

A CHECKLIST OF FISHES ON THE DEPARTMENT OF ENERGY OAK RIDGE RESERVATION

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ABSTRACT

Fish collections have been made over the past 10 years on the Department of Energy Oak Ridge Reservation (ORR) in conjunction with several biomonitoring programs conducted by Oak Ridge National Laboratory. The ORR contains a wide range of habitats, from small spring-fed streams to large riverine and reservoir systems. The fish checklist generated for the ORR includes 17 families, 39 genera, and 64 species. Several uncommon species or unusual distribution records are

noted, including *Phoxinus oreas* and *Culaea inconstans*.

INTRODUCTION

The Oak Ridge Reservation (ORR) consists of 14,400 ha which includes three Department of Energy (DOE) facilities located in Oak Ridge, Roane and Anderson Counties, Tennessee at latitude 36 N and longitude 84 W (Figure 1).

The fish fauna of the ORR have been surveyed several times over the past 50 years. The Tennessee Valley

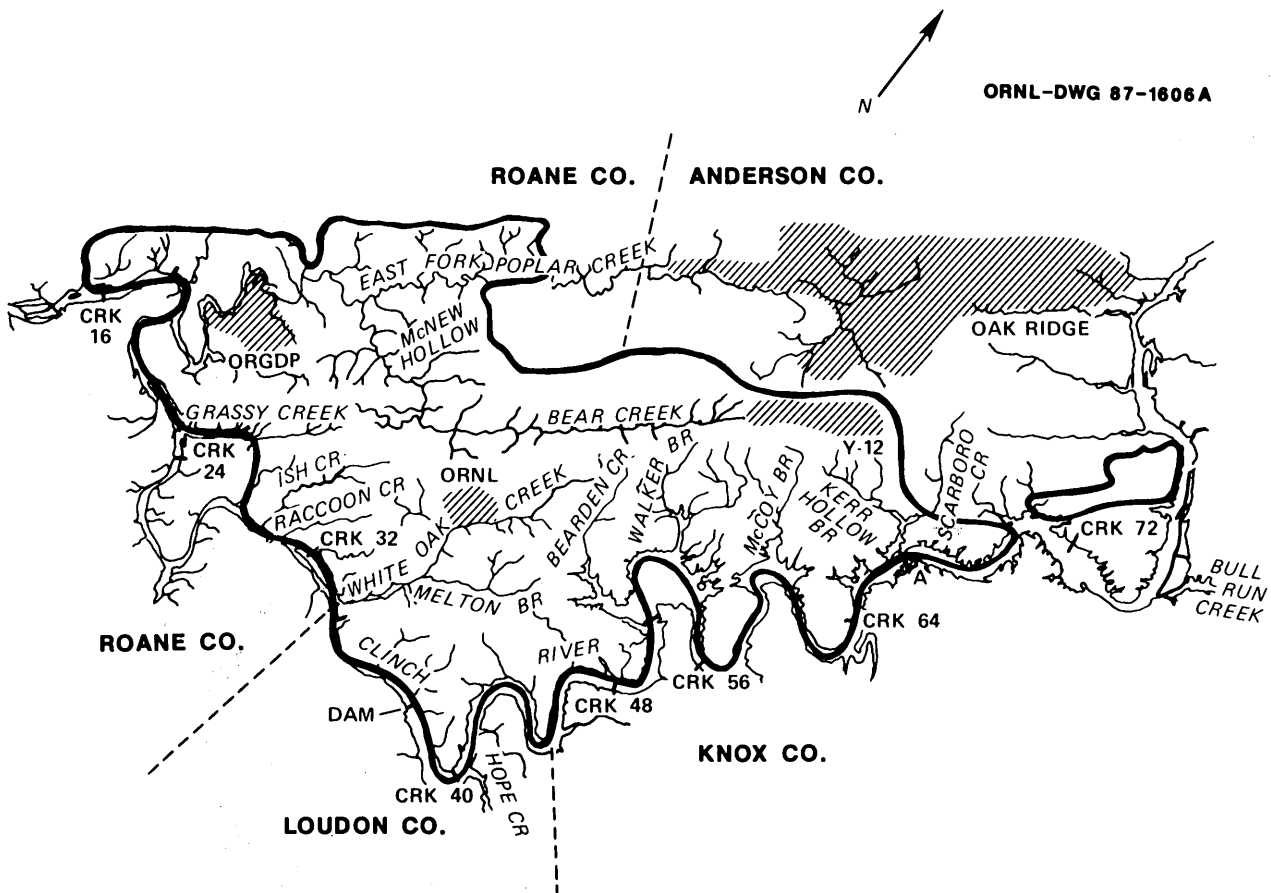


Figure 1. Major streams on the Department of Energy Oak Ridge Reservation (outlined by solid lines).

Table 1. Study area descriptions for the Oak Ridge Reservation.

Study area	Code	Description
Clinch River and Melton Hill Reservoir	CR	Upper Watts Bar Reservoir from river km 16 to 37 and Melton Hill Reservoir from dam, river km 37 to 79; includes Poplar Creek and several smaller embayments; average annual flow is 153 m ³ /s; controlled by releases from hydroelectric dams above and below the study area; mean depth of Melton Hill is 6.4 m and surface area is 2300 ha; habitat includes woody cover, substrates of bedrock with gravel, sand, and silt overlays, and large macrophyte beds. (Loar et al. 1981a)
East Fork Poplar Creek	EF	7.8 stream km reach above confluence with Poplar Creek in western end of city of Oak Ridge; originates from springs near Y-12 plant, supplemented by process water, and flow is regulated by New Hope Pond, a 2.2-ha retention pond; annual discharge of 1.47 m ³ /s; bordered by hardwood forest; riffle-pool sequences with undercut banks, woody cover, and substrates of rubble, gravel, sand, and silt. (Loar et al. 1981a)
Bear Creek	BC	13 stream km from headwaters near western end of Y-12 to confluence with EF; watershed area of 19.4 km ² ; bordered by agricultural land revegetated by pine and mixed hardwood; flow and thermal regime is dominated by several springs; habitat includes rubble and gravel with bedrock outcrops and undercut banks. (Loar et al. 1985)
White Oak Creek	WC	Includes White Oak Lake (a 15-ha impoundment), 6-km reach with tributaries above the lake, and 6 research ponds; separated from CR by impenetrable dam barrier; watershed area is 15.5 km ² and flow is augmented by releases from ORNL; habitat includes woody cover with gravel, sand, and silt substrates. (Loar et al. 1987)
Small creeks	BeC GC IC KB MB RC SC WB	Streams of similar size (first to third-order with watersheds < 20 km ²), flow characteristics (average annual flow < 0.4 m ³ /s), and habitat (woody cover with gravel, cobble, and bedrock substrates); includes Bearden Creek (BeC), Grassy Creek (GC), Ish Creek (IC), Kerr Hollow Branch (KB), McCoy Branch (MB), Raccoon Creek (RC), Scarboro Creek (SC), and Walker Branch (WB). (Loar et al. 1984)

Authority (TVA) surveyed Bear Creek, Poplar Creek, and several small tributaries in the ORR area during 1938–1942, prior to the construction of the DOE facilities (Etnier 1978). Krumholz (1951, 1954) and Kolehmainen and Nelson (1969) surveyed White Oak Lake and/or White Oak Creek during the 1950s and 1960s. Also surveys were made in the early 1960s by TVA in the Clinch River prior to the impoundment of Melton Hill reservoir (Morton 1962; Fitz 1968). Surveys and literature reviews of the fish fauna of the ORR were conducted throughout the 1970s (e.g., Dahlman et al. 1977). Although these earlier surveys were consulted, they frequently contained questionable species identifications

or distributions or represented conditions no longer existing. Therefore, the current checklist contains only species and distributions verified by us.

DESCRIPTION OF THE STUDY AREA

The ORR lies within the Ridge and Valley Physiographic Province and is dominated by southwest-northeast oriented ridges of sandstone, shale, and cherty-dolomite with elevations from 226 to 413 msl (Parr and Pounds 1987). Soils are members of the utisol group and are predominantly silty with considerable clay subsoil.

The main vegetational communities include natural yellow pine forests, bottomland hardwoods, oak-hickory forests, plantations of loblolly pine or tulip poplar, and old fields. More details on the ORR can be found in the Oak Ridge National Laboratory (ORNL) Resource Management Plan (e.g., Rothschild et al. 1984; Parr and Pounds 1987). Aquatic habitats within or adjacent to the ORR include 1) tailwaters and reservoir embayments, 2) impoundments, 3) large streams, 4) small streams, and 5) wetlands and floodplains. To describe fish distributions within these habitats, groupings were developed that reflect the major drainages or hydrologic pathways of similar nature (Table 1). Detailed descriptions of the aquatic habitats on the ORR are given by Loar (1984).

METHODS

Sampling was conducted over the past 10 years with 311 collections covering 85% of the stream habitat on the ORR. The sampling was associated with several projects to evaluate the environmental impact of plant operations and as part of the current biomonitoring required under National Pollutant Discharge Elimination System permits for the three DOE facilities in Oak Ridge [ORNL, Y-12, and the Oak Ridge Gaseous Diffusion Plant (ORGD)]. The principal collection method was electroshocking, either by backpack electrofishers or boat-mounted units. Streams were sampled using Smith-Root Model 15A backpack electrofishers and occasionally with 4-m seines (0.64 cm mesh). Larger stream, impoundment, and river areas were sampled with a boat-mounted Smith-Root Type IV electrofisher and augmented by the use of gill nets and trot lines. The gill nets were either 22.9 or 48.5 m by 1.8 m with six panels of 1.9 to 7.6-cm bar mesh. Surveys were conducted more frequently on the East Fork Poplar Creek, White Oak Creek, and Bear Creek systems. Fish were usually anesthetized, identified on site, and released. However, representative species and specimens in need of verification were preserved in 10% formalin and retained in a reference collection.

RESULTS

Sixty-four species of fish were found in the aquatic habitats of the ORR. Forty-six species were found in the Clinch River area, 41 in the East Fork Poplar Creek area, 20 in the Bear Creek area, 30 in the White Oak Creek area, and 19 in other ORR streams. Although some uncommon species were collected, no species currently on Federal or State Endangered and Threatened Species lists were taken. The Clinch River/Melton Hill area contains a rich assemblage of species, although not nearly as rich as that observed in pre-impoundment surveys (Fitz 1968). One of the most notable aspects of the current list is the number of introduced species. For example, species such as

Morone saxatilis and *Esox lucius* were stocked by the Tennessee Wildlife Resources Agency (TWRA) to enhance sport fishing. The East Fork Poplar Creek area contains fish representative of both reservoirs (e.g., *Ictiobus*) and small tributaries (e.g., *Rhinichthys*). The species list for this section of the creek also indicates that species richness is high with most common genera represented by several species. The Bear Creek area has fewer species, due in part to the presence of a large weir at Bear Creek Kilometer (BCK) 4.5, effectively isolating the upper 8.5 km of the stream. However, even in lower Bear Creek many common species (e.g., *Gambusia*) are absent. The most significant aspect of the species list for the Bear Creek area is the abundance of *Phoxinus oreas* throughout upper Bear Creek (upstream of BCK 4.5). The species list for the White Oak Creek area represents two separate situations. The total number of species is high because the area contains several introduced species that occur in research ponds or associated creeks near the west end of ORNL. However, the native fauna is somewhat depauperate due to past impacts from the ORNL facilities; several genera (e.g., *Notropis*) are absent, yet found in abundance elsewhere in the area (Ryon 1987). The majority of species located on the ORR are typical of the Clinch River system in East Tennessee (Etnier 1986), but a few species represent unique distributions or are of special interest.

ANNOTATED LIST OF FISHES

PETROMYZONTIDAE

Ichthyomyzon castaneus Girard Chestnut lamprey. Areas: EF. Specimens found attached to individuals of *Ictiobus bubalus* and *Cyprinus carpio*

POLYDONTIDAE

Polyodon spathula (Walbaum) Paddlefish. Areas: CR. Large specimen taken in Melton Hill Reservoir.

LEPISOSTEIDAE

Lepisosteus oculatus (Winchell) Spotted gar. Areas: CR (in Poplar Creek area only), WC.

L. osseus (Linnaeus) Longnose gar. Areas: CR.

CLUPEIDAE

Alosa chrysochloris (Rafinesque) Skipjack herring. Areas: CR.

Dorosoma cepedianum (Lesueur) Gizzard shad. Areas: CR, EF, WC.

D. petenense (Gunther) Threadfin shad. Areas: CR, WC.

HIODONTIDAE

Hiodon tergisus Lesueur Mooneye. Areas: CR.

ESOCIDAE

Esox lucius Lesueur Northern pike. Areas: CR (in Melton Hill Reservoir).

CYPRINIDAE

Campostoma anomalum (Rafinesque) Stoneroller. Areas: BC, EF, GC, SC, WC.

Carassius auratus (Linnaeus) Goldfish. Areas: CR, WC.
Ctenopharyngodon idella (Valenciennes) Grass carp. Areas: CR, WC. Introduced in 1982 to several ponds (near ORGDP and west end of ORNL) within ORR for aquatic vegetation control. Individuals for first stocking obtained from Arkansas Game and Fish Department under guidance of TWRA and TVA (Hughes 1987). No evidence of reproduction was observed.

Cyprinus carpio Linnaeus Carp. Areas: CR, EF, WC.

Notemigonus crysoleucas (Mitchill) Golden shiner. Areas: EF, WC.

Notropis ardens (Cope) Rosefin shiner. Areas: BC, EF.

N. atherinoides Rafinesque Emerald shiner. Areas: BC, CR, EF.

N. chrysocephalus (Rafinesque) Striped shiner. Areas: BC, BeC, CR, EF, GC, IC.

N. spilopterus (Cope) Spotfin shiner. Areas: BC.

Phoxinus oreas (Cope) Mountain redbelly dace. Areas: BC, EF, IC. The mountain redbelly dace has a very limited range in Tennessee and is listed as a species in need of management by the TWRA (Starnes and Etnier 1980). On the ORR, it is a common species with high densities (up to 2 individuals/m²). Its distribution is very sporadic and is absent from several tributaries interspersed between known localities. For example, reproducing populations of *P. oreas* are found in Ish Creek, but not in similar, adjacent streams such as Grassy or Raccoon Creeks (Figure 1). In our sampling, its typical habitat is pools in first- or second-order streams, particularly those with undercut banks, and is generally associated with springs. In Bear Creek, *P. oreas* is abundant throughout the upper 8.5 km of the stream. The abundance of *P. oreas* on the ORR represents a unique opportunity for research and preservation purposes.

Pimephales notatus (Rafinesque) Bluntnose minnow. Areas: BC, BeC, CR, EF, MB, RC, SC.

P. promelas (Rafinesque) Fathead minnow. Areas: WC. The fathead minnow was not reported in early surveys of Bear Creek and Poplar Creek (Etnier 1978) or in subsequent ORR surveys of the 1950s to the early 1980s. However, population studies conducted in the White Oak Creek area over the past several years (Ryon 1987) have documented the introduction, rapid spread, and (using the terminology of the AFS) establishment (Shafland and Lewis 1984) of a large reproducing population. At one site, densities (number of fish/m²) increased from 0.03 in 1985 to 0.57 in 1986 and 0.95 in 1987. *P. promelas* was used in the aquatic research facility at ORNL as food in

various experiments and later as a test species for toxicological evaluations. By traversing wastewater systems, escapees from these studies became established in research ponds and later in the White Oak Creek area. Although not totally unexpected, the success of *P. promelas* in establishing large populations so rapidly may reflect the limited cyprinid diversity in White Oak Creek. Becker (1983) describes the fathead as a "pioneer" capable of rapid dispersal in marginal habitats, but also one that becomes abundant only in streams lacking numerous kinds of fish or minnows.

Rhinichthys atratulus (Herman) Blacknose dace. Areas: BC, BeC, EF, GC, IC, KB, SC, WB, WC.

Semotilus atromaculatus (Mitchill) Creek chub. Areas: BC, BeC, EF, GC, IC, WB, WC.

CATOSTOMIDAE

Carpiodes carpio (Rafinesque) River carpsucker. Areas: CR.

C. cyprinus (Lesueur) Quillback. Areas: CR.

Catostomus commersoni (Lacepede) White sucker. Areas: BC, EF, GC.

Hypentelium nigricans (Lesueur) Northern hog sucker. Areas: BC, CR, EF, SC.

Ictiobus bubalus (Rafinesque) Smallmouth buffalo. Areas: CR, EF, WC.

I. niger (Rafinesque) Black buffalo. Areas: CR.

Minytrema melanops (Rafinesque) Spotted sucker. Areas: CR, EF, WC.

Moxostoma anisurum (Rafinesque) Silver redhorse. Areas: CR.

M. duquesnei (Lesueur) Black redhorse. Areas: CR, EF.

M. erythrurum (Rafinesque) Golden redhorse. Areas: EF.

ICTALURIDAE

Ictalurus furcatus (Lesueur) Blue catfish. Areas: CR.

I. melas (Rafinesque) Black bullhead. Areas: WC.

I. natalis (Lesueur) Yellow bullhead. Areas: CR, EF, MB, WC.

I. punctatus (Rafinesque) Channel catfish. Areas: CR, EF.

Pylodictis olivaris (Rafinesque) Flathead catfish. Areas: CR, WC (research ponds near west end of ORNL).

POECILIIDAE

Gambusia affinis (Baird and Girard) Mosquitofish. Areas: CR, EF, MB, RC, SC, WC.

ATHERINIDAE

Labidesthes sicculus (Cope) Brook silverside. Areas: CR, EF.

GASTEROSTEIDAE

Culaea inconstans (Kirtland) Brook stickleback. Areas: WC. The brook stickleback is another introduced species. It occasionally arrived with shipments of *P. promelas* and

followed a similar escape and establishment pattern, although it was not discovered until 1986. Currently, the population is small and reproduction may occur only in the research ponds. Habitat descriptions for *C. inconstans* indicate that it can occur in boggy lakes and streams, alkaline lakes, spring seeps, and trout streams (Hubbs and Lagler 1964). With this habitat flexibility, *C. inconstans* should disperse throughout the White Oak Creek area. The normal distribution of the species is the Great Lakes system, and the reproducing population on the ORR may represent the only such population in Tennessee (Etnier 1987).

PERCICHTHYIDAE

Morone chrysops (Rafinesque) White bass. Areas: CR.
M. mississippiensis Jordon and Eigenmann Yellow bass. Areas: CR, EF, WC.
M. saxatilis (Walbaum) Striped bass. Areas: CR, EF, WC (research ponds near west end of ORNL).

CENTRARCHIDAE

Ambloplites rupestris (Rafinesque) Rock bass. Areas: BC, CR, EF, WC.
Lepomis auritus (Linnaeus) Redbreast sunfish. Areas: BC, BeC, CR, EF, IC, MB, RC, WC.
L. cyanellus Rafinesque Green sunfish. Areas: BC, EF, GC, WC.
L. gulosus (Cuvier) Warmouth. Areas: CR, EF, WC.
L. macrochirus Rafinesque Bluegill. Areas: BC, CR, EF, GC, MB, RC, WC.
L. megalotis (Rafinesque) Longear sunfish. Areas: BC, CR, EF.
L. microlophus (Gunther) Redear sunfish. Areas: CR, EF, WC.
Micropterus dolomieu Lacepede Smallmouth bass. Areas: CR, EF, WC (research ponds near west end of ORNL).
M. punctulatus (Rafinesque) Spotted bass. Areas: CR, SC, WC.
M. salmoides (Lacepede) Largemouth bass. Areas: CR, EF, GC, WC.
Pomoxis annularis Rafinesque White crappie. Areas: CR.

PERCIDAE

Etheostoma blennioides Rafinesque Greenside darter. Areas: EF.
E. duryi Henshall Blackside snubnose darter. Areas: BC, EF, GC.
E. kennicotti (Putnam) Stripetail darter. Areas: BC, EF.
E. simoterum (Cope) Tennessee snubnose darter. Areas: BC, EF, GC.
Perca flavescens (Mitchill) Yellow perch. Areas: CR, EF. The yellow perch is an introduced species that may have spread in the Tennessee system from stockings in the Hiawasse River (Etnier 1988). The species was not

reported in ORR surveys conducted prior to the mid-1970s (Fitz 1968; Loar 1981b) and was first collected in the White Oak Creek embayment in 1979. In recent surveys of the East Fork Poplar Creek area, although few individuals are taken, their frequency in samples is increasing.

Percina caprodes (Rafinesque) Logperch. Areas: CR, EF.
Stizostedion canadense (Smith) Sauger. Areas: CR, EF.

SCIAENIDAE

Aplodinotus grunniens Rafinesque Freshwater drum. Areas: CR, EF, RC, WC.

COTTIDAE

Cottus carolinae (Gill) Banded sculpin. Areas: BC, CR, EF, GC, KB, SC, WC.

The distribution data represented in this checklist indicate the process of change typical of areas of development in Tennessee. Over time the fauna of a region such as the ORR undergoes compositional changes due to introductions, extinctions, and natural range extensions. Therefore it is important to record the fish fauna and any changes to understand the natural history of that area.

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