Table 6. Total catch and catch per unit effort (fish/hour) of sauger and saugeye collected near the Rankin Bridge (FBRM 71-71.3). The fish were collected by electro-shocking. Electro-shocking began April 4 and ended on April 18, 1991, for a total of 4.75 hours.

| Common Name | Scientific Name                                   | Total Catch | Number of Fish/Hour |
|-------------|---------------------------------------------------|-------------|---------------------|
| Saugeye     | <u>Stizostedion canadense</u> x <u>S. vitreum</u> | 9           | 1.89                |
| Sauger      | <u>Stizostedion canadense</u>                     | 7           | 1.47                |
|             |                                                   | 16          |                     |

cobble, and sand. Current velocity at this site ranged from 0.2 to 0.4 m/second. The optimal velocity for sauger spawning is 0.09 to 0.61 m/second as reported by Crance (1986). Water temperatures ranged from 14 to 17.3 C on dates when sauger were captured.

The CPUE for sauger at the fourth primary netting site (FBRM 45.5) was 0.25 fish/hour (Table 7). Saugeye were also radio tagged at this time and their catch per unit effort was 0.23 fish/hour. Both sauger and saugeye were caught at this site between June 6 and July 13, 1991, with netting success being highest from 2030 to 2130 hours. Sauger and saugeye were captured in depths of 2.75 to 8 m. This site was located at the mouth of a cove, near the Dandridge Boat Dock, and had a substrate consisting of clay, silt, boulders, and shale. Water temperatures ranged from 24.9 to 28.7 C on dates that sauger were captured. Mortality for gill-netted sauger and saugeye was 25 and 47%, respectively. No net mortality was recorded from other sites.

The presence of a high percentage of saugeye (36% of all Stizostedion sp. captured) may indicate a lack of potential mates of the same species for sauger and walleye (Karr 1981). Nelson (1977) observed that hybrids of saugers and walleyes are not uncommon in Lewis and Clark Lake. He states hybridization probably occurs because the spawning area for these species is limited and the spawning seasons overlap. Over 50% of the Stizostedion sp. collected in the spawning area at FBRM 71 were saugeye; in addition, 50% of the those caught at FBRM 45.5 in June and July were saugeye. They were caught at every primary netting site along with sauger. Swenson and Smith (1976); Ali et al. (1977); Collette et al. (1977); and Fitz and Holbrook (1978)

Table 7. Total catch and catch per unit effort (fish/hour) of each fish species collected near the Dandridge Boat Dock in Douglas Reservoir (Primary Netting Site 4, FBRM 45.5). The fish were primarily collected using experimental gill nets and occasionally standard gill nets. Gill netting began June 6 and ended on July 13, 1991, for a total of 81.05 net hours.

| Common Name        | Scientific Name                          | Total Catch | Number of Fish/Hour |
|--------------------|------------------------------------------|-------------|---------------------|
| Gizzard shad       | <u>Dorosoma cepedianum</u>               | 497         | 6.13                |
| White bass         | <u>Morone chrysops</u>                   | 54          | 0.67                |
| White crappie      | <u>Pomoxis annularis</u>                 | 51          | 0.63                |
| Freshwater drum    | <u>Aplodinotus grunniens</u>             | 39          | 0.48                |
| Carp sucker        | <u>Carpiodes</u> sp.                     | 30          | 0.37                |
| Sauger             | <u>Stizostedion canadense</u>            | 20          | 0.25                |
| Saugeye            | <u>S. canadense</u> x <u>S. vitreum</u>  | 19          | 0.23                |
| Channel catfish    | <u>Ictalurus punctatus</u>               | 16          | 0.20                |
| Smallmouth buffalo | <u>Ictiobus bubalus</u>                  | 11          | 0.14                |
| Shortnose gar      | <u>Lepisosteus platostomus</u>           | 5           | 0.06                |
| Carp               | <u>Cyprinus carpio</u>                   | 4           | 0.05                |
| Largemouth bass    | <u>Micropterus salmoides</u>             | 4           | 0.05                |
| Blue catfish       | <u>Ictalurus furcatus</u>                | 2           | 0.02                |
| Walleye            | <u>Stizostedion vitreum</u>              | 2           | 0.02                |
| Black crappie      | <u>Pomoxis nigromaculatus</u>            | 1           | 0.01                |
| Bluegill           | <u>Lepomis macrochirus</u>               | 1           | 0.01                |
| Golden shiner      | <u>Notemigonus crysoleucas</u>           | 1           | 0.01                |
| Hybrid bass        | <u>M. chrysops</u> x <u>M. saxatilis</u> | 1           | 0.01                |
|                    |                                          | 757         |                     |

all stated that walleye and sauger are different in distribution when found in the same body of water. This study indicates that hybrids of these two species, i.e., saugeye, more closely resemble the sauger in distribution. The presence of a large number of hybrids at the spawning ground may affect reproductive success, since not all saugeye are fertile (M. Smith, TWRA, 1991, personal communication).

Catch per unit effort (CPUE) and cove rotenone data indicate that sauger are continuing to decline in Douglas Reservoir. Creel data are less reliable since creel clerks infrequently check anglers in the headwaters of Douglas Reservoir where the sauger fishery is concentrated. TVA reported that CPUE for sauger, using experimental gill nets, from Douglas Reservoir was 3.7 and 1.4 fish/net night for 1989 and 1990, respectively (Hickman et al. 1991). In 1991, the TVA catch per unit effort for sauger in Douglas Reservoir dropped to 0.87 fish/net night (0.04 sauger/hour). The catch per unit effort for sauger from Douglas Reservoir in this study was 0.14 fish/hour.

The Tennessee Wildlife Resources Agency collected 43 young-of-year sauger in 1990 but only one in 1991. The 43 young-of-year collected in 1990 are probably the offspring of sauger stocked in 1986 and 1987. Numbers of young-of-year collected in 1991 probably declined due to a decrease in numbers of surviving stocked fish. The stocked fish were four and five years of age in 1991. Hackney and Holbrook (1978) stated that few sauger attain age three and practically none survive to age four and five. The sauger population may increase when the 1990 year class collected in this study reproduce in 1992 and 1993.

### Sauger Movements

Maps and data showing movements of individual radio-tagged fish from December 1990 to October 1991 can be found in Appendix A (pages 49-103). The 29 sauger and saugeye carrying radio transmitters were tracked a mean number of 76 days with a mean number of 12 observations per fish. These averages include two fish which were each located only 2 times for 6 and 16 days after tagging, respectively. One fish was never found after tagging and was not included in the above averages.

Six of the eight fish tagged in December, 1990, at FBRM 34.5 were tracked out of the tagging area by January 1, 1991. During this period of time the tagged fish moved upstream showing a strong affinity for the old river channel. Two sauger #48.640 and #48.590, after moving upstream to FBRM 40.5 and 36.5, respectively, returned downstream and were located in the forebay of Douglas Dam. Sauger #48.590 passed through one of the turbine intakes of the dam between January 9 and 13, 1991. (Other sauger tagged in this study may have passed through Douglas Dam as well). The sluice gates of Douglas Dam were not open, not even for testing, during this period of time (Felts, TVA, 1992, personal communication). Turbine discharge for January 9 to 13 ranged from 1,668 to 15,568 cfs. The powerhouse was discharging water continuously except for part of Saturday, January 12. Fish #48.590 was located by airplane, 4.0 km downstream of Douglas Dam near Saffel Island. This sauger was later tracked upstream to FBRM 32.1 proving it had survived passage through the dam.

Passage of sauger through Douglas Dam was previously documented by Yeager and Tomljanovich (1990). Their fish were marked with spaghetti tags so it was not

known exactly when or where these fish passed through the dam. Sauger have been observed moving upstream through navigation locks in dams located on mainstream reservoirs (Scott and Hevel 1991). It is not possible for sauger to migrate upstream through Douglas Dam since it has no navigation lock. Dam passage by sauger may represent an important source of recruitment for the tailwater population. Conversely, sauger are lost through dam passage from Douglas Reservoir to the tailwater.

Sauger #48.640 left the forebay of the dam and was tracked upstream and downstream from January to early March, 1991. This fish was last located on March 4 at FBRM 34.5, near where it was originally tagged. It had moved a total of 97.0 km yet was never observed upstream of Indian Creek, FBRM 50.

Sauger #48.660, #48.700, and #48.720 were tracked upstream to Henderson Island (FBRM 43.5) or the Dandridge area (FBRM 45) during January, 1991. Fish #48.660 disappeared in this area on January 1. Sauger #48.700 and #48.720 did not move from this area before March and April when their signals were no longer received. It was in January that a commercial gill net fishermen reported to Jim Negus, UT fisheries graduate student, that he had caught a radio-tagged sauger in the Henderson Island or Dandridge area. Commercial gill net fishermen were frequently observed running nets in the old river channel near Henderson Island and Dandridge during January, 1991.

Sauger #48.910 never moved from the tagging site at FBRM 34.5. Fish #48.960, after staying very near the capture site for 6 days, disappeared from the study area. These two fish are not represented in Appendix A since no movement was recorded. Of

the original eight fish tagged at this site, only #48.830 continued to move upstream past Dandridge and Indian Creek during February, 1991.

The second group of 14 sauger were tagged between January 30 and March 4, 1991. This group consisted of 6 males, 7 females, and one fish of unidentified sex. Two of these sauger, #49.150 and #48.840, were tagged at FBRM 34.5. These fish quickly moved upstream during February and were located with #48.830 between FBRM 62 and 65 from February 24 to 27, 1991. These three sauger were joined by fish #48.930, #48.950, #48.990, #48.860, #48.790, and #48.880. These fish were tagged at FBRM 55-56, moved upstream during February, and were located between FBRM 60 and 68 from February 24 to 27. This group of 9 fish represented the largest concentration of tagged sauger during the study. The transmitter signal from fish #49.150 was last received at FBRM 64.4 on March 9.

Five of the eight remaining fish in this area were males (#48.840, #48.860, #48.990, #48.930, #48.790) and moved upstream during March to FBRM 69, opposite the mouth of the Nolichucky River. These males were located primarily in this area between March 26 and 30. They were joined by #48.830, probably a male, which disappeared near FBRM 69.8 on April 6. This area consisted of a shoal 1-2 m deep bordered upstream and downstream by pools 4 to 5 m deep. This type of habitat, a shoal with an adjacent deep pool upstream, is believed to be the favored spawning habitat of sauger in reservoir headwaters (Hevel 1991). It is believed that sauger stage in pools during the day and spawn in shoals at night. One sauger egg was collected here in late March (Skelton 1992).

Between March 30 and April 5 this area increased 4 m in depth due to heavy precipitation in the upstream watershed and discharge retention at Douglas Dam. The five radio-tagged male sauger moved upstream to the next shoal located at FBRM 71-71.3 near the Rankin Bridge by April 5. It is probable that the sudden increase in depth and change in flow disturbed spawning at the first shoal causing the sauger to move upstream. Nelson (1968 and 1969); Walburg (1972); Busch et al (1975); and Saylor et al (1983) all suggested water level fluctuations and flow velocity may effect sauger spawning behavior.

The FBRM 71-71.3 shoal, 0.5 to 1.5 m in depth, did not have a deep pool nearby. The males seemed to be using the Rankin Bridge as cover during the day and moved out from under it as the sun set. Ali et al. (1977) and Collette et al. (1977) both found sauger to be light-sensitive which may explain the use of the Rankin Bridge as cover, or as a substitute for a deep pool, during the day. Tagged male sauger were observed in this area from April 5 with the last males observed here on April 15. Sauger eggs were collected at this site from April 5 to April 16 (Skelton 1992). Four of these males returned downstream, except for #48.790 which disappeared from the Rankin area on April 6, 1991. Fish #48.930 made a brief foray 1.0 km up the Nolichucky River after leaving Rankin but then returned to Douglas Reservoir. This was the only radio-tagged sauger observed in the Nolichucky River.

Seven female sauger (#48.950, #49.250, #49.200, #48.970, #48.820, #48.880, and #48.810) were radio tagged. Only #48.880 was observed as far upstream as FBRM 69, and later at FBRM 74.4, during March and early April. On April 6 this female was

observed back in the reservoir at FBRM 59.5.

All six of the other female sauger were never observed near FBRM 69 or 71 where spawning was occurring. Several of these fish were not located after March. It is also possible that some or all of these females were sexually immature although big enough to tag. Carlander (1949), Carufel (1963), Nelson (1969), Priegel (1969), Hackney and Holbrook (1978) reported that female sauger mature later than males. Hassler (1958) found 65% of two-year olds, 84% of three-year olds, and 98% of four-year old female sauger mature in Norris Reservoir. Sexual immaturity is one possible explanation why these fish did not move upstream to spawn.

Four sauger and four saugeye were caught and radio-tagged in June and July, 1991, near FBRM 45.5. These fish showed less movement than fish tagged in winter or spring. They also showed a stronger preference for cove habitat. Three sauger and one saugeye were tagged with temperature-sensing transmitters at this time. They were found in water with temperatures ranging from 25 to 28.5 C. This temperature range surpasses the upper physiological optimum of 22 C for sauger (Hokanson 1977). All eight of the fish tagged in June or July were presumed dead in August and September due to lack of movement. Dead fish, including sauger, were observed in the transition zone of Douglas Reservoir in late August. Low dissolved oxygen and high water temperatures may have caused these fish to die (E. Scott, TVA, 1991, personal communication). Four of the transmitters placed on fish in June/July were recovered along the shoreline in October 1991 when the reservoir level dropped. This data supports TWRA's contention that sauger may have difficulty surviving in the less than

optimum water temperatures and dissolved oxygen of the middle and lower areas of Douglas Reservoir.

### Age and Growth

Scales were taken from 56 sauger collected in Douglas Reservoir in 1991 for age and growth analysis. Five year classes (young-of-year to age four) were identified in the sample. The 1990 year class (one-year-old sauger ) represented 57% (N=32) of the sample. Only one young-of-year sauger was collected in 1991. Male sauger were collected in a 2:1 ratio over females.

### **Back-Calculated Lengths**

Average back-calculated lengths for each age class of sauger can be found in Table 8. Average annual increments of back-calculated lengths for each age class of sauger can be found in Table 9. The growth rate of Douglas Reservoir sauger was greater than sauger collected in northern lakes (Carlander 1949; Nelson 1969). Douglas growth rates also surpassed sauger growth rates recorded in Norris Reservoir (Hassler 1957). Stroud (1949) calculated average lengths of one- and two-year-old sauger from Douglas Reservoir at 211 and 333 mm, respectively. Back-calculated lengths for one- and two-year-old sauger from this sample were calculated at 209 and 322 mm, respectively. Growth of Douglas Reservoir sauger collected in 1991 was less than average growth of sauger collected by TVA from all Tennessee River storage reservoirs. Age classes one and two from this sample were also less than mainstream reservoir growth rates but greater growth rates were exhibited by year classes three and four of this sample.

Table 8. Average back-calculated lengths (mm) for each age class of sauger collected from Douglas Reservoir in 1991.

| Year<br>Class | Age | N  | Back-calculation Age |        |        |        |
|---------------|-----|----|----------------------|--------|--------|--------|
|               |     |    | 1                    | 2      | 3      | 4      |
| 1990          | 1   | 32 | 191.99               |        |        |        |
| 1989          | 2   | 6  | 235.45               | 349.62 |        |        |
| 1988          | 3   | 13 | 239.60               | 319.53 | 390.87 |        |
| 1987          | 4   | 4  | 199.17               | 286.47 | 372.44 | 419.20 |
| All Classes   |     |    | 208.51               | 321.63 | 386.53 | 419.20 |
| N             |     |    | 56                   | 55     | 23     | 17     |
|               |     |    |                      |        |        | 4      |

Table 9. Average annual increments (mm) of back-calculated lengths for each age class of sauger collected from Douglas Reservoir in 1991.

| Year<br>Class | Age | N  | Back-calculation Age |        |       |       |
|---------------|-----|----|----------------------|--------|-------|-------|
|               |     |    | 1                    | 2      | 3     | 4     |
| 1990          | 1   | 32 | 191.99               |        |       |       |
| 1989          | 2   | 6  | 235.45               | 114.16 |       |       |
| 1988          | 3   | 13 | 239.60               | 79.93  | 71.34 |       |
| 1987          | 4   | 4  | 199.17               | 87.30  | 85.97 | 46.76 |
| All Classes   |     |    | 208.51               | 90.14  | 74.78 | 46.76 |
| N             |     | 56 | 55                   | 23     | 17    | 4     |

### Relative Weight ( $W_r$ )

Relative weights were calculated for prespawn, spawning, and postspawn adult sauger (Figure 5). The  $W_r$  value of 114 for prespawn adults exceeds the "typical" value of 100 plus or minus five for sauger as established by Anderson (1980). This value is probably inflated due to the prespawn condition of female fish. The spawning relative weight value of 93 is less than the "typical" value and is probably the result of stress associated with spawning and a high number of males in the sample. Postspawn fish exhibited a "typical"  $W_r$  value of 98. Wahl et al. (1985) found the same decline and eventual increase in weight of adult sauger during prespawn, spawn, and postspawn months in the Ohio River.

Relative weight was also calculated for one-, two-, three- and four-year old sauger. The  $W_r$  value for one-year old fish was 82. This value is below "typical" weight and may reflect an emphasis of growth in length versus weight gain for this age class of sauger. Relative weight values for age two ( $W_r=96$ ), age three ( $W_r=101$ ), and age four ( $W_r=104$ ) fall within the "typical" range for sauger.

## RELATIVE WEIGHT OF SAUGER - 1991

DOUGLAS RESERVOIR

RELATIVE WEIGHT

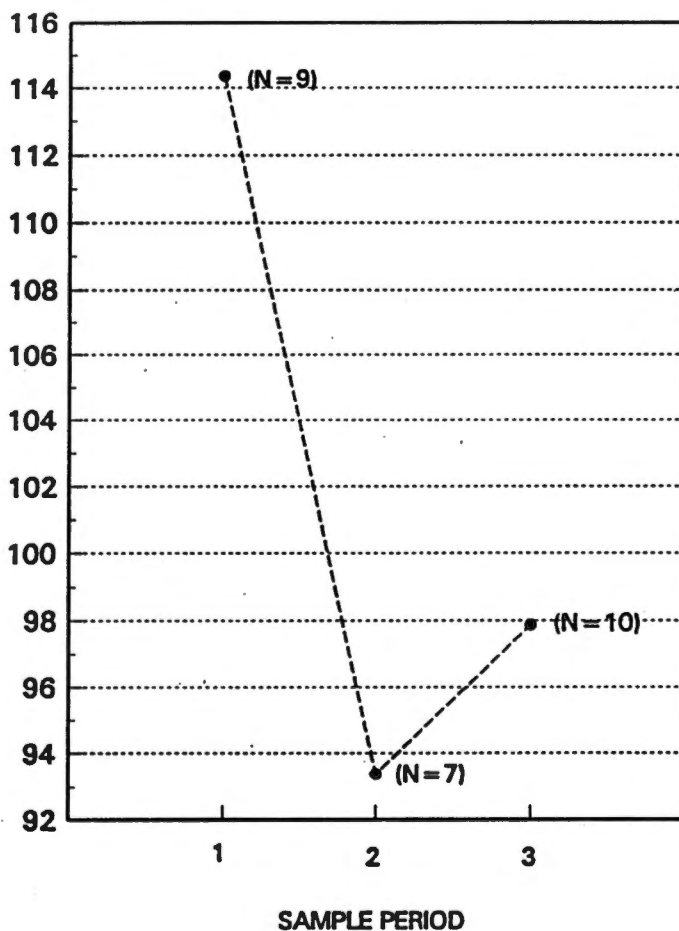


Figure 5. Relative weight of sauger ( $\geq 2$  years old) collected from Douglas Reservoir in 1991. Sample period 1 (February & March, 1991); sample period 2 (April, 1991); sample period 3 (June & July, 1991).

## CHAPTER 5

### SUMMARY AND RECOMMENDATIONS

The CPUE for sauger during the course of this study was 0.14 fish/hour. The highest CPUE of fish/hour for sauger was recorded at FBRM 71-71.3, a probable spawning site. Net mortality was relatively high (sauger=25%; saugeye=47%) during June and July at FBRM 45.5. Saugeye made up at least 36% of the total number of Stizostedion sp. captured and approximately 50% of the total after the first saugeye was positively identified in February.

Radio-tagged male sauger moved upstream and were found in a shoal area at FBRM 69 between March 26 and 30. Concurrent with a change in depth at this site was an upstream move by the males to the next shoal at FBRM 71. They were found at this shoal on April 5 and were last observed at this site on April 15. Sauger eggs were collected at both shoals when males were present (Skelton 1992). Tagged female sauger were not observed at these shoals except for fish #48.880. The other females may have been sexually immature. Some females disappeared from the study area in March.

One sauger was tracked through Douglas Dam in January, 1991. This fish passed through one of the turbine intakes (i.e., the sluice gates were not opened at this time) and survived.

Sauger and saugeye tagged in June and July moved less than fish tagged in winter and spring. Fish tagged with temperature-sensing transmitters were found in 25 to 28.5 C water. All fish tagged in June or July were presumed dead in August and September due to lack of movement.

due to lack of movement.

Relative weights of Douglas Reservoir sauger were "typical" or showed normal fluctuations according to season or year class. Growth rates compared favorably to northern sauger and were similar to previous records from Douglas Reservoir. However, back-calculated lengths were below average compared to sauger from other TVA storage reservoirs.

The following recommendations are suggested to improve the sauger fishery in Douglas Reservoir.

1. Walleye or saugeye should not be stocked in Douglas Reservoir due to hybridization and competition with sauger at spawning sites.
2. Radio-tagging of walleye and sauger prior to their respective spawning seasons would provide additional data on potential hybridization and competition at spawning sites in the headwaters of Douglas Reservoir.
3. The reservoir level could be manipulated so the depth of the shoal at FBRM 68-69 remains relatively constant during sauger spawning (March and April). Sauger spawning was disturbed at this site in 1991 due to a 4-m increase in depth and a change in flow between March 26 and March 30.
4. Any alterations to potential sauger spawning habitat in the headwaters of Douglas Reservoir should be carefully considered.
5. Radio-tagging of sauger in the inflow, transition, and forebay areas of Douglas Reservoir in the summer (July-September) would show how well

sauger survive in less than optimal environmental conditions (such as high temperature and low dissolved oxygen) in different parts of the lake.

6. The possibility of refuge areas being used by sauger in the summer months, such as springs, should be investigated.

A number of questions arose during this project which were not addressed and should be considered by biologists managing Douglas Reservoir.

1. Future sauger stocking should be considered in order to sustain consistent year-to-year reproduction in Douglas Reservoir. (Successful reproduction occurred in 1990 from sauger stocked in 1986 and 1987). Cove rotenone results will help determine the continued need for future stocking.
2. Declining populations of walleye in some southeastern reservoirs were restored from stockings of northern strains (Hackney and Holbrook 1978). The same strategy might be applied to sauger if a northern, lake-adapted source of fish could be found.
3. A creel clerk checking anglers at the Highway 25E Bridge, Leadvale, and Rankin areas between February 1 and May 1 would give more accurate information on harvest of sauger.
4. Douglas Reservoir may need to be closed to sauger fishing in certain years or seasons in order to rebuild the population. Closure could be based on creel and cove rotenone data.
5. Gill netting by commercial fishermen should be prohibited (or restricted)

in the old river channel during sauger spawning migrations (January-April).

6. The French Broad River should be monitored for sources of pollution by the Tennessee Department of Environmental Health and Conservation and efforts continued to ensure suitable water quality for aquatic organisms. Surveillance of the Pigeon River, especially the Champion Paper Mill, should continue.

The following studies would provide useful data in understanding and improving the sauger population in Douglas Reservoir.

1. A study should be conducted to determine the effects of sedimentation on sauger spawning in the Nolichucky River and the headwaters of Douglas Reservoir. Sauger could potentially spawn in the Nolichucky.
2. A radiotelemetry and stomach analysis study on white bass would provide data on possible competition with and predation of sauger.

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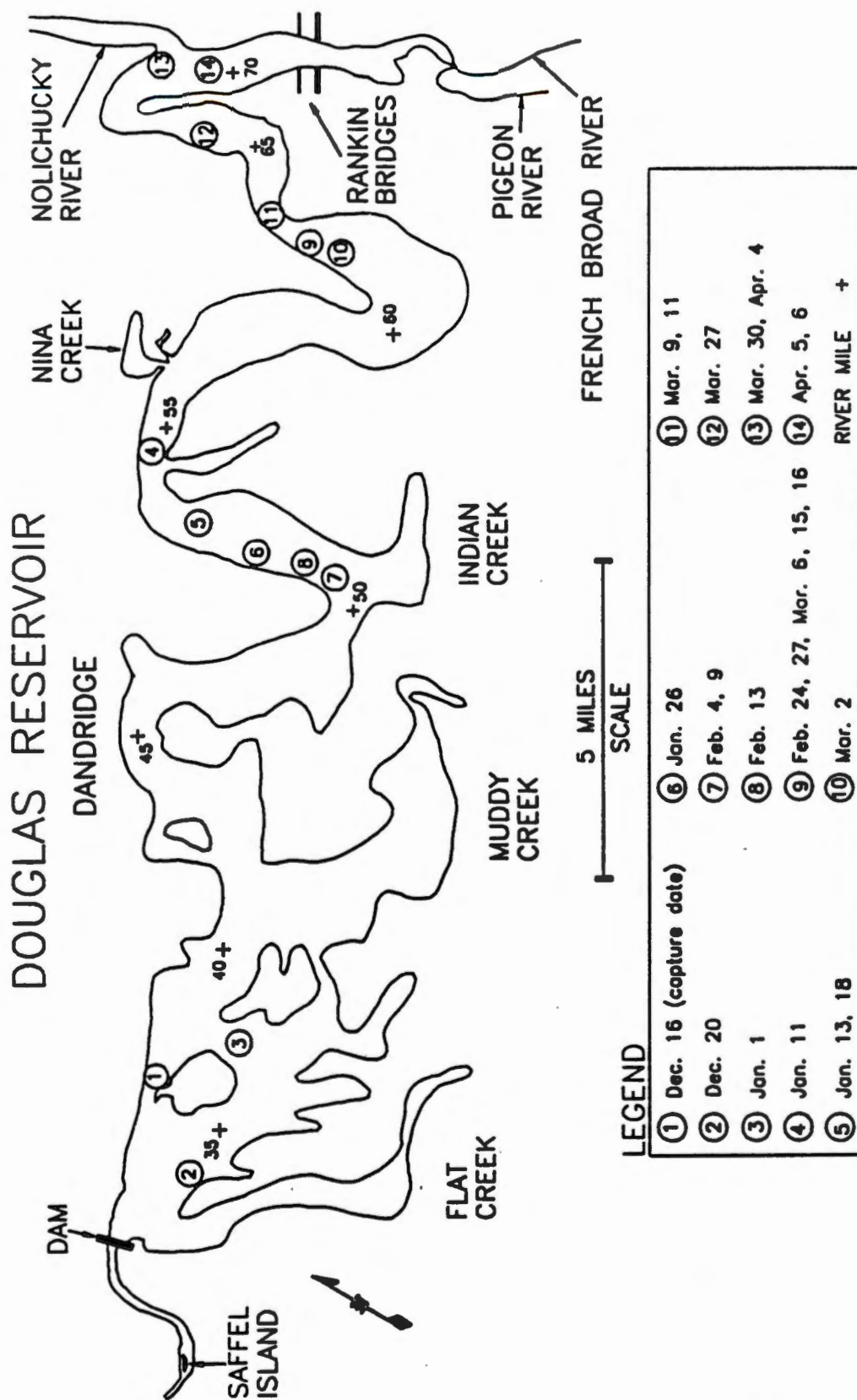
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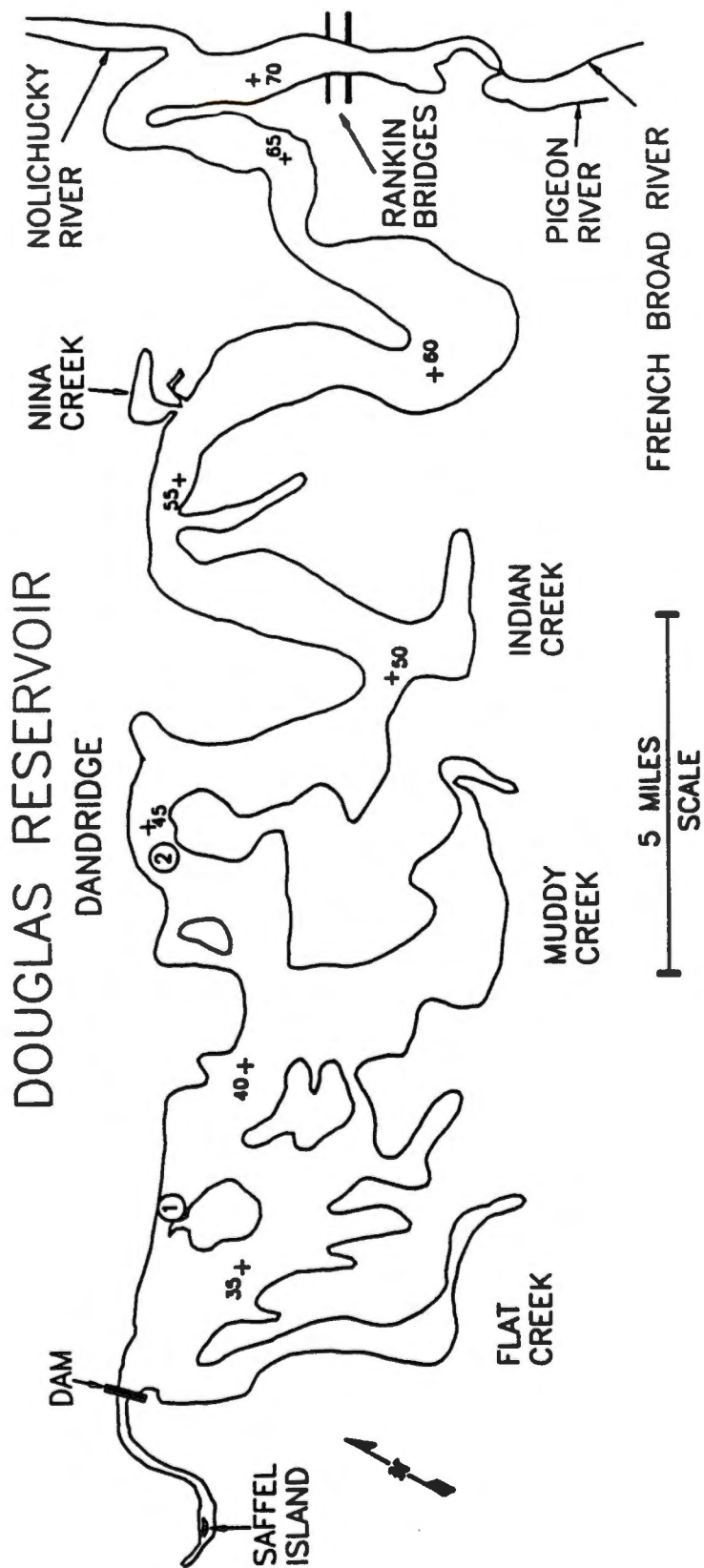


Appendix A.1. Movement of sauger #48.830 from Dec. 16, 1990, to April 6, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.1. Movement data for sauger #48.830.

Species: Sauger  
 Transmitter Frequency/Transmitter Type: 48.830  
 Capture Location: Cove near RM 34.5, across from Cowboy's Restaurant  
 Capture Date: 12-16-90  
 Total Length (mm): 480  
 Weight (g): 1070  
 Sex: Unknown  
 Tracking Duration: 12-16-90 to 04-06-91, 111 days  
 Number of Observations: 22  
 Total River Miles (RM) Traveled: 46

| Date     | Time | RM   | Location                                                     | Comments                                        |
|----------|------|------|--------------------------------------------------------------|-------------------------------------------------|
| 12-20-90 | 1615 | 34   | Southwest bank                                               | Boat                                            |
| 01-01-91 | 1115 | 37   | Channel                                                      | Boat                                            |
| 01-11-91 | 1210 | 54.5 | Channel, I-40 Bridge                                         | Boat                                            |
| 01-13-91 | 1140 | 53.2 | Channel                                                      | Aerial                                          |
| 01-18-91 | 1150 | 53.2 | Northwest bank, just downstream from Douglas Lake Campground | Boat                                            |
| 01-26-91 | 1105 | 52.2 | Northwest bank, Pt. 15                                       | Aerial                                          |
| 02-04-91 | 1030 | 50.5 | Channel, Pt. 14, near Indian Cr.                             | Boat                                            |
| 02-09-91 | 1115 | 50.5 | "                                                            | Aerial                                          |
| 02-13-91 | 1600 | 51   | Northwest bank, Pt. 15                                       | Boat                                            |
| 02-24-91 | 1045 | 63.5 | Channel, Pt. 19                                              | Aerial                                          |
| 02-27-91 | 1710 | 63.5 | Channel, Pt. 19                                              | Boat                                            |
| 03-02-91 | 1645 | 62.8 | Channel, opposite double silo                                | Boat, with #48.860                              |
| 03-06-91 | 1745 | 63.5 | Channel, Pt. 19                                              | Boat, with #48.990                              |
| 03-09-91 | 1045 | 64.1 | Channel, just downstream from Walter's Bridge                | Aerial, with #49.150                            |
| 03-11-91 | 1745 | 64.1 | "                                                            | Boat                                            |
| 03-15-91 | 1900 | 63.7 | Channel, Pt. 19                                              | Boat                                            |
| 03-16-91 | 1100 | 63.7 | "                                                            | Aerial                                          |
| 03-27-91 | 1800 | 66.2 | Channel, upstream from island                                | Boat                                            |
| 03-30-91 | 1100 | 68.8 | Near mouth of Nolichucky                                     | Aerial, with #48.860, #48.930, #48.990, #48.790 |
| 04-04-91 | 2000 | 68.8 | "                                                            | Boat, others gone                               |
| 04-05-91 | 1800 | 69.8 | Near McCowan Creek                                           | Boat, #48.930 far away                          |
| 04-06-91 | 0945 | 69.8 | "                                                            | Aerial                                          |



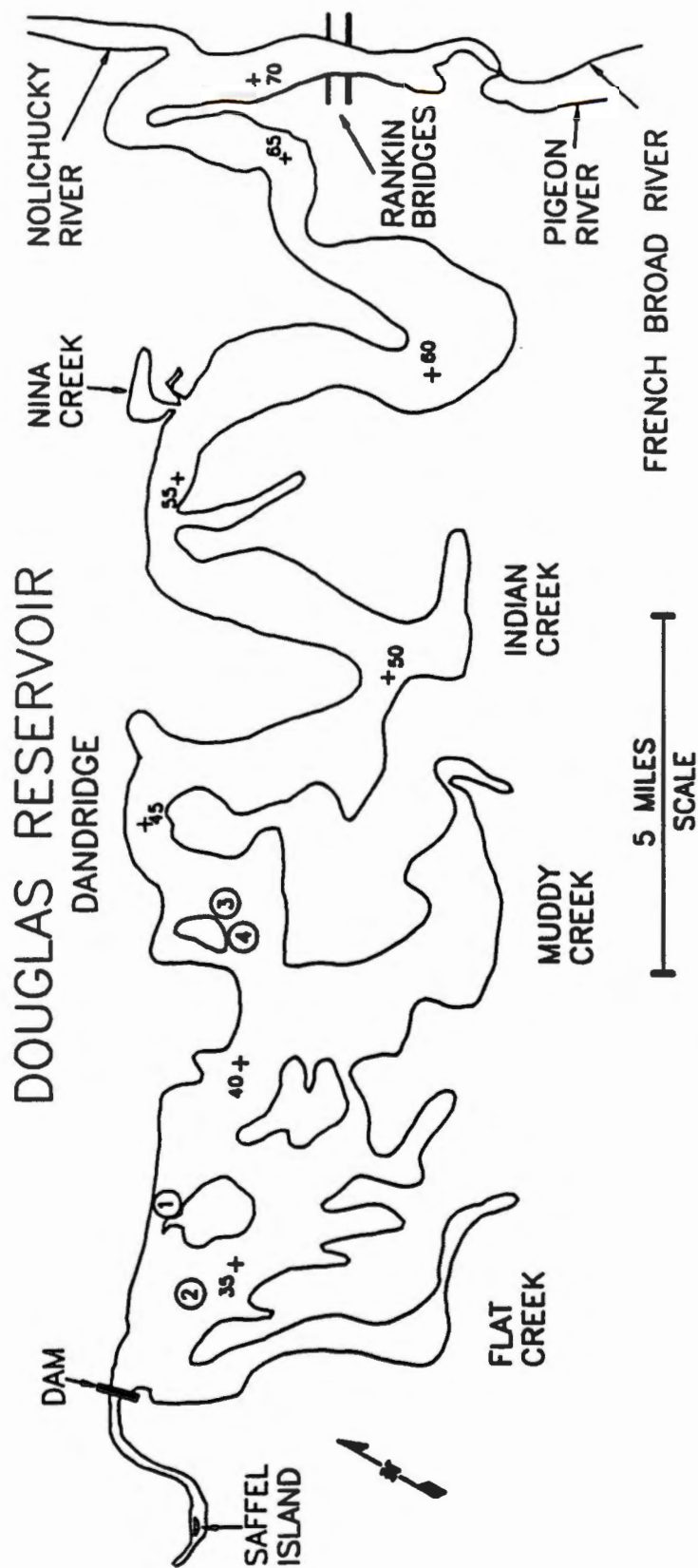
# LEGEND

- |                          |              |
|--------------------------|--------------|
| ① Dec. 16 (capture date) | RIVER MILE + |
| ② Jan. 1                 |              |

Appendix A.2. Movement of sauger #48.660 from Dec. 16, 1990, to January 1, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.2. Movement data for sauger #48.660.

| Species: Sauger                                                      |      |      |                         | Number of Observations: 1<br>Total River Miles (RM) Traveled: 10 |
|----------------------------------------------------------------------|------|------|-------------------------|------------------------------------------------------------------|
| Transmitter Frequency/Transmitter Type: 48.660                       |      |      |                         |                                                                  |
| Capture Location: Cove near RM 34.5, across from Cowboy's Restaurant |      |      |                         |                                                                  |
| Capture Date: 12-16-90                                               |      |      |                         |                                                                  |
| Total Length (mm): 460                                               |      |      |                         |                                                                  |
| Weight (g): 1130                                                     |      |      |                         |                                                                  |
| Sex: Unknown                                                         |      |      |                         |                                                                  |
| Tracking Duration: 12-16-90 to 01-01-91, 16 days                     |      |      |                         |                                                                  |
| Date                                                                 | Time | RM   | Location                | Comments                                                         |
| 01-01-91                                                             | 1410 | 44.5 | Channel, right at Pt. 9 | Boat, commercial gill net fishermen working this area            |



# LEGEND

|                          |                    |
|--------------------------|--------------------|
| ① Dec. 16 (capture date) | ④ Jan. 6 - Mar. 16 |
| ② Dec. 20                |                    |
| ③ Jan. 1, 4              | RIVER MILE +       |

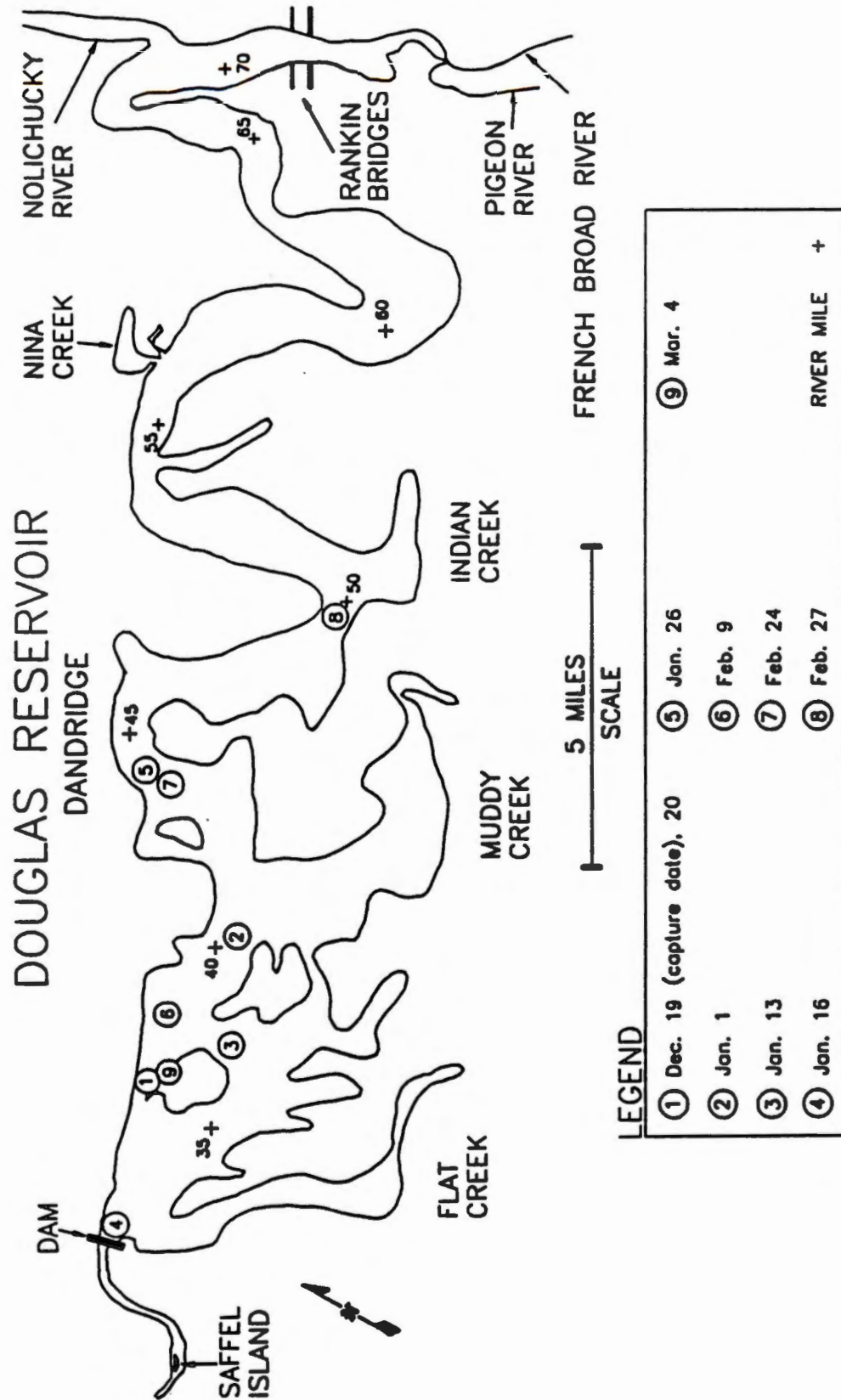
Appendix A.3. Movement of sauger #48.700 from Dec. 16, 1990, to Mar. 16, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.3. Movement data for sauger #48.700.

Species: Sauger  
Transmitter Frequency/Transmitter Type: 48.700  
Capture Location: Cove near RM 34.5, across from Cowboy's Restaurant  
Capture Date: 12-16-90  
Total Length (mm): 480  
Weight (g): 1270  
Sex: Unknown  
Tracking Duration: 12-16-90 to 03-16-91, 90 days

Number of Observations: 14  
Total River Miles (RM) Traveled: 10.5

| Date     | Time | RM   | Location                     | Comments                                              |
|----------|------|------|------------------------------|-------------------------------------------------------|
| 12-20-90 | 1615 | 34   | North of channel             | Boat                                                  |
| 01-01-91 | 1230 | 43.5 | Near bank next to Henderson  | Boat, commercial gill net fishermen working this area |
|          |      |      | Island State Wildlife Refuge |                                                       |
| 01-04-91 | 1345 | 43.5 | "                            | Boat                                                  |
| 01-06-91 | 1400 | 43   | "                            | Boat                                                  |
| 01-09-91 | 1200 | 43   | "                            | Boat                                                  |
| 01-11-91 | 1130 | 43   | "                            | Boat                                                  |
| 01-13-91 | 1135 | 43   | "                            | Aerial                                                |
| 01-18-91 | 1300 | 43   | "                            | Boat                                                  |
| 01-26-91 | 1100 | 43   | "                            | Aerial                                                |
| 01-30-91 | 1600 | 43   | "                            | Boat                                                  |
| 02-09-91 | 1110 | 43   | "                            | Aerial                                                |
| 02-27-91 | 1530 | 43   | "                            | Boat                                                  |
| 03-09-91 | 1115 | 43   | "                            | Aerial                                                |
| 03-16-91 | 1030 | 43   | "                            | Aerial                                                |



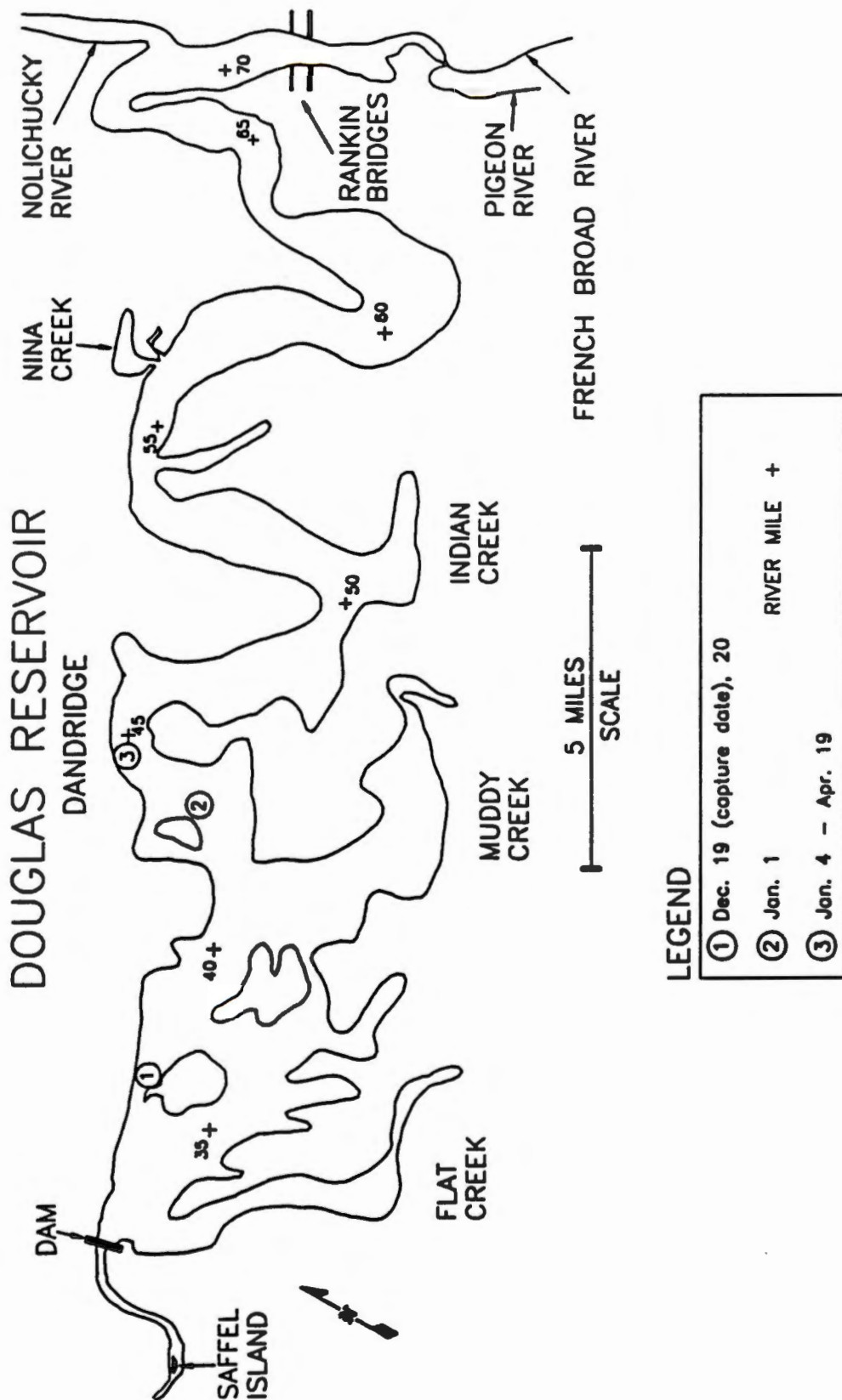
Appendix A.4. Movement of sauger #48.640 from Dec. 19, 1990, to Mar. 4, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.4. Movement data for sauger #48.640.

Species: Sauger  
 Transmitter Frequency/Transmitter Type: 48.640  
 Capture Location: Cove near RM 34.5, across from Cowboy's Restaurant  
 Capture Date: 12-19-90  
 Total Length (mm): 500  
 Weight (g): 1290  
 Sex: Unknown  
 Tracking Duration: 12-19-90 to 03-04-91, 75 days

Number of Observations: 9  
 Total River Miles (RM) Traveled: 60.4

| Date     | Time | RM   | Location                                                  | Comments |
|----------|------|------|-----------------------------------------------------------|----------|
| 12-20-90 | 1615 | 34.5 | Capture site                                              | Boat     |
| 01-01-91 | 1200 | 40.5 | Channel, Pt. 6                                            | Boat     |
| 01-13-91 | 1130 | 36.7 | Channel, Pt. 3                                            | Aerial   |
| 01-16-91 | 1300 | 32.5 | Forebay of Douglas Dam                                    | Boat     |
| 01-26-91 | 1100 | 44.7 | Channel, just downstream from<br>Dandridge Municipal Park | Aerial   |
| 02-09-91 | 1120 | 38   | Channel                                                   | Aerial   |
| 02-24-91 | 1030 | 44.3 | Channel, Pt. 9                                            | Aerial   |
| 02-27-91 | 1600 | 50   | Channel, across from Indian<br>Creek                      | Boat     |
| 03-04-91 | 1750 | 34.5 | Capture site                                              | Boat     |

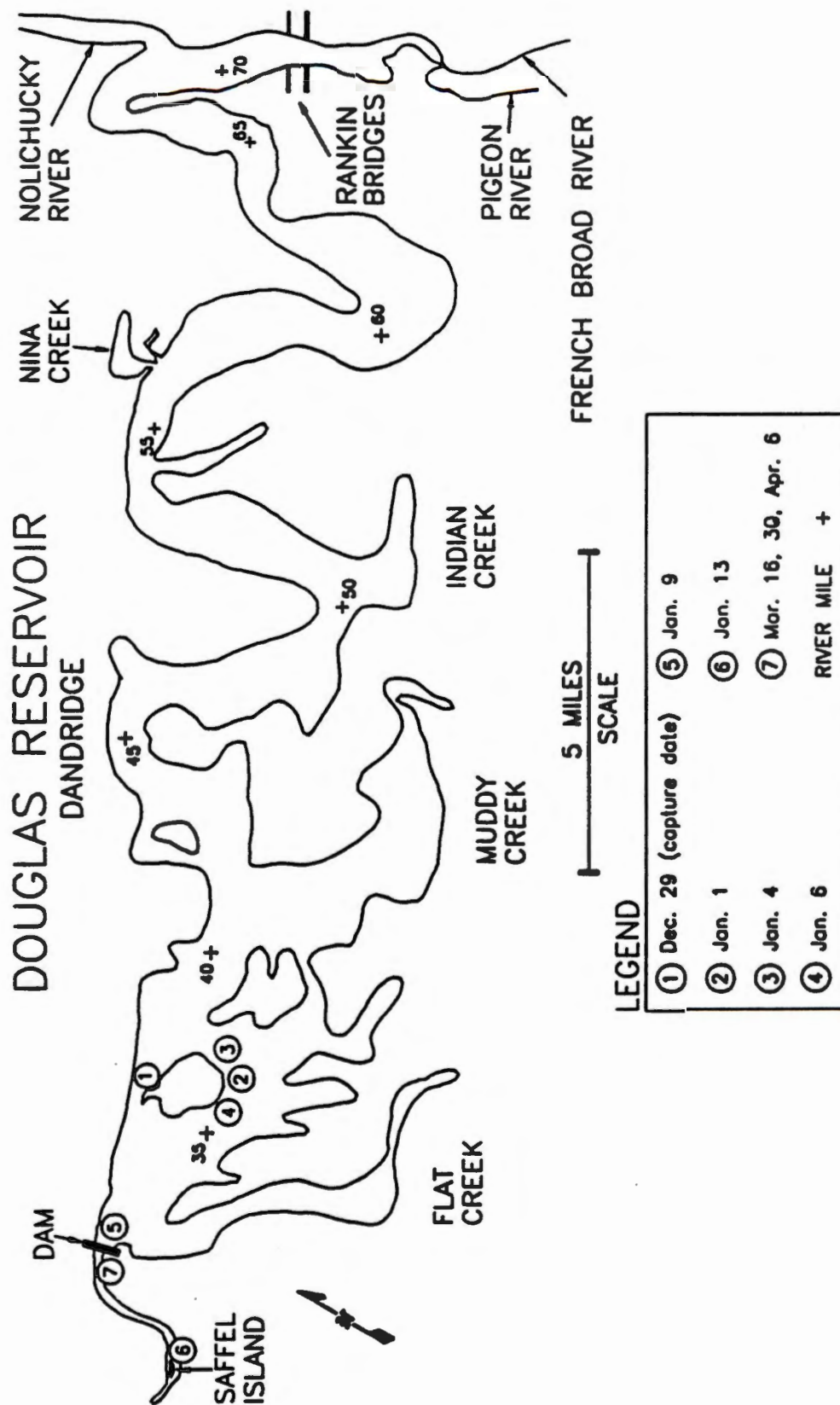


Appendix A.5. Movement of sauger #48.720 from Dec. 19, 1990, to Apr. 19, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.5. Movement data for sauger #48.720.

Species: Sauger  
 Transmitter Frequency/Transmitter Type: 48.720  
 Capture Location: Cove near RM 34.5, across from Cowboy's Restaurant  
 Capture Date: 12-19-90  
 Total Length (mm): 460  
 Weight (g): 1089  
 Sex: Unknown  
 Tracking Duration: 12-19-90 to 04-19-91, 121 days  
 Number of Observations: 16  
 Total River Miles (RM) Traveled: 10.5

| Date     | Time | RM   | Location                                        | Comments                                              |
|----------|------|------|-------------------------------------------------|-------------------------------------------------------|
| 12-20-90 | 1615 | 34.5 | Capture site                                    | Boat                                                  |
| 01-01-91 | 1215 | 43   | Channel                                         | Boat, commercial gill net fishermen working this area |
| 01-04-91 | 1400 | 45   | North bank, just downstream from Hoskins Bridge | Boat                                                  |
| 01-06-91 | 1415 | 45   | "                                               | Boat                                                  |
| 01-09-91 | 1315 | 45   | "                                               | Boat                                                  |
| 01-11-91 | 1145 | 45   | "                                               | Boat                                                  |
| 01-13-91 | 1135 | 45   | "                                               | Aerial                                                |
| 01-18-91 | 1055 | 45   | "                                               | Boat                                                  |
| 01-26-91 | 1100 | 45   | "                                               | Aerial                                                |
| 01-30-91 | 1600 | 45   | "                                               | Boat                                                  |
| 02-09-91 | 1110 | 45   | "                                               | Aerial                                                |
| 02-24-91 | 1030 | 45   | "                                               | Aerial                                                |
| 02-27-91 | 1530 | 45   | "                                               | Boat                                                  |
| 03-09-91 | 1115 | 45   | "                                               | Aerial                                                |
| 03-16-91 | 1030 | 45   | "                                               | Aerial                                                |
| 04-19-91 | 1450 | 45   | "                                               | Boat                                                  |



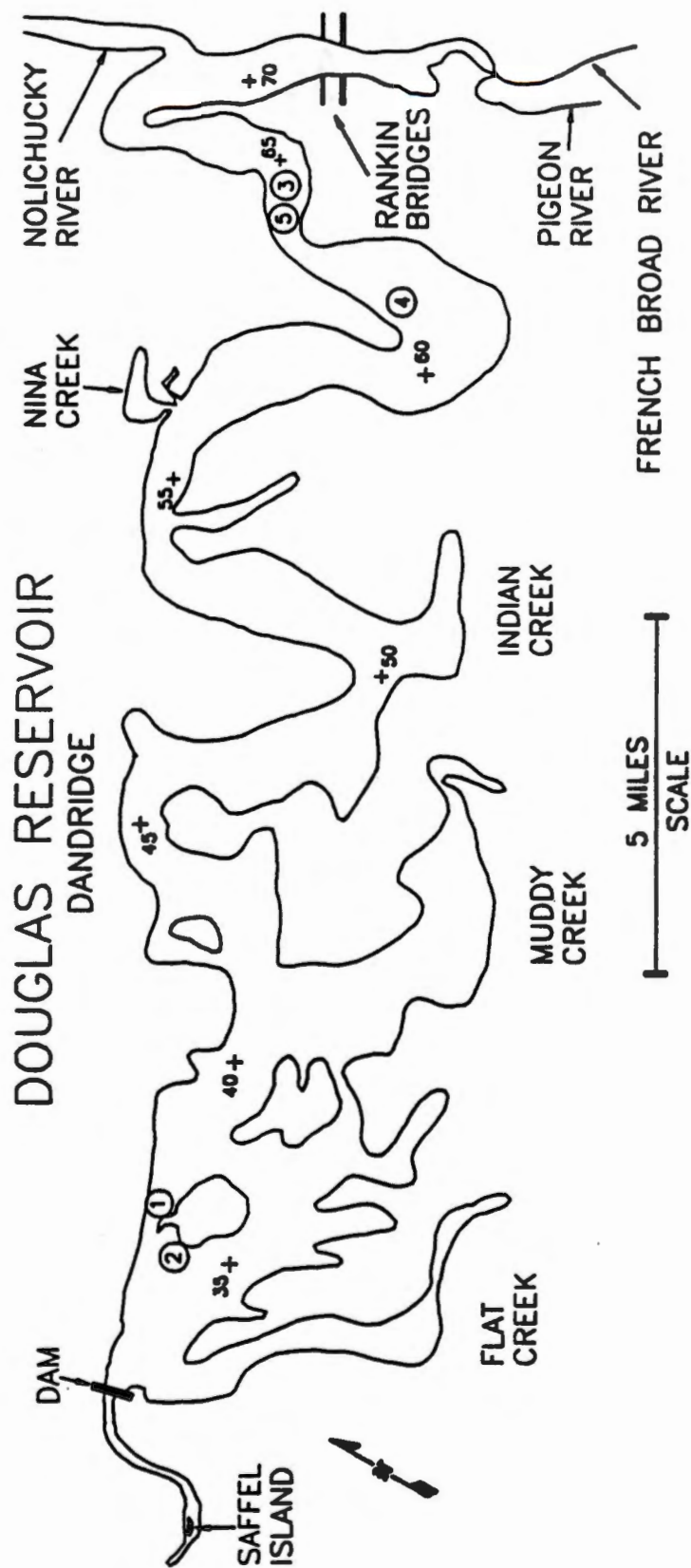
Appendix A.6. Movement of sauger #48.590 from Dec. 29, 1990, to Apr. 6, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.6. Movement data for sauger #48.590.

Species: Sauger  
Transmitter Frequency/Transmitter Type: 48.590  
Capture Location: Cove near RM 34.5, across from Cowboy's Restaurant  
Capture Date: 12-29-90  
Total Length (mm): 460  
Weight (g): 998  
Sex: Unknown  
Tracking Duration: 12-29-90 to 04-06-91, 98 days

Number of Observations: 8  
Total River Miles (RM) Traveled: 11

| Date     | Time | RM   | Location                          | Comments                 |
|----------|------|------|-----------------------------------|--------------------------|
| 01-01-91 | 1115 | 36   | Channel                           | Boat                     |
| 01-04-91 | 1250 | 36.5 | Channel, across from Pt. 3        | Boat                     |
| 01-06-91 | 1250 | 35.5 | Channel, just upstream from Pt. 2 | Boat                     |
| 01-09-91 | 0938 | 32.6 | Forebay of Douglas Dam            | Boat                     |
| 01-13-91 | 1115 | 29.8 | Saffel Island, French Broad River | Aerial, went through dam |
| 03-16-91 | 1000 | 32.1 | Just below Douglas Dam            | Aerial                   |
| 03-30-91 | 1000 | 32.1 | "                                 | Aerial                   |
| 04-16-91 | 1015 | 32.1 | "                                 | Aerial                   |



# LEGEND

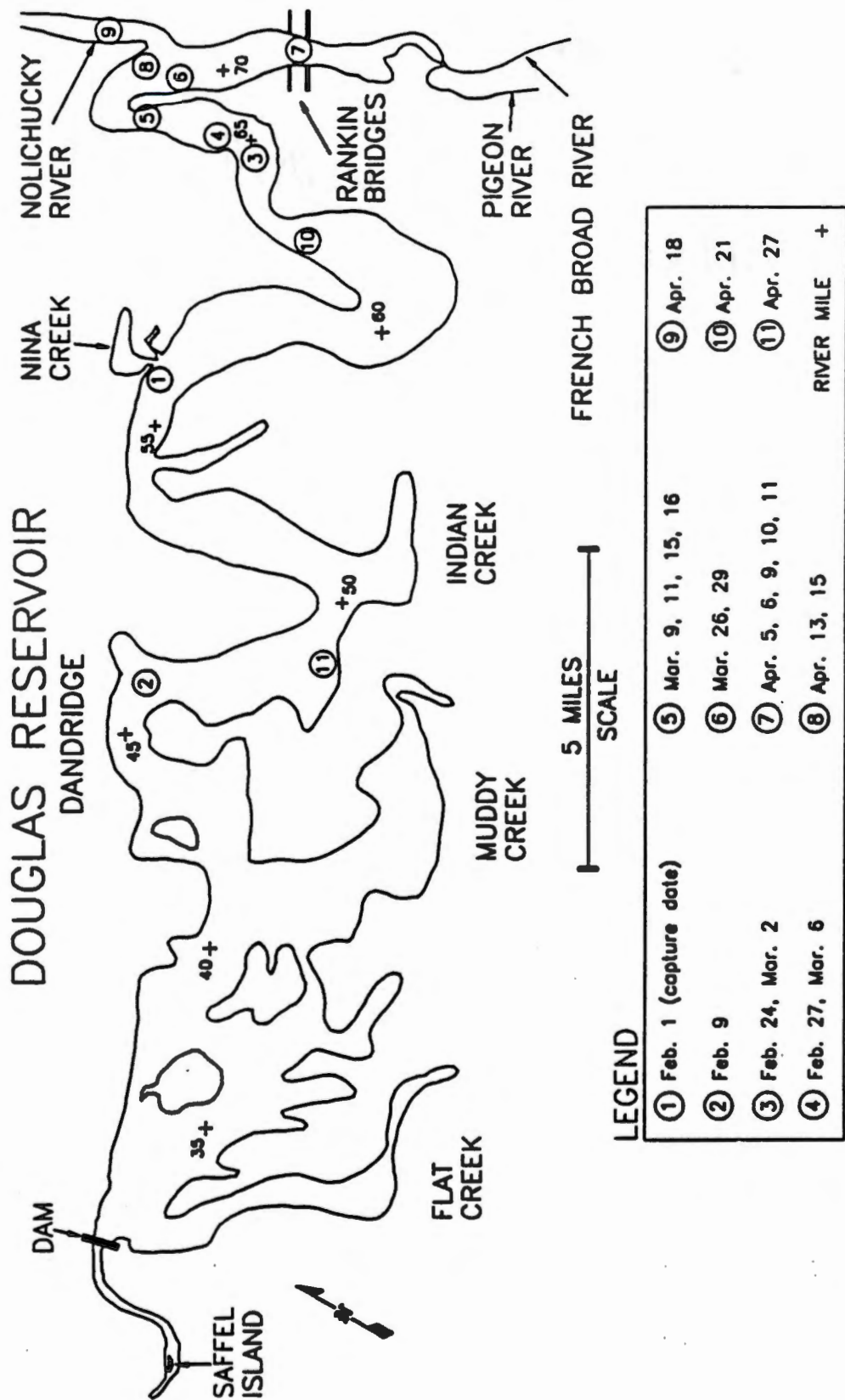
|                           |              |
|---------------------------|--------------|
| ① Jan. 30, (capture date) | ④ Mar. 2, 6  |
| ② Feb. 4                  | ⑤ Mar. 9     |
| ③ Feb. 27                 | RIVER MILE + |

Appendix A.7. Movement of sauger #49.150 from Jan. 30 to Mar. 9, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.7. Movement data for sauger #49.150.

Species: Sauger  
 Transmitter Frequency/Transmitter Type: 49.150  
 Capture Location: Cove near RM 34.5, across from Cowboy's Restaurant  
 Capture Date: 01-30-91  
 Total Length (mm): 480  
 Weight (g): 1120  
 Sex: Unknown  
 Tracking Duration: 01-30-91 to 03-09-91, 37 days  
 Number of Observations: 5  
 Total River Miles (RM) Traveled: 36.7

| Date     | Time | RM   | Location                                    | Comments             |
|----------|------|------|---------------------------------------------|----------------------|
| 02-04-91 | 1920 | 34   | Just outside of Cowboy's cove               | Boat                 |
| 02-27-91 | 1730 | 64.8 | Channel, between Walter's Bridge and Pt. 20 | Boat                 |
| 03-02-91 | 1630 | 61.7 | Channel, upstream of Taylor's Bend          | Boat, with #48.990   |
| 03-06-91 | 1735 | 61.7 | "                                           | Boat                 |
| 03-09-91 | 1045 | 64.4 | Channel, just upstream from Walter's Bridge | Aerial, with #48.830 |



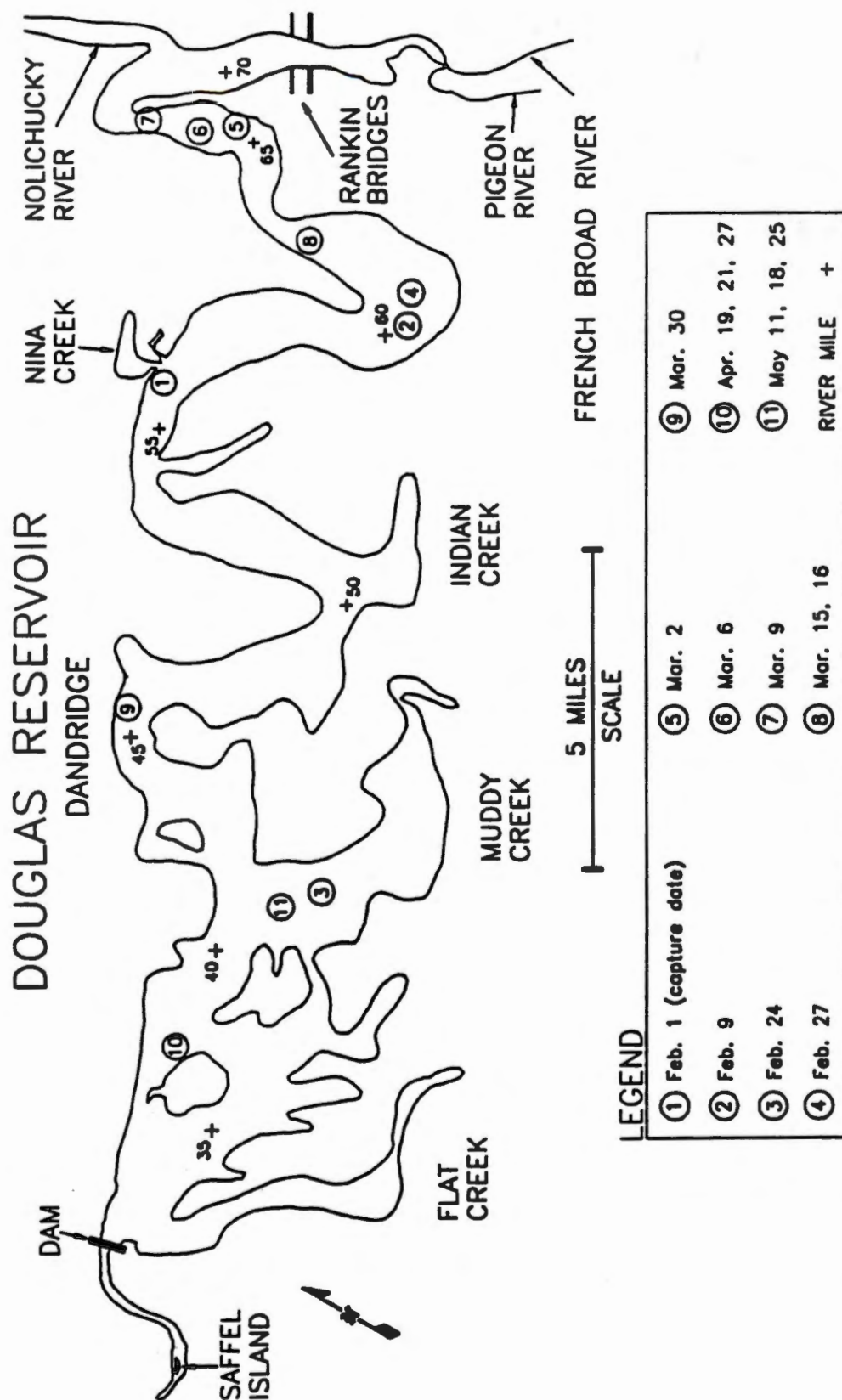
Appendix A.8. Movement of male sauger #48,930 from Feb. 1 to April 27, 1991. Circled numbers represent observed locations in chronological order.

## Appendix A.8. Movement data for sauger #48.930.

Species: Sauger  
 Transmitter Frequency/Transmitter Type: 48.930  
 Capture Location: RM 56, Nina Creek  
 Capture Date: 02-01-91  
 Total Length (mm): 430  
 Weight (g): 1043  
 Sex: Male  
 Tracking Duration: 02-01-91 to 04-27-91, 86 days

Number of Observations: 21  
 Total River Miles (RM) Traveled: 59.9

| Date     | Time | RM   | Location                                       | Comments                                        |
|----------|------|------|------------------------------------------------|-------------------------------------------------|
| 02-09-91 | 1115 | 46   | Channel, across from Lake View Park            | Aerial                                          |
| 02-24-91 | 1045 | 65   | Channel, Pt. 20                                | Aerial                                          |
| 02-27-91 | 1745 | 65.7 | Channel                                        | Boat                                            |
| 03-02-91 | 1700 | 65   | Channel, Pt. 20                                | Boat                                            |
| 03-06-91 | 1755 | 65.5 | Channel                                        | Boat, #48.860 close by                          |
| 03-09-91 | 1100 | 66.8 | Channel, Pt. 21                                | Aerial, with #48.950                            |
| 03-11-91 | 1810 | 66.7 | Channel, Downstream from Pt. 21                | Boat, with #48.990                              |
| 03-15-91 | 1830 | 66.8 | "                                              | Boat, with #48.880                              |
| 03-16-91 | 1100 | 66.8 | "                                              | Aerial                                          |
| 03-26-91 | 1900 | 69   | Across from mouth of Nolichucky River          | Boat, with #48.840, #48.860, #48.990            |
| 03-30-91 | 1100 | 69   | "                                              | Aerial, with #48.990, #48.790, #48.830, #48.860 |
| 04-05-91 | 1815 | 71   | Rankin Bridge                                  | Boat, with #48.840, #48.860                     |
| 04-06-91 | 1000 | 71   | "                                              | Aerial, with #48.990, #48.790, #48.840, #48.860 |
| 04-09-91 | 2010 | 71   | "                                              | Boat, with #48.990, #48.860, 48.840             |
| 04-10-91 | 1930 | 71   | "                                              | Boat, "                                         |
| 04-11-91 | 1930 | 71.3 | "                                              | Boat, "                                         |
| 04-13-91 | 1930 | 68.8 | Just downstream from Nolichucky River          | Boat, "                                         |
| 04-15-91 | 2000 | 68.8 | "                                              | Boat                                            |
| 04-18-91 | 1950 | .6   | Nolichucky River, downstream from pump station | Boat                                            |
| 04-21-91 | 1020 | 63.5 | Channel, Pt. 19                                | Aerial                                          |
| 04-27-91 | 0820 | 49.5 | Channel, Douglas Estates                       | Aerial                                          |



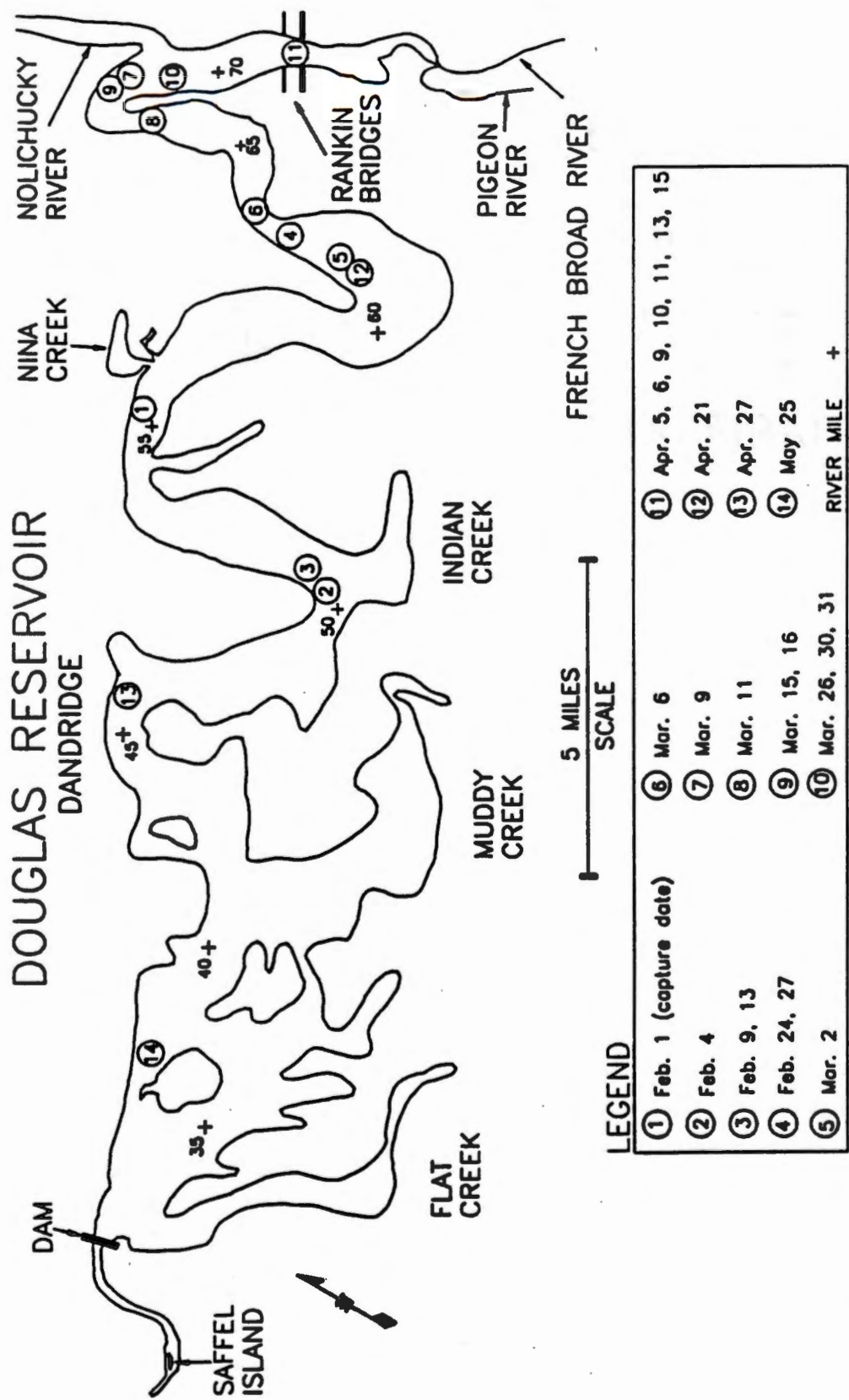
Appendix A.9. Movement of female sauger #48,950 from Feb. 1 to May 25, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.9. Movement data for sauger #48.950.

Species: Sauger  
 Transmitter Frequency/Transmitter Type: 48.950  
 Capture Location: RM 56, just downstream of Mina Creek  
 Capture Date: 02-01-91  
 Total Length (mm): 420  
 Weight (g): 821  
 Sex: Female  
 Tracking Duration: 02-01-91 to 05-25-91, 114 days

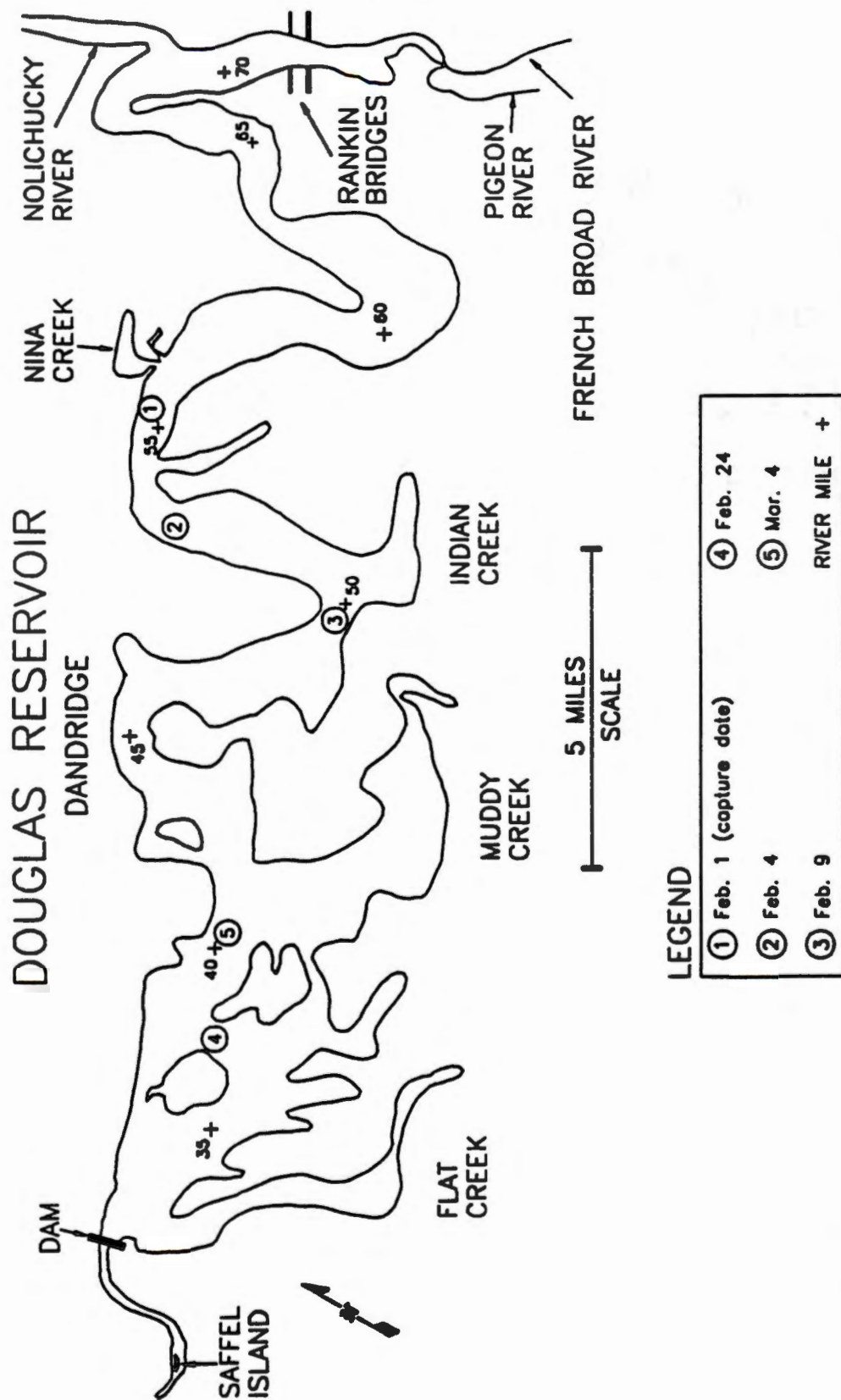
Number of Observations: 15  
 Total River Miles (RM) Traveled: 81.8

| Date     | Time | RM   | Location                           | Comments             |
|----------|------|------|------------------------------------|----------------------|
| 02-09-91 | 1050 | 60   | Channel                            | Aerial               |
| 02-24-91 | 1015 | 41   | Just inside of Muddy Creek         | Aerial               |
| 02-27-91 | 1700 | 60.3 | Channel, Taylor Bend               | Boat                 |
| 03-02-91 | 1745 | 65.4 | Channel                            | Boat, with #48.840   |
| 03-06-91 | 1800 | 66   | Channel                            | Boat, with #48.840   |
| 03-09-91 | 1100 | 67   | Channel, Pt. 21                    | Aerial, with #48.930 |
| 03-15-91 | 1900 | 63   | Channel, Pt. 19                    | Boat                 |
| 03-16-91 | 1100 | 63   | "                                  | Aerial               |
| 03-30-91 | 1045 | 45.6 | Near bank, Dandridge side          | Aerial               |
| 04-19-91 | 1430 | 37.6 | Behind Pt. 4                       | Boat                 |
| 04-21-91 | 1000 | 37.6 | "                                  | Aerial               |
| 04-27-91 | 0800 | 37.6 | "                                  | Aerial               |
| 05-11-91 | 0945 | 41   | Channel, near mouth of Muddy Creek | Aerial               |
| 05-18-91 | 1000 | 41   | "                                  | Aerial               |
| 05-25-91 | 0913 | 41   | "                                  | Aerial               |



Appendix A.10. Movement of male sauger #48.990 from Feb. 1 to May 25, 1991. Circled numbers represent observed locations in chronological order.





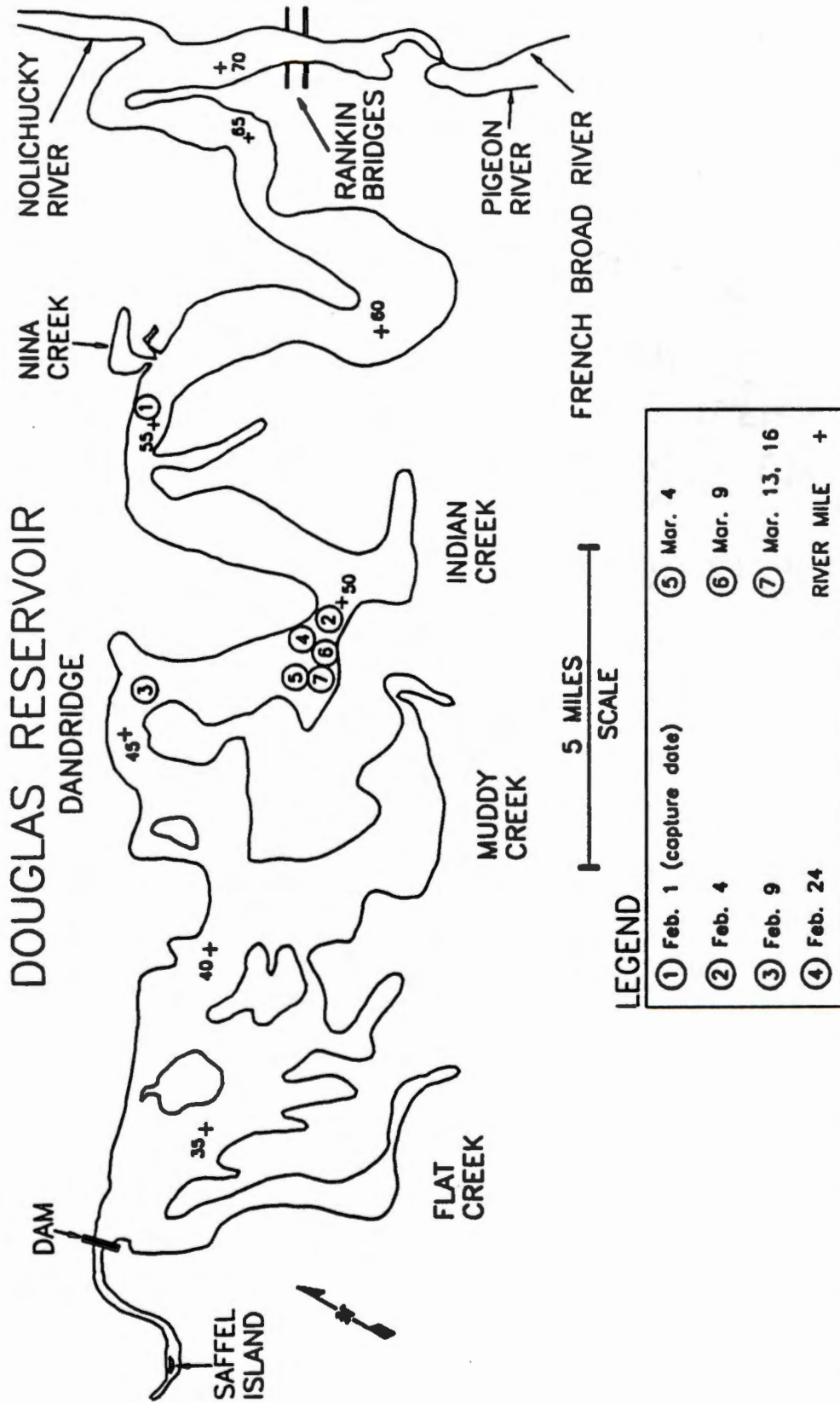
Appendix A.11. Movement of female sauger #49.250 from Feb. 1 to Mar. 4, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.11. Movement data for sauger #49.250.

Species: Sauger  
Transmitter Frequency/Transmitter Type: 49.250  
Capture Location: RM 55  
Capture Date: 02-01-91  
Total Length (mm): 490  
Weight (g): 1357  
Sex: Female  
Tracking Duration: 02-01-91 to 03-04-91, 32 days

Number of Observations: 4  
Total River Miles (RM) Traveled: 20

| Date     | Time | RM   | Location                                         | Comments |
|----------|------|------|--------------------------------------------------|----------|
| 02-04-91 | 1110 | 53.2 | Channel, downstream from Douglas Lake Campground | Boat     |
| 02-09-91 | 1115 | 50   | Channel, downstream from Indian Creek            | Aerial   |
| 02-24-91 | 1000 | 37.5 | Channel, Pt. 4                                   | Aerial   |
| 03-04-91 | 1815 | 40   | Channel                                          | Boat     |



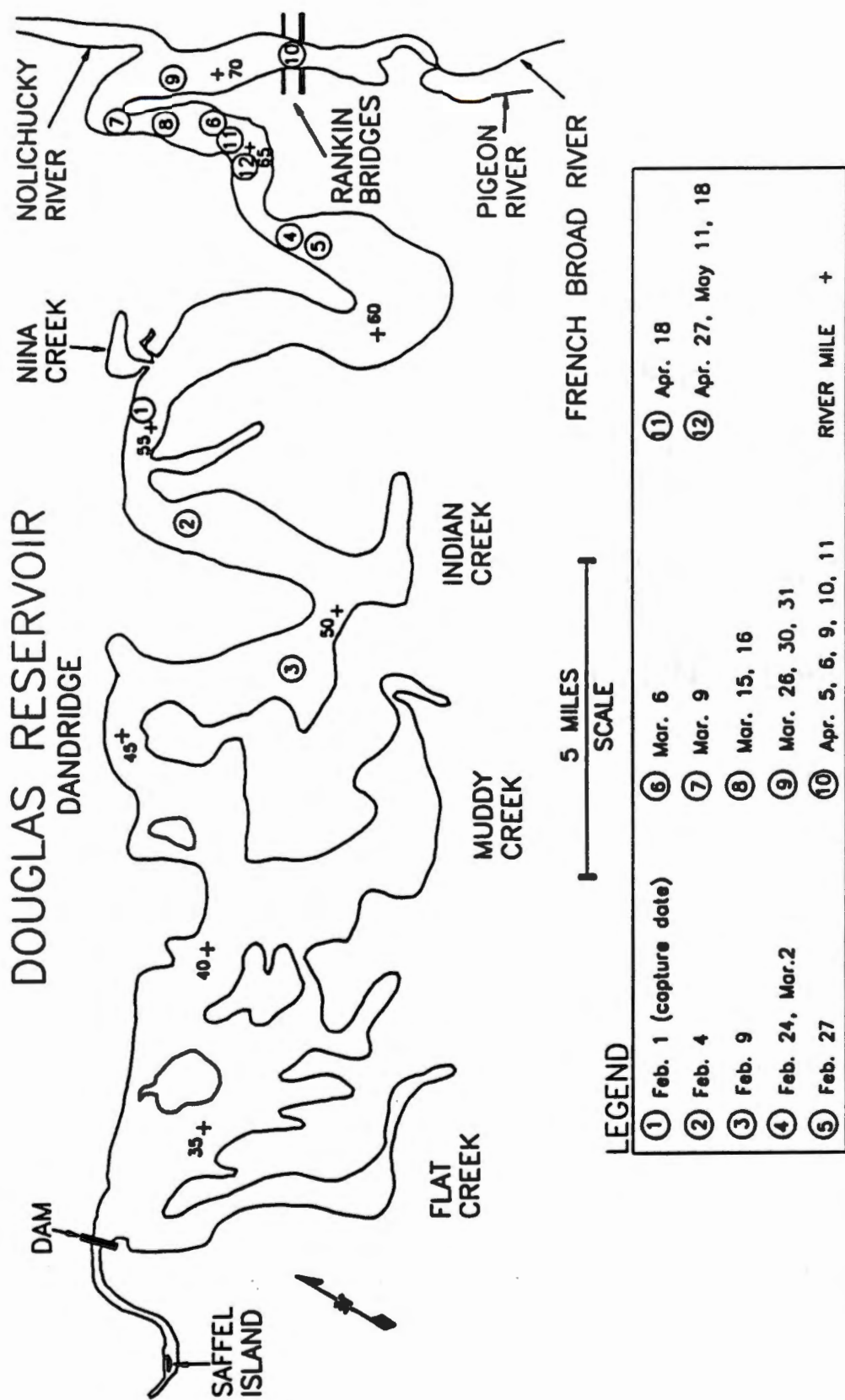
Appendix A.12. Movement of female sauger #49.200 from Feb. 1 to Mar. 16, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.12. Movement data for sauger #49.200.

Species: Sauger  
Transmitter Frequency/Transmitter Type: 49.200  
Capture Location: RM 55  
Capture Date: 02-01-91  
Total Length (mm): 450  
Weight (g): 1023  
Sex: Female  
Tracking Duration: 02-01-91 to 03-16-91, 44 days

Number of Observations: 7  
Total River Miles (RM) Traveled: 13.7

| Date     | Time | RM   | Location                          | Comments |
|----------|------|------|-----------------------------------|----------|
| 02-04-91 | 1030 | 50   | Channel, Pt. 13                   | Boat     |
| 02-09-91 | 1110 | 46   | Channel, near Dandridge Boat Dock | Aerial   |
| 02-24-91 | 1030 | 49.5 | Channel                           | Aerial   |
| 03-04-91 | 1900 | 49   | Channel, Douglas Estates          | Boat     |
| 03-09-91 | 1030 | 49.5 | "                                 | Aerial   |
| 03-13-91 | 1310 | 49.3 | "                                 | Boat     |
| 03-16-91 | 1030 | 49.3 | "                                 | Aerial   |

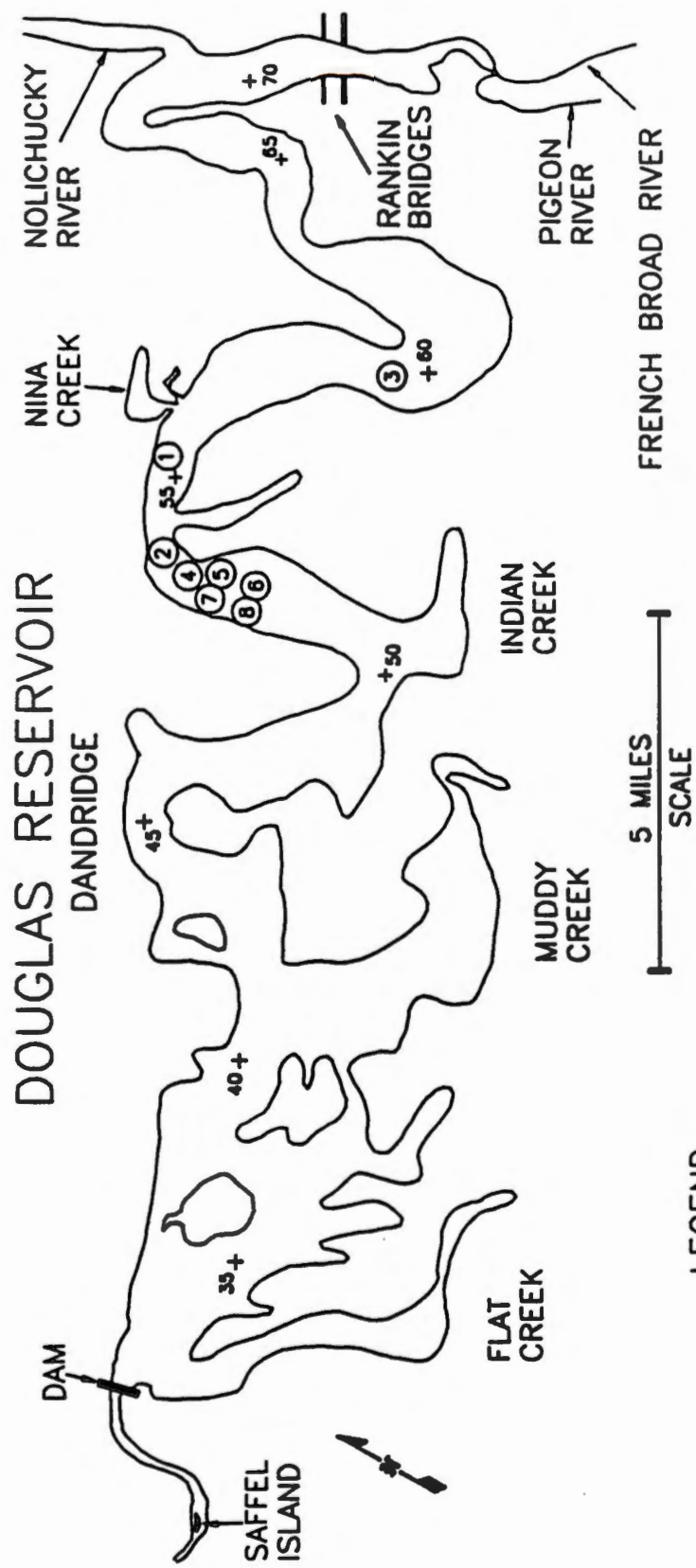


Appendix A.13. Movement of male sauger #48.860 from Feb. 1 to May 18, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.13. Movement data for sauger #48.860.

Species: Sauger  
 Transmitter Frequency/Transmitter Type: 48.860  
 Capture Location: RM 55  
 Capture Date: 02-01-91  
 Total Length (mm): 420  
 Weight (g): 874  
 Sex: Male  
 Tracking Duration: 02-01-91 to 05-18-91, 107 days  
 Number of Observations: 21  
 Total River Miles (RM) Traveled: 36.4

| Date     | Time | RM   | Location                                         | Comments                                        |
|----------|------|------|--------------------------------------------------|-------------------------------------------------|
| 02-04-91 | 1050 | 53   | Channel, downstream from Douglas Lake Campground | Boat                                            |
| 02-09-91 | 1115 | 49   | Channel, Douglas Estates                         | Aerial                                          |
| 02-24-91 | 1045 | 63   | Channel, downstream from Pt. 19                  | Aerial                                          |
| 02-27-91 | 1710 | 62.6 | Channel                                          | Boat                                            |
| 03-02-91 | 1700 | 63   | Channel, downstream from Pt. 19                  | Boat, with #48.830                              |
| 03-06-91 | 1830 | 65.5 | Channel                                          | Boat, with #48.930                              |
| 03-09-91 | 1100 | 67.3 | Channel                                          | Aerial, with #48.790                            |
| 03-15-91 | 1830 | 66.7 | Channel, just downstream from Pt. 21             | Boat, with #48.930                              |
| 03-16-91 | 1100 | 66.7 | "                                                | Aerial                                          |
| 03-26-91 | 1900 | 69   | Across from mouth of Nolichucky River            | Boat, with #48.840, #48.930, #48.990            |
| 03-30-91 | 1100 | 69   | "                                                | Aerial, with #48.830, #48.930, #48.990, #48.790 |
| 03-31-91 | 1830 | 69   | "                                                | Boat, with #48.990                              |
| 04-05-91 | 1815 | 71   | Rankin Bridge                                    | Boat, with #48.840, #48.930                     |
| 04-06-91 | 1000 | 71   | "                                                | Aerial, with #48.790, #48.840, #48.930, #48.990 |
| 04-09-91 | 2015 | 71   | "                                                | Boat, with #48.840, #48.990, #48.930            |
| 04-10-91 | 1930 | 71   | "                                                | Boat, "                                         |
| 04-11-91 | 1945 | 71.2 | "                                                | Boat, "                                         |
| 04-18-91 | 1800 | 65.3 | Channel, opposite Pt. 20                         | Boat                                            |
| 04-27-91 | 0835 | 65   | Channel                                          | Aerial                                          |
| 05-11-91 | 1000 | 65   | Channel                                          | Aerial                                          |
| 05-18-91 | 1000 | 65   | Channel                                          | Aerial                                          |



**LEGEND**

| ① Feb. 1 (capture date) | ⑤ Mar. 9      | RIVER MILE | + |
|-------------------------|---------------|------------|---|
| ② Feb. 4                | ⑥ Mar. 13     |            |   |
| ③ Feb. 24               | ⑦ Apr. 6      |            |   |
| ④ Feb. 27               | ⑧ Apr. 19, 27 |            |   |

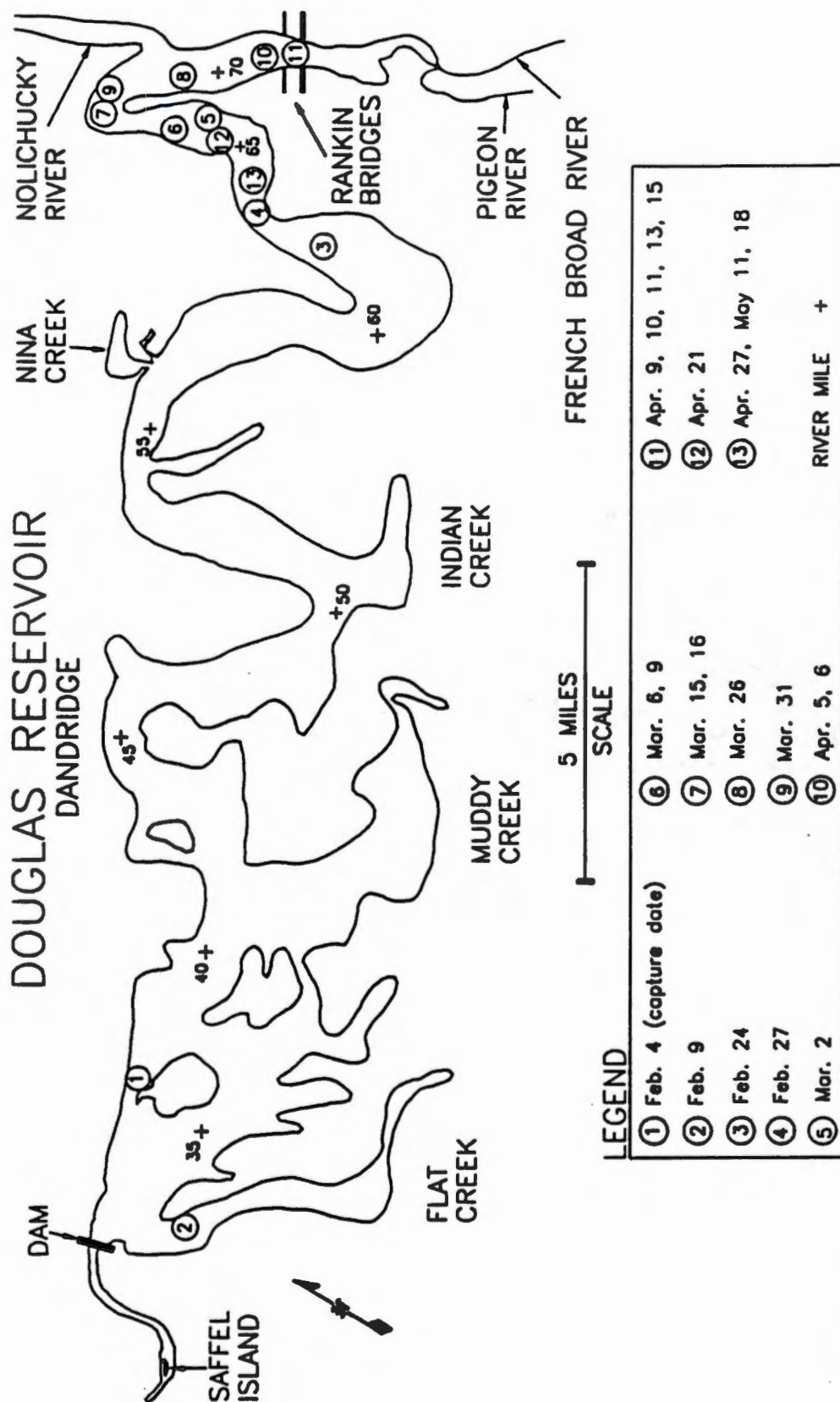
Appendix A.14. Movement of female sauger #48.970 from Feb. 1 to Apr. 27, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.14. Movement data for sauger #48.970.

Species: Sauger  
Transmitter Frequency/Transmitter Type: 48.970  
Capture Location: RM 55  
Capture Date: 02-01-91  
Total Length (mm): 470  
Weight (g): 1169  
Sex: Female  
Tracking Duration: 02-01-91 to 04-27-91, 86 days

Number of Observations: 8  
Total River Miles (RM) Traveled: 14

| Date     | Time | RM   | Location                           | Comments |
|----------|------|------|------------------------------------|----------|
| 02-04-91 | 1110 | 54   | Channel, just downstream from I-40 | Boat     |
| 02-24-91 | 1045 | 59.5 | Channel                            | Aerial   |
| 02-27-91 | 1600 | 53.6 | Channel                            | Boat     |
| 03-09-91 | 1030 | 53.4 | Channel                            | Aerial   |
| 03-13-91 | 1330 | 53   | Channel                            | Boat     |
| 04-06-91 | 0920 | 53.5 | Channel                            | Aerial   |
| 04-19-91 | 1540 | 53   | Channel                            | Boat     |
| 04-27-91 | 0825 | 53   | Channel                            | Aerial   |



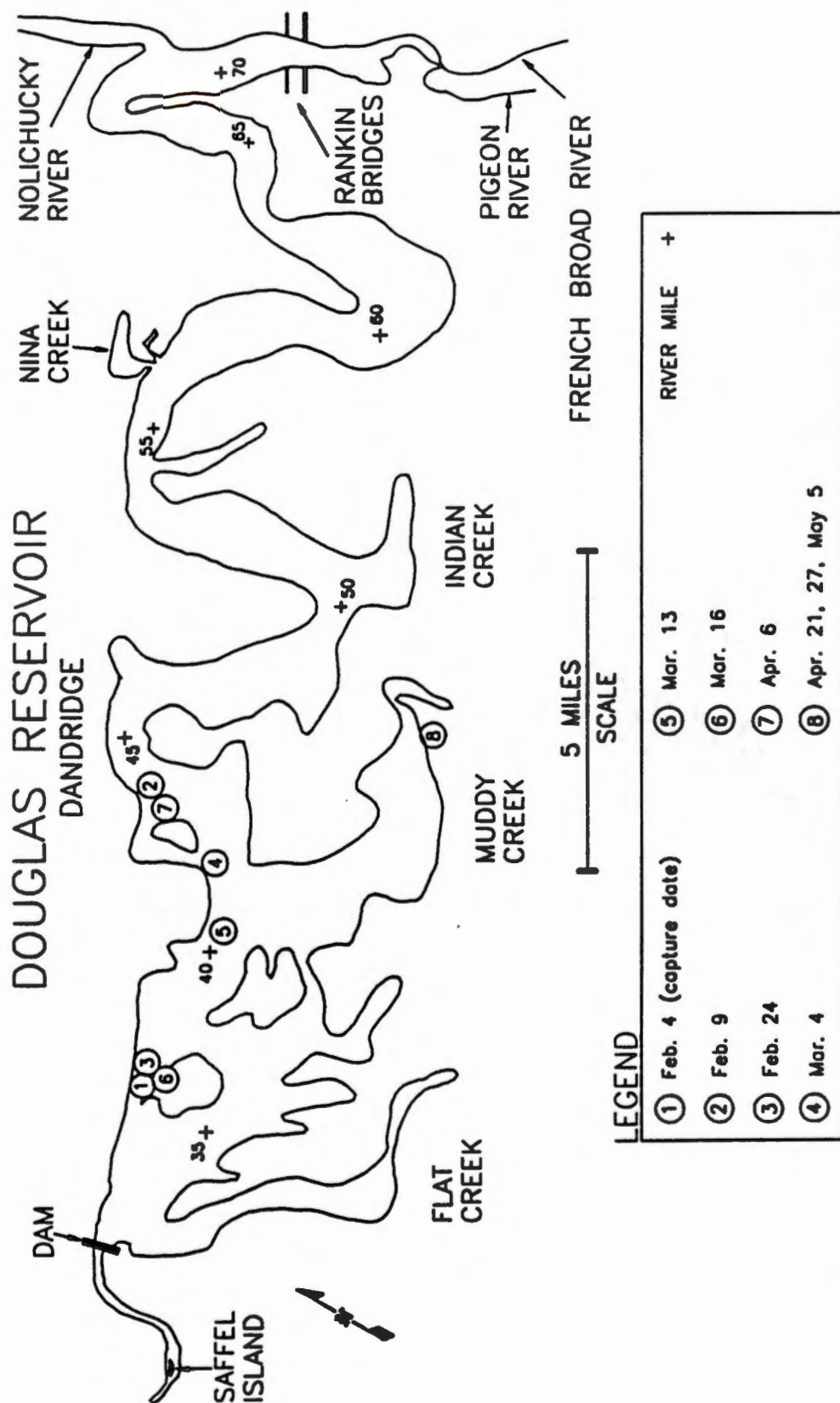
Appendix A.15. Movement of male sauger #48,840 from Feb. 4 to May 18, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.15. Movement data for sauger #48.840.

Species: Sauger  
Transmitter Frequency/Transmitter Type: 48.840  
Capture Location: Cove near RM 34.5, across from Cowboy's Restaurant  
Capture Date: 02-04-91  
Total Length (mm): 440  
Weight (g): 998  
Sex: Male  
Tracking Duration: 02-04-91 to 05-18-91, 103 days

Number of Observations: 21  
Total River Miles (RM) Traveled: 47.8

| Date     | Time | RM   | Location                                 | Comments                                        |
|----------|------|------|------------------------------------------|-------------------------------------------------|
| 02-09-91 | 1130 | 33   | Mouth of Flat Creek                      | Aerial                                          |
| 02-24-91 | 1045 | 62.8 | Channel, across from double silos        | Aerial                                          |
| 02-27-91 | 1730 | 64.3 | Channel, downstream from Walter's Bridge | Boat                                            |
| 03-02-91 | 1745 | 65.4 | Channel, Pt. 20                          | Boat, with #48.950                              |
| 03-06-91 | 1805 | 66.3 | Channel                                  | Boat, "                                         |
| 03-09-91 | 1055 | 66.3 | Channel                                  | Aerial                                          |
| 03-15-91 | 1830 | 67.8 | Channel, just downstream from RR bridge  | Boat                                            |
| 03-16-91 | 1115 | 67.8 | "                                        | Aerial                                          |
| 03-26-91 | 1900 | 69   | Across from mouth of Nolichucky River    | Boat, with #48.860, #48.930, #48.990            |
| 03-31-91 | 1820 | 68.2 | Channel, downstream from RR bridge       | Boat, with #48.790                              |
| 04-05-91 | 1815 | 71   | Rankin Bridge                            | Boat, with #48.860, #48.930                     |
| 04-06-91 | 1000 | 71   | "                                        | Aerial, with #48.790, #48.860, #48.930, #48.990 |
| 04-09-91 | 2015 | 71.3 | "                                        | Boat, with #48.860, #48.930, #48.990            |
| 04-10-91 | 1930 | 71.3 | "                                        | Boat, "                                         |
| 04-11-91 | 1945 | 71.3 | "                                        | Boat, "                                         |
| 04-13-91 | 1945 | 71.3 | "                                        | Boat, with #48.990                              |
| 04-15-91 | 2015 | 71.3 | "                                        | Boat, with #48.990                              |
| 04-21-91 | 1030 | 65.2 | Channel, Pt. 20                          | Aerial                                          |
| 04-27-91 | 0830 | 64.3 | Channel, Walter's Bridge                 | Aerial                                          |
| 05-11-91 | 1000 | 64.3 | "                                        | Aerial                                          |
| 05-18-91 | 1000 | 64.3 | "                                        | Aerial                                          |



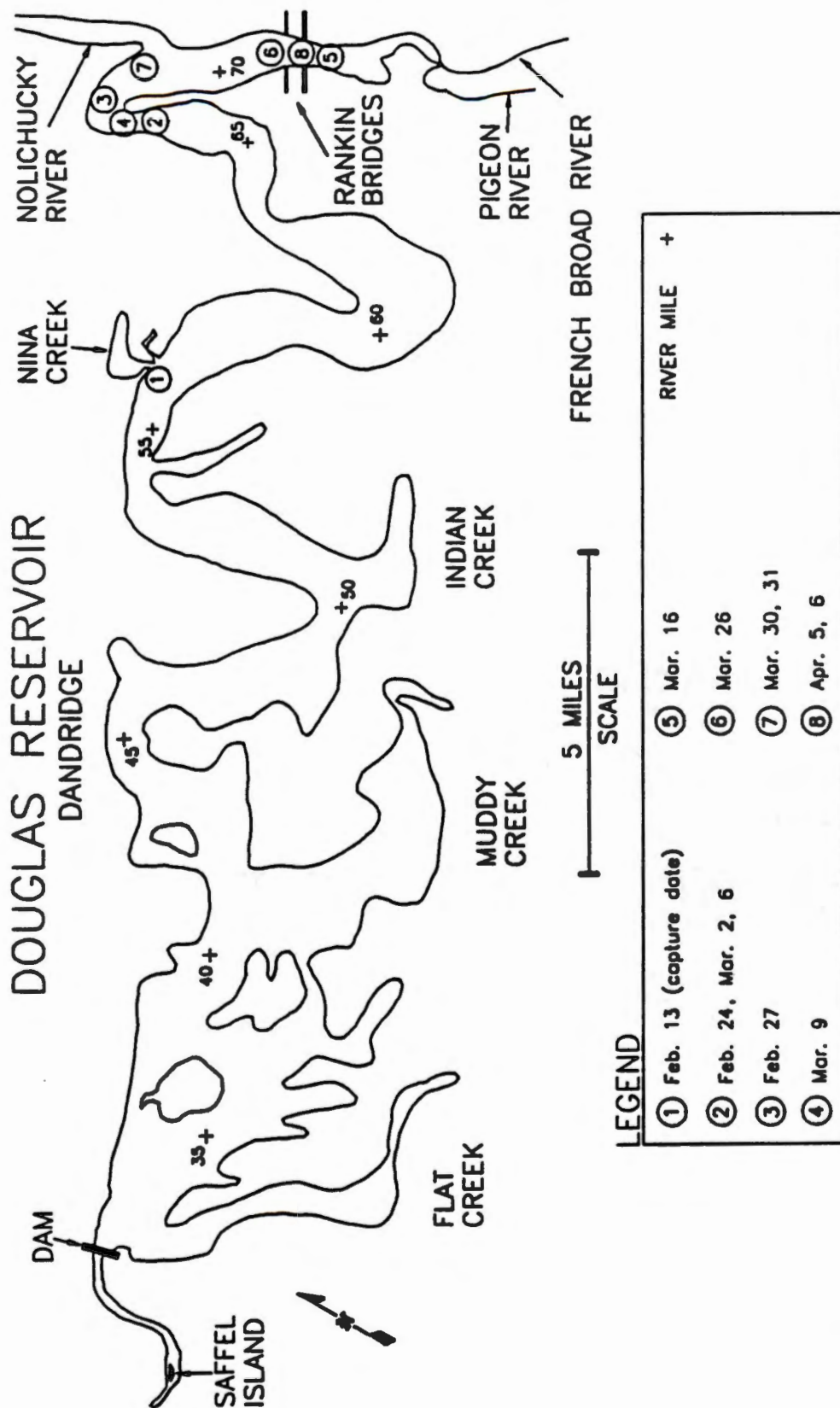
Appendix A.16. Movement of female sauger #48.820 from Feb. 4 to May 5, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.16. Movement data for sauger #48.820.

Species: Sauger  
 Transmitter Frequency/Transmitter Type: 48.820  
 Capture Location: Cove near RM 34.5, across from Cowboy's Restaurant  
 Capture Date: 02-04-91  
 Total Length (mm): 465  
 Weight (g): 1158  
 Sex: Female  
 Tracking Duration: 02-04-91 to 05-05-91, 90 days

Number of Observations: 9  
 Total River Miles (RM) Traveled: 41

| Date     | Time | RM    | Location                                             | Comments |
|----------|------|-------|------------------------------------------------------|----------|
| 02-09-91 | 1115 | 44    | Channel, near Henderson Island                       | Aerial   |
| 02-24-91 | 1000 | 34.5  | Near capture site                                    | Aerial   |
| 03-04-91 | 1835 | 42    | Channel, Pt. 7                                       | Boat     |
| 03-13-91 | 1245 | 40.4  | Channel, Pt. 6                                       | Boat     |
| 03-16-91 | 1015 | 34.5  | Near capture site                                    | Aerial   |
| 04-06-91 | 0915 | 44    | Channel, near Henderson Island                       | Aerial   |
| 04-21-91 | 1015 | Pt. D | Just inside Clear Creek which flows into Muddy Creek | Aerial   |
| 04-27-91 | 0810 | Pt. D | "                                                    | Aerial   |
| 05-05-91 | 1320 | Pt. D | "                                                    | Boat     |



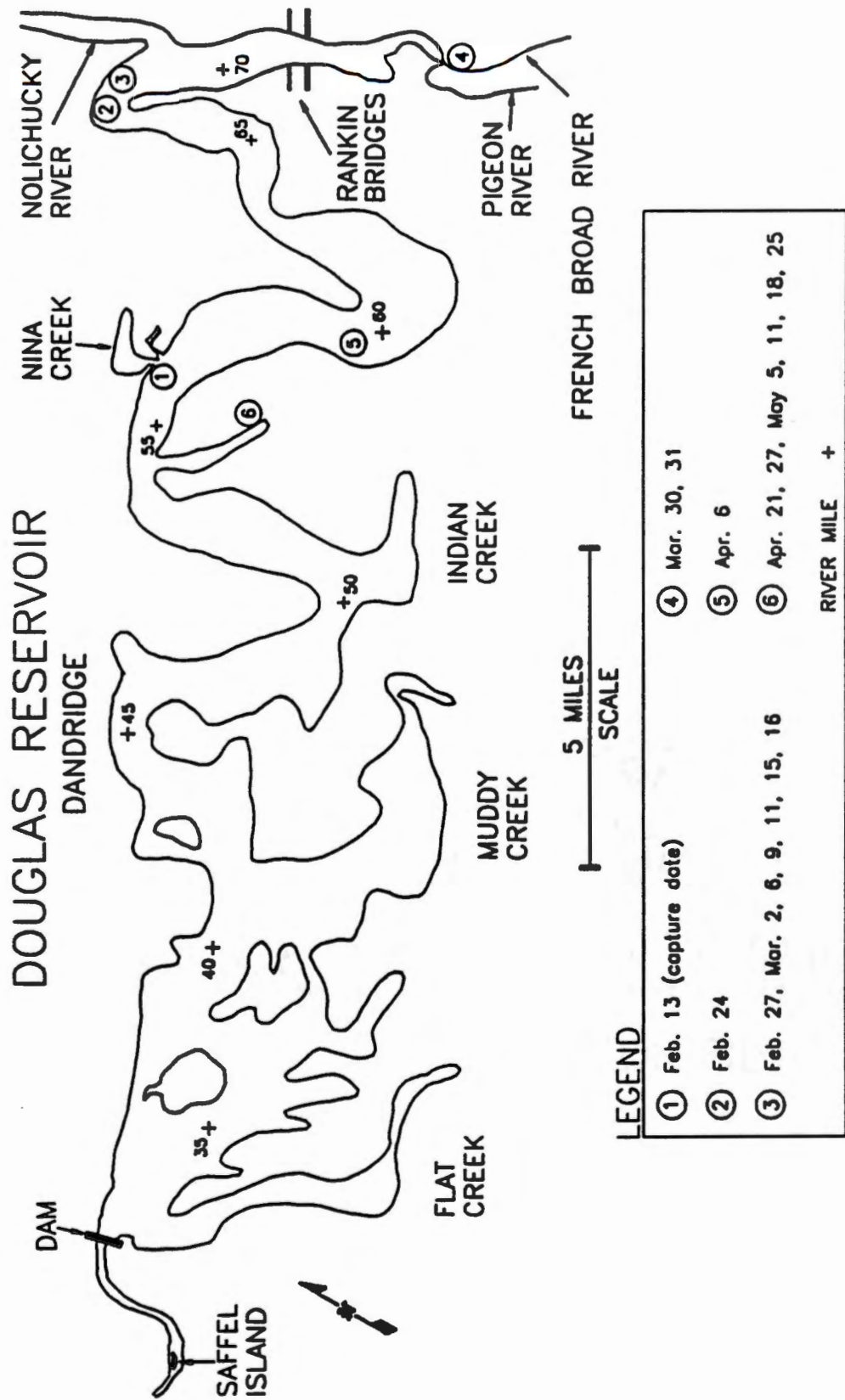
Appendix A.17. Movement of male sauger #48,790 from Feb. 13 to April 6, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.17. Movement data for sauger #48.790.

Species: Sauger  
 Transmitter Frequency/Transmitter Type: 48.790  
 Capture Location: RM 56, Mina Creek  
 Capture Date: 02-13-91  
 Total Length (mm): 440  
 Weight (g): 860  
 Sex: Male  
 Tracking Duration: 02-13-91 to 04-06-91, 52 days

Number of Observations: 11  
 Total River Miles (RM) Traveled: 24.6

| Date     | Time | RM   | Location                                | Comments                                        |
|----------|------|------|-----------------------------------------|-------------------------------------------------|
| 02-24-91 | 1045 | 67   | Channel, just upstream from Pt. 21      | Aerial                                          |
| 02-27-91 | 1800 | 67.8 | Channel, just downstream from RR bridge | Boat                                            |
| 03-02-91 | 1800 | 67   | Channel, just upstream from Pt. 21      | Boat                                            |
| 03-06-91 | 1815 | 67   | "                                       | Boat                                            |
| 03-09-91 | 1100 | 67.5 | Channel                                 | Aerial, with #48.860                            |
| 03-16-91 | 1130 | 72   | Upstream from Rankin Bridge             | Aerial                                          |
| 03-26-91 | 1930 | 71   | Rankin Bridge                           | Boat                                            |
| 03-30-91 | 1100 | 68.8 | Near mouth of Nolichucky River          | Aerial, with #48.930, #48.830, #48.860          |
| 03-31-91 | 1820 | 68.2 | Channel, upstream of RR bridge          | Boat, with #48.840                              |
| 04-05-91 | 1845 | 71.4 | Right under Rankin Bridge               | Boat, with #48.990                              |
| 04-06-91 | 1000 | 71.4 | "                                       | Aerial, with #48.990, #48.930, #48.840, #48.860 |

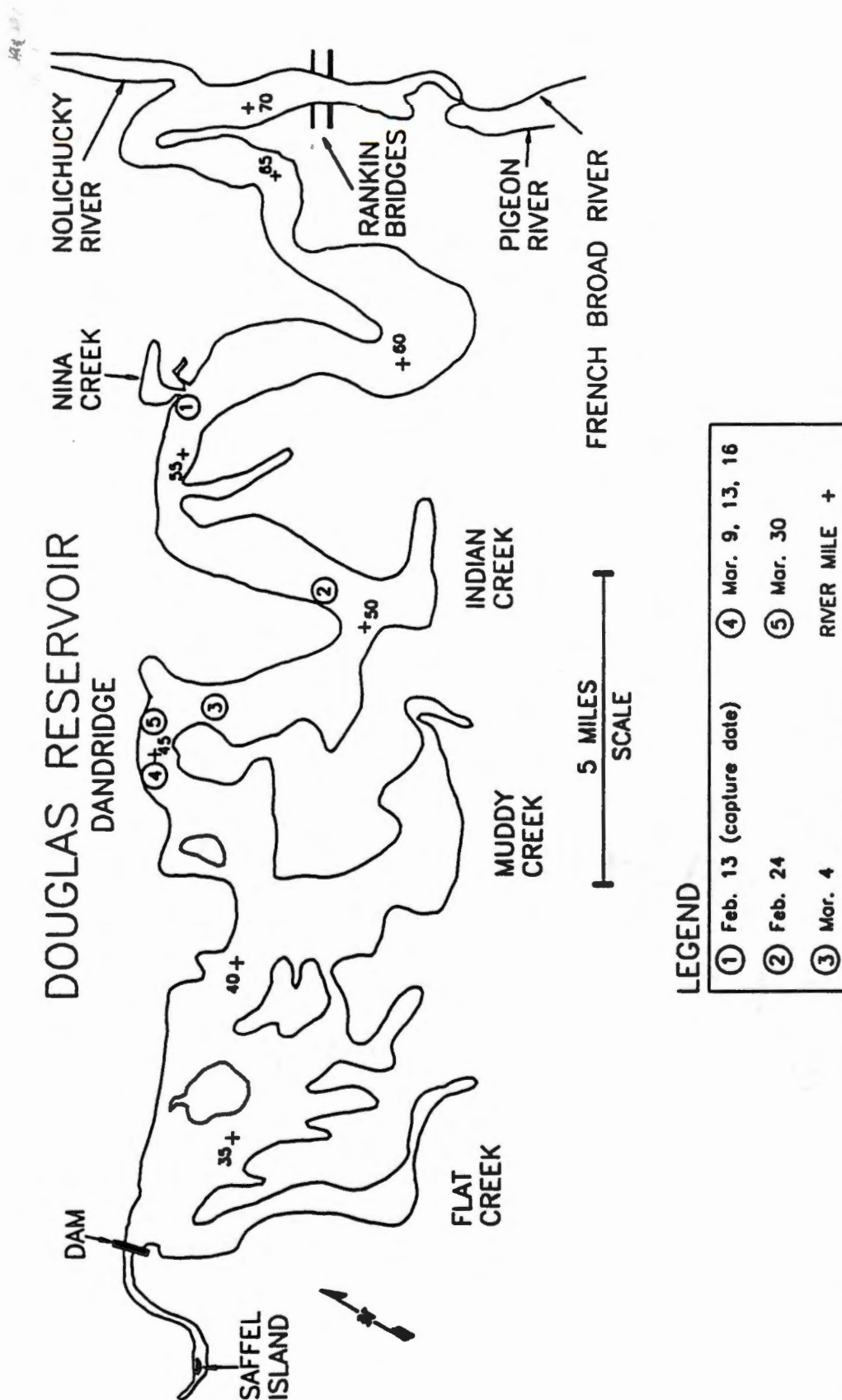


Appendix A.18. Movement of female sauger #48.880 from Feb. 13 to May 25, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.18. Movement data for sauger #48.880.

Species: Sauger  
 Transmitter Frequency/Transmitter Type: 48.880  
 Capture Location: RM 56, downstream from Nina Creek  
 Capture Date: 02-13-91  
 Total Length (mm): 480  
 Weight (g): 1260  
 Sex: Female  
 Tracking Duration: 02-13-91 to 05-25-91, 101 days  
 Number of Observations: 17  
 Total River Miles (RM) Traveled: 38.4

| Date     | Time | RM   | Location                           | Comments             |
|----------|------|------|------------------------------------|----------------------|
| 02-24-91 | 1045 | 67.5 | Channel, downstream from RR Bridge | Aerial               |
| 02-27-91 | 1810 | 68.4 | Upstream from coal tipple          | Boat                 |
| 03-02-91 | 1815 | 68.4 | "                                  | Boat                 |
| 03-06-91 | 1820 | 68.4 | "                                  | Boat                 |
| 03-09-91 | 1100 | 68.4 | "                                  | Aerial, with #48.990 |
| 03-11-91 | 1820 | 68.4 | "                                  | Boat                 |
| 03-15-91 | 1800 | 68.4 | "                                  | Boat, with #48.990   |
| 03-16-91 | 1115 | 68.4 | "                                  | Aerial               |
| 03-30-91 | 1115 | 74.4 | Upstream from Pigeon River         | Aerial               |
| 03-31-91 | 1930 | 74.4 | "                                  | Boat                 |
| 04-06-91 | 0930 | 59.5 | "                                  | Aerial               |
| 04-21-91 | 1100 | 54.4 | Up Seahorn Creek                   | Aerial               |
| 04-27-91 | 0825 | 54.4 | "                                  | Aerial               |
| 05-05-91 | 1110 | 54.4 | "                                  | Boat                 |
| 05-11-91 | 0950 | 54.4 | "                                  | Aerial               |
| 05-18-91 | 1000 | 54.4 | "                                  | Aerial               |
| 05-25-91 | 0925 | 54.4 | "                                  | Aerial               |



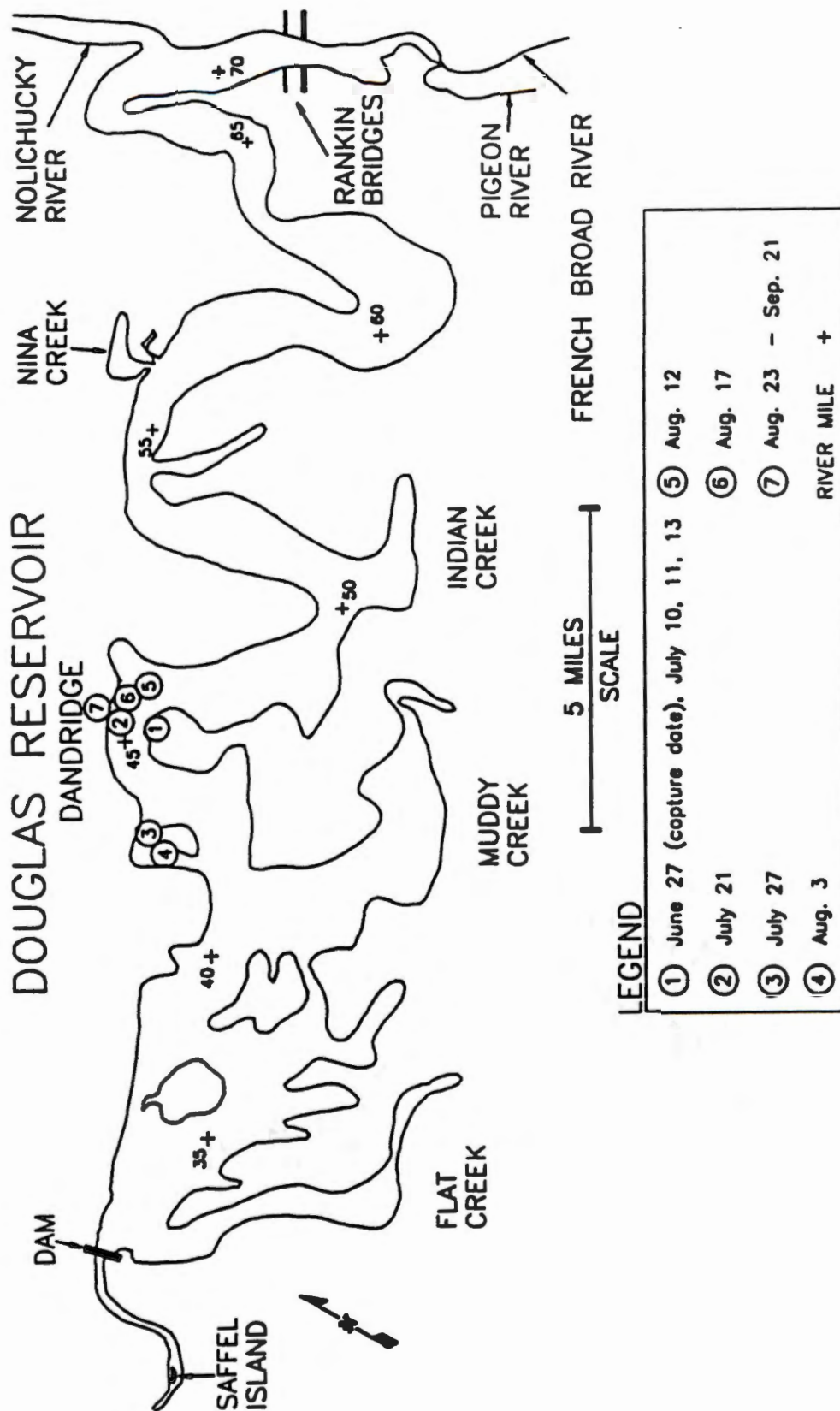
Appendix A.19. Movement of female sauger #48.810 from Feb. 13 to Mar. 30, 1991. Circled numbers represent observed locations in chronological order.

## Appendix A.19. Movement data for sauger #48.810.

Species: Sauger  
 Transmitter Frequency/Transmitter Type: 48.810  
 Capture Location: RM 56, downstream from Nina Creek  
 Capture Date: 02-13-91  
 Total Length (mm): 470  
 Weight (g): 1240  
 Sex: Female  
 Tracking Duration: 02-13-91 to 03-30-91, 45 days

Number of Observations: 6  
 Total River Miles (RM) Traveled: 11.3

| Date     | Time | RM   | Location                                | Comments |
|----------|------|------|-----------------------------------------|----------|
| 02-24-91 | 1030 | 51   | Channel                                 | Aerial   |
| 03-04-91 | 1850 | 47   | Channel, Pt 11, Koontz Creek            | Boat     |
| 03-09-91 | 1030 | 45   | Channel, downstream from Hoskins Bridge | Aerial   |
| 03-13-91 | 1300 | 45   | "                                       | Boat     |
| 03-16-91 | 1030 | 45   | "                                       | Aerial   |
| 03-30-91 | 1015 | 45.3 | Channel, upstream from Hoskins Bridge   | Aerial   |

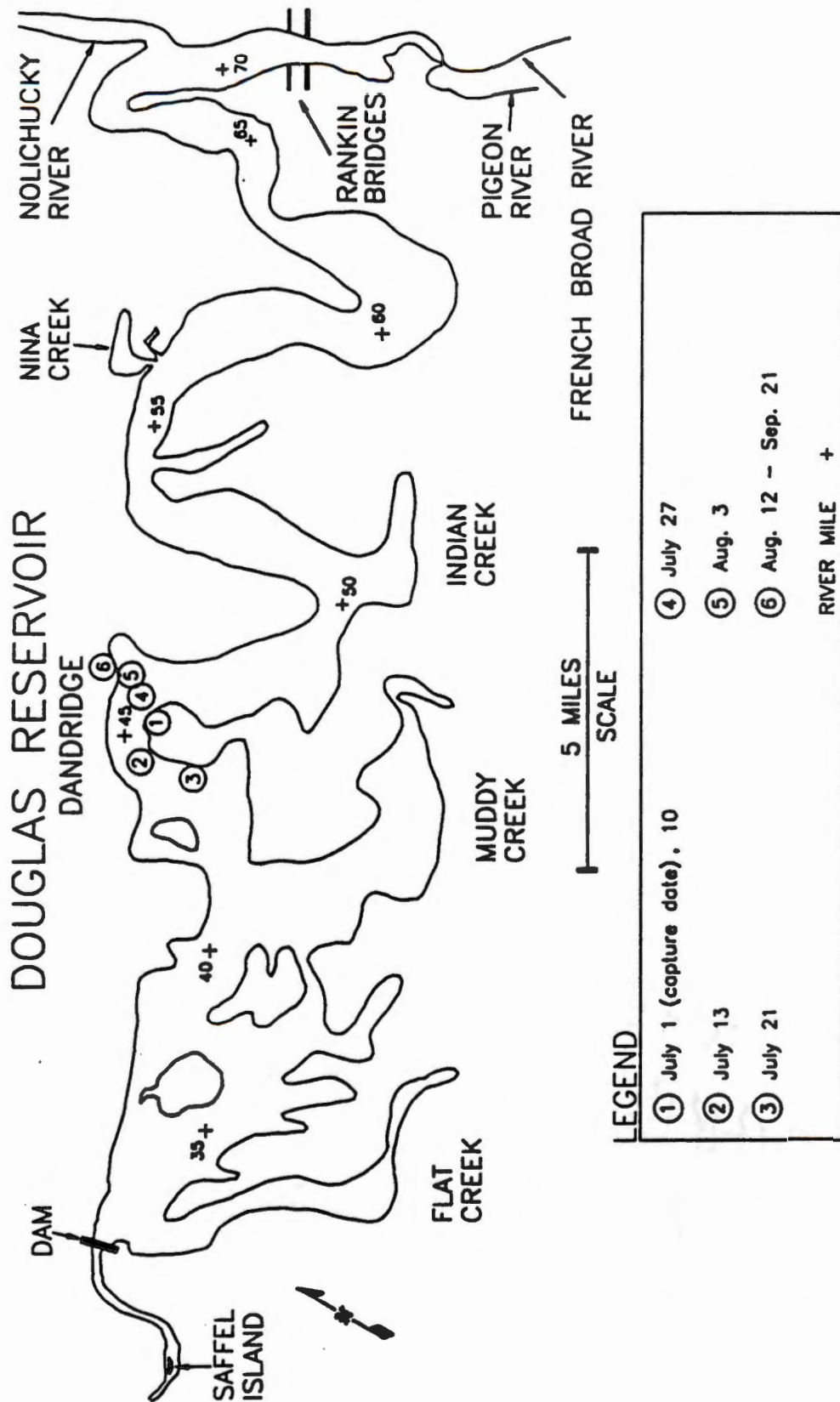


Appendix A.20. Movement of saugeye #49.400 from June 27 to Sep. 21, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.20. Movement data for saugeye #49.400.

Species: Saugeye  
 Transmitter Frequency/Transmitter Type: 49.400, temperature sensor  
 Capture Location: Mouth of cove near RM 45.5, across from Dandridge Boat Dock  
 Capture Date: 06-27-91  
 Total Length (mm): 520  
 Weight (g): 1702  
 Sex: Unknown  
 Tracking Duration: 06-27-91 to 09-21-91, 86 days  
 Number of Observations: 13  
 Total River Miles (RM) Traveled: 8.2

| Date     | Time | RM   | Location                                            | Comments                             |
|----------|------|------|-----------------------------------------------------|--------------------------------------|
| 07-10-91 | 2020 | 45.5 | Capture site                                        | Boat, with #48.300, #49.450, #49.300 |
| 07-11-91 | 2045 | 45.5 | "                                                   | Boat                                 |
| 07-13-91 | 1050 | 45.5 | "                                                   | Aerial, with #49.450                 |
| 07-21-91 | 1015 | 45.3 | Near riprap on Dandridge side                       | Boat                                 |
| 07-27-91 | 1040 | 44.4 | Behind Henderson Island                             | Aerial                               |
| 08-03-91 | 1000 | 42   | Near Smoky View Campground, behind Henderson Island | Aerial                               |
| 08-12-91 | 2305 | 46   | Channel                                             | Boat                                 |
| 08-17-91 | 0930 | 45.5 | "                                                   | Aerial                               |
| 08-23-91 | 1130 | 45.3 | "                                                   | Boat                                 |
| 08-31-91 | 2005 | 45.3 | "                                                   | Boat                                 |
| 09-07-91 | 1237 | 45.3 | "                                                   | Aerial                               |
| 09-15-91 | 0725 | 45.3 | Near riprap on Dandridge side                       | Boat                                 |
| 09-21-91 | 0840 | 45.3 | "                                                   | Aerial                               |



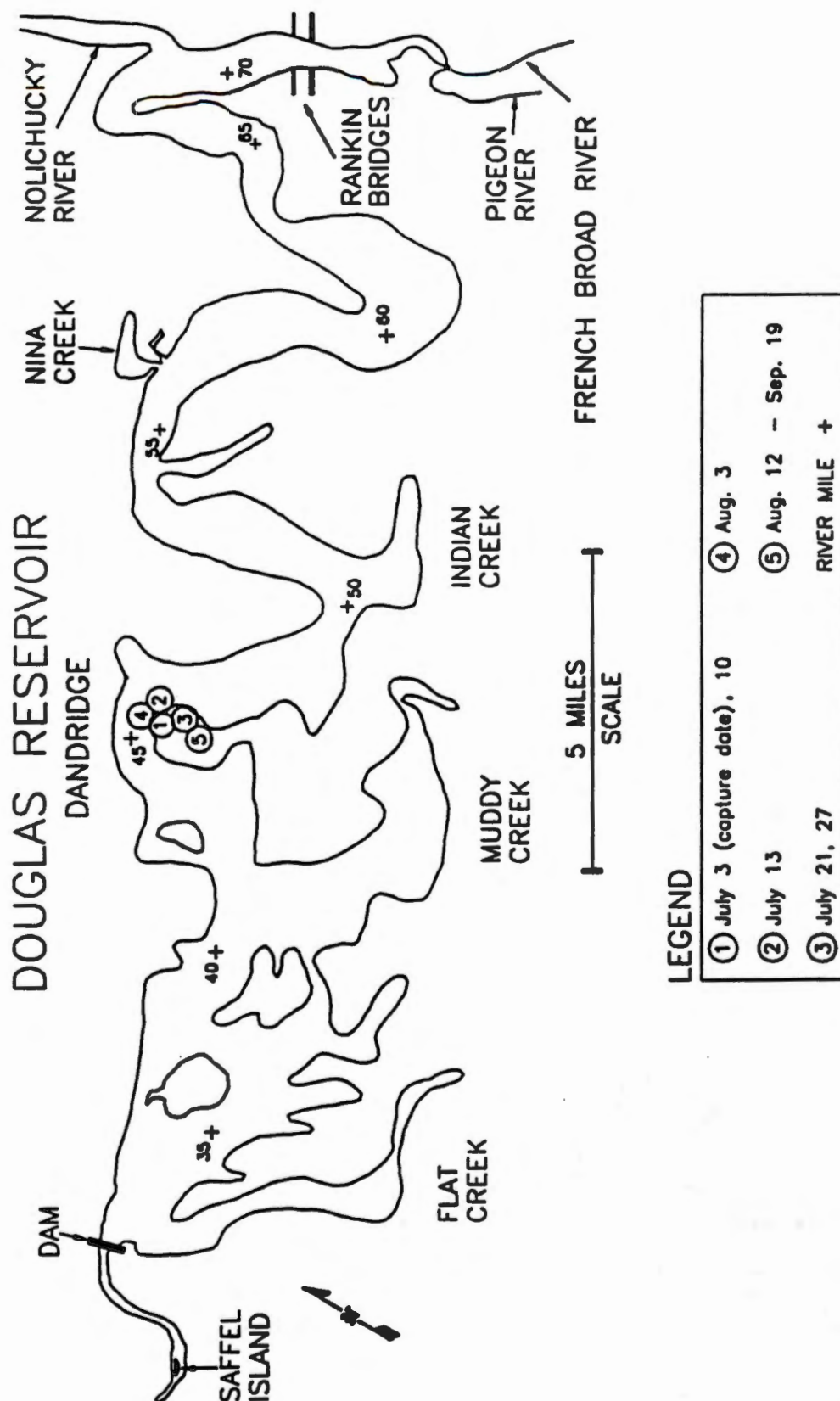
Appendix A.21. Movement of saugeye #48.830 from July 1 to Sep. 21, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.21. Movement data for saugeye #48.830.

Species: Saugeye  
 Transmitter Frequency/Transmitter Type: 48.830  
 Capture Location: Mouth of cove near RM 45.5, across from Dandridge Boat Dock  
 Capture Date: 07-01-91  
 Total Length (mm): 478  
 Weight (g): 1135  
 Sex: Unknown  
 Tracking Duration: 07-01-91 to 08-23-91, 54 days  
 Number of Observations: 12  
 Total River Miles (RM) Traveled: 5.4

| Date     | Time | RM   | Location                                                | Comments                                                     |
|----------|------|------|---------------------------------------------------------|--------------------------------------------------------------|
| 07-10-91 | 2025 | 45.5 | Capture site                                            |                                                              |
| 07-13-91 | 1055 | 44.8 | Channel, downstream of Hoskins Bridge                   | Boat, with #49.300, #49.400, #49.450<br>Aerial, with #48.870 |
| 07-21-91 | 1220 | 43.2 | Near bank, by Pt. 8                                     | Boat                                                         |
| 07-27-91 | 1055 | 46   | Channel                                                 | Aerial, with #49.350                                         |
| 08-03-91 | 1015 | 46   | Near bank, between silo and mouth of Lakeview Park cove | Aerial                                                       |
| 08-12-91 | 2050 | 46.3 | In cove, near Lakeview Park                             | Boat, with #48.870                                           |
| 08-17-91 | 1000 | 46.3 | Mouth of Lakeview Park cove                             | Aerial, with #48.870                                         |
| 08-23-91 | 1145 | 46.3 | In cove, near Lakeview Park                             | Boat, with #48.870                                           |

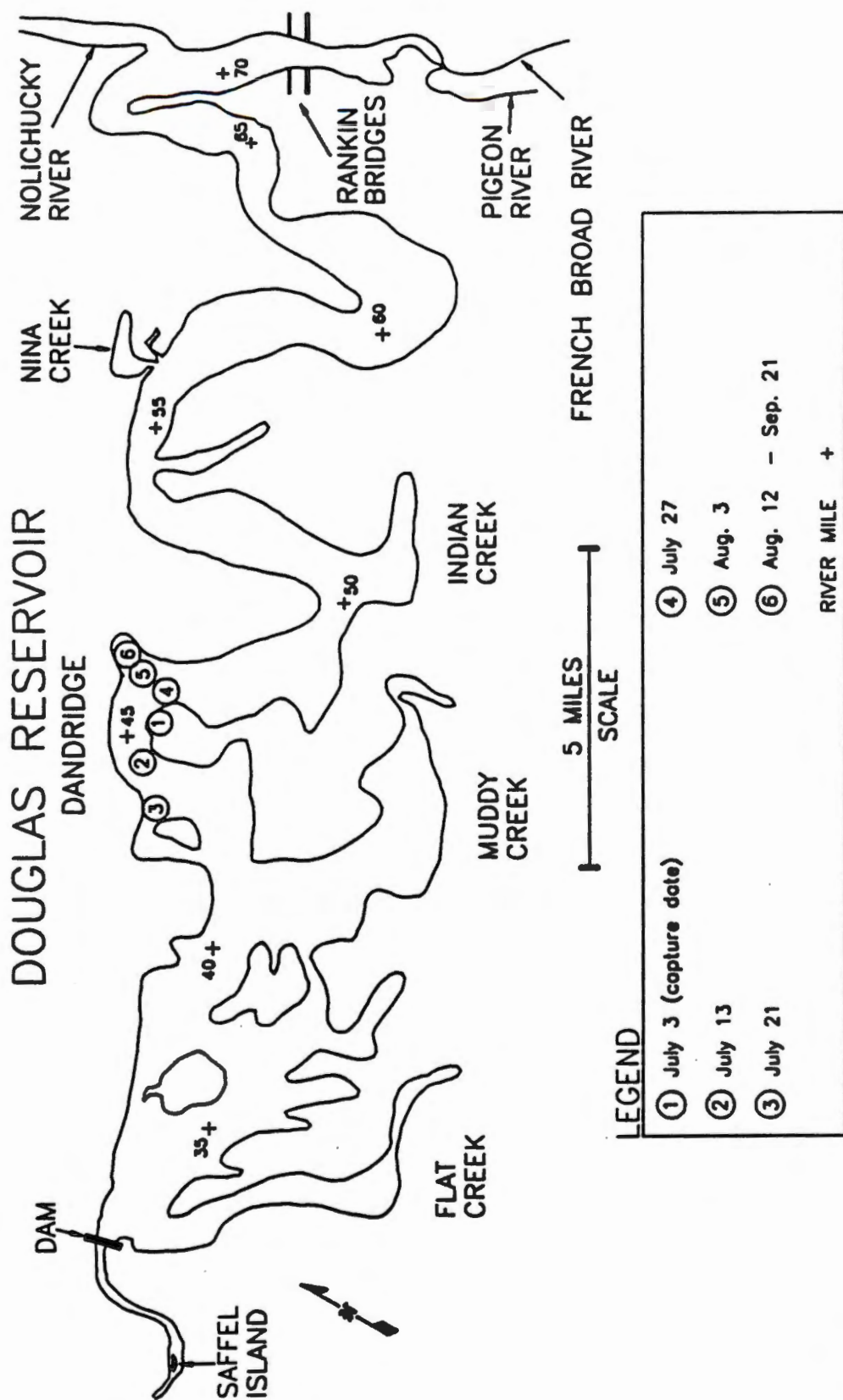
Note: Signal from transmitter 48.830 was received from 08-23-91 to 09-21-91 but no movement was observed.



Appendix A.22. Movement of sauger #49,300 from July 3 to Sep. 19, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.22. Movement data for sauger #49.300.

| <p>Species: Sauger<br/> Transmitter Frequency/Transmitter Type: 49.300, temperature sensor<br/> Capture Location: Mouth of cove near RM 45.5, across from Dandridge Boat Dock<br/> Capture Date: 07-03-91<br/> Total Length (mm): 460<br/> Weight (g): 908<br/> Sex: Unknown<br/> Tracking Duration: 07-03-91 to 09-19-91, 78 days</p> |      |      |                                        | <p>Number of Observations: 12<br/> Total River Miles (RM) Traveled: 3</p> |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|----------------------------------------|---------------------------------------------------------------------------|--|
| Date                                                                                                                                                                                                                                                                                                                                   | Time | RM   | Location                               | Comments                                                                  |  |
| 07-10-91                                                                                                                                                                                                                                                                                                                               | 2020 | 45.5 | Capture site                           | Boat, with #49.400, #49.450, #48.830                                      |  |
| 07-13-91                                                                                                                                                                                                                                                                                                                               | 1130 | 46   | In cove, just upstream of capture site | Boat                                                                      |  |
| 07-21-91                                                                                                                                                                                                                                                                                                                               | 1050 | 46.5 | In cove                                | Boat, with #48.850                                                        |  |
| 07-27-91                                                                                                                                                                                                                                                                                                                               | 1050 | 46.5 | " "                                    | Aerial, with #48.850, #48.870                                             |  |
| 08-03-91                                                                                                                                                                                                                                                                                                                               | 1015 | 45.5 | Near capture site                      | Aerial                                                                    |  |
| 08-12-91                                                                                                                                                                                                                                                                                                                               | 2110 | 46.5 | In cove                                | Boat                                                                      |  |
| 08-17-91                                                                                                                                                                                                                                                                                                                               | 1000 | 46.5 | " "                                    | Aerial                                                                    |  |
| 08-23-91                                                                                                                                                                                                                                                                                                                               | 1210 | 46.5 | " "                                    | Boat                                                                      |  |
| 08-31-91                                                                                                                                                                                                                                                                                                                               | 2105 | 46.5 | " "                                    | Boat                                                                      |  |
| 09-07-91                                                                                                                                                                                                                                                                                                                               | 1241 | 46.5 | " "                                    | Aerial                                                                    |  |
| 09-15-91                                                                                                                                                                                                                                                                                                                               | 0800 | 46.5 | " "                                    | Boat                                                                      |  |
| 09-19-91                                                                                                                                                                                                                                                                                                                               | 1400 | 46.5 | " "                                    | Boat, recovered transmitter 20 feet up bank and buried 2 inches.          |  |



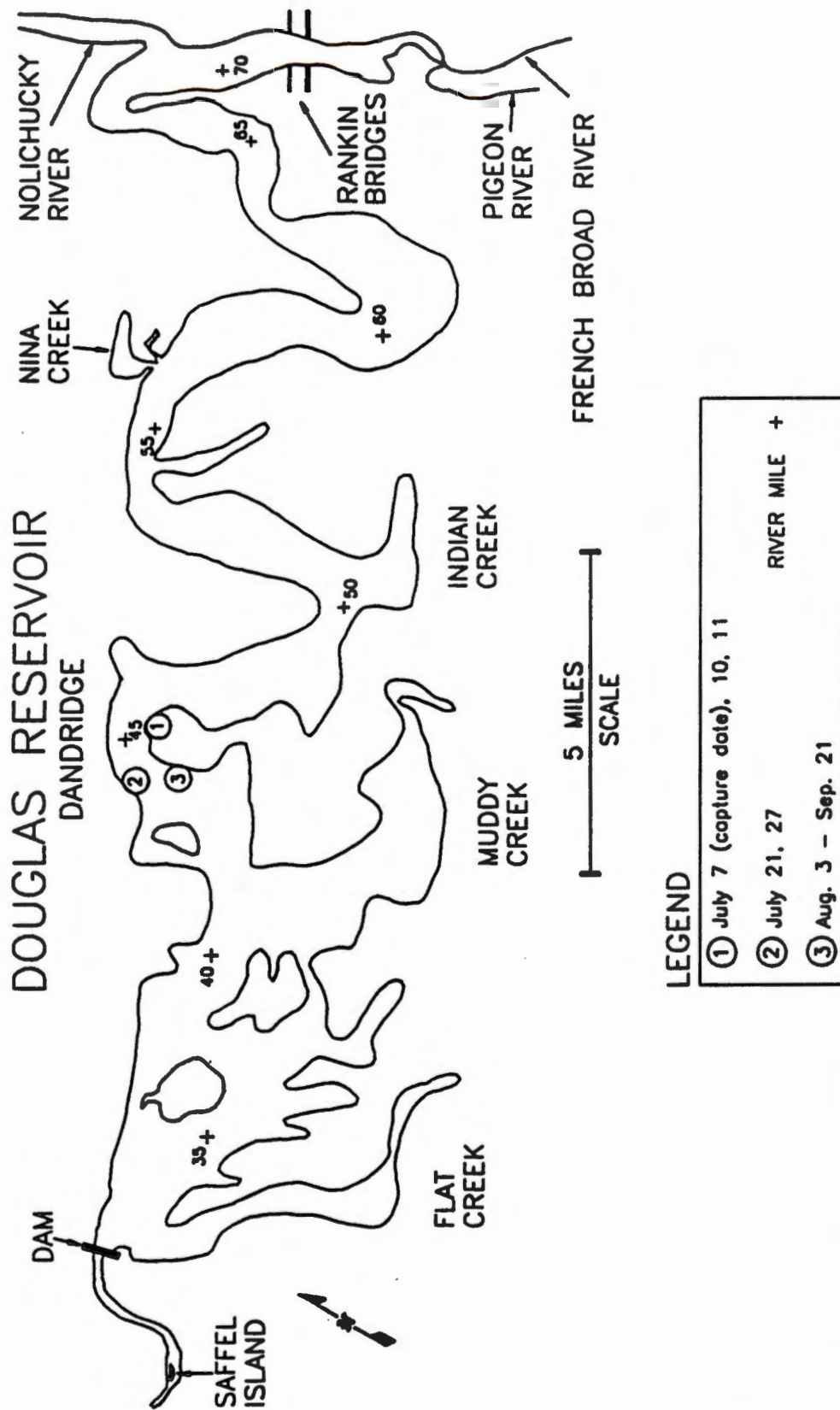
Appendix A.23. Movement of saugeye #48.870 from July 3 to Sep. 21, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.23. Movement data for saugeye #48.870.

Species: Saugeye  
Transmitter Frequency/Transmitter Type: 48.870  
Capture Location: Mouth of cove near RM 45.5, across from Dandridge Boat Dock  
Capture Date: 07-03-91  
Total Length (mm): 499  
Weight (g): 1362  
Sex: Unknown  
Tracking Duration: 07-03-91 to 09-21-91, 80 days

Number of Observations: 11  
Total River Miles (RM) Traveled: 4

| Date     | Time | RM   | Location                                   | Comments                      |
|----------|------|------|--------------------------------------------|-------------------------------|
| 07-13-91 | 1055 | 44.8 | Channel, downstream of Hoskins Bridge      | Aerial, with #48.830          |
| 07-21-91 | 1000 | 44   | In cove between Henderson Island and Pt. 9 | Boat                          |
| 07-27-91 | 1050 | 46.4 | Mouth of cove, downstream of capture site  | Aerial, with #49.300, #48.850 |
| 08-03-91 | 1015 | 46.4 | "                                          | Aerial                        |
| 08-12-91 | 2050 | 46.3 | In middle of cove near Lakeview Park       | Boat, with #48.830            |
| 08-17-91 | 1000 | 46.3 | Mouth of cove, near Lakeview Park          | Aerial, with #48.830          |
| 08-23-91 | 1140 | 46.3 | In middle of cove near Lakeview Park       | Boat, with #48.830            |
| 08-31-91 | 2045 | 46.3 | "                                          | Boat, with #48.830            |
| 09-07-91 | 1234 | 46.3 | "                                          | Aerial                        |
| 09-15-91 | 0732 | 46.3 | "                                          | Boat, with #48.830            |
| 09-21-91 | 0835 | 46.3 | "                                          | Aerial, with #48.830          |

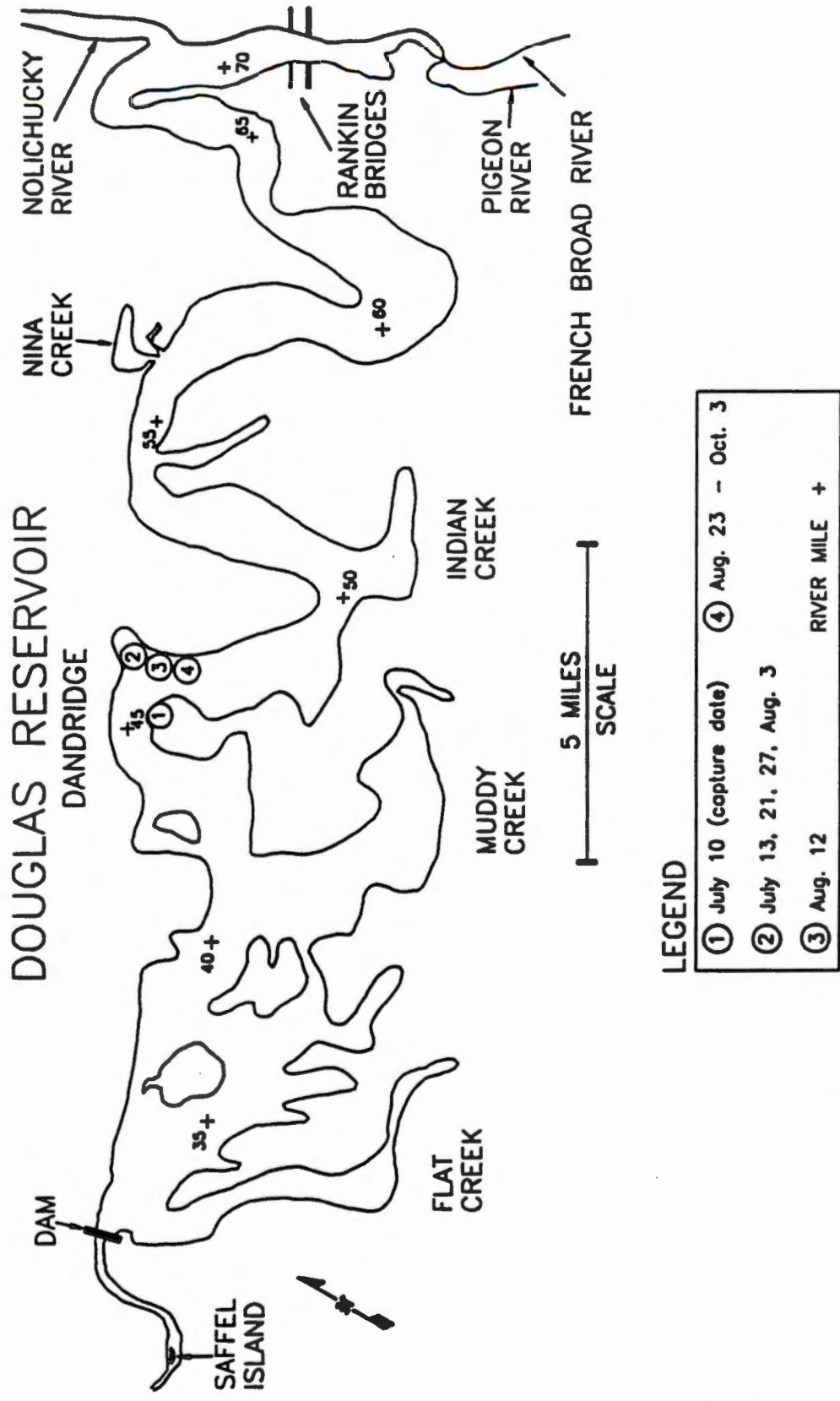


Appendix A.24. Movement of sauger #49.450 from July 7 to Sep. 21, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.24. Movement data for sauger #49.450.

Species: Sauger  
 Transmitter Frequency/Transmitter Type: 49.450, temperature sensor  
 Capture Location: Mouth of cove near RM 45.5, across from Dandridge Boat Dock  
 Capture Date: 07-07-91  
 Total Length (mm): 484  
 Weight (g): 1090  
 Sex: Unknown  
 Tracking Duration: 07-07-91 to 09-21-91, 76 days  
 Number of Observations: 12  
 Total River Miles (RM) Traveled: 1.5

| Date     | Time | RM   | Location                                | Comments                             |
|----------|------|------|-----------------------------------------|--------------------------------------|
| 07-10-91 | 2019 | 45.5 | Capture site                            | Boat, with #49.300, #49.400, #48.830 |
| 07-11-91 | 2050 | 45.5 | " "                                     | Aerial, with #49.400                 |
| 07-21-91 | 0950 | 44.4 | Small cove, just upstream of Pt. 9      | Boat                                 |
| 07-27-91 | 1035 | 44.4 | " "                                     | Aerial                               |
| 08-03-91 | 1000 | 44   | Channel                                 | Aerial                               |
| 08-12-91 | 2000 | 44   | Channel                                 | Boat                                 |
| 08-17-91 | 0930 | 44   | Channel                                 | Aerial                               |
| 08-23-91 | 1250 | 44   | Near Bank, across from Henderson Island | Boat                                 |
| 08-31-91 | 1945 | 44   | " "                                     | Boat                                 |
| 09-07-91 | 1231 | 44   | " "                                     | Aerial                               |
| 09-15-91 | 0745 | 44   | " "                                     | Boat                                 |
| 09-21-91 | 0825 | 44   | " "                                     | Aerial                               |



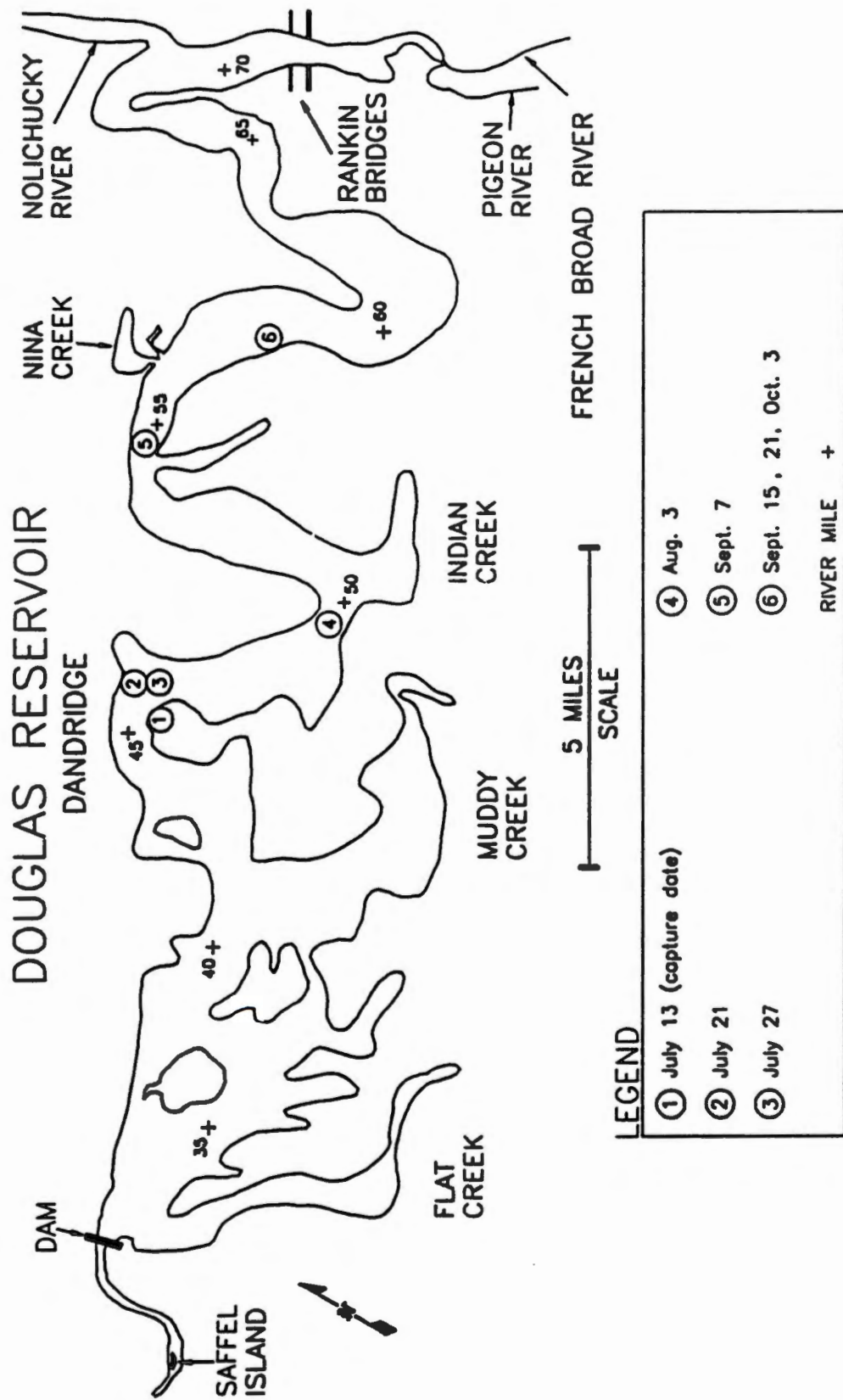
Appendix A.25. Movement of saugeye #48.910 from July 10 to Oct. 3, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.25. Movement data for saugeye #48.910.

Species: Saugeye  
 Transmitter Frequency/Transmitter Type: 48.910  
 Capture Location: Mouth of cove near RM 45.5, across from Dandridge Boat Dock  
 Capture Date: 07-10-91  
 Total Length (mm): 494  
 Weight (g): 1407  
 Sex: Unknown  
 Tracking Duration: 07-10-91 to 10-03-91, 86 days

Number of Observations: 12  
 Total River Miles (RM) Traveled: 1.3

| Date     | Time | RM   | Location                         | Comments                                    |
|----------|------|------|----------------------------------|---------------------------------------------|
| 07-13-91 | 1100 | 46.4 | Mouth of cove near Lakeview Park | Aerial                                      |
| 07-21-91 | 1120 | 46.4 | "                                | Boat                                        |
| 07-27-91 | 1050 | 46.4 | "                                | Aerial                                      |
| 08-03-91 | 1015 | 46.4 | "                                | Aerial                                      |
| 08-12-91 | 2115 | 46.6 | Upstream from Lakeview Park      | Boat                                        |
| 08-17-91 | 1015 | 46.6 | "                                | Aerial                                      |
| 08-23-91 | 1200 | 46.8 | Near mouth of Koontz Creek       | Boat                                        |
| 08-31-91 | 2055 | 46.8 | "                                | Boat                                        |
| 09-07-91 | 1245 | 46.8 | "                                | Aerial                                      |
| 09-15-91 | 0743 | 46.8 | "                                | Boat                                        |
| 09-21-91 | 0835 | 46.8 | "                                | Aerial                                      |
| 10-03-91 | 1000 | 46.8 | "                                | Boat, recovered transmitter 20' up on bank. |



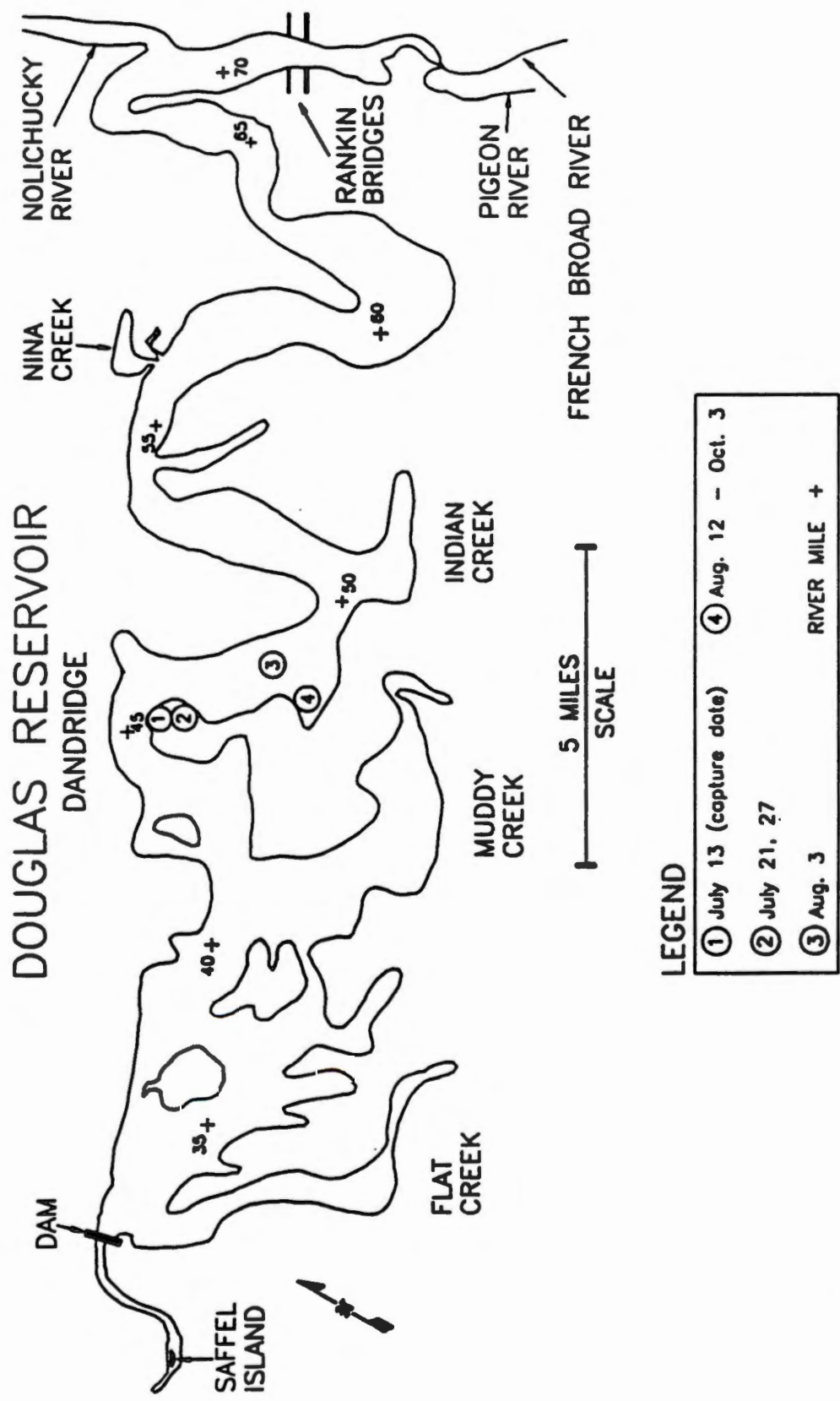
Appendix A.26. Movement of sauger #49.350 from July 13 to Oct. 3, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.26. Movement data for sauger #49.350.

Species: sauger  
 Transmitter Frequency/Transmitter Type: 49.350, temperature sensor  
 Capture Location: Mouth of cove near RM 45.5, across from Dardridge Boat Dock  
 Capture Date: 07-13-91  
 Total Length (mm): 455  
 Weight (g): 885  
 Sex: Unknown  
 Tracking Duration: 07-13-91 to 10-03-91, 82 days

Number of Observations: 7  
 Total River Miles (RM) Traveled: 11.9

| Date     | Time | RM   | Location                                      | Comments                                |
|----------|------|------|-----------------------------------------------|-----------------------------------------|
| 07-21-91 | 1035 | 46   | Near silo, downstream from Lakeview Park cove | Boat                                    |
| 07-27-91 | 1050 | 46   | Channel                                       | Aerial, with #48.830                    |
| 08-03-91 | 1030 | 49.4 | Channel                                       | Aerial                                  |
| 09-07-91 | 1254 | 54.6 | Channel, upstream of I-40 Bridge              | Aerial                                  |
| 09-15-91 | 1030 | 57.4 | Near bank, behind silo                        | Boat                                    |
| 09-21-91 | 0840 | 57.4 | "                                             | Aerial                                  |
| 10-03-91 | 1200 | 57.4 | On bank                                       | Boat, recovered transmitter near water. |



Appendix A.27. Movement of sauger #48.850 from July 13 to Oct. 3, 1991. Circled numbers represent observed locations in chronological order.

Appendix A.27. Movement data for sauger #48.850.

Species: Sauger  
Transmitter Frequency/Transmitter Type: 48.850  
Capture Location: Mouth of cove near RM 45.5, across from Dandridge Boat Dock  
Capture Date: 07-13-91  
Total Length (mm): 460  
Weight (g): 908  
Sex: Unknown  
Tracking Duration: 07-13-91 to 10-03-91, 82 days

Number of Observations: 11  
Total River Miles (RM) Traveled: 3.5

| Date     | Time | RM   | Location                          | Comments                                    |
|----------|------|------|-----------------------------------|---------------------------------------------|
| 07-21-91 | 1055 | 46.5 | Cove, upstream from capture site  | Boat, with #49.300                          |
| 07-27-91 | 1055 | 46.5 | "                                 | Aerial, with #49.300, #48.870               |
| 08-03-91 | 1030 | 48.5 | Channel, near Douglas Estates     | Aerial                                      |
| 08-12-91 | 2225 | 49   | In cove, opposite Douglas Estates | Boat                                        |
| 08-17-91 | 1030 | 49   | "                                 | Aerial                                      |
| 08-23-91 | 1230 | 49   | "                                 | Boat                                        |
| 08-31-91 | 2120 | 49   | "                                 | Boat                                        |
| 09-07-91 | 1245 | 49   | "                                 | Aerial                                      |
| 09-15-91 | 0845 | 49   | "                                 | Boat                                        |
| 09-21-91 | 0840 | 49   | "                                 | Aerial                                      |
| 10-03-91 | 1100 | 49   | On bank                           | Boat, recovered transmitter 20' up on bank. |

## VITA

Paul E. Stodola was born in Hammond, Indiana, on March 14, 1956. He attended elementary school in Hammond and graduated from Bishop Noll Institute in 1974. In May 1978, he received the Bachelor of Science degree from Purdue University, West Lafayette, Indiana. Mr. Stodola served as a Peace Corps fisheries volunteer and trainer from September, 1978, to December, 1981. After leaving the Peace Corps he worked as a product manager at Ekk-Will tropical fish farm in Florida for two years. In 1983, Mr. Stodola was married and moved to Pullman, Washington, where he worked as a fishery biologist and technician for the Army Corps of Engineers, National Marine Fisheries Service, and the University of Idaho on a seasonal basis. In 1986, Mr. and Mrs. Stodola relocated to Knoxville, Tennessee, where he accepted a position as an elephant keeper with the Knoxville Zoo. Mr. Stodola returned to school in 1988 and received an Associate Degree in Veterinary Technology from Lincoln Memorial University in May, 1990, at Harrogate, Tennessee. He attended the University of Tennessee from July, 1990, to August, 1992, while serving as a graduate research assistant. In August, 1992, he received the Master of Science degree in Wildlife and Fisheries Science.

The author is a member of the honorary fraternity Phi Kappa Phi. He is also a member of the American Fisheries Society.

