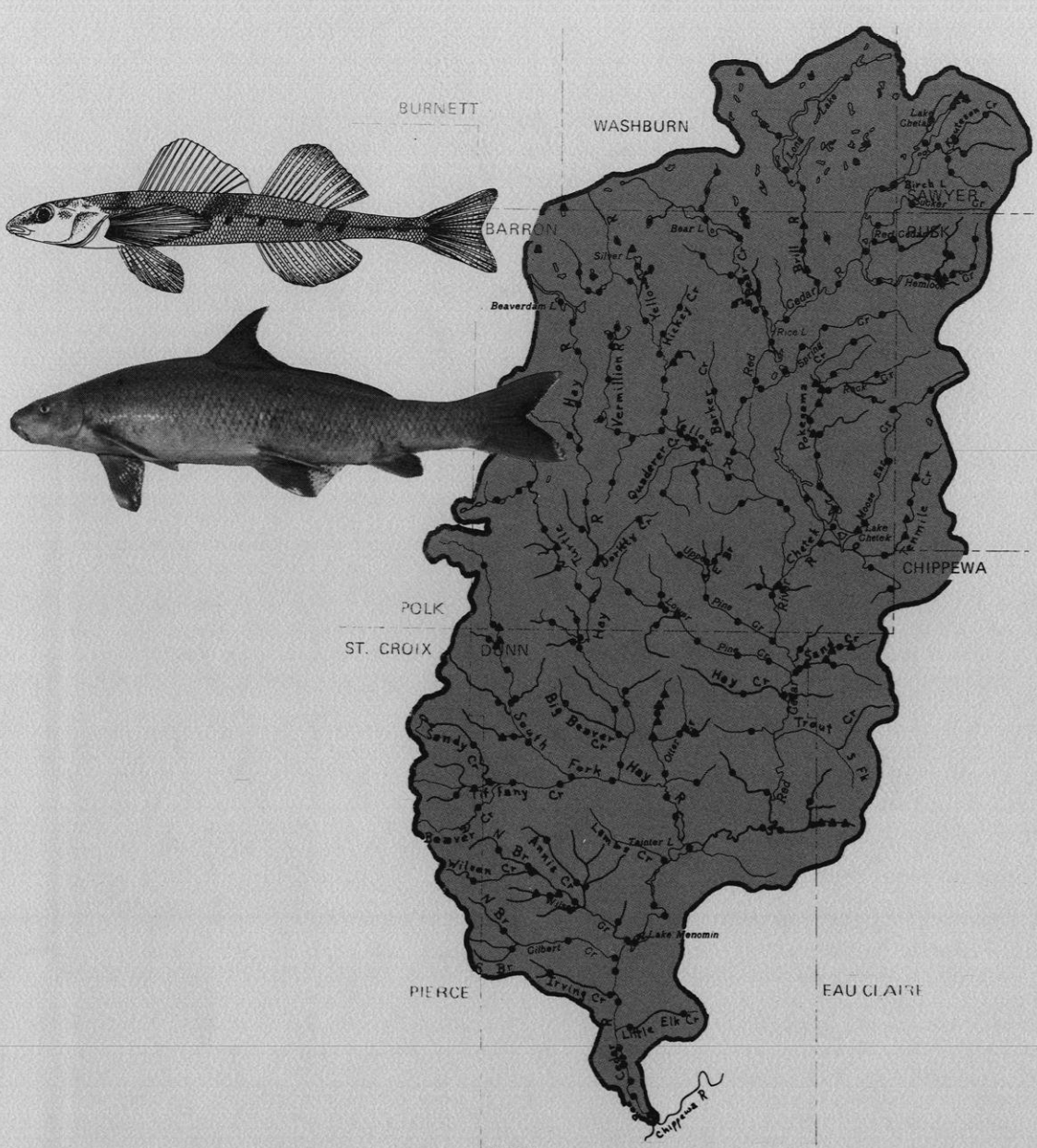
Distribution and relative abundance of fishes in Wisconsin: III. Red Cedar River basin. No. 143 1984

Fago, Don

Madison, Wisconsin: Wisconsin Department of Natural Resources, 1984



DISTRIBUTION AND RELATIVE ABUNDANCE OF FISHES IN WISCONSIN

III. Red Cedar River Basin

Technical Bulletin No. 143
Department of Natural Resources
Madison, Wisconsin
1984

Crystal darter (endangered) and blue sucker (threatened) from the Red Cedar River basin.

This report is dedicated to the nongame fish, whose interrelationship in the aquatic ecosystem is generally not well documented or appreciated.

PREFACE

Little attention has been given to nongame fish species which comprise over 75% of the 150 fish species in Wisconsin waters. Yet many of those species play a major role in maintenance of sport fish populations so vital to recreational and economic interests in the state. In essentially disregarding these species, their right to exist and their role in maintaining community stability through species diversity have been overlooked. The nongame fish not only make up the majority of fish species in Wisconsin but are also more abundant than sport fish species in both total number and total biomass.

Further attention by either research or management to nongame fish species must be preceded by an inventory of what we have and where we have it. In 1974 the Bureau of Research of the Wisconsin Department of Natural Resources (DNR), with inputs from field fish management personnel, began a statewide assessment of the distribution and relative abundance of fish species, emphasizing but not limited to nongame species. This assessment was begun using a basin approach to delineate location of sampling stations on the over 7,200 lakes (over 350,000 ha) and 11,000 streams (over 68,000 km) within the state. The 3 major basins (Mississippi River, Lake Michigan, and Lake Superior) were further divided into 30 minor basins.

The last report on the distribution of fish species throughout the state was made by C. W. Greene (1935) for the 1900-31 period. He covered about 1,400 sampling stations. Since then, other collectors, notably Dr. George Becker (1959, 1964a, b, 1966, 1983), Professor Marlin Johnson (1970), and the students at the University of Wisconsin of Madison (including McNaught 1963) and Stevens Point, have added appreciably to knowledge of regional distribution of Wisconsin fishes.

The need to update our knowledge of statewide fish distribution is most clearly evident from the dearth of information available on nongame species in most watersheds for preparing environmental impact assessments and reports and department master plans. In addition, both federal and state law now require the establishment of an endangered and threatened species list. Furthermore, the Wisconsin Department of Natural Resources has been directed to "conduct research on endangered and threatened species of this state and shall implement programs directed at conserving, protecting, restoring, and propagating selected state endangered and threatened species to the maximum extent practicable." (Chap.29.415, Wis. Stats.)

Field collecting under the research study initiated in 1974 was essentially terminated in 1980 due to reduced funding, with only limited sampling after that time. Of the 30 river basins in the state, sampling has now been completed in 17 and nearly completed in 1. Only scattered samples were taken in the other 12 basins. These samples inventoried about 45% of the state.

The results of the work so far completed on fish distribution are being published in a series of separate bulletins dealing with one or more minor basins. The following reports are now available: Greater Rock River basin (Fago 1982), and Black, Trempealeau, and Buffalo river basins (Fago 1983a). The bulk of the data presented refers primarily to collections made during the Bureau of Reseach study. However, other fishery biologists and managers have made numerous collections over the years, and their published and unpublished records, when available to us, are included. Therefore, data from as early as 1900 are available for some basins, permitting comparisons between historical and current records.

This series of reports, however, constitutes only an overview of a voluminous mass of data now permanently stored in computer files. For the field manager or investigator, the greatest value of this study lies in the availability of fish data on specific waters or on waters in close proximity to those of immediate concern. Data now in computer files (over 16,900 collections) have already, in over 200 cases, proven to be very useful to DNR personnel in several bureaus and to other state and federal agencies, environmental consultants, and students. They have used the data for various purposes; e.g., to make assessments on past as well as potential changes in the aquatic environment, indicate water quality through fish species composition, and determine ranges in Wisconsin for particular fish species.

Sufficient data were collected during the research study to recommend the revision of Wisconsin's endangered and threatened fish species lists in 1979 and again in 1982. The first revision added 15 species to both lists and removed 3 from the endangered list. The second revision added 2 to the endangered list, and removed 1 from the endangered and 3 from the threatened list.

The bulk of the preserved fish collections are curated at the Milwaukee Public Museum, further enhancing the value and significance of this study. There they are used by scientists and educators interested in taxonomy, systematics, and natural history. They also are serving as a baseline collection from which to determine changes in fish community structure and environmental loads of pollutants and toxicants.

This report deals with the Red Cedar River basin.

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III. Red Cedar River Basin

By
Don Fago

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Box 7921, Madison, Wisconsin 53707
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ABSTRACT

A statewide survey of the inland waters of Wisconsin was initiated by the Bureau of Research, Wisconsin Department of Natural Resources to establish a comprehensive data base on the distribution and relative abundance of all fish species. The Red Cedar River basin was sampled from 1975 through 1981 at 417 stations by research personnel and at 4 stations by fish management personnel. An additional 80 stations were partially sampled by fish management personnel and other collectors.

A total of 97 species was collected from the Red Cedar River basin. Included were the endangered crystal darter and the threatened Ozark minnow and blue sucker. Seven species on the Department's watch list were also collected.

Data from the 1975-81 period for the Red Cedar River basin were compared to those from the 1900-31 and the 1959-74 periods. Twenty-nine species were collected which had not been previously reported from the Red Cedar River basin. Two species have apparently been extirpated from the Red Cedar River basin.

This report includes numerous tables, distribution maps of the species, and discussion on many aspects of fish distribution in the Red Cedar River basin. The continued use of this data base for the preparation of environmental impact assessments, for the development of master plans for the aquatic resource, and for research on nongame species, fish communities, and ecosystems is therefore recommended.

CONTENTS

TABLE 1. *Land area, streams, and lakes of the Red Cedar River basin.*

Land area (km^2)	4,843
Streams	
Total no.	255
(Unnamed creeks or ditches)	(141)
Total length (km)	2,095
Lakes/impoundments*	
Total no.	293
Area (ha)	11,924
No. dams	41

* Impoundments are bodies of water with dams at their outlets.

STUDY AREA

The Red Cedar River basin is a subbasin of the Chippewa River basin (300), located in the northwestern portion of Wisconsin (Fig. 1). It encompasses parts of the following counties: Barron, Chippewa, Dunn, Polk, Rusk, Sawyer, St. Croix, and Washburn. The watershed contains an area of approximately 4,843 km^2 (Holmstrom 1982). Within this area, we have defined 255 streams with a total length of 2,095 km (Table 1)*. Of these, 141 are unnamed creeks and ditches. There are 293 lakes** in the basin, with a total area of 11,924 ha. The average size is 41 ha with only 14 over 150 ha.

The average annual precipitation within the Red Cedar River basin is 74 cm (71-76 cm) (Wisconsin DNR 1971). The average gradient for the Red Cedar River (179 km in length) is 87 cm/km. The average discharge at Menomonie, which includes 94% of the drainage area, is 35 m^3/sec (U.S. Geol. Surv. 1982). We determined from the data collected at our sampling stations that the Red Cedar River's stream bottom is composed of primarily sand, gravel, and rubble with limited areas of boulder, muck and silt.

The major land use in this basin is agriculture (64%), primarily dairy farming. Second in importance is forest land with approximately 27% (Wisconsin DNR 1971, and Sather and Threinen 1962, 1964).

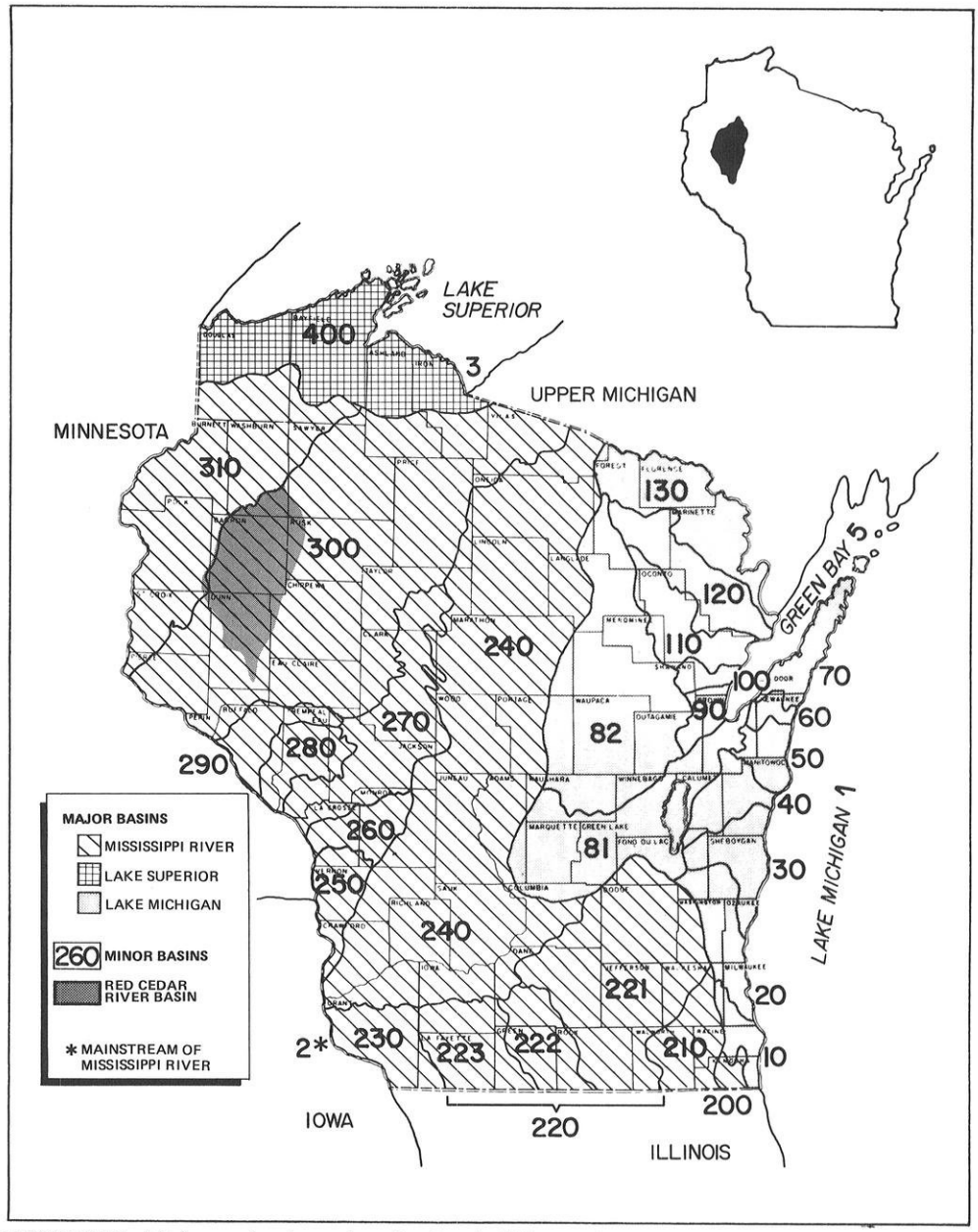
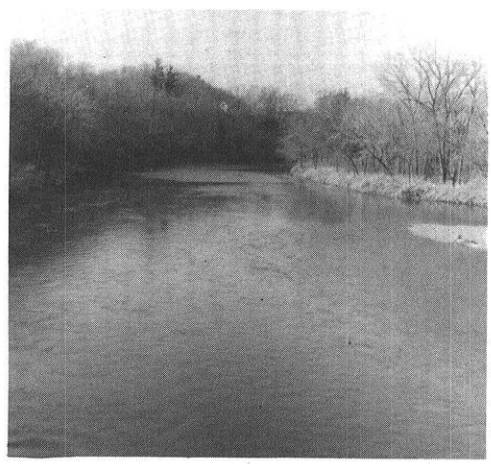


FIGURE 1. *Major and minor river basins in Wisconsin.*



Lyle Christenson

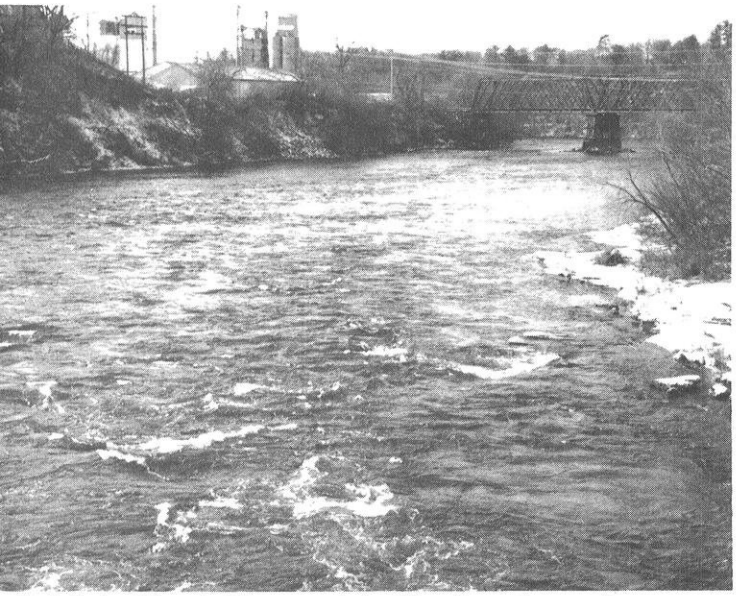
Red Cedar River upstream of the Highway 25 bridge west of Downsville at high water.

Ronnie Masterjohn

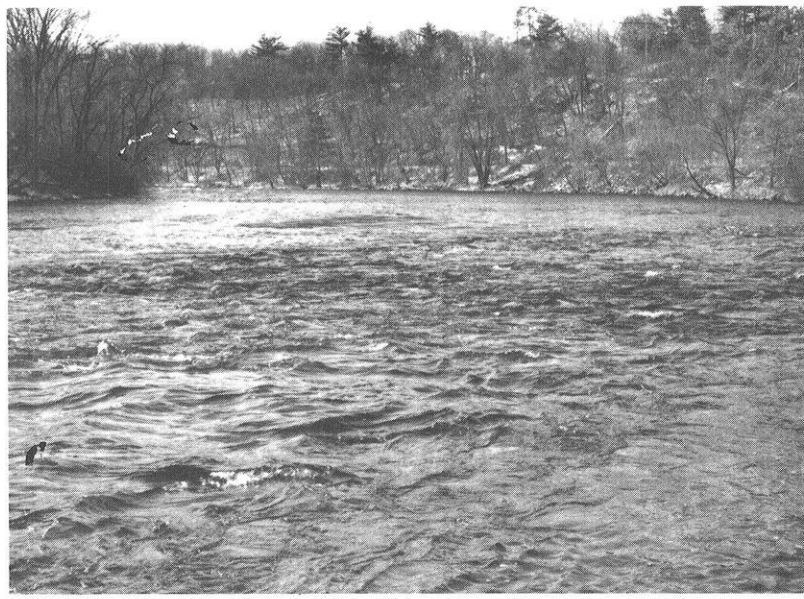
Red Cedar River upstream of Highway 25 bridge west of Downsville showing the low water level and bedrock stream bottom.

*These were defined through a water mileage system that divided the state into 3 major and 30 minor basins (Fago 1983b).

**Lakes in this report refer to naturally occurring lakes as well as impoundments (bodies of water with dams at their outlets) unless otherwise specified.



Red Cedar River in Menomonie looking downstream of Lake Menomin dam.



Howard Snow

Red Cedar River in Menomonie looking downstream of railroad trestle.

METHODS

Data Sources and Time Periods

All collections are divided into 3 time periods: 1900-31, 1959-74, and 1975-81. The earlier records provide the basis for assessment of change over time in distribution of fish species within the basin.

If a location was sampled within a time period more than once, only 1 collection is used in the counts of number of stations sampled and number of stations at which a species was taken.

Stations were classified in one of two ways, except for the 1900-31 period, depending on how the samples were taken: complete (those in which all species collected were recorded and identified), and partial (those in which sampling effort and/or species identification were incomplete and therefore did not yield adequate assessment of total species composition).

1900-31 Period. Collections from this period were made at 14 stations by a number of collectors. They included R. R. Pope, W. E. Dickman, E. P. Creaser, S. N. Jones, G. Wagner, and P. Okkelberg (names taken from original field notes). Most specimens from these collections were verified by Dr. Carl Hubbs or Dr. C. W. Greene and cited by Greene (1935). Seventy-one percent of the stations were sampled in 1928 or 1931. The stations sampled were located on 7 streams and 5 lakes in this basin (Table 2). Thoroughness of sampling effort was unknown, and therefore calculation of percent occurrence of each species was not attempted (Table 5).

1959-74 Period. Complete collections from the period were made at 29 stations on 16 streams and 3 lakes in this basin (Table 2). An additional 125 partial stations increased the number of streams sampled by 31 and lakes by 13. The data from these partial samples were kept separate in Table 2 and not included in the percentages of total stations sampled presented in Table 5. These partial samples came from written records provided by fish management and the N.U.S. Corporation (North. States Power Co. 1974).

The complete samples from this basin (all collected in 1973-74) were collected by the following: Milwaukee Public Museum (unpubl. data)—16 stations; Dr. George Becker and his students (unpubl. data and 1983)—7 stations; Wisconsin DNR Bureau of Research—6 stations.

Total occurrences are defined as the sum of the number of species captured at each station. For example, if a collector took 10 species at one station, 20 at another, and 30 at another, the total species occurrences would be 60. This information has been calculated for collections since 1959, and reveals the volume of data from both complete and partial samples used (Table 3). For the earliest period, only a grand total of occurrences was calculated (Table 5). Total occurrences increased from 132 for the 1900-31 period to 660 for the 1959-74 period for the Red Cedar River basin. During 1959-74, total occurrences for the Red Cedar River basin numbered 660, 54% of which were accounted for by fish management personnel. Collections by the Milwaukee Public Museum and Dr. Becker and his students provided 34 species not taken by fish management in the Red Cedar River basin (Table 3 and Append. A Table 16).

1975-81 Period. Complete collections from this period were made at 421 sampling stations (99% collected in 1975-76) on 91 streams and 42 lakes in the Red Cedar River basin (Table 2). There were an additional 80 partial collections which increased the number of streams by 6 and lakes by 5.

For the Red Cedar River basin, the number of complete samples increased over 1,300% during the 1959-74 period (Table 2). DNR research personnel sampled 417 (99%) of the complete

samples, and fish management personnel sampled 4 (1%).

The 80 partial samples were collected by fish management personnel, research personnel, and commercial fishermen.

Total occurrences increased from 660 for the 1959-74 period to 4,530 for the Red Cedar River basin; 92% of these were recorded by research personnel (Table 3). We also collected 93 out of the 97 total species found in the Red Cedar River basin (for list of species taken by all other collectors see Append. A Table 16).

COLLECTION METHODS AND GEAR*

We used 5 types of electrofishing gear depending on the size of the body of water. The types of gear and percentage of stations where each was used, were: boom shocker (4%), AC stream shocker (7%), DC stream shocker (25%), AC battery-powered backpack (2%), and longline shocker (8%). Small mesh seines were used at 53% of the stations, primarily in lakes and large rivers.

All generators produced direct current, with the boom shocker permitting a choice of several pulse rates and frequencies. The boom shocker also produced alternating current and it was used occasionally when the DC unit was inoperative. For more information concerning the boom and stream shocking equipment, see Novotny and Priegel (1971, 1974). The AC battery-powered backpack uses a 12-volt deep cycle battery and outputs alternating current at several voltages. The seines were 1.2-m and 9.1-m bag seines with 4.8-mm delta mesh.

SAMPLING EFFORT

We established sampling locations based on habitat diversity, the distance between stations, and accessibility. The length of a sampling station was approximately 80 m for all electrofishing gear except for the boom shocker. Boom shocker stations averaged 3.9 km. Areas seined averaged 242 m^2. Distance between stations on the main stem of the Red Cedar River averaged 6.8 km. There was an average of 1 station/8 km of the total length of all sampled streams with one or more complete stations. On sampled lakes there was an average of 1 station/42 ha of water.

Complete collections were made on 36% of the streams and 14% of the lakes in the Red Cedar River basin (Tables 1 and 2). While these percentages are relatively low, the streams that were sampled comprised 75% of the total length of all streams in the Red Cedar River basin. The sampled lakes comprised 74% of the total surface area for all lakes in the basin. This was due to the fact that most lakes were small, averaging only 41 ha for the Red Cedar River basin.

Figure 2 shows the locations of 249 of the 421 complete and 44 of the 80 partial stations. Only one dot per lake was shown and dots were eliminated that would overlap another dot.

DATA HANDLING

Data collected at the sampling stations were recorded in pencil on form 8100-46 (Append. A Fig. 5), and include station and species information, and ecological data. This form is made of polyethylene paper, is virtually unaffected by salt and fresh water, and is resistant to tearing, discoloration, and rotting.

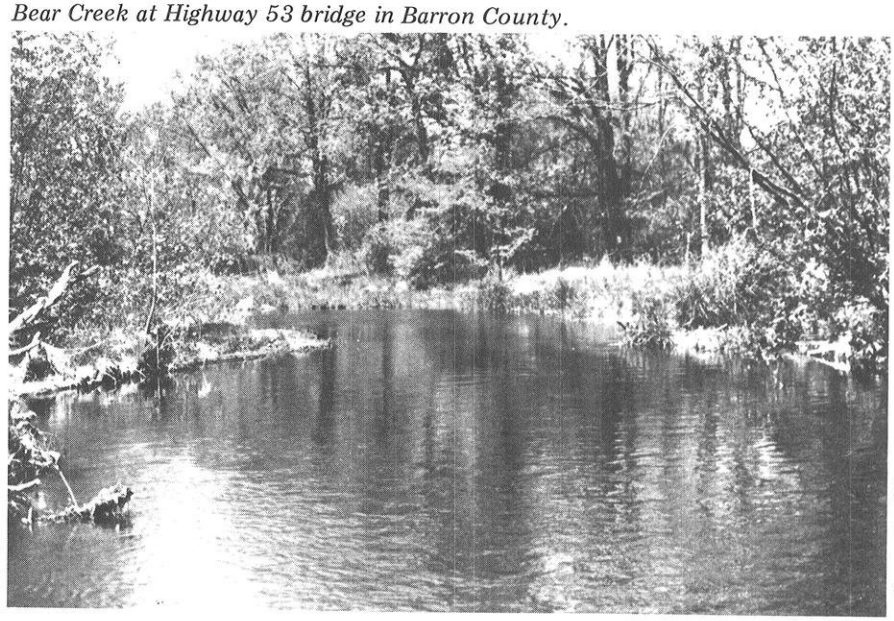
In order to handle the data on 780 collections from the Red Cedar River basin, dating from 1900, Cobol and

TABLE 2. *Summary of stream and lake sampling effort in the Red Cedar River basin, 1900-81.*

	1900-31	1959-74	1975-81
Streams			
No. sampled	7	16*(31)**	91(6)
No. stations	9	25 (110)	210(60)
Lakes/impoundments			
No. sampled	5	3 (13)	42(5)
No. stations	5	4 (15)	211(20)
Total no. stations	14	29 (125)	421(80)

* Complete samples.
** Partial samples.

Bear Creek at Highway 53 bridge in Barron County.



Jerry Perkins

*Only the methods and gear employed by DNR research personnel are described; fish management personnel used similar equipment.

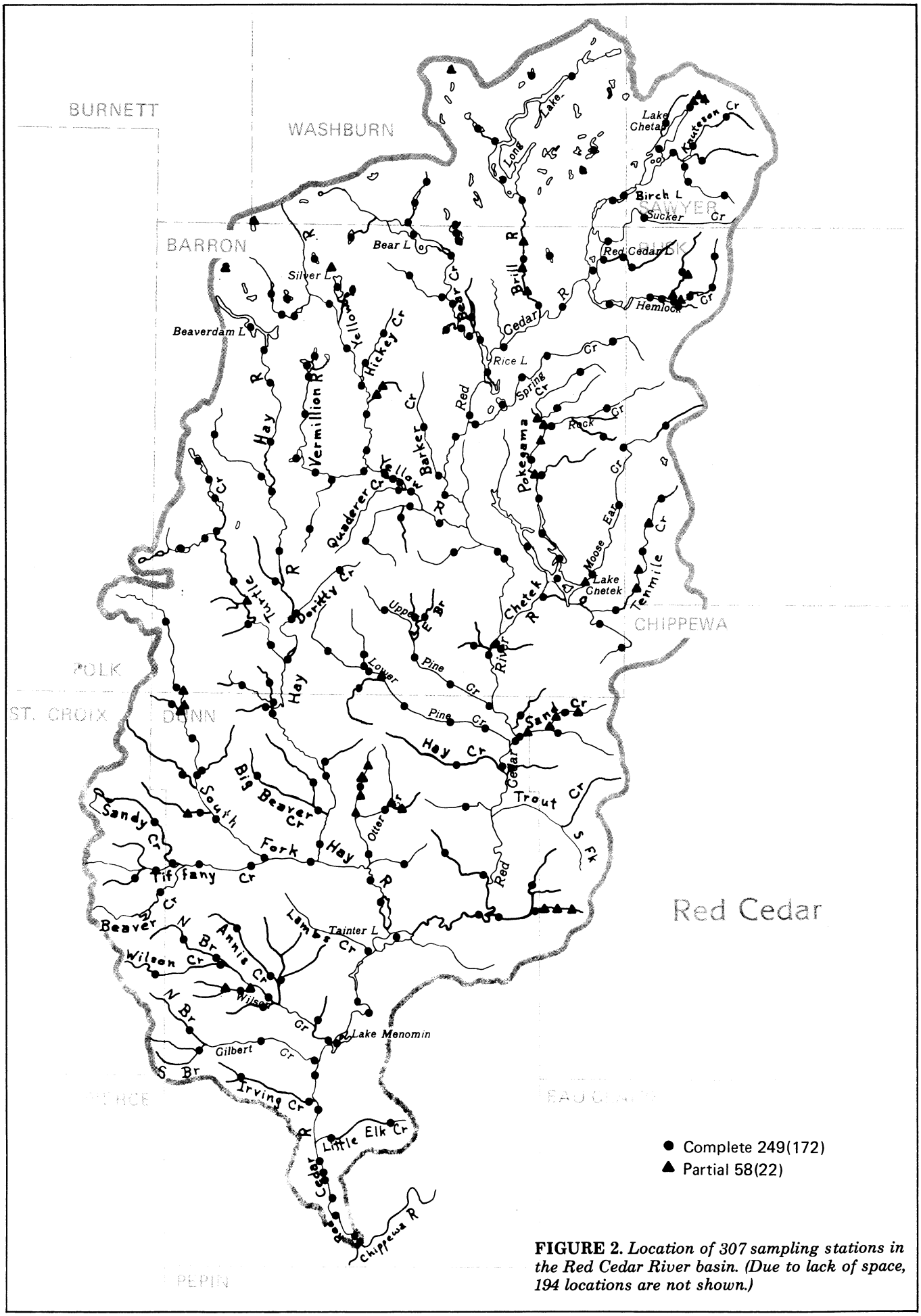


FIGURE 2. *Location of 307 sampling stations in the Red Cedar River basin. (Due to lack of space, 194 locations are not shown.)*

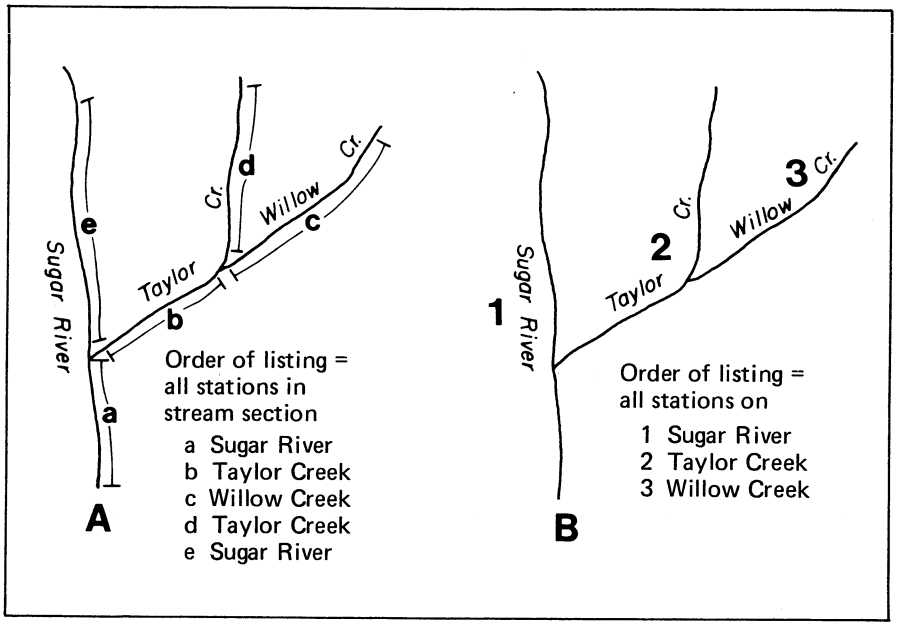


FIGURE 3. *Two methods of organizing stations on computer printouts.*

TABLE 3. *List of collectors with number of species taken and total occurrences for samples from the Red Cedar River basin.*

Source of Data*	1959-74 No. Species	1959-74 Total Occurrences	1975-81 No. Species	1975-81 Total Occurrences
Research 0	25	68(10)**	93	4,166(92)
Fish Mgt. 1	22	351(54)	44	363(8)
Becker 2	33	74(11)	—	—
Mil. Pub. Mus. 5	36	152(23)	—	—
Comm. fish 7	—	—	1	1(t)
N.U.S. Corp. 10	9	15(2)	—	—
Grand total of occurrences		660		4,530

*Collectors identified in Appendix A Table 16.
**Total occurrences are defined as the sum of the number of species collected at each station; percent of total occurrences in parentheses.
t = less than 0.5%.

Mark IV computer programs were developed through a cooperative effort with the DNR's Bureau of Information Management to organize, store, and retrieve the data. Some programs are used to update the Fish Master File which contains all data on the stations in the basin as well as 16,120 additional stations throughout the state.

Other programs are used to help in the analysis of the data. One analysis uses a Cobol program to organize the data by species, and lists all stations for each species. This listing, based on a water mileage system developed for this study, was organized in 2 ways (Fig. 3a and b):

(1) All stations on a river are listed until a tributary of the river is reached (Fig. 3a). All stations on that tributary are then listed before going back to the confluence of the tributary with the original river. This procedure is followed for all tributaries in the basin of the first tributary before going back to the original river.
(2) All stations on a river are listed before going back to the first tributary of the original river and listing all stations on the tributary (Fig. 3b). This procedure is followed for all tributaries in the basin of the first tributary before going to the second tributary of the original river.

The program for both of these methods can be restricted to one or more of the following criteria: particular minor basins, a sub-basin or part of a sub-basin, individual collectors, dates, township and range (by entire township or contiguous townships), counties, water types, and selected species. At each station, the stream name along with water type, number of fish taken, collector, gear, effort, date, township description, and county are listed. An example of the Cobol listing for one species is shown in Appendix A Figure 6. At the end of each species listing, the total number of stations, total number of specimens, average number of fish/station, and number of stations for each collector is computed. At the end of the printout, a summary table is given that lists each species, the number stations at which it was taken, the percent of the total stations possible, grand total of species occurrences, totals for each collector, and totals for number of species and hybrids (Append. A Fig 7).

Another type of analysis uses a Mark IV program to organize the data by stations, and lists for each station all information (number of specimens of each species, and the total number of species, hybrids, and unspecified categories). The program can be restricted to the same criteria cited above for the Cobol program, and the listing can be organized the same two ways (Fig. 3a and b). However, only the Mark IV listing can be restricted to gear, or any of the 10 ecological variables. This program can be organized in still different ways, including: (1) by county and then alphabetically by name of stream or lake, (2) by county and then by basin, or (3) by township, range, and section. An example of the Mark IV listing is shown in Appendix A Figure 8.

A water mileage system was devised to permit computer analysis of the data and still allow easy recognition of the

location by persons wishing to use the data. This was accomplished by using the town, range, section, quarter section, and county along with basin numbers, a series of mileages, and the name of the body of water. A Master Stream and Lake File containing this information has been generated by this study for most streams and lakes in Wisconsin. Mark IV computer programs are available to obtain a variety of listings such as streams and/or lakes in each basin listed alphabetically.

An example of a page of the water mileage system from a computer printout of the Master Stream and Lake File is shown in Appendix A Figure 9. An example of a page of the Master Fish File which uses the water mileage system to organize the biological and environmental data is included in Appendix A Figure 8. A detailed explanation of the data storage system as exemplified in these figures is presented in Fago (1983b).

FISH IDENTIFICATION AND ENUMERATION

In order to reduce the volume of specimens taken back to the laboratory, larger fish were identified to species in the field and were usually returned to the water. Generally all others were preserved in 10% Formalin for later identification (using the unpubulished keys of Dr. G. Becker) in the laboratory.

At least a few stonerollers at each station were keyed to species. The remainder were left as stonerollers (*Campostoma* spp.). Research personnel identified all fish for the 1975-81 period except for some specimens of 26 species (indicated by an asterisk in Append. A Table 16) collected by fish management personnel, and lake sturgeon caught by commercial fishermen. For the 1959-74 period species records are based upon the collectors' identification. The common and scientific names of fish species cited in this report (Table 4) follow names established by the American Fisheries Society's Committee on Names of Fishes (Robins 1980). All hybrids and specimens not keyed to species, except stonerollers, were not dealt with in this report.

At each station, the number of specimens for each species was counted to 98 and recorded on Form 8100-46 (Append. A Fig. 5). However, at many stations there were more than 98 specimens taken for certain species. They were recorded as 99. Therefore, the number of specimens recorded in Table 6 for some species is substantially lower than the number actually captured. Furthermore, there were up to 6 stations for certain species at which the

TABLE 4. *List of common and scientific names of all fish species cited in this report.*

Computer No.	Common Name	Scientific Name
	Lampreys	Petromyzontidae
A02	Chestnut lamprey	*Ichthyomyzon castaneus*
A03	Northern brook lamprey	*Ichthyomyzon fossor*
A04	Silver lamprey	*Ichthyomyzon unicuspis*
A05	American brook lamprey	*Lampetra appendix*
	Sturgeons	Acipenseridae
B01	Lake sturgeon	*Acipenser fulvescens*
B02	Shovelnose sturgeon	*Scaphirhynchus platorynchus*
	Gars	Lepisosteidae
D01	Longnose gar	*Lepisosteus osseus*
D02	Shortnose gar	*Lepisosteus platostomus*
	Bowfins	Amiidae
E01	Bowfin	*Amia calva*
	Freshwater eels	Anguillidae
F01	American eel	*Anguilla rostrata*
	Mooneyes	Hiodontidae
H02	Mooneye	*Hiodon tergisus*
	Trouts	Salmonidae
I04	Cisco or lake herring	*Coregonus artedii*
I05	Lake whitefish	*Coregonus clupeaformis*
I21	Brown trout	*Salmo trutta*
I22	Brook trout	*Salvelinus fontinalis*
	Smelts	Osmeridae
J01	Rainbow smelt	*Osmerus mordax*
	Mudminnows	Umbridae
K01	Central mudminnow	*Umbra limi*
	Pikes	Esocidae
L02	Northern pike	*Esox lucius*
L03	Muskellunge	*Esox masquinongy*
	Minnows and carps	Cyprinidae
M06	Central stoneroller	*Campostoma anomalum*
M07	Largescale stoneroller	*Campostoma oligolepis*
M12	Common carp	*Cyprinus carpio*
M14	Brassy minnow	*Hybognathus hankinsoni*
M15	Mississippi silvery minnow	*Hybognathus nuchalis*
M19	Hornyhead chub	*Nocomis biguttatus*
M20	Golden shiner	*Notemigonus crysoleucas*
M22	Pugnose shiner	*Notropis anogenus*
M23	Emerald shiner	*Notropis atherinoides*
M24	River shiner	*Notropis blennius*
M28	Common shiner	*Notropis cornutus*
M29	Bigmouth shiner	*Notropis dorsalis*
M31	Blackchin shiner	*Notropis heterodon*
M32	Blacknose shiner	*Notropis heterolepis*
M34	Ozark minnow	*Notropis nubilus*
M35	Rosyface shiner	*Notropis rubellus*
M36	Spotfin shiner	*Notropis spilopterus*
M37	Sand shiner	*Notropis stramineus*
M38	Weed shiner	*Notropis texanus*
M39	Redfin shiner	*Notropis umbratilis*
M40	Mimic shiner	*Notropis volucellus*
M42	Northern redbelly dace	*Phoxinus eos*
M44	Finescale dace	*Phoxinus neogaeus*
M45	Bluntnose minnow	*Pimephales notatus*
M46	Fathead minnow	*Pimephales promelas*
M47	Bullhead minnow	*Pimephales vigilax*
M48	Blacknose dace	*Rhinichthys atratulus*
M49	Longnose dace	*Rhinichthys cataractae*
M50	Creek chub	*Semotilus atromaculatus*
M51	Pearl dace	*Semotilus margarita*

TABLE 4 *(Cont.)*

Computer No.	Common Name	Scientific Name
	Suckers	Catostomidae
N05	River carpsucker	*Carpiodes carpio*
N06	Quillback	*Carpiodes cyprinus*
N07	Highfin carpsucker	*Carpiodes velifer*
N09	White sucker	*Catostomus commersoni*
N10	Blue sucker	*Cycleptus elongatus*
N13	Northern hog sucker	*Hypentelium nigricans*
N14	Smallmouth buffalo	*Ictiobus bubalus*
N15	Bigmouth buffalo	*Ictiobus cyprinellus*
N18	Silver redhorse	*Moxostoma anisurum*
N21	Golden redhorse	*Moxostoma erythrurum*
N22	Shorthead redhorse	*Moxostoma macrolepidotum*
N23	Greater redhorse	*Moxostoma valenciennesi*
	Bullhead catfishes	Ictaluridae
O05	Black bullhead	*Ictalurus melas*
O06	Yellow bullhead	*Ictalurus natalis*
O07	Brown bullhead	*Ictalurus nebulosus*
O08	Channel catfish	*Ictalurus punctatus*
O10	Stonecat	*Noturus flavus*
O11	Tadpole madtom	*Noturus gyrinus*
O12	Flathead catfish	*Pylodictis olivaris*
	Trout-perches	Percopsidae
Q01	Trout-perch	*Percopsis omiscomaycus*
	Codfishes	Gadidae
R01	Burbot	*Lota lota*
	Killifishes	Cyprinodontidae
S01	Banded killifish	*Fundulus diaphanus*
	Silversides	Atherinidae
T01	Brook silverside	*Labidesthes sicculus*
	Sticklebacks	Gasterosteidae
U01	Brook stickleback	*Culaea inconstans*
	Temperate basses	Percichthyidae
V01	White bass	*Morone chrysops*
	Sunfishes	Centrarchidae
W04	Rock bass	*Ambloplites rupestris*
W05	Green sunfish	*Lepomis cyanellus*
W06	Pumpkinseed	*Lepomis gibbosus*
W07	Warmouth	*Lepomis gulosus*
W09	Bluegill	*Lepomis macrochirus*
W11	Smallmouth bass	*Micropterus dolomieui*
W12	Largemouth bass	*Micropterus salmoides*
W13	White crappie	*Pomoxis annularis*
W14	Black crappie	*Pomoxis nigromaculatus*
	Perches	Percidae
X03	Crystal darter	*Ammocrypta asprella*
X07	Rainbow darter	*Etheostoma caeruleum*
X09	Iowa darter	*Etheostoma exile*
X10	Fantail darter	*Etheostoma flabellare*
X11	Least darter	*Etheostoma microperca*
X12	Johnny darter	*Etheostoma nigrum*
X14	Banded darter	*Etheostoma zonale*
X15	Yellow perch	*Perca flavescens*
X16	Logperch	*Percina caprodes*
X18	Blackside darter	*Percina maculata*
X20	River darter	*Percina shumardi*
X21	Sauger	*Stizostedion canadense*
X22	Walleye	*Stizostedion vitreum vitreum*
	Drums	Sciaenidae
Y01	Freshwater drum	*Aplodinotus grunniens*
	Sculpins	Cottidae
Z01	Mottled sculpin	*Cottus bairdi*
Z02	Slimy sculpin	*Cottus cognatus*

number taken was unknown, further underestimating the total number of specimens.

Questionable specimens were sent to Dr. George Becker at the University of Wisconsin-Stevens Point for verification.

ENDANGERED, THREATENED, AND WATCH SPECIES

The State of Wisconsin currently has 8 species on its endangered list*, 6 species on its threatened list*, and 18 species on its unofficial watch list. These 3 categories are defined as follows:

Endangered: Any species or subspecies in danger of becoming extirpated. Its continued existence as part of the state's wildlife resources is in jeopardy.

Threatened: Any species or subspecies which appears likely, within the foreseeable future, to become endangered.

Watch: Species or subspecies that may or may not be holding their own at the present time. They will be under special observation to identify conditions that could cause further decline, or any factors that could help to insure their survival in the state.

*Chap. NR 27, Wis. Adm. Code.

RESULTS AND DISCUSSION

Findings are presented for the Red Cedar River basin followed by a discussion of some of the more interesting species in the basin including those on the Wisconsin DNR endangered, threatened, or watch lists. Unless otherwise indicated, findings refer only to the 1975-81 period.

SPECIES FOUND

Over 99,000 specimens representing 97 species were identified in samples from the Red Cedar River basin (Tables 5 and 6). This includes the endangered crystal darter, 2 threatened species (Ozark minnow and blue sucker), and 7 watch species. Distribution maps for all species are presented in Appendix B; each map shows the location of stations where the species was collected. An index to the maps is contained in Table 5 and in the front of Appendix B.

REPRODUCING POPULATIONS

Of the 97 known species found in the Red Cedar River basin, 95 species are believed to have reproducing populations. The presence of reproducing populations of the muskellunge is questionable since the only known possible area of reproduction is above Hemlock Lake (R. Cornelius pers. comm.). The other species, the Americn eel, does not spawn in fresh water.

STREAM VS. LAKE HABITAT

Of all stations sampled in the Red Cedar River basin, 54% were in a stream environment and 46% in a lake environment (Table 2). Of the 95 species known to have reproducing populations in this basin, 64 occurred in streams more than 50% of the time (Table 7); 39 of these 64 occurred in streams at least 95% of the time. Of the 31 species collected more than 50% of the time in a lake environment, only 6 were taken 95% or more of the time in lakes.

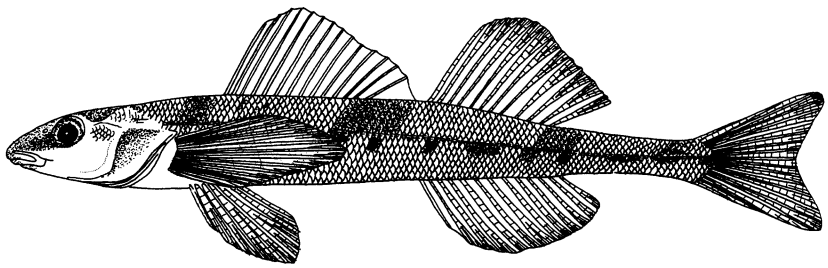
COMMON AND RARE SPECIES

The 5 most common species (caught at the highest percentage of complete stations) were white sucker (56%), bluegill (50%), Johnny darter (50%), yellow perch (49%), and bluntnose minnow (48%) (Table 5). The 5 most numerous species (most specimens caught) were bluegill (9,100), white sucker (8,400), bluntnose minnow (8,200), yellow perch (7,700), and common shiner (4,900) (Table 6). The Johnny darter was 9th most numerous species.

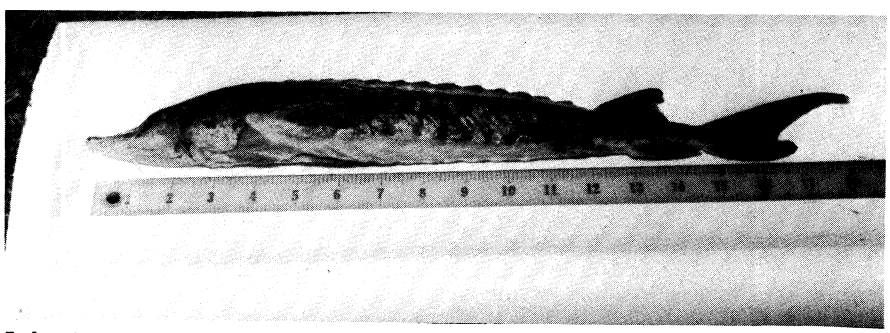
Of the 29 rarest species (those caught at 5 or fewer of all the stations, Table 8), all but 3 (cisco or lake herring, Mississippi silvery minnow, and redfin shiner) were also represented by the smallest total number of specimens (Table 6).

DIFFERENCES BETWEEN TIME PERIODS

Twenty-nine species of fish collected during the 1975-81 period have not been previously reported for this basin (Table 9).

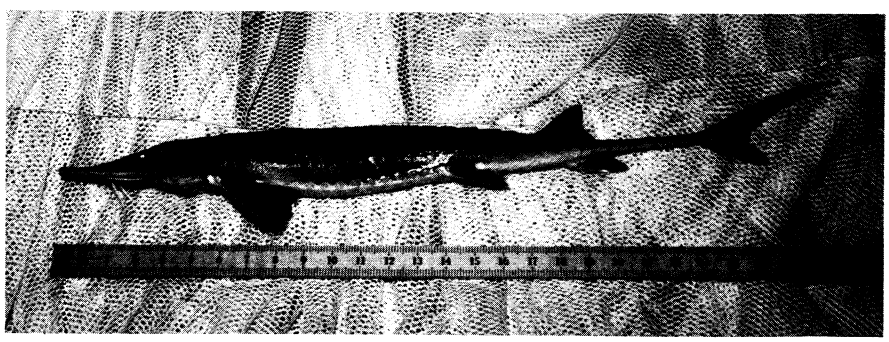


The endangered crystal darter was taken at 5 stations in the Red Cedar River basin.



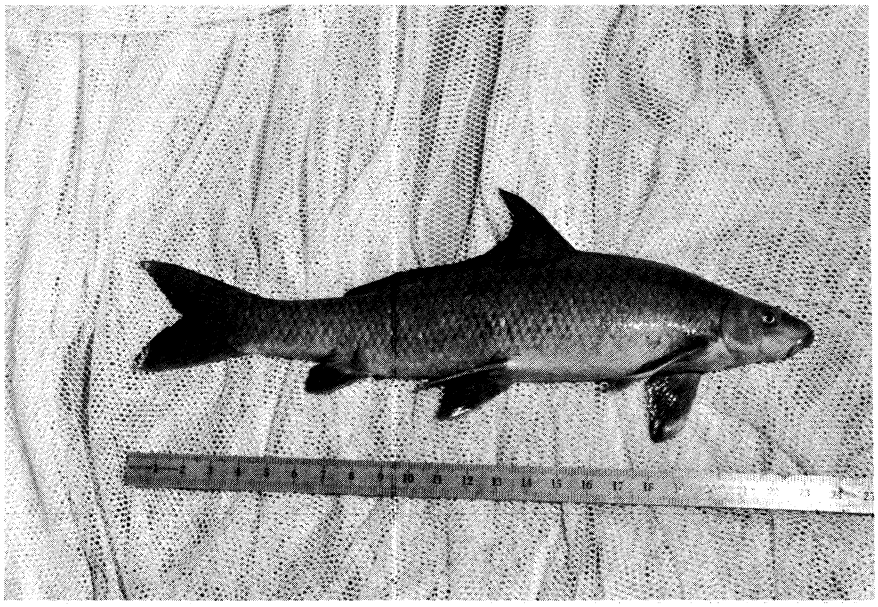
Howard Snow

Lake sturgeon ...



Leon Johnson

...and shovelnose sturgeon were both taken in the Red Cedar River basin.



Blue sucker, a threatened species found in the Red Cedar River basin.

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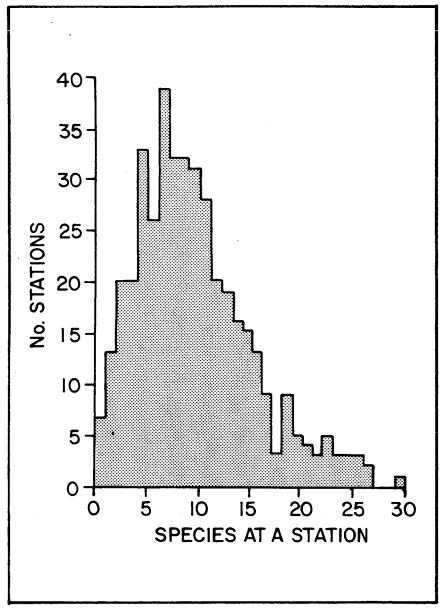

FIGURE 4. *Number of stations at which varying numbers of species were taken in the Red Cedar River basin.*

Two species are apparently no longer present in the Red Cedar River basin. The lake whitefish was last observed before 1931 (and even then was only collected at 1 station) (Table 10). The flathead catfish was last reported in 1963 from 3 stations on the Red Cedar River between the dam at Menomonie and the mouth of the Red Cedar River. It too is apparently extirpated or present in very low numbers.

Nine species that we collected had not been reported between 1932 and 1975 from this basin (Table 11).

One of the most important results of this study was the documentation of changes in the known distribution of species within the Red Cedar River basin in 1975-81 as compared to previous periods (Table 5). These changes have ranged from decreases in the number of stations for 6 species to increases for 63 species, and no change for the trout-perch. The decreases ranged from 100% for 2 species to 33% for the freshwater drum. The increases ranged from 64% for the walleye to 5,800% for the pearl dace (average = 1,200%), and were due primarily but perhaps not entirely to increased sampling effort in 1975-81. There were 75 more streams and 39 more lakes with at least 1 complete station compared to 1958-74 and 84 streams and 37 lakes compared to 1900-31 (Table 2). When the total number of complete stations sampled in the 1975-81 period was compared with the 1959-74 and 1900-31 periods, there were increases of 1,400% and 2,900%, respectively.

SPECIES DIVERSITY

Twenty-nine stations (7%) sampled by research personnel in the Red Cedar River basin had 20 or more species and 6 stations had more than 25 species (Fig. 4). The average number of species taken per station was 10.

ENDANGERED SPECIES

Only 1 species on the state's endangered species list was found in the Red Cedar River basin (Table 12). The **crystal darter** was taken at 5 stations on the Red Cedar River between its mouth and 6 miles upstream (Append. B Map 71). Previously, this species had not been reported from this basin. This darter, the largest found in Wisconsin, was taken over clean gravel and sand where stream velocity was moderate. Stream habitat characteristics for this darter and 5 other rare species are shown in Table 13.

THREATENED SPECIES

Two threatened species were found the Red Cedar River basin (Table 14). The **Ozark minnow** was captured from 3 rivers and 1 lake for a total of 7 stations and 66 specimens (Append. B Map 26). This disjunct population in the Red Cedar River basin (all other known locations in extreme southern Wisconsin) was previously reported from a single collection made in the 1920's. The other species is the **blue sucker** which was taken from 5 stations on the mainstem of the lower Red Cedar River (Append. 13 Map 44). A total of 19 specimens (one-4.6 kg and 750 mm) were caught from moderately deep pools where the water velocity was moderate. Previously, this species had not been reported from this basin.

WATCH SPECIES

A total of 7 watch species were captured in the Red Cedar River basin (Table 15). **Lake sturgeon** were taken from Lake Menomin and Tainter Lake (Append. B Map 4). Previously, this species had been reported at one station on the Red Cedar River near its mouth. One **American eel** was taken in the Red Cedar River (Append. B Map 6); this species was previously reported from 3 stations on this same lower section of the Red Cedar River. The **pugnose shiner** was captured from a total of 9 stations on 4 lakes (Append. B Map 20); it had not been reported from this basin in the past. The **weed shiner** occurred at a total of 19 stations in 6 lakes and 4 streams (Append. B Map 30). This fish had been previously reported from 1 station on the Red Cedar River in 1973. The **redfin shiner** was taken at a total of 4 stations in 3 lakes and 1 river (Append. B Map 31). Previously, this species had been reported

TABLE 5. *Number of stations and percent of total stations at which each species was collected and percent change in occurrence, Red Cedar River basin, 1900-81.*

Map No.	Species	1900-31 No. Stn.	1959-74 No. Stn.	1959-74 Percent Total	1975-81 No. Stn.	1975-81 Percent Total	Percent Change In Occurrence[2]
1	Chestnut lamprey	0	1	3	10	2	900
2	Northern brook lamprey	0	0	-	14	3	-
2	Silver lamprey	0	0	-	1	t**	-
3	American brook lamprey	0	0	-	54(1)	13	-
4	Lake sturgeon (W)[1]	0	0(1)*	-	0(2)	-	100
4	Shovelnose sturgeon	0	0(8)	-	4	1	-50
5	Longnose gar	0	0	-	2	t	-
5	Shortnose gar	0	0	-	2	t	-
6	Bowfin	0	0(6)	-	3(10)	1	120
6	American eel (W)	0	0(3)	-	1	t	-67
7	Mooneye	0	0	-	8	2	-
7	Cisco or lake herring	2	0(1)	-	1(1)	t	100
-	Lake whitefish	1	0	-	0	-	-100
8	Brown trout	1	2(25)	7	36(17)	9	96
9	Brook trout	0	4(47)	14	78(49)	19	150
10	Rainbow smelt	0	0	-	0(1)	-	-
10	Central mudminnow	2	8(15)	28	70(26)	17	320
11	Northern pike	1	5(22)	17	106(28)	25	400
12	Muskellunge	0	0	-	0(2)	-	-
-	Stonerollers	0	6	21	0	-	-
13	Central stoneroller	0	0	-	18	4	-
14	Largescale stoneroller	6	4	14	61	14	1,400
15	Common carp	1	0(11)	-	30(4)	7	210
16	Brassy minnow	1	3	10	50	12	1,600
17	Mississippi silvery minnow	1	0	-	3	1	200
18	Hornyhead chub	4	12	41	66	16	450
19	Golden shiner	1	3	10	55	13	1,700
20	Pugnose shiner (W)	0	0	-	9	2	-
21	Emerald shiner	0	3	10	12	3	300
17	River shiner	0	0	-	3	1	-
22	Common shiner	7	18	62	124	29	600
23	Bigmouth shiner	2	1	3	34	8	3,300
24	Blackchin shiner	1	1	3	28	7	2,700
25	Blacknose shiner	1	5	17	18	4	260
26	Ozark minnow (T)	1	0	-	7	2	600
27	Rosyface shiner	1	8	28	38	9	380
28	Spotfin shiner	1	3	10	21	5	600
29	Sand shiner	1	0	-	7	2	600
30	Weed shiner (W)	0	1	3	19	5	1,800
31	Redfin shiner (W)	1	0	-	4	1	300
32	Mimic shiner	3	1	3	30	7	2,900
33	Northern redbelly dace	0	1	3	22	5	2,100
34	Finescale dace	0	2	7	6	1	200
35	Bluntnose minnow	8	12	41	204	48	1,600
36	Fathead minnow	1	5	17	114	27	2,200
31	Bullhead minnow	0	0	-	1	t	-
37	Blacknose dace	4	8	28	117	28	1,400
38	Longnose dace	1	3	10	64	15	2,000
39	Creek chub	9	13	45	147	35	1,000
40	Pearl dace	1	0	-	59	14	5,800
41	River carpsucker	0	0	-	1	t	-
42	Quillback	0	0	-	9	2	-
41	Highfin carpsucker	0	0	-	4	1	-
43	White sucker	10	19(81)	66	236(35)	56	200
44	Blue sucker (T)	0	0(2)	-	5	1	150
45	Northern hog sucker	3	3(23)	10	52(7)	12	130
46	Smallmouth buffalo	0	0	-	1	t	-
46	Bigmouth buffalo	0	0	-	2	t	-
47	Silver redhorse	1	0	-	32	8	3,100
48	Golden redhorse	2	1	3	29	7	2,800
49	Shorthead redhorse	1	1	3	39	9	3,800
50	Greater redhorse (W)	0	0	-	4	1	-
51	Black bullhead	1	2	7	21	5	950
52	Yellow bullhead	0	0	-	25	6	-
53	Brown bullhead	0	1	3	43	10	4,200

TABLE 5 *(Cont.)*

Map No.	Species	1900-31 No. Stn.	1959-74 No. Stn	1959-74 Percent Total	1975-81 No. Stn.	1975-81 Percent Total	Percent Change In Occurrence[2]
54	Channel catfish	0	0(9)	-	5	1	-44
55	Stonecat	0	3	10	15	4	400
56	Tadpole madtom	0	4	14	19	5	380
-	Flathead catfish	0	0(3)	-	0	-	-100
57	Trout-perch	0	2(1)	7	2(1)	t	0
58	Burbot	0	0(5)	-	9(2)	2	120
59	Banded killifish	0	0	-	9	2	-
60	Brook silverside	0	0	-	6(4)	1	-
61	Brook stickleback	4	9(14)	31	103(26)	24	460
62	White bass	0	0	-	10	2	-
63	Rock bass	4	8	28	103	24	1,200
64	Green sunfish	0	0	-	4	1	-
65	Pumpkinseed	0	4	10	115	27	2,800
64	Warmouth	0	0	-	4	1	-
66	Bluegill	5	5	14	209	50	4,100
67	Smallmouth bass	0	1(23)	3	113(11)	27	420
68	Largemouth bass	6	3(13)	10	185(16)	44	1,200
69	White crappie	0	0	-	3	1	-
70	Black crappie	2	6	21	122	29	1,900
71	Crystal darter (E)	0	0	-	5	1	-
72	Rainbow darter	0	11	38	48	11	340
73	Iowa darter	4	0	-	53	13	1,200
74	Fantail darter	4	14	48	72	17	410
75	Least darter (W)	1	0	-	5	1	400
76	Johnny darter	8	21	72	212	50	910
77	Banded darter	1	0	-	15	4	1,400
78	Yellow perch	6	6(14)	21	208(25)	49	1,100
79	Logperch	5	9	31	115	27	1,200
80	Blackside darter	2	6	21	56	13	830
81	River darter	0	0	-	3	1	-
82	Sauger	0	0	-	4	1	-
83	Walleye	0	1(27)	3	28(18)	7	64
84	Freshwater drum	0	0(9)	-	6	1	-33
85	Mottled sculpin	4	11(19)	38	93(33)	22	320
85	Slimy sculpin	0	0	-	1	t	-
	No. of Species	47	60		97		
	Total No. of occurrences (Sum of number of species taken at each station)	132	660		4,530		

* Number in parentheses indicates partial stations. They were kept separate since not all of the fish from the stations were adequately keyed to species.

**t = less than 0.5%.

[1]E = Endangered, T = Threatened, W = Watch.

[2]Percent change over next most recent period in which species was collected (partial stations included in calculations).

from only 1 station in the Yellow River. Ten specimens of the **greater redhorse** were caught at a total of 4 stations in the Red Cedar and Brill rivers (Append B Map 50). This species had not been previously reported from this basin. Six specimens of the **least darter** were taken at a total of 5 stations in 2 lakes and 3 streams (Append. B Map 75). The species had been previously collected from 1 station on the Brill River. Our sampling of this same section of river failed to collect it. However, we did find it in Hemlock Creek which is less than 6 miles from the mouth of the Brill River.

Habitat characteristics of 4 of the watch species are shown in Table 13.

TABLE 6. *Number of specimens and number of stations for each species collected in the Red Cedar River basin, 1975-81.*

Common Name	No. Specimens*	No. Stations** <99	>98	"Unknown"
Bluegill	9,100	151	57	1
White sucker	8,400	212	33	26
Bluntnose minnow	8,200	164	40	
Yellow perch	7,700	195	31	7
Common shiner	4,900	91	33	
Brook trout	4,600	99	27	1
Creek chub	3,900	136	11	
Largemouth bass	3,700	196	5	
Johnny darter	3,400	204	8	
Blacknose dace	3,100	109	8	
Mottled sculpin	2,800	93	6	27
Black crappie	2,600	111	11	
Fantail darter	2,300	60	12	
Hornyhead chub	2,100	53	13	
Stonerollers	2,000	22	13	
Longnose dace	2,000	56	8	
Logperch	1,700	112	3	
Pearl dace	1,600	54	5	
Brook stickleback	1,600	110	4	15
Pumpkinseed	1,500	109	6	
Rainbow darter	1,400	40	8	
Walleye	1,300	38	8	
Shorthead redhorse	1,300	35	4	
Northern hog sucker	1,200	49	3	7
Rock bass	1,200	103		
Rosyface shiner	1,100	35	3	
Fathead minnow	1,100	111	3	
Northern pike	1,100	131	1	2
Golden shiner	890	50	5	
Smallmouth bass	720	124		
Brassy minnow	710	49	1	
Brown bullhead	690	40	3	
Bigmouth shiner	690	33	1	
Emerald shiner	640	6	6	
Blackside darter	590	56		
Central mudminnow	570	77	2	17
Common carp	540	30	1	3
Blackchin shiner	480	27	1	
Brown trout	470	52	1	
Black bullhead	420	19	2	
American brook lamprey	410	55		
Mimic shiner	390	29	1	
Iowa darter	380	53		
Northern redbelly dace	290	21	1	
Silver redhorse	270	31	1	
Largescale stoneroller	270	61		
Blacknose shiner	270	18		
Golden redhorse	210	29		
Mississippi silvery minnow	200	1	2	
Banded darter	200	15		
Weed shiner	190	18	1	
Spotfin shiner	160	21		
Quillback	130	9		
Sand shiner	120	7		
Brook silverside	110	6	1	3
Bowfin	110	9		4
Stonecat	110	15		
Cisco or lake herring	100	1	1	
Yellow bullhead	97	25		
Pugnose shiner	91	9		
Central stoneroller	81	18		
Redfin shiner	77	4		
Mooneye	69	8		
Ozark minnow	66	7		
Finescale dace	56	6		
Banded killifish	54	9		
Freshwater drum	52	6		
Northern brook lamprey	46	14		
Burbot	43	10		1
Tadpole madtom	40	19		
White bass	30	10		
Blue sucker	19	5		
White crappie	16	3		
Chestnut lamprey	15	10		
Crystal darter	13	5		
River darter	13	3		
River shiner	11	3		
Muskellunge	10	2		
Greater redhorse	10	4		
Channel catfish	10	5		
Slimy sculpin	10	1		
Green sunfish	9	4		
Shovelnose sturgeon	8	4		
Warmouth	7	4		
Sauger	7	4		
Highfin carpsucker	6	4		
Least darter	6	5		
Trout-perch	2	2		1
Longnose gar	2	2		
Shortnose gar	2	2		
River carpsucker	2	1		
Bigmouth buffalo	2	2		
Lake sturgeon	1	1		1
Silver lamprey	1	1		
American eel	1	1		
Bullhead minnow	1	1		
Smallmouth buffalo	1	1		
Rainbow smelt	-			1
Total	99,217	4,066	395	117

* Rounded to 2 significant figures for each species.

** <99 = 98 or fewer specimens collected/station.
>98 = 99 or more specimens collected/station.
Unknown = counts of specimens were not made.

TABLE 7. *Percent occurrence of fish species in the Red Cedar River basin* for the 1975-81 period arranged by their importance in stream vs. lake environments.*

Common Name	Percent Occurrence In Streams	Percent Occurrence In Lakes
Chestnut lamprey	100	0
Northern brook lamprey	100	0
Silver lamprey	100	0
American brook lamprey	100	0
Shovelnose sturgeon	100	0
Longnose gar	100	0
Shortnose gar	100	0
Mooneye	100	0
Brown trout	100	0
Central stoneroller	100	0
Mississippi silvery minnow	100	0
River shiner	100	0
Finescale dace	100	0
Bullhead minnow	100	0
River carpsucker	100	0
Quillback	100	0
Highfin carpsucker	100	0
Blue sucker	100	0
Smallmouth buffalo	100	0
Bigmouth buffalo	100	0
Greater redhorse	100	0
Channel catfish	100	0
Stonecat	100	0
Burbot	100	0
Crystal darter	100	0
River darter	100	0
Sauger	100	0
Freshwater drum	100	0
Slimy sculpin	100	0
Brown trout	99	1
Fantail darter	99	1
Blacknose dace	98	2
Longnose dace	98	2
Brook stickleback	98	2
Rainbow darter	98	2
Mottled sculpin	98	2
Blackside darter	96	4
Northern redbelly dace	95	5
Northern hog sucker	95	5
Brassy minnow	94	6
Bigmouth shiner	94	6
Central mudminnow	93	7
Golden redhorse	93	7
Banded darter	93	7
Emerald shiner	92	8
Creek chub	90	10
White bass	90	10
Largescale stoneroller	88	12
Rosyface shiner	82	18
Pearl dace	82	18
Common shiner	77	23
Shorthead redhorse	77	23
Silver redhorse	75	25
Hornyhead chub	72	28
Ozark minnow	71	29
Sand shiner	71	29
Fathead minnow	71	29
White sucker	71	29
Black bullhead	71	29
Green sunfish	67	33
Least darter	60	40
Common carp	59	41
Johnny darter	55	45
Spotfin shiner	52	48
Tadpole madtom	47	53
Logperch	45	55
Blacknose shiner	44	56
Northern pike	39	61
Walleye	35	65
Trout-perch	33	67
Warmouth	33	67
Weed shiner	32	68
Yellow bullhead	32	68
Golden shiner	30	70
Rock bass	30	70
Bluntnose minnow	27	73
Blackchin shiner	25	75
Redfin shiner	25	75
Iowa darter	25	75
Smallmouth bass	24	76
Black crappie	18	82
Yellow perch	18	82
Bluegill	13	87
Brown bullhead	12	88
Pumpkinseed	12	88
Largemouth bass	10	90
Mimic shiner	10	90
Lake sturgeon	0	100
Bowfin	0	100
Cisco or lake herring	0	100
Rainbow smelt	0	100
Pugnose shiner	0	100
Banded killifish	0	100
Brook silverside	0	100
White crappie	0	100

* Known to have reproducing populations within the basin.

TABLE 8. *List of species collected at 5 or fewer stations from the Red Cedar River basin, 1975-81.*

Silver lamprey	Highfin carpsucker
Lake sturgeon	Blue sucker
Shovelnose sturgeon	Smallmouth buffalo
Longnose gar	Bigmouth buffalo
Shortnose gar	Greater redhorse
American eel	Channel catfish
Cisco or lake herring	Trout-perch
Rainbow smelt	Green sunfish
Muskellunge	Warmouth
Mississippi silvery minnow	White crappie
	Crystal darter
River shiner	Least darter
Redfin shiner	River darter
Bullhead minnow	Sauger
River carpsucker	Slimy sculpin

TABLE 9. *Fish species collected for the first time during the 1975-81 period from the Red Cedar River basin.*

Northern brook lamprey	Smallmouth buffalo
Silver lamprey	Bigmouth buffalo
American brook lamprey	Greater redhorse
Longnose gar	Yellow bullhead
Shortnose gar	Banded killifish
Mooneye	Brook silverside
Rainbow smelt	White bass
Muskellunge	Green sunfish
Central stoneroller	Warmouth
Pugnose shiner	White crappie
River shiner	Crystal darter
Bullhead minnow	River darter
River carpsucker	Sauger
Quillback	Slimy sculpin
Highfin carpsucker	

TABLE 10. *Fish species apparently no longer present in the Red Cedar River basin.*

Last Period Recorded	Species
1900-31	Lake whitefish
1958-74	Flathead catfish

TABLE 11. *Fish species reported prior to 1932 from the Red Cedar River basin but not collected again until 1975-81.*

Mississippi silvery minnow	Pearl dace
	Silver redhorse
Ozark minnow	Iowa darter
Sand shiner	Least darter
Redfin shiner	Banded darter

TABLE 12. *Endangered species collected in the Red Cedar River basin during 1975-81 and records from stations in other Wisconsin basins since 1974.*

Species	Body of Water	County	No. Stations	No. Fish	Avg. No. Fish/Station	No. Records From Other Basins*
Crystal darter	Red Cedar R.	Dunn	5	13		13(2,280,300,310)
		TOTAL	5	13	3	

* Basin numbers shown in parentheses (see Fig. 1).

TABLE 13. *Characteristics of aquatic habitat for selected species* collected in the Red Cedar River basin, 1975-81.*

Species	Stream Width (m)	Stream Depth (m)	Velocity**	Turbidity**	Cond. (umhos)	Temp. (F)
ENDANGERED						
Crystal darter	27-42	0.3-1	moderate	moderate	200	76
THREATENED						
Blue sucker	26-40	1-2.5	moderate	moderate	200	76
WATCH						
Pugnose shiner (lake stations)		(littoral zone with abundant aquatic vegatation)		slight	175	72-82
Weed shiner (lake stations)		(littoral zone with abundant aquatic vegetation)		slight-moderate	110	75-82
(stream stations)	4-10	0.3-1	slight	slight	180	72-77
Redfin shiner (lake stations)		(littoral zone with abundant aquatic vegetation)		slight-moderate	150-280	78
Greater redhorse	21-60	0.3-1.5	moderate	moderate	120	69-74

* Endangered, threatened, or watch species for which we have collected data from 3 or more stations.
** Terms are defined in Fago (1983b).

TABLE 14. *Threatened species collected in the Red Cedar River basin during 1975-81 and records from stations in other Wisconsin basins since 1974.*

Species	Body of Water	County	No. Stations	No. Fish	Avg. No. Fish/Station	No. Records From Other Basins*
Ozark minnow	Vermillion R.	Barron	2	44		43(221,223,230)
	Brill R.	Barron	2	12		
	Long L.	Washburn	2	6		
	Red Cedar R.	Barron	1	4		
		TOTAL	7	66	9	
Blue sucker	Red Cedar R.	Dunn	5	19		49(2,240,270,300,310)
		TOTAL	5	19	4	

* Basin numbers shown in parentheses (see Fig. 1).

TABLE 15. *Watch species collected in the Red Cedar River basin during 1975-81 and records from stations in other Wisconsin basins since 1974.*

Species	Body of Water	County	No. Stations	No. Fish	Avg. No. Fish/Station	No. Records From Other Basins*
Lake sturgeon	L. Menomin	Dunn	1	1		31(2,5,81,82,110,221,
	Tainter L.	Dunn	1	-		240,300,310)
		TOTAL	2	1	1	
American eel	Red Cedar R.	Dunn	1	1		40(2,5,81,221,222,240,
		TOTAL	1	1	1	270,280,300)
Pugnose shiner	Bear L.	Washburn	1	1		48(20,81,82,210,
	Kekegama L.	Washburn	1	12		221,300,310)
	Long L.	Washburn	6	75		
	Red Cedar L.	Barron	1	3		
		TOTAL	9	91	10	
Weed shiner	Barron Flowage (Lower)	Barron	1	1		53(2,82,120,222,240, 250,260,270,290)
	Yellow R.	Barron	2	9		
	Barron Flowage (Upper)	Barron	1	99		
	Vermillion R.	Barron	1	5		
	Sweeny Pond Cr.	Barron	2	12		
	Bear Cr.	Barron	1	1		
	Bear L.	Barron	4	12		
	Kekegama L.	Washburn	1	6		
	Hemlock L.	Barron	2	3		
	L. Chetac	Sawyer	4	38		
		TOTAL	19	186	10	
Redfin shiner	Tainter L.	Dunn	1	1		23(20,82,90,210,221,
	Barron Flowage (Lower)	Barron	1	60		222,240)
	Yellow R.	Barron	1	5		
	Barron Flowage (Upper)	Barron	1	11		
		TOTAL	4	77	19	
Greater redhorse	Red Cedar R.	Dunn	2	3		93(5,20,40,50,82,100,
	Red Cedar R.	Barron	1	4		110,221,240,300,310)
	Brill R.	Barron	1	3		
		TOTAL	4	10	3	
Least darter	Tenmile Cr.	Barron	1	1		84(20,82,120,200,210,
	Vermillion R.	Barron	1	1		221,222,270,300,310,
	Kekegama L.	Washburn	1	2		400)
	Long L.	Washburn	1	1		
	Hemlock Cr.	Rusk	1	1		
		TOTAL	5	6	1	

* Basin numbers shown in parentheses (see Fig. 1).

RECOMMENDATIONS

CONTINUING USE OF FISH DISTRIBUTION DATA

The data in both the Master Fish and Master Stream and Lake Files* are available and should be used by interested persons when preparing environmental impact assessments, forming master plans, and planning future research studies.

FUTURE RESEARCH STUDIES

This series of reports on fish distribution does not deal generally with the ecological data collected since 1974. Analysis of these data should be the subject of another study. The species composition of fish communities and their relationship to the ecological data collected are two other subjects for study.

The potential integration of the data compiled by the study with data collected by other researchers, on, for example, water quality, open up further areas for study and analysis.

*See section on Data Handling in this report and Fago (1983b) for explanation of these files.

PROTECTION OF ENDANGERED AND THREATENED SPECIES AND THEIR HABITAT

The aquatic environment of the Red Cedar River from below the Lake Menomin dam to its mouth should be protected, for both the endangered crystal darter and the threatened blue sucker are found there. Any manipulations of this habitat should recognize the presence of these 2 beautiful and valuable species.

The populations of the threatened Ozark minnow in the Red Cedar, Brill, and Vermillion rivers and Long Lake should be protected. Any plans to manipulate this environment should recognize their presence. These disjunct populations present a unique opportunity to make ecological comparisons between them and populations in southern Wisconsin.

UPDATING PRESENT RECORDS

District fish management personnel should in the course of routine surveys preserve at least 1 specimen of each endangered, threatened, and watch species they observe (except paddlefish, lake sturgeon, and American eel) and notify the Bureau of Research. Such collections will permit continuing reassessment of the endangered and threatened species lists as required by law and of the watch list as well.

COMPLETION OF THIS SURVEY

Completion of a statewide survey has not been achieved due to funding reduction; only 45% of the state has been covered. When additional funds become available for investigations of endangered, threatened, and/or nongame species, high priority should be accorded to completion of the surveys in compliance with the legislative mandate.

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APPENDIX A. Supplementary Data

TABLE 16. *List of species reported from the Red Cedar River basin by collectors other than DNR research personnel.*

Species	1959-74	1975-81
Chestnut lamprey	2	
Lake sturgeon*		1,7
Shovelnose sturgeon*	1,10	
Bowfin*	1	1
American eel*	1	
Cisco or lake herring*	1	1
Brown trout*	1,5	1
Brook trout*	1,5	1
Rainbow smelt*		1
Central mudminnow*	1,5	1
Northern pike*	1,5,10	1
Muskellunge*		1
Stoneroller (unsp.)	5	
Largescale stoneroller	2	1
Common carp*	1,10	1
Brassy minnow	2,5	1
Hornyhead chub	2,5	
Golden shiner	2	1
Emerald shiner	2,5	
Common shiner	2,5	1
Bigmouth shiner	2	
Blackchin shiner		1
Blacknose shiner	2	1
Rosyface shiner	2,5	
Spotfin shiner	2	
Weed shiner	5	
Mimic shiner	2	1
Northern redbelly dace		1
Finescale dace	5	
Bluntnose minnow	2,5	
Fathead minnow	2,5	1
Blacknose dace	5	1
Longnose dace	5	
Creek chub	2,5	1
Pearl dace		1
White sucker*	1,2,5,10	1
Northern hog sucker*	1,2,5,10	1
Golden redhorse	2	1
Shorthead redhorse	2	
Black bullhead	5	
Brown bullhead		1
Channel catfish*	1,10	
Stonecat	2,5	1
Tadpole madtom	2,5	
Flathead catfish*	1	
Trout-perch*	1,2	1
Burbot*	1	1
Brook silverside*		1
Brook stickleback*	1,2,5	1
Rock bass	2,5	1
Pumpkinseed	5	1
Bluegill	2,5	
Smallmouth bass*	1,5,10	1
Largemouth bass*	1,5	1
Black crappie	2,5	
Rainbow darter	2,5	1
Iowa darter		1
Fantail darter	2,5	1
Least darter		1
Johnny darter	2,5	1
Banded darter		1
Yellow perch*	1,2,5	1
Logperch	2,5	
Blackside darter	2,5	
Walleye*	1,2,10	1
Freshwater drum*	1,10	
Mottled sculpin*	1,5	1

*Records of this species collected by Fish Management, students, and sport and commercial fishermen are based upon their identification.

KEY TO COLLECTOR'S CODE

1 = All Fish Management collectons
2 = Dr. George Becker and his students
[3 = Professor Marlin Johnson and his students]
[4 = Dr. George Seeburger and his students]
5 = Milwaukee Public Museum
[6 = UW-Madison students]
7 = Commercial fishermen
[8 = Sport fishermen]
[9 = Upper Mississippi River Conservation Commission] (UMRCC)
10 = N.U.S. Corporation, Pittsburgh, PA

[ ] = Collector not used in this basin study.

DEPARTMENT OF NATURAL RESOURCES — FISH OR STREAM DATA INPUT — FORM 8100-58 REV. 4-81

1 ADD
2 CHANGE
3 DELETE

F OR S

☐ SEQUENCE __ __ __ __ __ __ __ ☐ MAJOR BASIN __ MINOR BASIN __ __ __

CC1 MB MILES __ __ __ __ . __ __

ORDER MILEAGES 1) __ __ __ __ . __ __ 2) __ __ __ __ . __ __ 3) __ __ __ __ . __ __

4) __ __ __ __ . __ __ 5) __ __ __ __ . __ __ 6) __ __ __ __ . __ __

7) __ __ __ __ . __ __ 8) __ __ __ __ . __ __ 9) __ __ __ __ . __ __

10) __ __ __ __ . __ __ 11) __ __ __ __ . __ __

REPORT LOCATION ☐

STATION MILEAGE __ __ __ __ . __ __

NAME __

DAM OR JAR CODE __ WATERTYPE __ LANDLOCKED SEQUENCE NUMBER __ __

	TOWNSHIP	RANGE	SEC.	1/16	1/4	COUNTY
STREAM OR LAKE LOCATION	__ __ __	__ __ __	__ __	__ __	__ __	__ __
STATION LOCATION	__ __ __	__ __ __	__ __	__ __	__ __	__ __

SOURCE OF DATA __ __ GEAR __ EFFORT __ __ DATE __ __ / __ __ / __ __ (MO / DAY / YR) HOUR __ __

WIDTH __ __ __ (L) __ __ __ (M) __ __ __ (U) DEPTH __ __ __ (L) __ __ __ (M) __ __ __ (U)

VELOCITY __ TEMPERATURE __ __ CONDUCTIVITY __ __ __ __ TURBIDITY __

BOTTOM TYPES	__ __	__ __	__ __	__ __	__ __	__ __	__ __	__ __
AQUATIC VEG.	__	__	__	__	__	__	__	__
STRM. BANK VEG.	__ __	__ __	__ __	__ __	__ __	__ __	__ __	__ __

FISH SPECIES

1) __ __ __ __ __	2) __ __ __ __ __	3) __ __ __ __ __	4) __ __ __ __ __
5) __ __ __ __ __	6) __ __ __ __ __	7) __ __ __ __ __	8) __ __ __ __ __
9) __ __ __ __ __	10) __ __ __ __ __	11) __ __ __ __ __	12) __ __ __ __ __
13) __ __ __ __ __	14) __ __ __ __ __	15) __ __ __ __ __	16) __ __ __ __ __

MORE DATA ON BACK: ☐ YES

17) __ __ __ __ __	18) __ __ __ __ __	19) __ __ __ __ __	20) __ __ __ __ __
21) __ __ __ __ __	22) __ __ __ __ __	23) __ __ __ __ __	24) __ __ __ __ __
25) __ __ __ __ __	26) __ __ __ __ __	27) __ __ __ __ __	28) __ __ __ __ __
29) __ __ __ __ __	30) __ __ __ __ __	31) __ __ __ __ __	32) __ __ __ __ __
33) __ __ __ __ __	34) __ __ __ __ __	35) __ __ __ __ __	36) __ __ __ __ __
37) __ __ __ __ __	38) __ __ __ __ __	39) __ __ __ __ __	40) __ __ __ __ __
41) __ __ __ __ __	42) __ __ __ __ __	43) __ __ __ __ __	44) __ __ __ __ __

FISH ONLY

FIGURE 5. *Example of field collection form (8100-46).*

```
MINOR=223SELECTION=223                                                          SOURCE=NOT 40 81 94 95 99        MILE ON                    PAGE  43
MIN. MONTH =     MAX. MONTH =       MIN. YEAR = 1950  MAX. YEAR = 1973   COUNTY = OR < 72

X12   JOHNNY DARTER                                                ETHEOSTOMA NIGRUM                                                  DATE RUN 11/09/83

                  ----------O R D E R  M I L E A G E S----------                                                                                 N86006A
BASIN    MBM       1        2/7       3/8       4/9      5/10     6/11     MILE  LAKE OR STREAM NAME              WT NO SD GEF --DATE--TWRRNGSECQTQTCO

2 223 1434.8R  156.9L                                                     139.1  PECATONICA R                      2  2 46 5    6/27/60  2N 3E12SESE33
2 223 1434.8R  156.9L                                                     182.4  PECATONICA R -MIFFLIN             2 11 46 5    8/15/62  5N 1E27SESE25
2 223 1434.8R  156.9L   72.8R                                              30.5  RICHLAND CR                       2    61 5   11/28/65  1N 8E 7SENE23
2 223 1434.8R  156.9L   72.8R   27.0R                                       1.8E TWIN GROVE BR                     2    61 5   10/20/64  1N 8E29NWNE23
2 223 1434.8R  156.9L  102.8R   13.8Y                                       1.3  BUCKSKIN SCHOOL CR                2    61 5    7/ 5/65  2N 7E 5SWSW23
2 223 1434.8R  156.9L  105.8R                                              30.2  E BR PECATONICA R                 2 44 46 5    6/30/60  4N 5E26SESE33
2 223 1434.8R  156.9L  105.8R                                              40.3  E BR PECATONICA R                 2 27 46      6/30/60  4N 5E 4SENE25
2 223 1434.8R  156.9L  105.8R                                              53.4  E BR PECATONICA R                 2    61 5   10/15/64  5N 5E 4NWNW25
2 223 1434.8R  156.9L  105.8R                                              58.3  E BR PECATONICA R                 2  3 61 5    8/ 1/69  6N 5E22  SE25
2 223 1434.8R  156.9L  105.8R   10.9L                                        .5  WHITESIDE CR                      2  3 46      6/30/60  2N 5E 3SESW33
2 223 1434.8R  156.9L  105.8R   10.9L    1.6R                               1.9  APPLE BR                          2    61 5   10/ 7/65  3N 5E32  NE33
2 223 1434.8R  156.9L  105.8R   10.9L    1.6R                               3.3E APPLE BR                          2 19 46      6/29/60  3N 5E30SESE33
2 223 1434.8R  156.9L  105.8R   15.0R                                       5.3  DOUGHERTY CR                      2    61 5   10/ 6/64  3N 6E19NWSE23
2 223 1434.8R  156.9L  105.8R   19.2L                                        .3  MUD BR                            2 24 46      6/29/60  3N 5E22  SW33
2 223 1434.8R  156.9L  105.8R   19.2L                                       3.7  MUD BR                            2    61 5   10/ 1/64  3N 5E20NWNW33
2 223 1434.8R  156.9L  105.8R   19.2L                                       9.6  MUD BR                            2 24 46      6/29/60  3N 4E15NENW33
2 223 1434.8R  156.9L  105.8R   19.7L                                       6.1E YELLOWSTONE R                     2  5 46      6/29/60  3N 5E 8SENE33
2 223 1434.8R  156.9L  105.8R   19.7L                                      17.0  YELLOWSTONE R                     2  9 46      6/28/60  4N 4E23SESE33
2 223 1434.8R  156.9L  105.8R   25.4R                                       1.3  SAWMILL CR                        2    61 5   10/ 7/64  3N 5E 2NESE33
2 223 1434.8R  156.9L  105.8R   25.4R                                       6.5E SAWMILL CR                        2    61 5   10/ 6/64  4N 6E20SESW23
2 223 1434.8R  156.9L  105.8R   27.5L                                       1.0  UN CR                             2 27 46      6/28/60  4N 5E27NWSE33
2 223 1434.8R  156.9L  105.8R   33.5R                                        .9  GORDON CR                         2    61 5   10/ 1/64  4N 5E13NWSW25
2 223 1434.8R  156.9L  105.8R   44.2L    6.1R                               6.3  CONLEY LEWIS CR                   2  1 61 5    8/ 1/69  6N 4E34SWNE25
2 223 1434.8R  156.9L  139.5L                                               1.2  AMES BR                           2  3 46      6/27/60  2N 3E11SESE33
2 223 1434.8R  156.9L  141.0R                                                .4  OTTER CR                          2  2 46      6/27/60  2N 4E 6SENW33
2 223 1434.8R  156.9L  153.4L                                               5.1  BONNER BR                         2  7 46      8/15/62  3N 2E11SENW33
2 223 1434.8R  156.9L  159.0R                                               9.9  MINERAL POINT BR                  2  3 46 5    8/15/62  4N 2E10  NE25
2 223 1434.8R  156.9L  159.0R                                              13.7  MINERAL POINT BR                  2  1 46      8/ 9/62  5N 2E36SWNE25
2 223 1434.8R  156.9L  159.0R    8.8L                                       8.3  SUDAN BR                          2  4 46      8/14/62  5N 2E29SWSE25
2 223 1434.8R  156.9L  159.0R    8.8L   10.6R                                .4  PEDLER CR                         2  2 46      8/14/62  5N 2E21SWNE25
2 223 1434.8R  156.9L  172.9L                                               1.5  JONES BR                          2    45      7/11/62  4N 1E23SWSE33

NUMBER OF STATIONS WITH FISH =   31     NUMBER OF STATIONS WITH 1-98 FISH =   20   NUMBER OF STATIONS WITH 99 OR MORE FISH =    0
TOTAL NUMBER OF FISH =     221          AVERAGE NUMBER OF FISH = 11.1  (ESTIMATE)
PERCENT OF TOTAL NUMBER OF STATIONS = 79.49                      NUMBER OF STATIONS WITH A " " = 11
# STATIONS/SD:   SD-11=   0      SD-14,16=  0  SD-15,17,19=  0  SD-23-33=  0     SD-40=  0  SD-45,46= 19      SD-50=  0  SD-55,56=  0
                 SD-61= 12          SD-66=  0        SD-72=  0     SD-75=  0     SD-76=  0     SD-77=  0      SD-78=  0     SD-80=  0
                 SD-83=  0          SD-86=  0        SD-88=  0     SD-89=  0     SD-94=  0     SD-98=  0      SD-99=  0     SD-36=  0

                      TOTAL NUMBER OF SPECIES OCCURRENCES     31
```

FIGURE 6. *Sample listing for a species using the Cobol program (listing method B, Figure 3, used here).*

MINOR=223SELECTION=223 SOURCE=NOT 40 81 94 95 99 MILE ON

A86006

		NUMBER OF STATIONS	PERCENT OF TOTAL STATIONS
I21	BROWN TROUT	1	2.56
KO1	CENTRAL MUDMINNOW	4	10.26
MO5	STONEROLLERS	13	33.33
MO6	CENTRAL STONEROLLER	19	48.72
MO7	LARGESCALE STONEROLLER	4	10.26
M12	COMMON CARP	5	12.82
M14	BRASSY MINNOW	5	12.82
M19	HORNYHEAD CHUB	21	53.85
M23	EMERALD SHINER	1	2.56
M28	COMMON SHINER	28	71.79
M29	BIGMOUTH SHINER	5	12.82
M35	ROSYFACE SHINER	17	43.59
M36	SPOTFIN SHINER	16	41.03
M37	SAND SHINER	14	35.90
M41	SUCKERMOUTH MINNOW	8	20.51
M43	SOUTHERN REDBELLY DACE	18	46.15
M45	BLUNTNOSE MINNOW	29	74.36
M46	FATHEAD MINNOW	6	15.38
M48	BLACKNOSE DACE	2	5.13
M50	CREEK CHUB	27	69.23
M76	COMMON SHINER X ROSYFACE SHINER	1	2.56
NO2	SUCKERS	1	2.56
NO4	REDHORSES	1	2.56
NO6	QUILLBACK	1	2.56
NO9	WHITE SUCKER	29	74.36
N13	NORTHERN HOG SUCKER	10	25.64
N15	BIGMOUTH BUFFALO	3	7.69
N18	SILVER REDHORSE	9	23.08
N21	GOLDEN REDHORSE	8	20.51
N22	SHORTHEAD REDHORSE	13	33.33
O08	CHANNEL CATFISH	1	2.56
O10	STONECAT	5	12.82
SO2	BLACKSTRIPE TOPMINNOW	1	2.56
UO1	BROOK STICKLEBACK	12	30.77
WO4	ROCK BASS	5	12.82
WO5	GREEN SUNFISH	6	15.38
WO8	ORANGESPOTTED SUNFISH	5	12.82
WO9	BLUEGILL	10	25.64
W11	SMALLMOUTH BASS	14	35.90
W12	LARGEMOUTH BASS	6	15.38
XO7	RAINBOW DARTER	2	5.13
X10	FANTAIL DARTER	13	33.33
X12	JOHNNY DARTER	31	79.49
X14	BANDED DARTER	5	12.82
X15	YELLOW PERCH	3	7.69
X18	BLACKSIDE DARTER	7	17.95
X19	SLENDERHEAD DARTER	4	10.26
X22	WALLEYE	1	2.56
ZO1	MOTTLED SCULPIN	7	17.95

TOTAL NUMBER OF SPECIES OCCURRENCES 441

STATIONS/SD: SD-11= 0 SD-14,16= 0 SD-15,17,19= 0 SD-23-33= 0 SD-40= 0 SD-45,46= 283 SD-50= 0 SD-55,56= 0
SD-61= 158 SD-66= 0 SD-72= 0 SD-75= 0 SD-76= 0 SD-77= 0 SD-78= 0 SD-80= 0
SD-83= 0 SD-86= 0 SD-88= 0 SD-89= 0 SD-94= 0 SD-98= 0 SD-99= 0 SD-36= 0

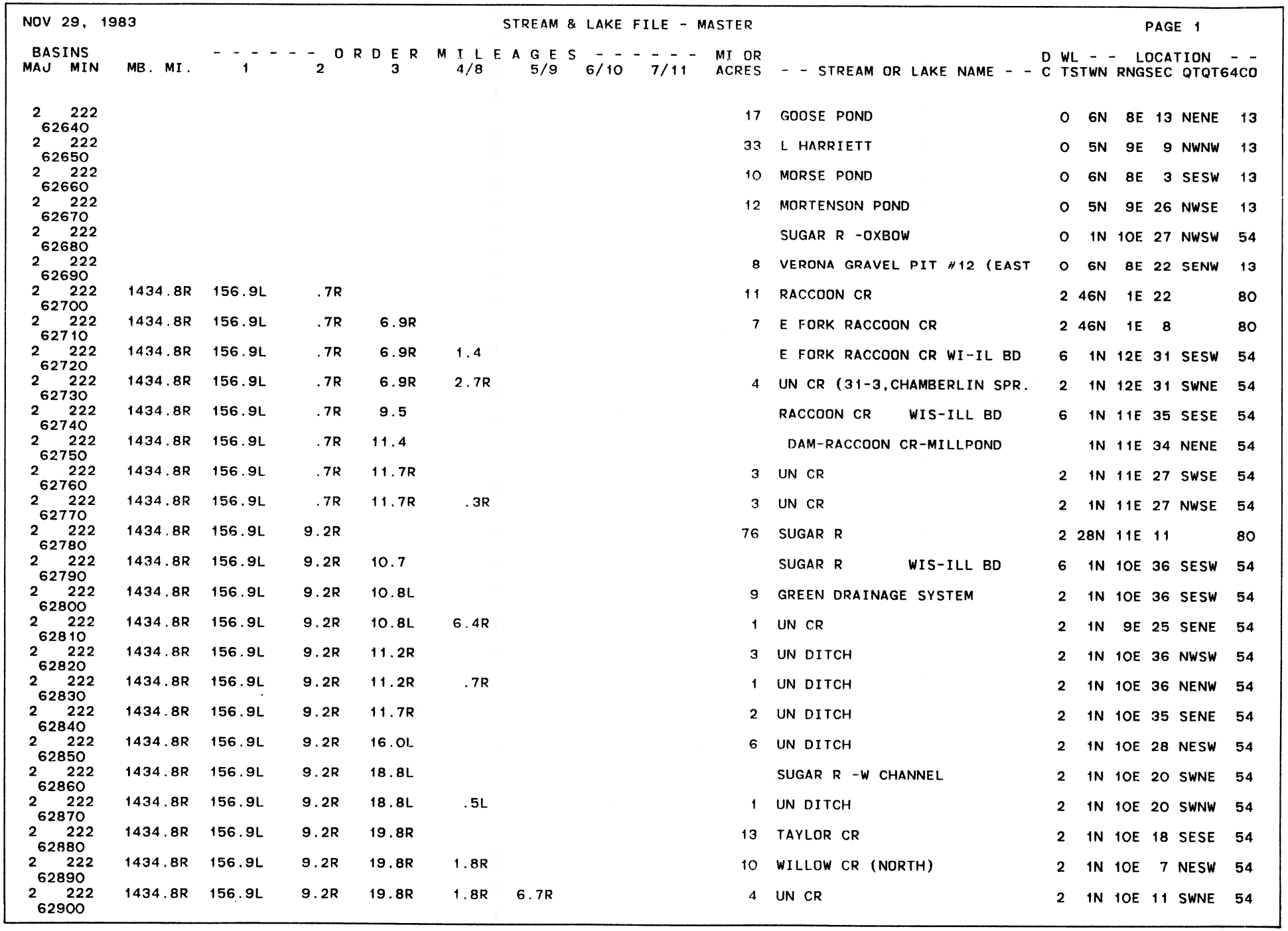
TOTAL NUMBER OF SPECIES OCCURRENCES 441

TOTAL NUMBER OF STATIONS
(WITH MILE RULE) 39
(WITHOUT MILE RULE) 42
TOTAL NUMBER OF SPECIES 45
TOTAL NUMBER OF HYBRIDS 1

FIGURE 7. *Sample summary report for species listing shown in Figure 6.*

```
NOV 23, 1983             FISH MASTER FILE                                                     MILE OFF           PAGE 1
  SEQ. JAR WT   ------------O R D E R  M I L E A G E S---------                                                 STATION LOCATION
BASIN    MBM        1       2/7      3/8     4/9     5/10    6/11     MILE   ----STREAM OR LAKE NAME----   SD G EF --DATE-- TWNRNGSECQTQTCO


2 222              1N       10E      27      SW 54                       +   SUGAR R -OXBOW              46 5      8/ 0/63   1N10E27NWSW54

          SP=04 HY=00 UNSP=00  FISH  M20  +  005  +  SO2  +  W08  +

2 222   1434.8R  156.9L     .7R    6.9R                          2.3   E FORK RACCOON CR           61 5     12/12/65   1N12E31NWSE54

          SP=13 HY=00 UNSP=02  FISH  M04  +  M05  +  M14  +  M28  +  M29  +  M41  +  M43  +  M45  +  M50  +
                                     N09  +  U01  +  X10  +  X12  +  X14  +  X18  +

2 222   1434.8R  156.9L     .7R    6.9R                          2.4   E FORK RACCOON CR           11 2 06  5/15/74   1N12E31SWNE54

          SP=15 HY=01 UNSP=01  FISH  A05  4  I21 10  LO2  6  LO7  1  M05  6  M12 .1  M28  1  M29  1  M45 13
                                     M50  2  N09 28  W05  3  W09  1  X10 11  X12 25  X14  2  Z01  6

2 222   1434.8R  156.9L     .7R    6.9R    2.7R                  1.5   UN CR (CHAMBERLIN SPRINGS)  71 5     10/ 5/77   1N12E29SWNW54

          SP=08 HY=00 UNSP=00  FISH  M06  1  M29 27  M43 10  M48 29  M50 99  N09  3  U01  5  X12 11

2 222   1434.8R  156.9L     .7R    6.9R    2.7R                  3.8   UN CR                       11 3 06  5/15/74   1N12E21NWNW54

          SP=07 HY=00 UNSP=01  FISH  M05 99  M43 19  M46  4  M48 75  M50 53  N09 30  U01  8  X12  2

2 222   1434.8R  156.9L     .7R    6.9R                          3.2   E FORK RACCOON CR           11 2 05 11/ 5/75   1N12E31NENW54

          SP=17 HY=00 UNSP=01  FISH  A05  2  K01  6  L01  2  M05 33  M28  2  M45 11  M46  3  M48 20  M50 16  (006      030   0      40)
                                     N09 47  W05 10  W09  6  X07  1  X10 30  X12 25  X14  2  X18 10  Z01 27  (1 49        3  0001     )
                                                                                                             (ET F1 G2 H5 I2          )
                                                                                                             (D3 FT K4 M2 01          )

2 222   1434.8R  156.9L     .7R    6.9R                          3.3   E FORK RACCOON CR           61 5      6/10/65   1N12E31NENW54

          SP=07 HY=00 UNSP=01  FISH  M05  +  M28  +  M39  +  M43  +  M45  +  M50  +  N09  +  X10  +

2 222   1434.8R  156.9L     .7R    6.9R                          7.8   E FORK RACCOON CR           11 2 06  5/15/74   1N11E12SESW54

          SP=16 HY=00 UNSP=01  FISH  I21  2  K01  2  M05 99  M09  1  M43 99  M45 99  M46  5  M48 79  M50 99
                                     N09 99  U01 99  W05  5  W08  1  X10 99  X11 46  X12 61  Z01  2

2 222   1434.8R  156.9L     .7R                                 10.7   RACCOON CR                  11 2 06  7/ 0/74   1N11E35SENW54

          SP=19 HY=00 UNSP=01  FISH  LO2  8  M05 15  M12  7  M19  6  M28 32  M36 27  M45 54  M46  6  M50  3
                                     N09 11  005  1  006 13  010  2  U01  2  W04  2  W05  2  W06  1  X12  3
                                     X14  4  X18  4

2 222   1434.8R  156.9L     .7R                                 10.7   RACCOON CR                  61 5      6/10/65   1N11E35SENW54

          SP=12 HY=00 UNSP=00  FISH  K01  +  LO2  1  M39  +  M45  +  N09  +  005  +  006  +  SO2  +  U01  +
                                     W05  +  X12  +  X18  +
```

FIGURE 8. *Sample page from the Master Fish File using a Mark IV program (listing method A, Figure 3, used here).*

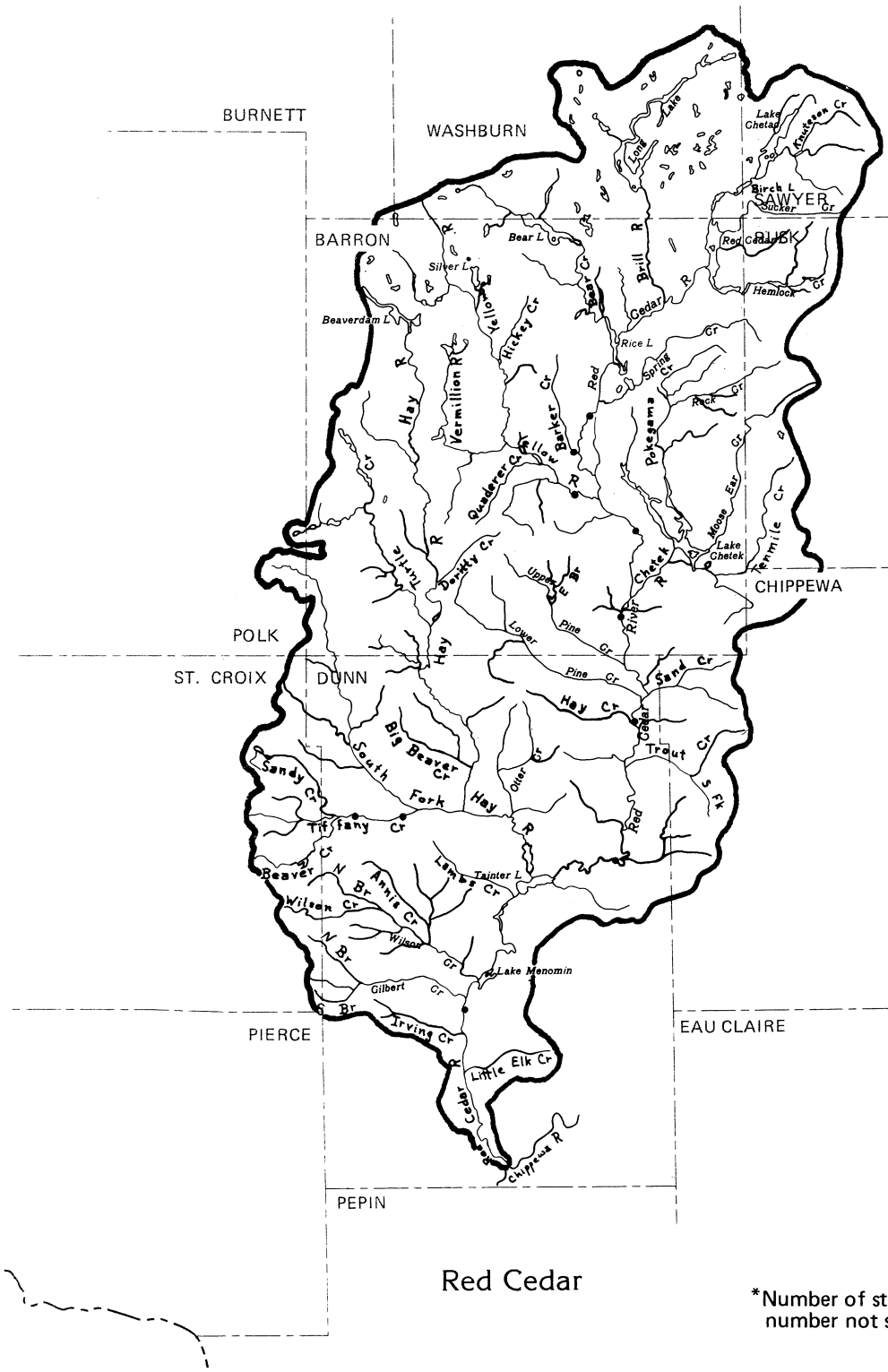


NOV 29, 1983 STREAM & LAKE FILE - MASTER PAGE 1

BASINS MAJ	BASINS MIN	MB. MI.	ORDER MILEAGES 1	2	3	4/8	5/9	6/10	7/11	MI OR ACRES	STREAM OR LAKE NAME	D C	WL TSTWN	RNGSEC	LOCATION QTQT64CO	
2	222 62640									17	GOOSE POND	0	6N	8E 13	NENE	13
2	222 62650									33	L HARRIETT	0	5N	9E 9	NWNW	13
2	222 62660									10	MORSE POND	0	6N	8E 3	SESW	13
2	222 62670									12	MORTENSON POND	0	5N	9E 26	NWSE	13
2	222 62680										SUGAR R -OXBOW	0	1N	10E 27	NWSW	54
2	222 62690									8	VERONA GRAVEL PIT #12 (EAST	0	6N	8E 22	SENW	13
2	222 62700	1434.8R	156.9L	.7R						11	RACCOON CR	2	46N	1E 22		80
2	222 62710	1434.8R	156.9L	.7R	6.9R					7	E FORK RACCOON CR	2	46N	1E 8		80
2	222 62720	1434.8R	156.9L	.7R	6.9R	1.4					E FORK RACCOON CR WI-IL BD	6	1N	12E 31	SESW	54
2	222 62730	1434.8R	156.9L	.7R	6.9R	2.7R				4	UN CR (31-3,CHAMBERLIN SPR.	2	1N	12E 31	SWNE	54
2	222 62740	1434.8R	156.9L	.7R	9.5						RACCOON CR WIS-ILL BD	6	1N	11E 35	SESE	54
2	222 62750	1434.8R	156.9L	.7R	11.4						DAM-RACCOON CR-MILLPOND		1N	11E 34	NENE	54
2	222 62760	1434.8R	156.9L	.7R	11.7R					3	UN CR	2	1N	11E 27	SWSE	54
2	222 62770	1434.8R	156.9L	.7R	11.7R	.3R				3	UN CR	2	1N	11E 27	NWSE	54
2	222 62780	1434.8R	156.9L	9.2R						76	SUGAR R	2	28N	11E 11		80
2	222 62790	1434.8R	156.9L	9.2R	10.7						SUGAR R WIS-ILL BD	6	1N	10E 36	SESW	54
2	222 62800	1434.8R	156.9L	9.2R	10.8L					9	GREEN DRAINAGE SYSTEM	2	1N	10E 36	SESW	54
2	222 62810	1434.8R	156.9L	9.2R	10.8L	6.4R				1	UN CR	2	1N	9E 25	SENE	54
2	222 62820	1434.8R	156.9L	9.2R	11.2R					3	UN DITCH	2	1N	10E 36	NWSW	54
2	222 62830	1434.8R	156.9L	9.2R	11.2R	.7R				1	UN DITCH	2	1N	10E 36	NENW	54
2	222 62840	1434.8R	156.9L	9.2R	11.7R					2	UN DITCH	2	1N	10E 35	SENE	54
2	222 62850	1434.8R	156.9L	9.2R	16.0L					6	UN DITCH	2	1N	10E 28	NESW	54
2	222 62860	1434.8R	156.9L	9.2R	18.8L						SUGAR R -W CHANNEL	2	1N	10E 20	SWNE	54
2	222 62870	1434.8R	156.9L	9.2R	18.8L	.5L				1	UN DITCH	2	1N	10E 20	SWNW	54
2	222 62880	1434.8R	156.9L	9.2R	19.8R					13	TAYLOR CR	2	1N	10E 18	SESE	54
2	222 62890	1434.8R	156.9L	9.2R	19.8R	1.8R				10	WILLOW CR (NORTH)	2	1N	10E 7	NESW	54
2	222 62900	1434.8R	156.9L	9.2R	19.8R	1.8R	6.7R			4	UN CR	2	1N	10E 11	SWNE	54

FIGURE 9. *Sample page from the Master Stream and Lake File.*

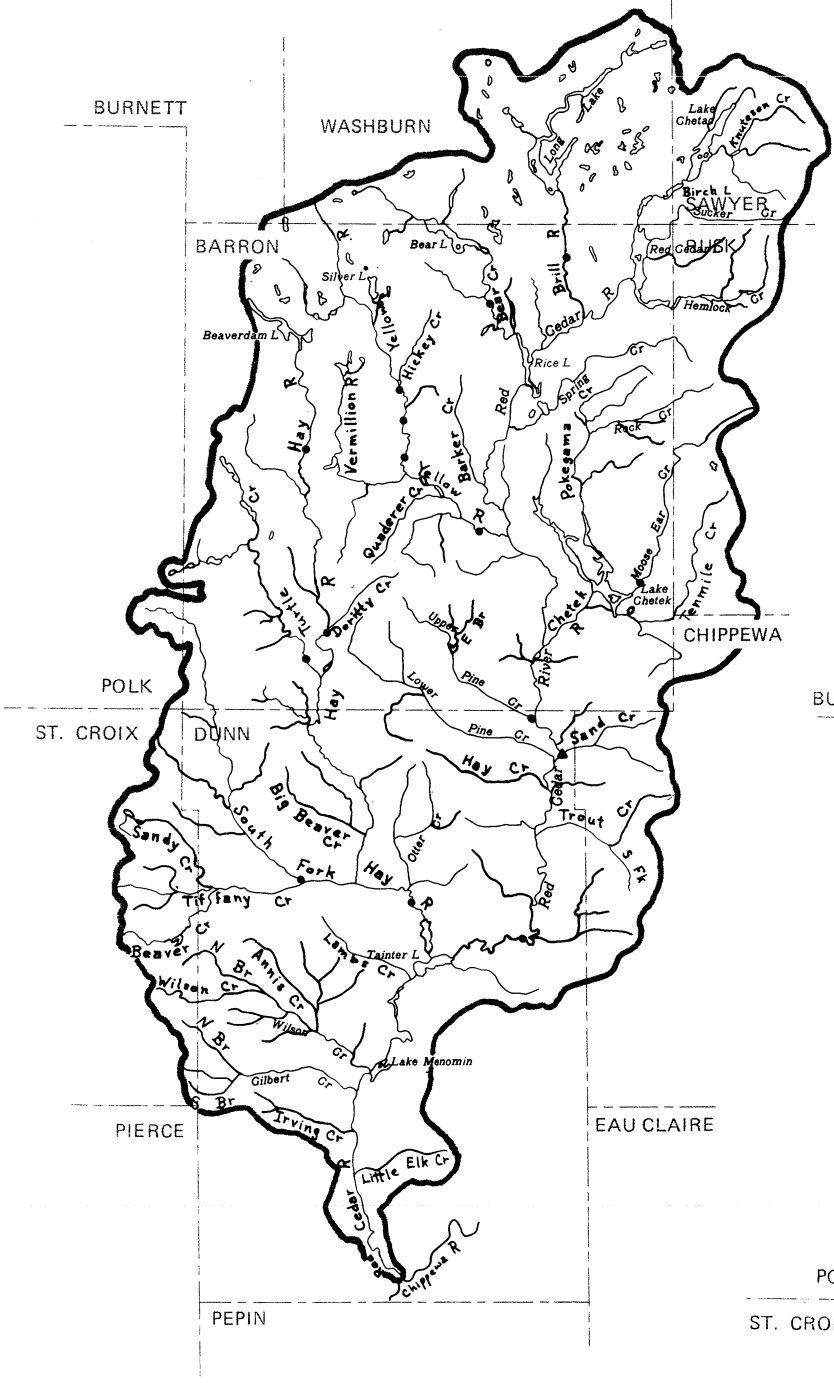
APPENDIX B. Distribution Maps For All Species Collected During 1975-81



MAP 1

● Chestnut lamprey 10(0)

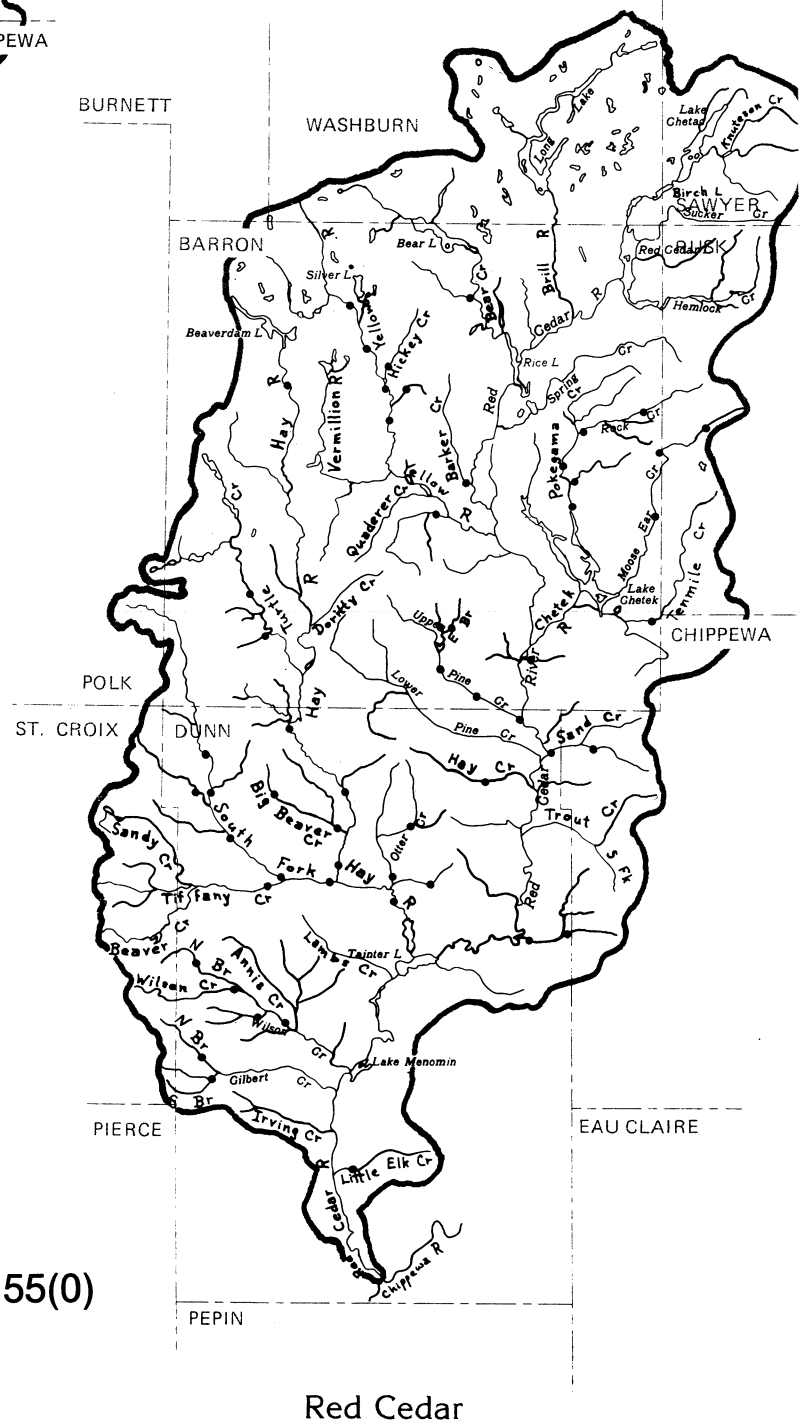
*Number of stations shown on map; number not shown is in parentheses.



MAP 2

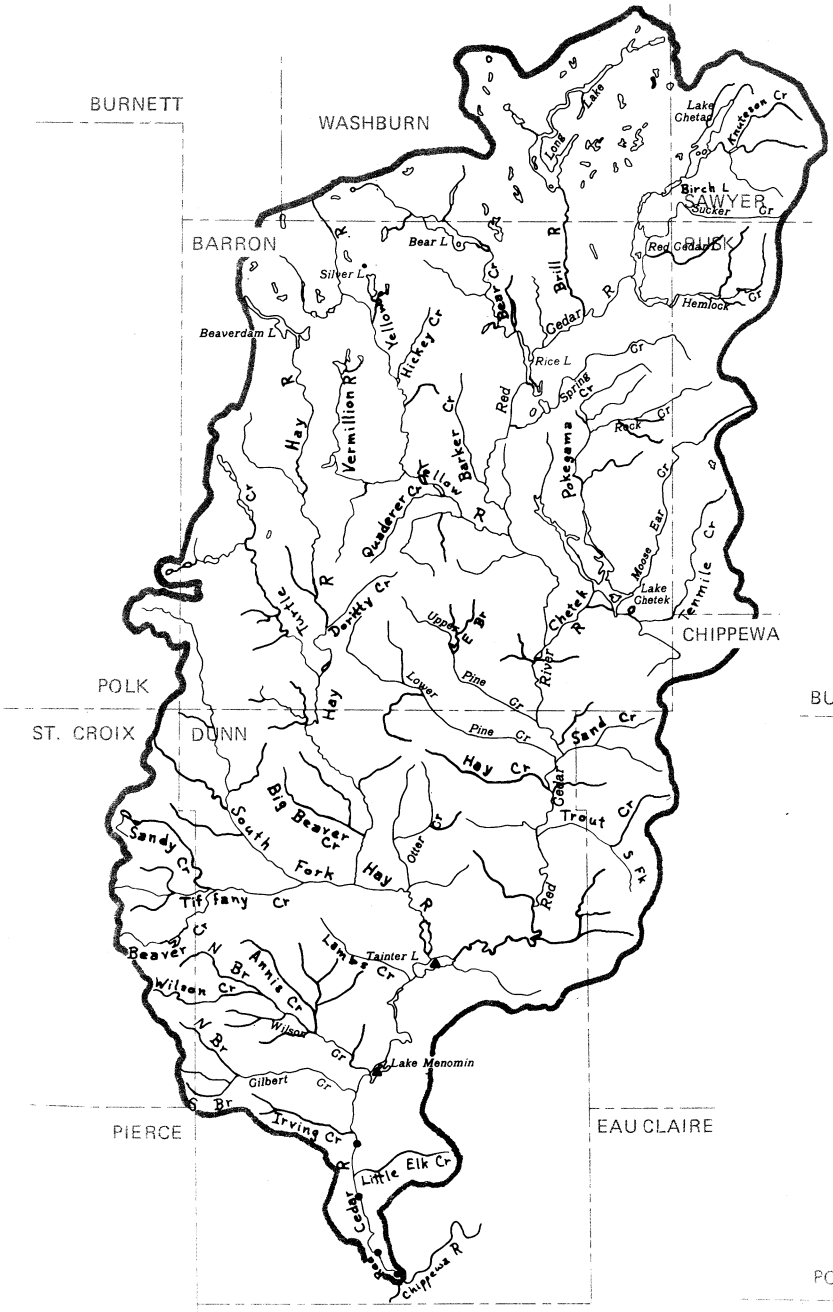
● Northern brook lamprey 14(0)

▲ Silver lamprey 1(0)



MAP 3

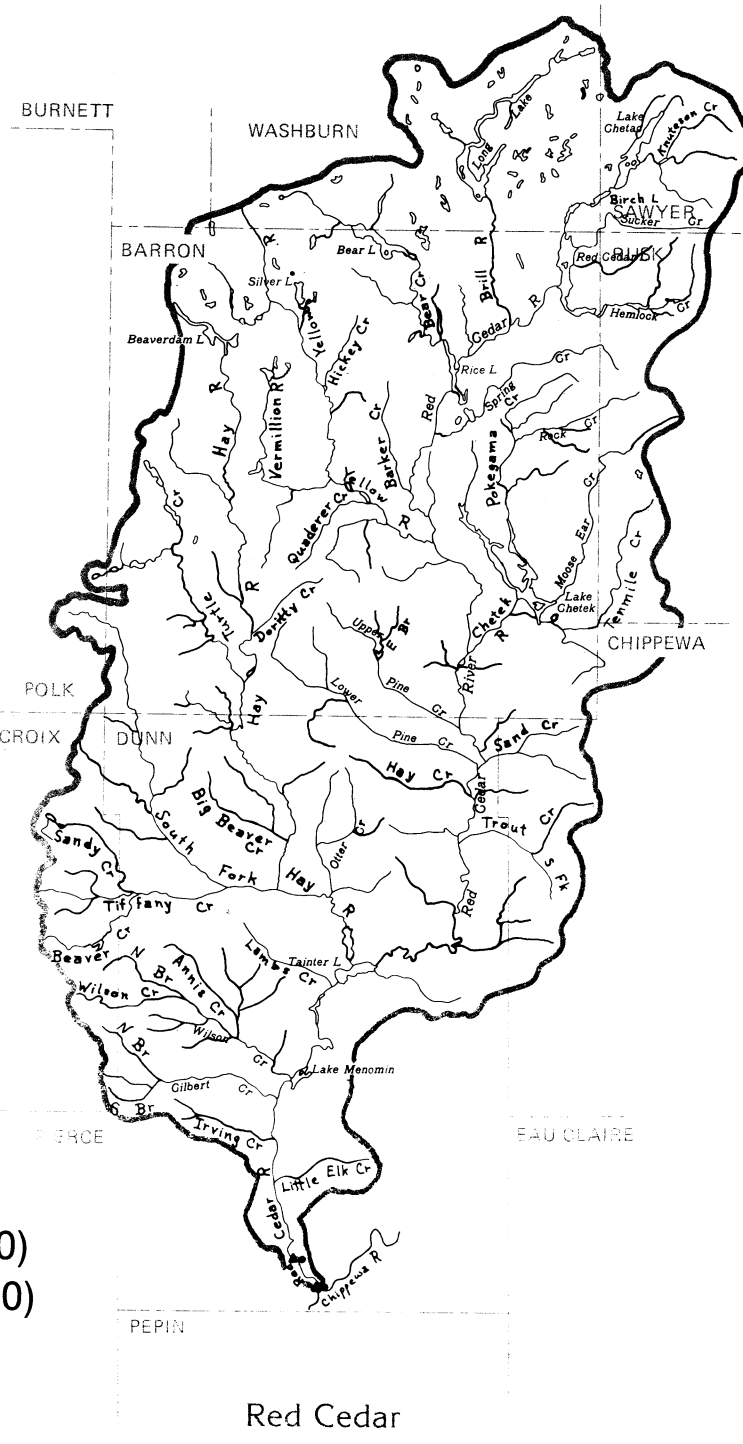
● American brook lamprey 55(0)



MAP 4

● Shovelnose sturgeon 4(0)

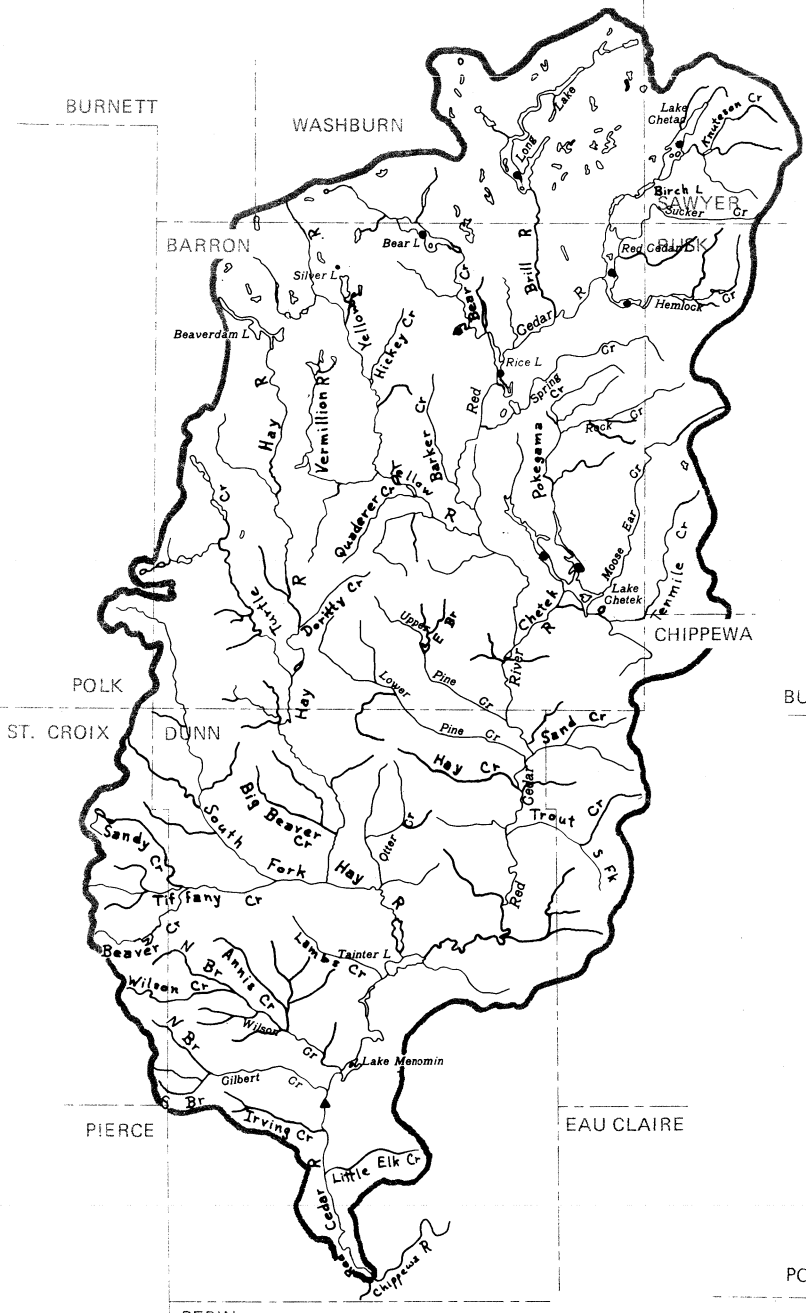
▲ Lake sturgeon 2(0)



MAP 5

● Longnose gar 2(0)

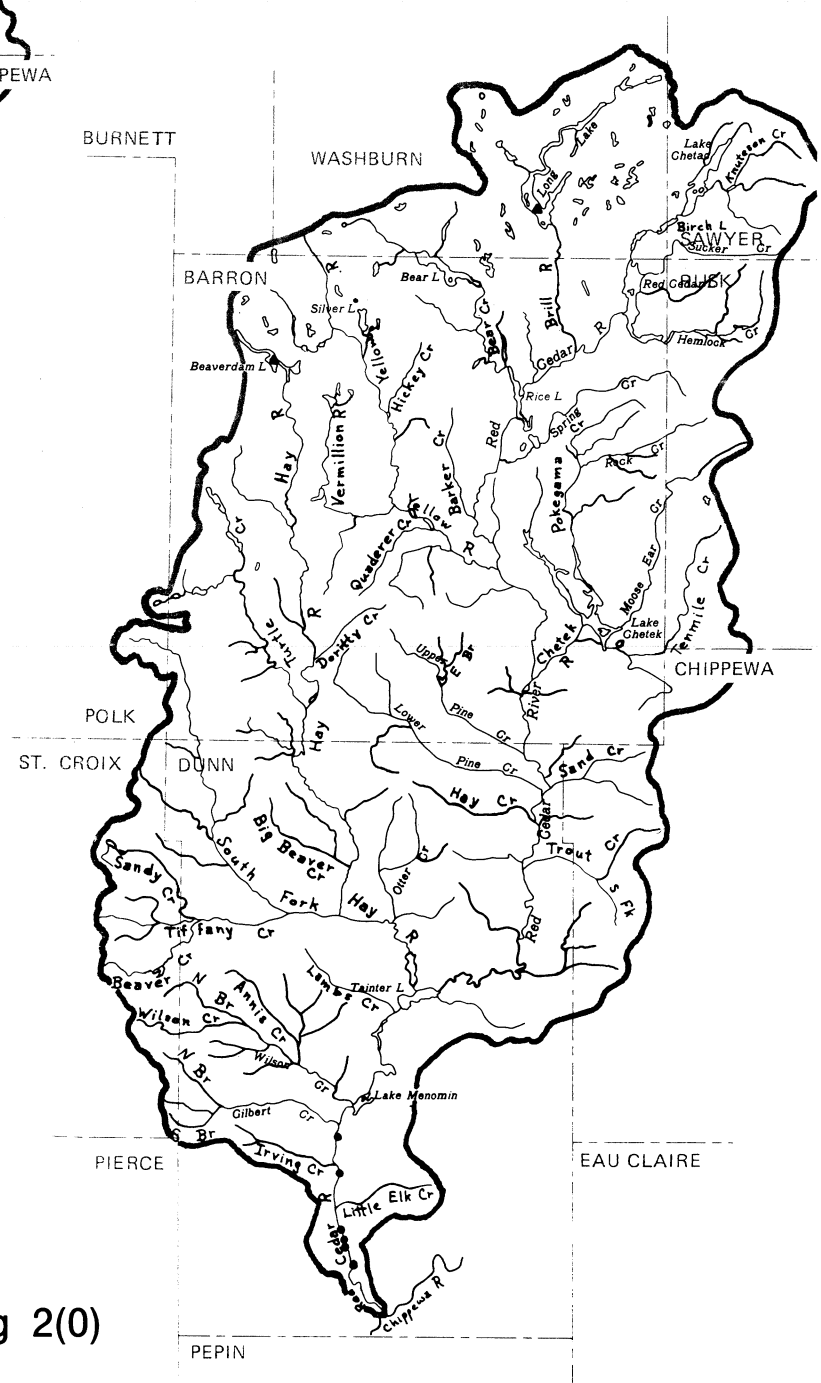
▲ Shortnose gar 2(0)



Red Cedar

MAP 6

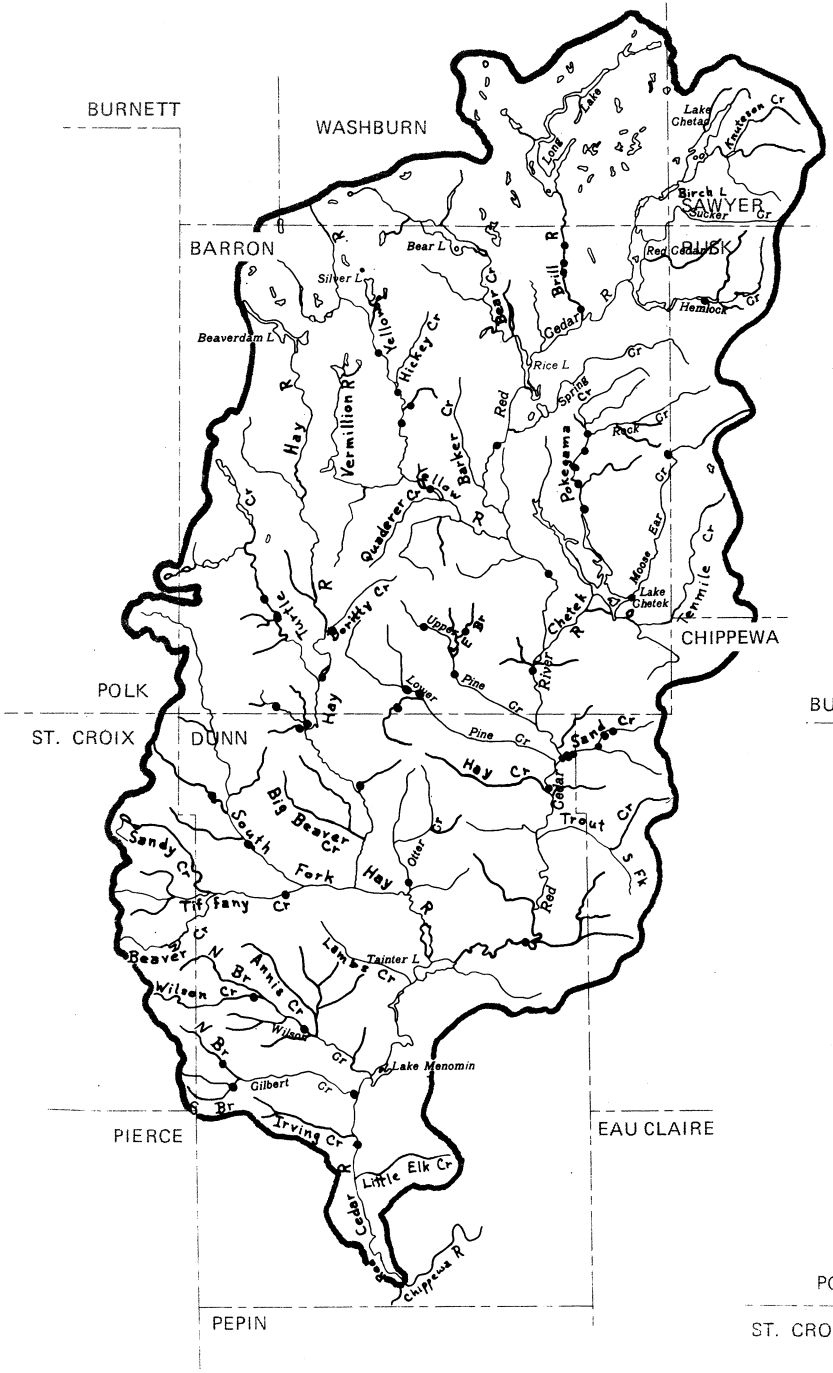
- Bowfin 9(4)
- American eel 1(0)



Red Cedar

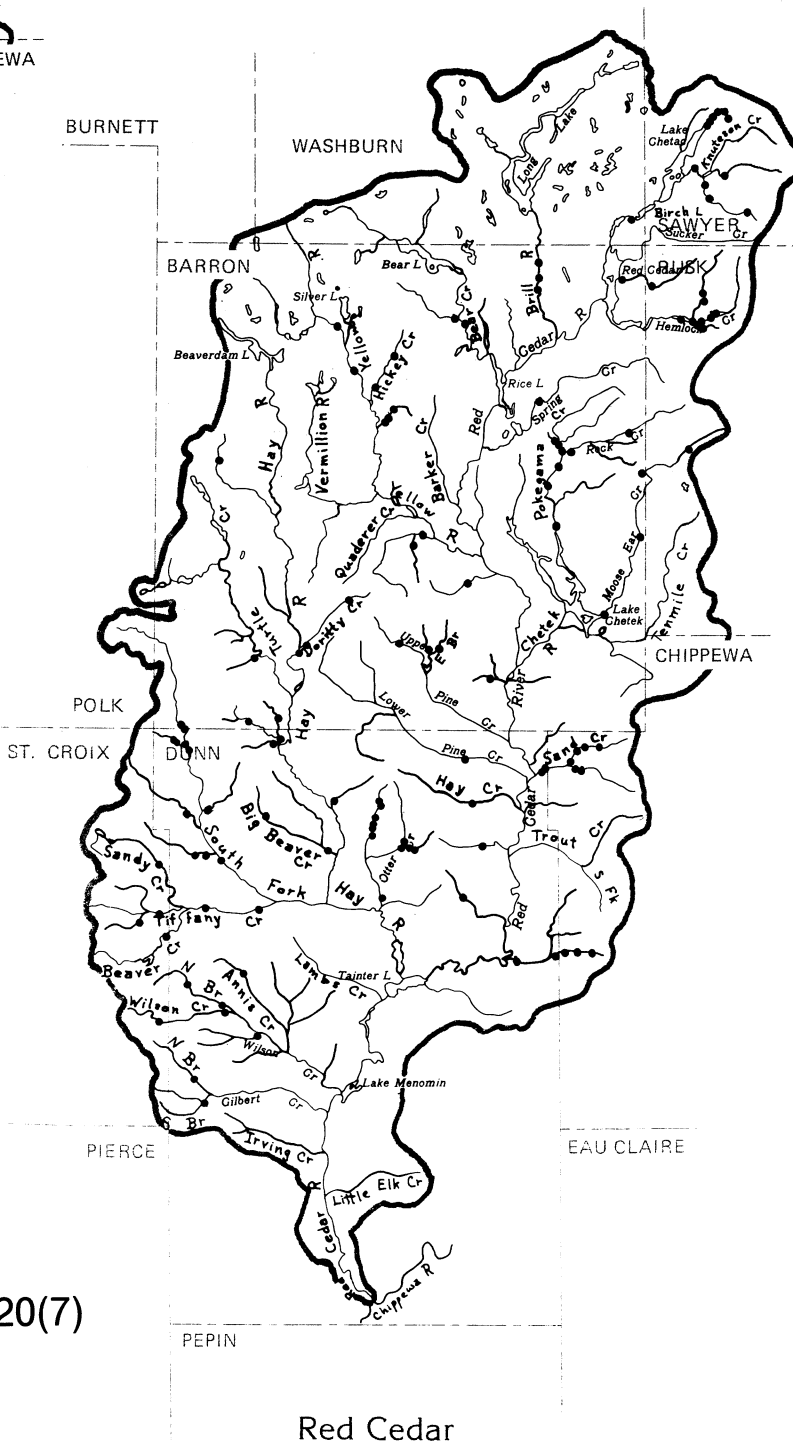
MAP 7

- Mooneye 7(1)
- Cisco or lake herring 2(0)



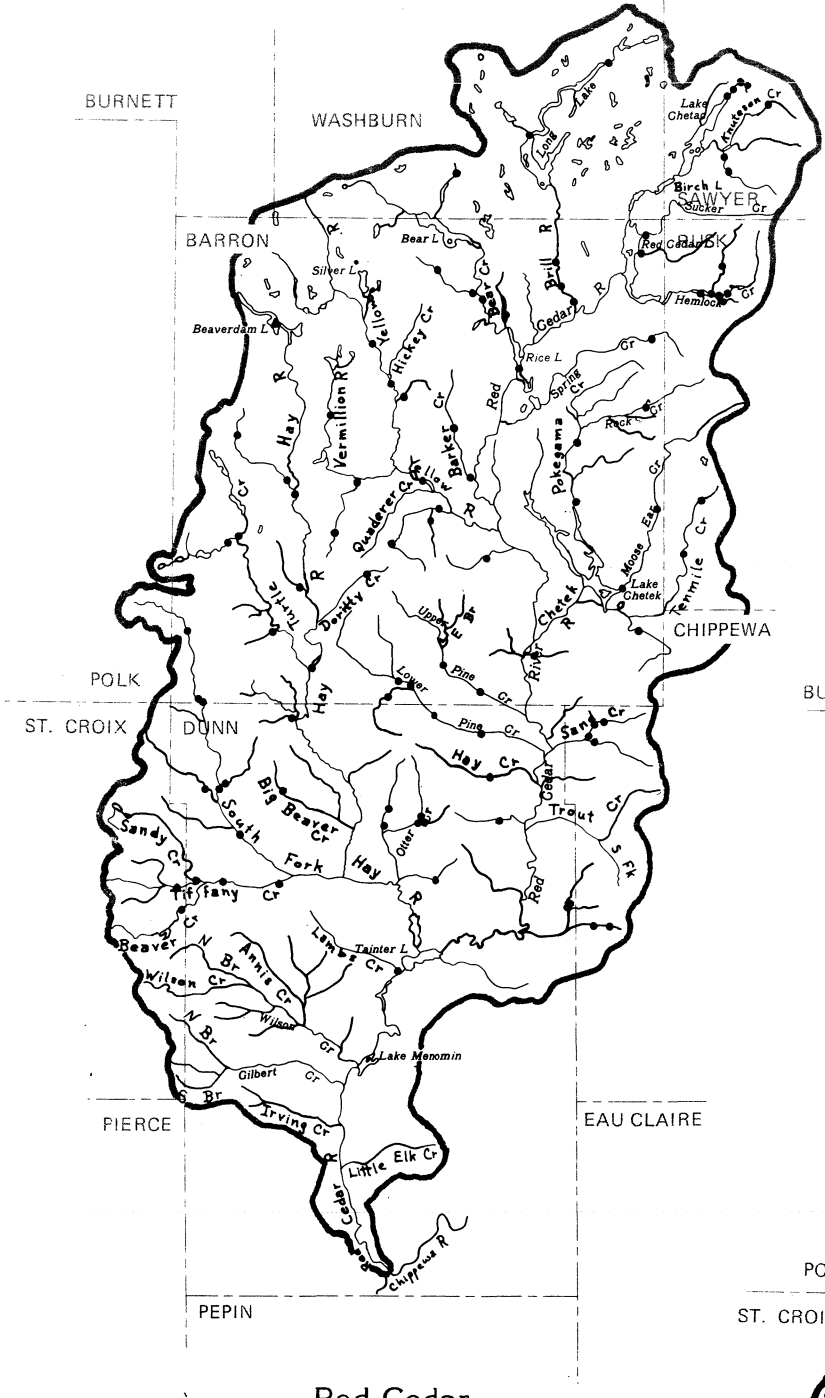
MAP 8

●Brown trout 52(1)



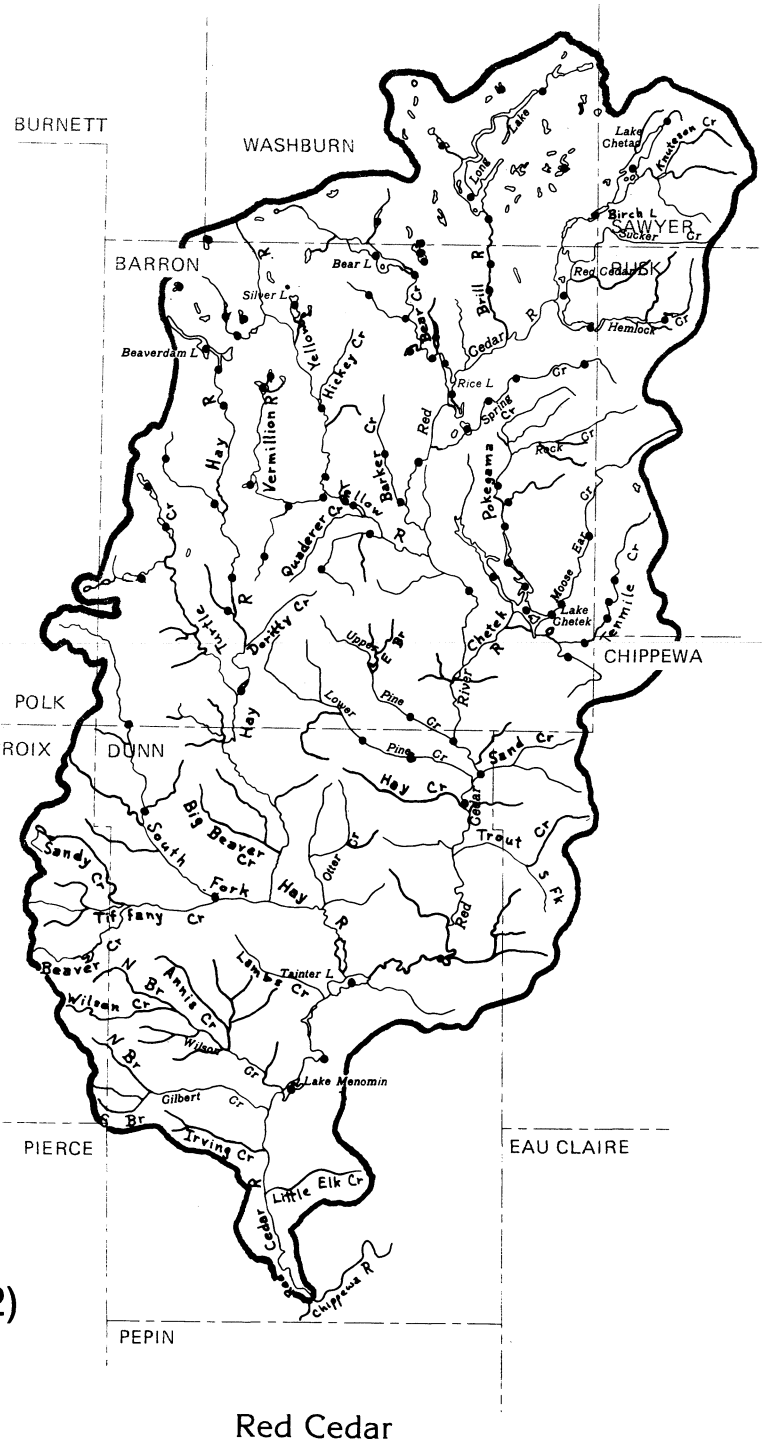
MAP 9

●Brook trout 120(7)



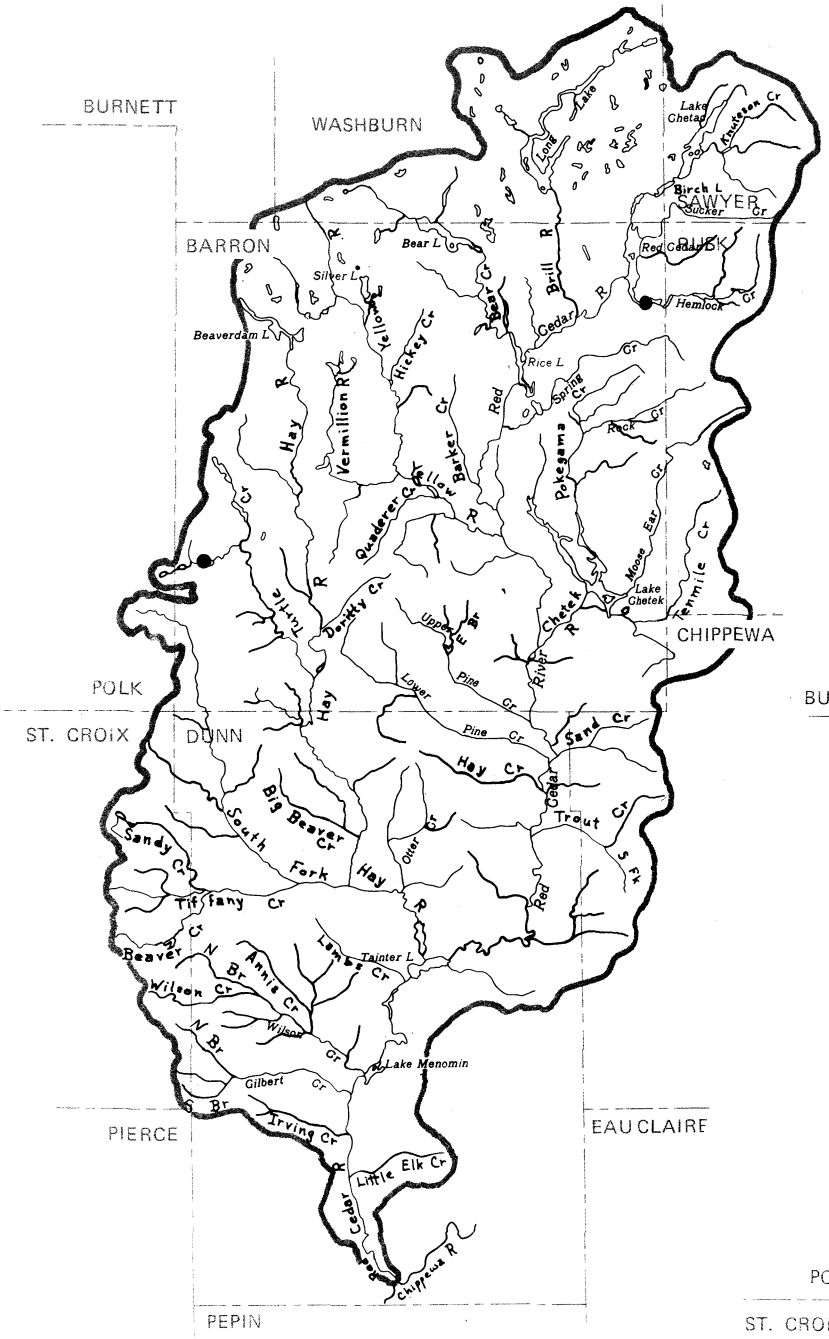
MAP 10

- Central mudminnow 95(1)
- Rainbow smelt 1(0)



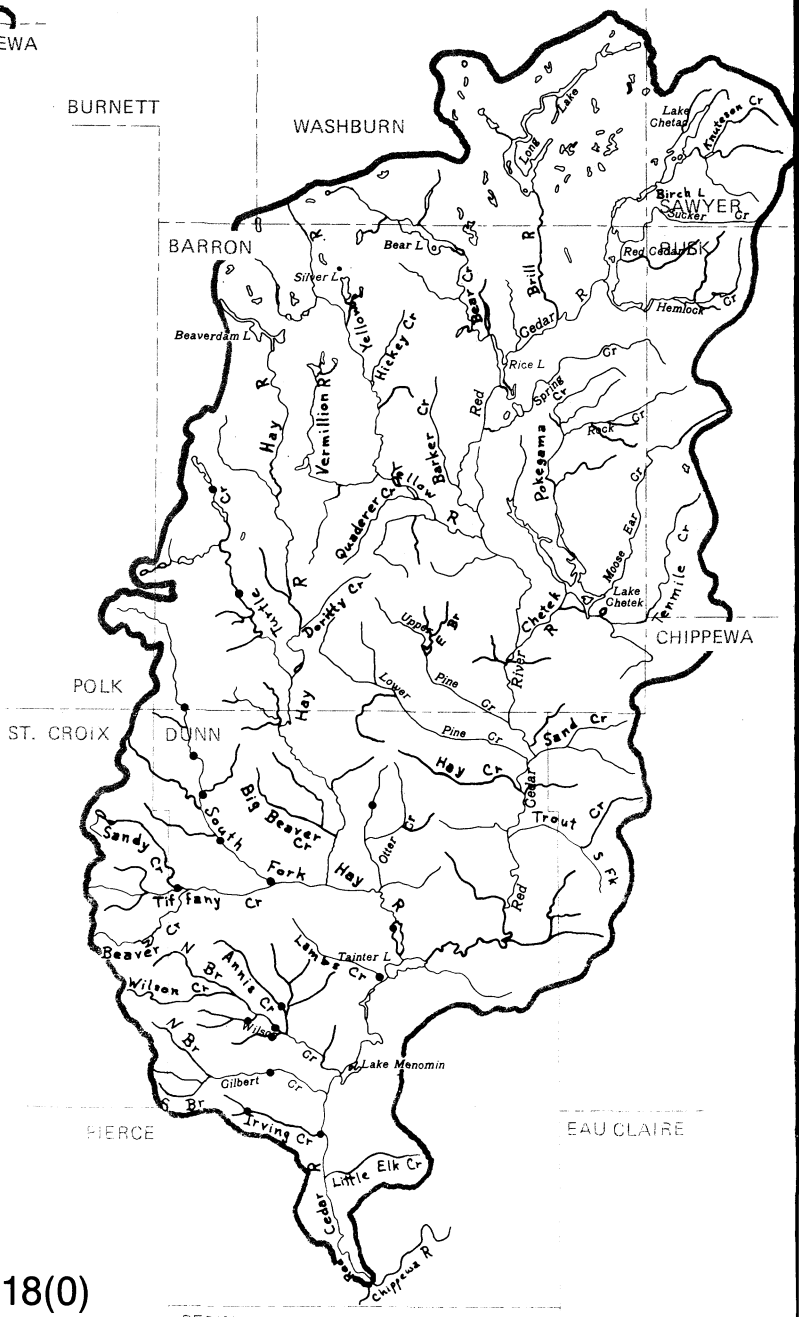
MAP 11

- Northern pike 92(42)



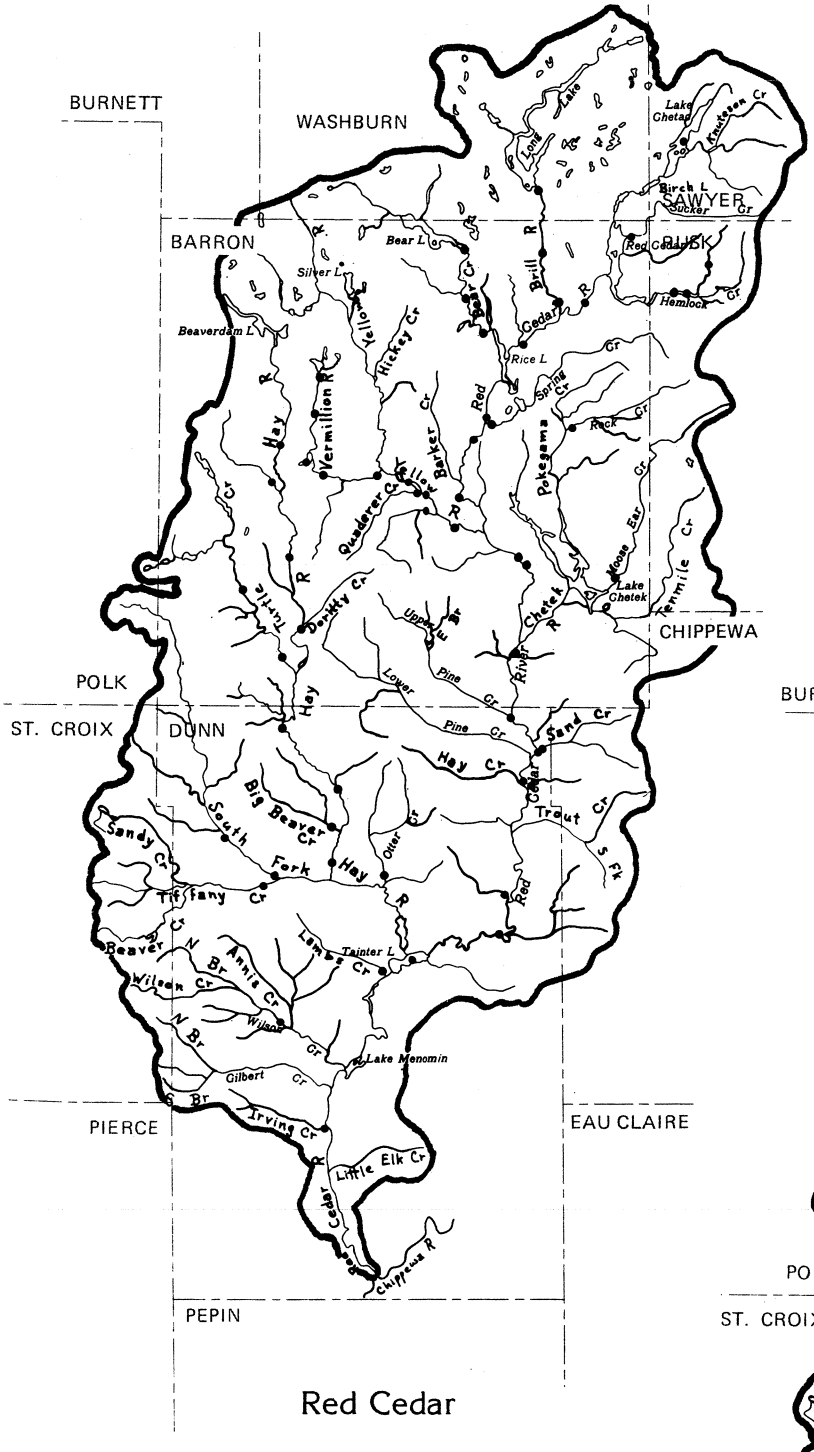
MAP 12

●Muskellunge 2(0)



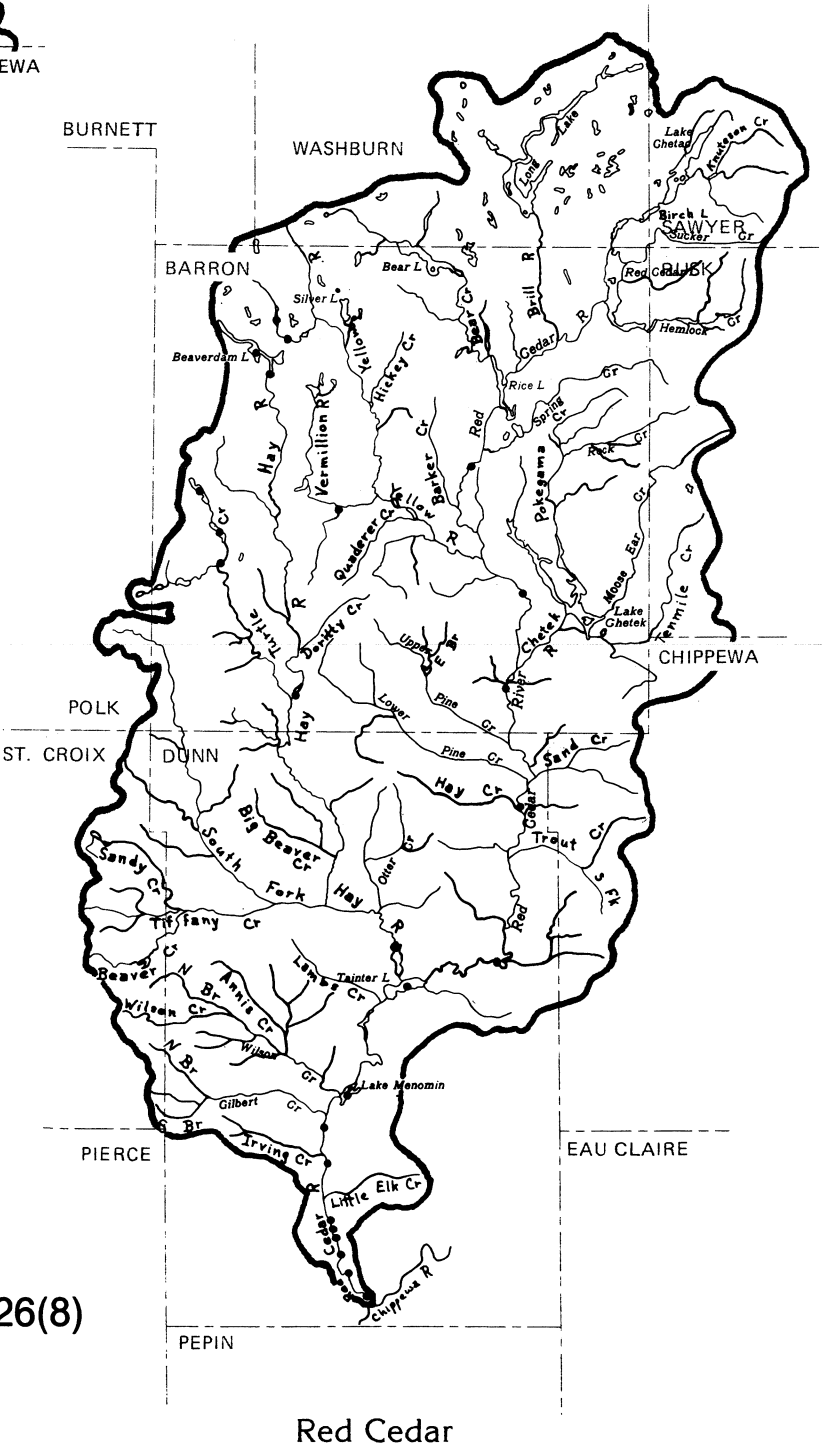
MAP 13

●Central stoneroller 18(0)



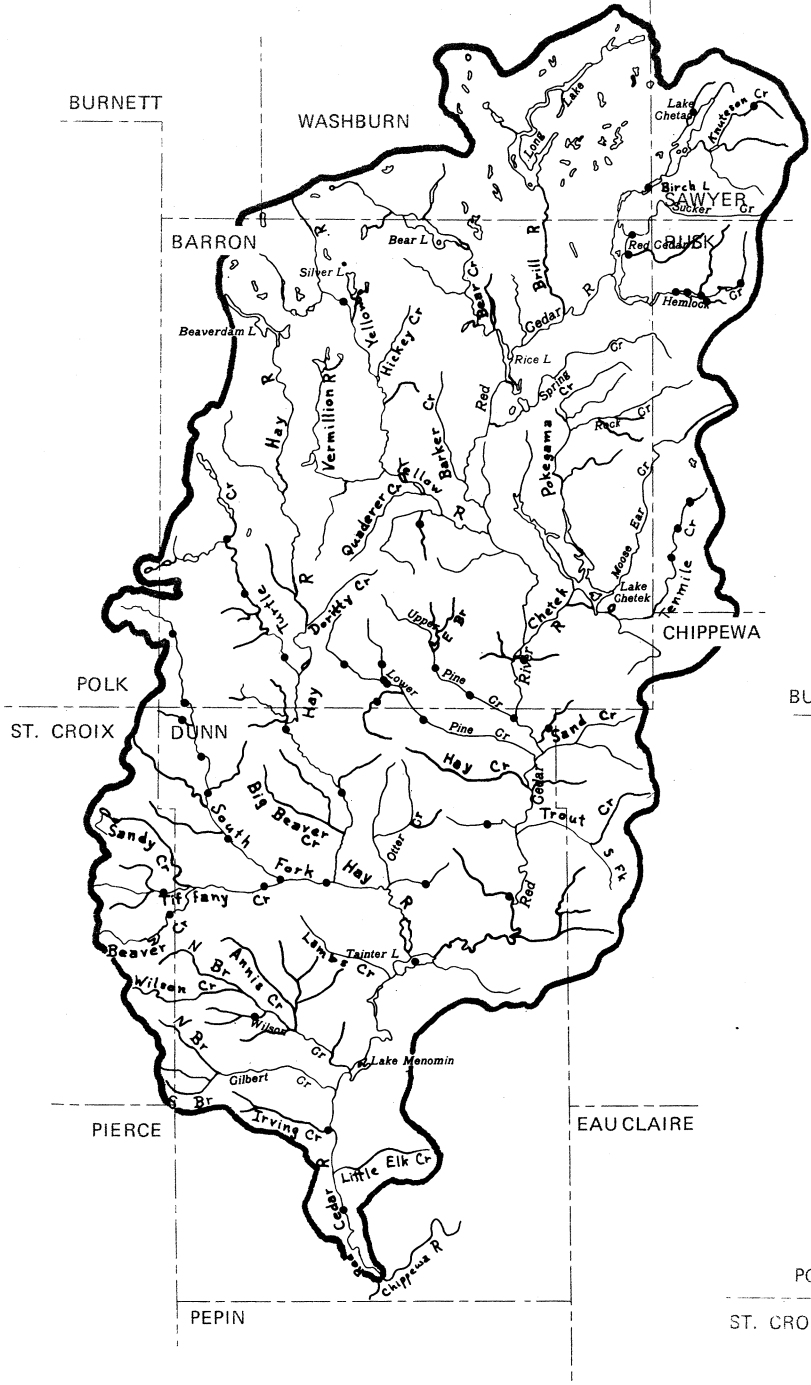
MAP 14

● Largescale stoneroller 57(4)



MAP 15

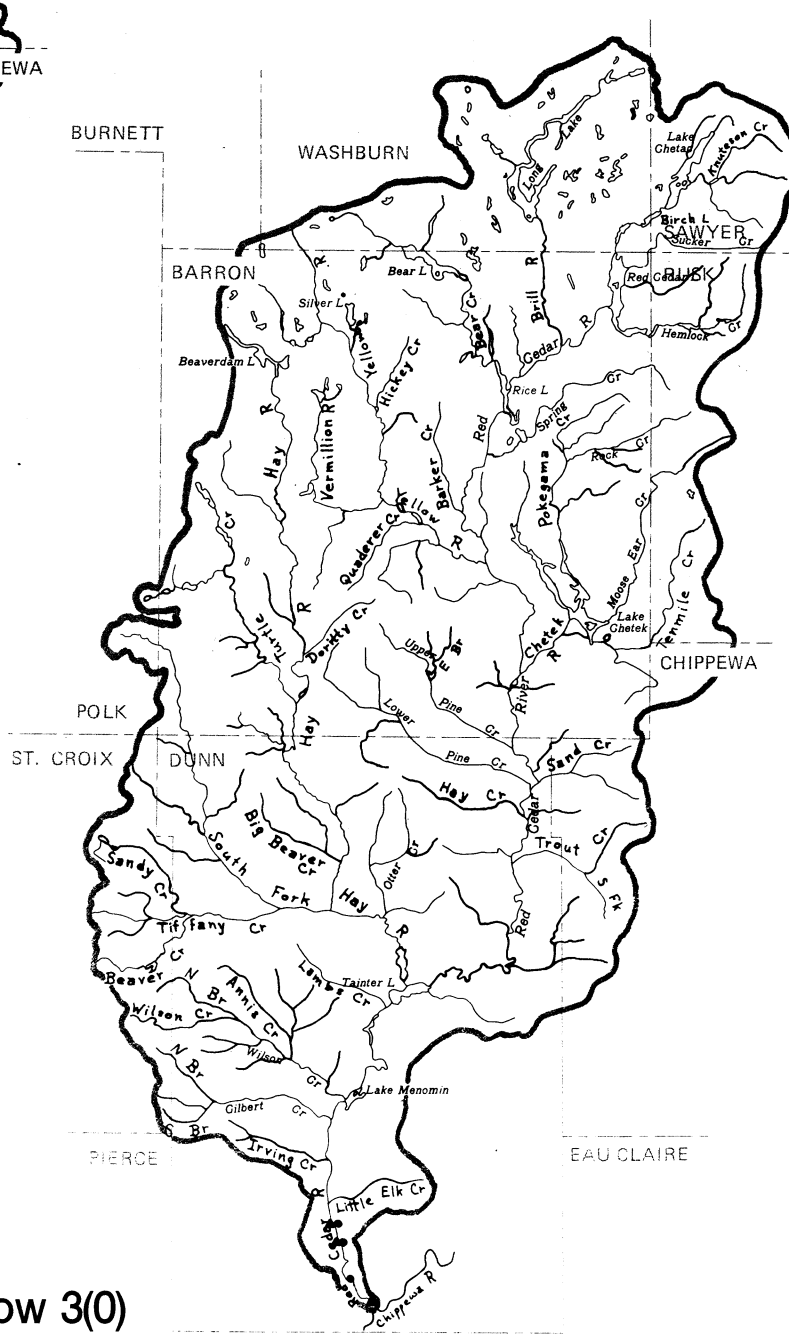
● Common carp 26(8)



Red Cedar

MAP 16

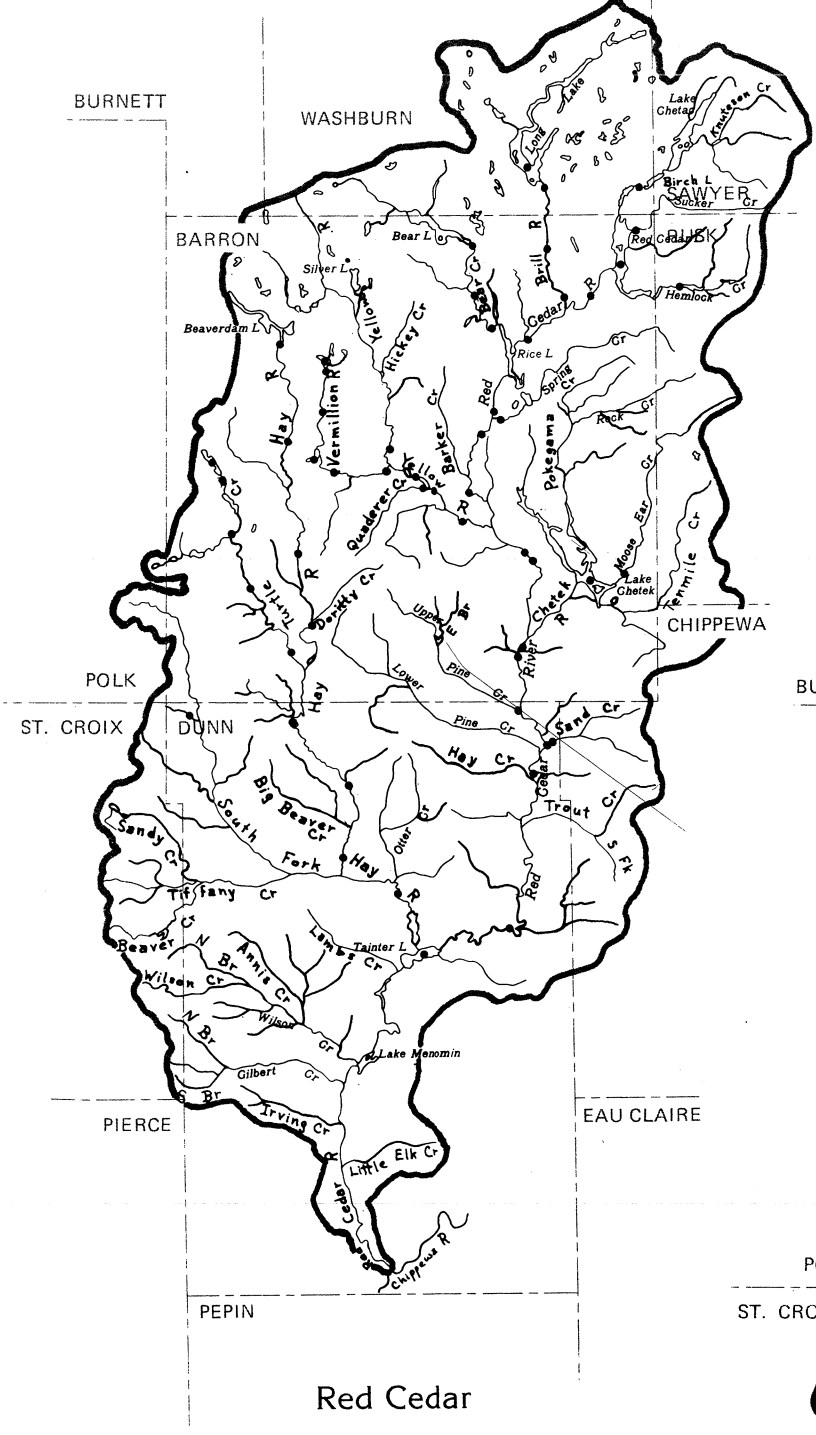
- Brassy minnow 49(1)



Red Cedar

MAP 17

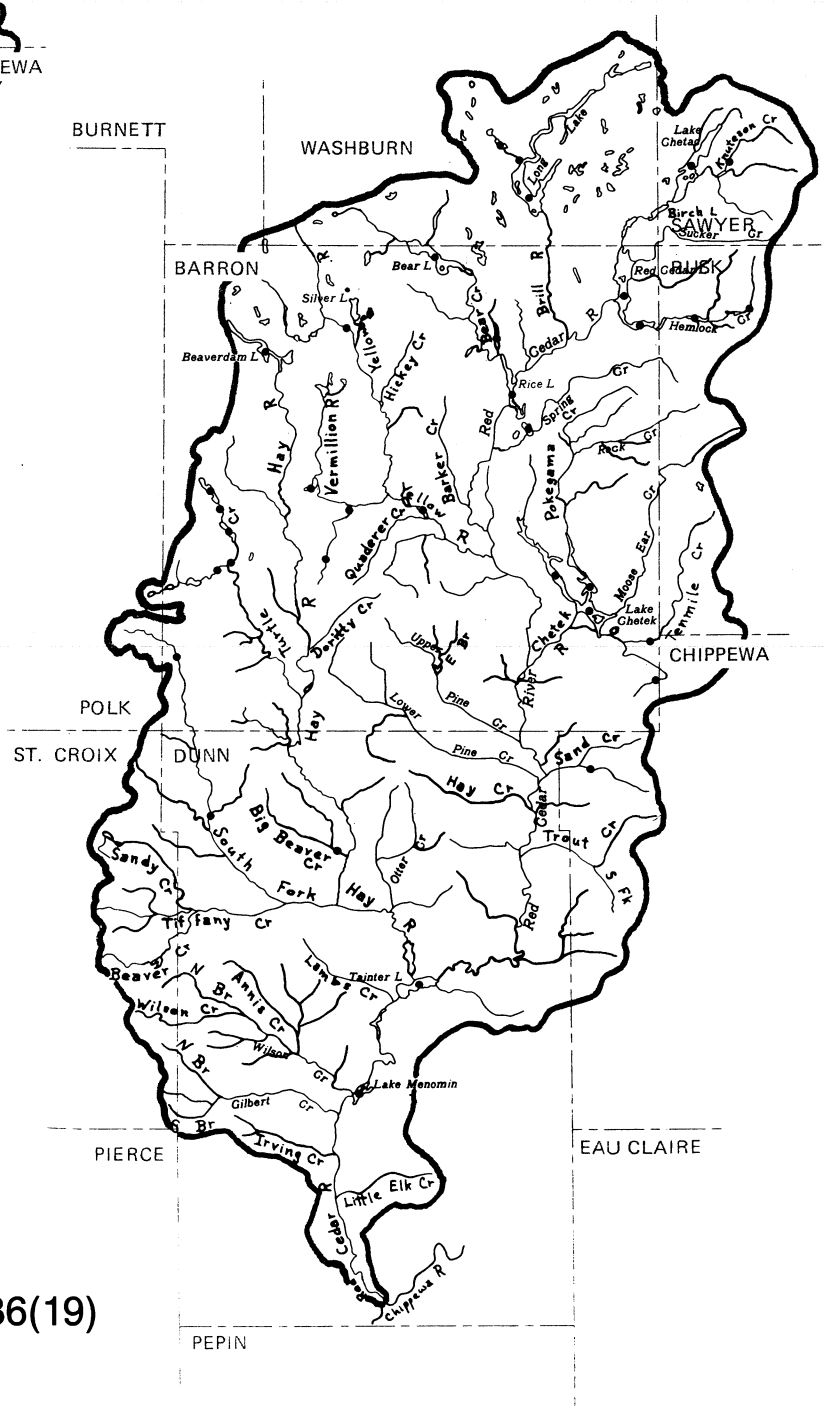
- Mississippi silvery minnow 3(0)
- ▲River shiner 3(0)



Red Cedar

MAP 18

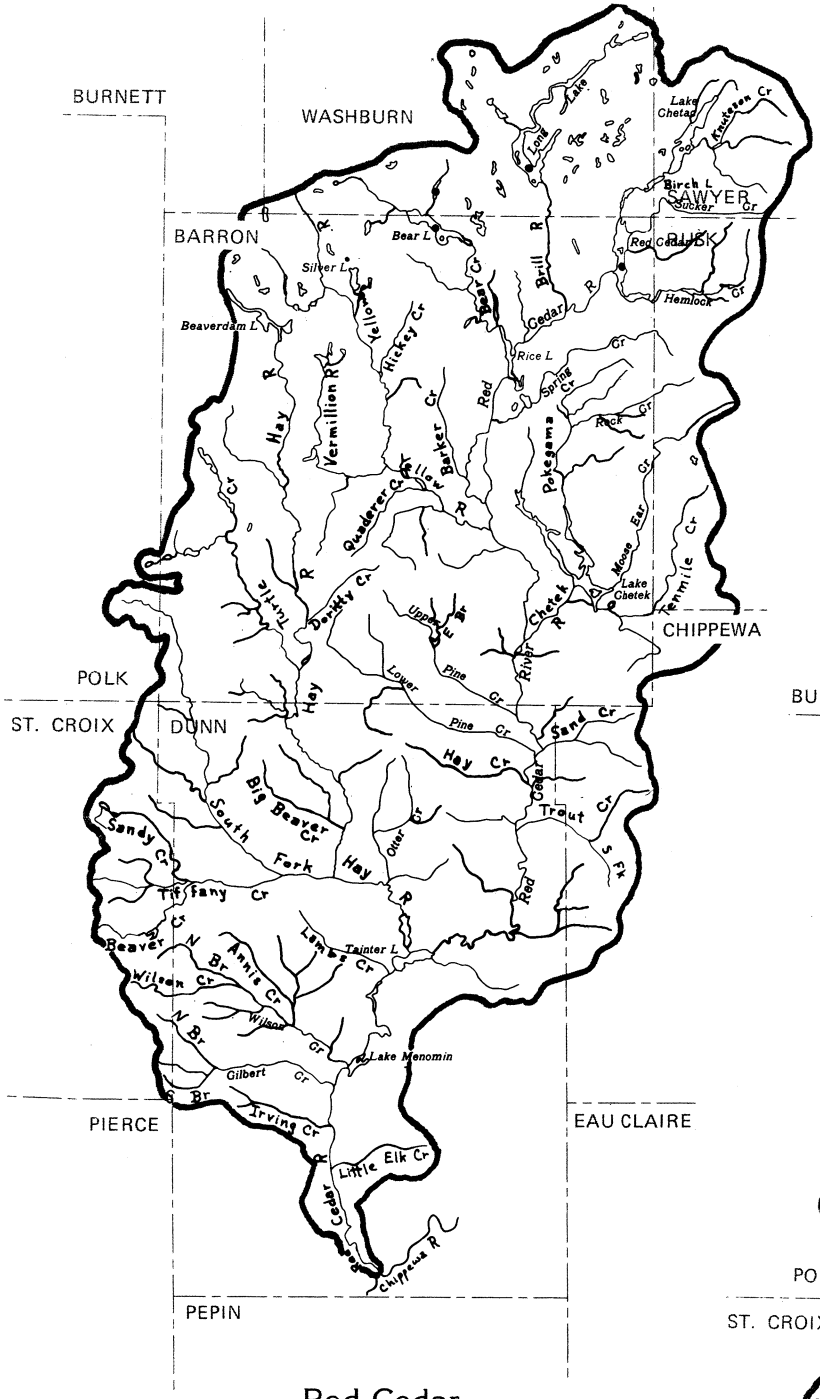
● Hornyhead chub 54(12)



Red Cedar

MAP 19

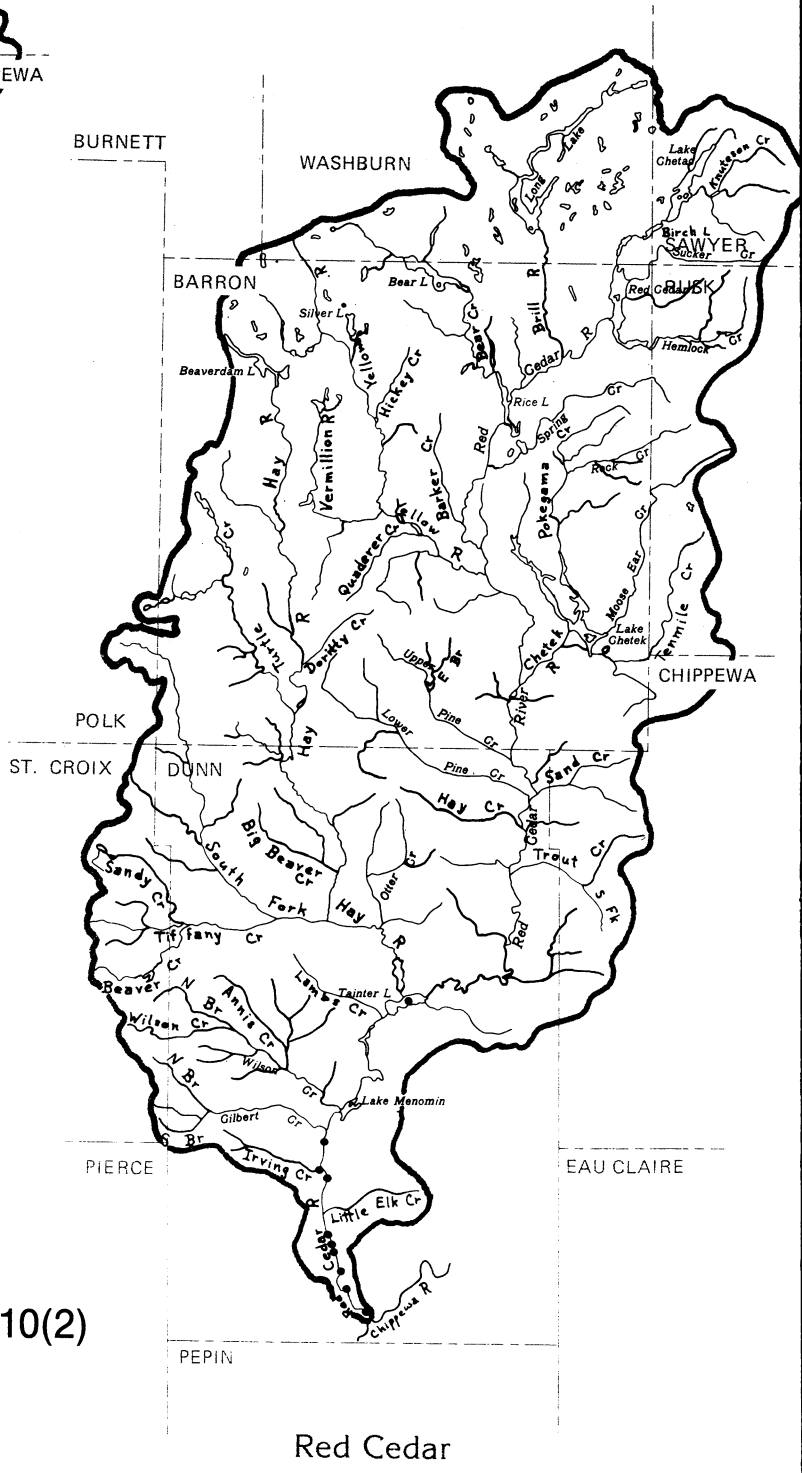
● Golden shiner 36(19)



MAP 20

● Pugnose shiner 4(5)

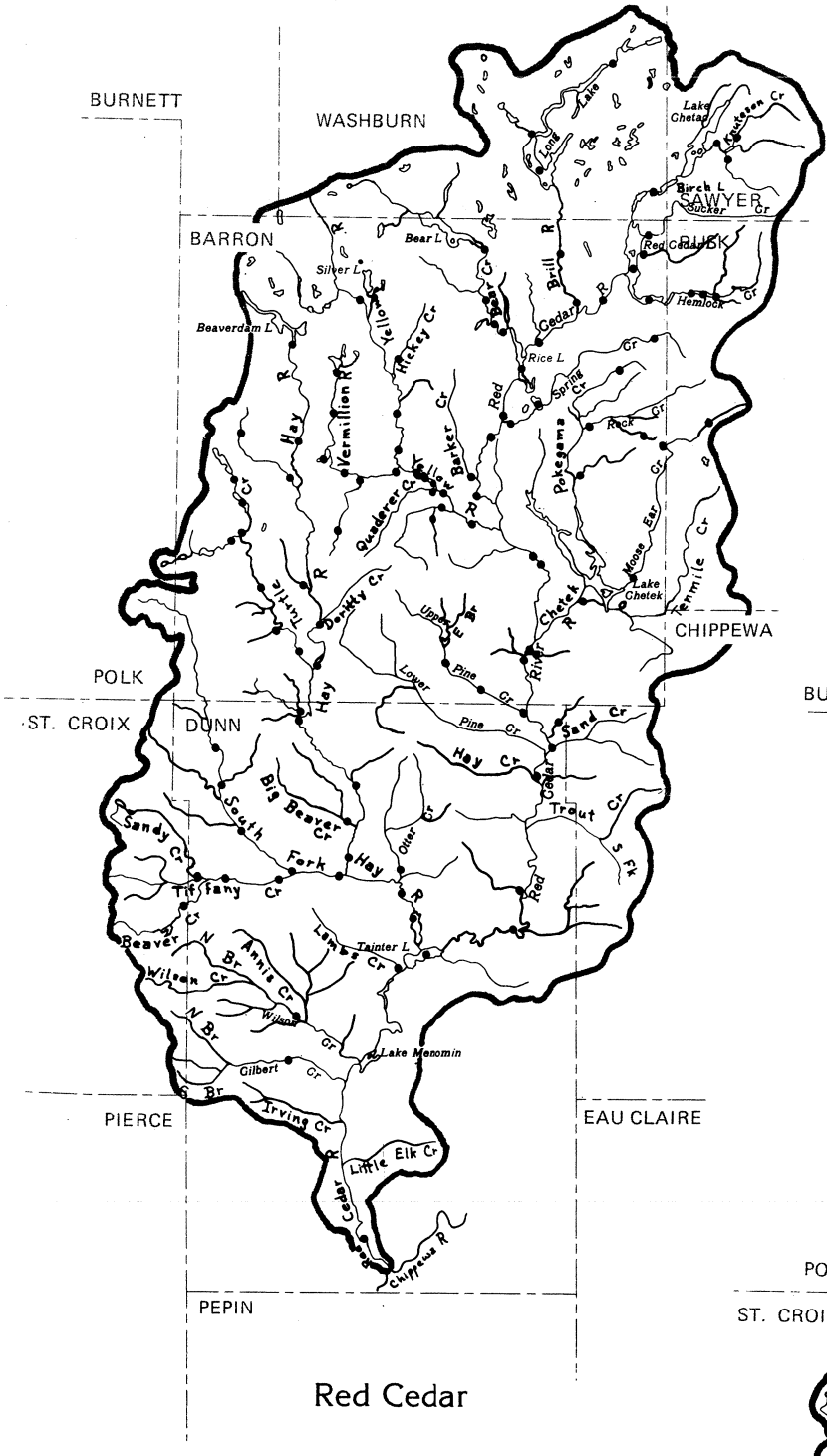
Red Cedar



MAP 21

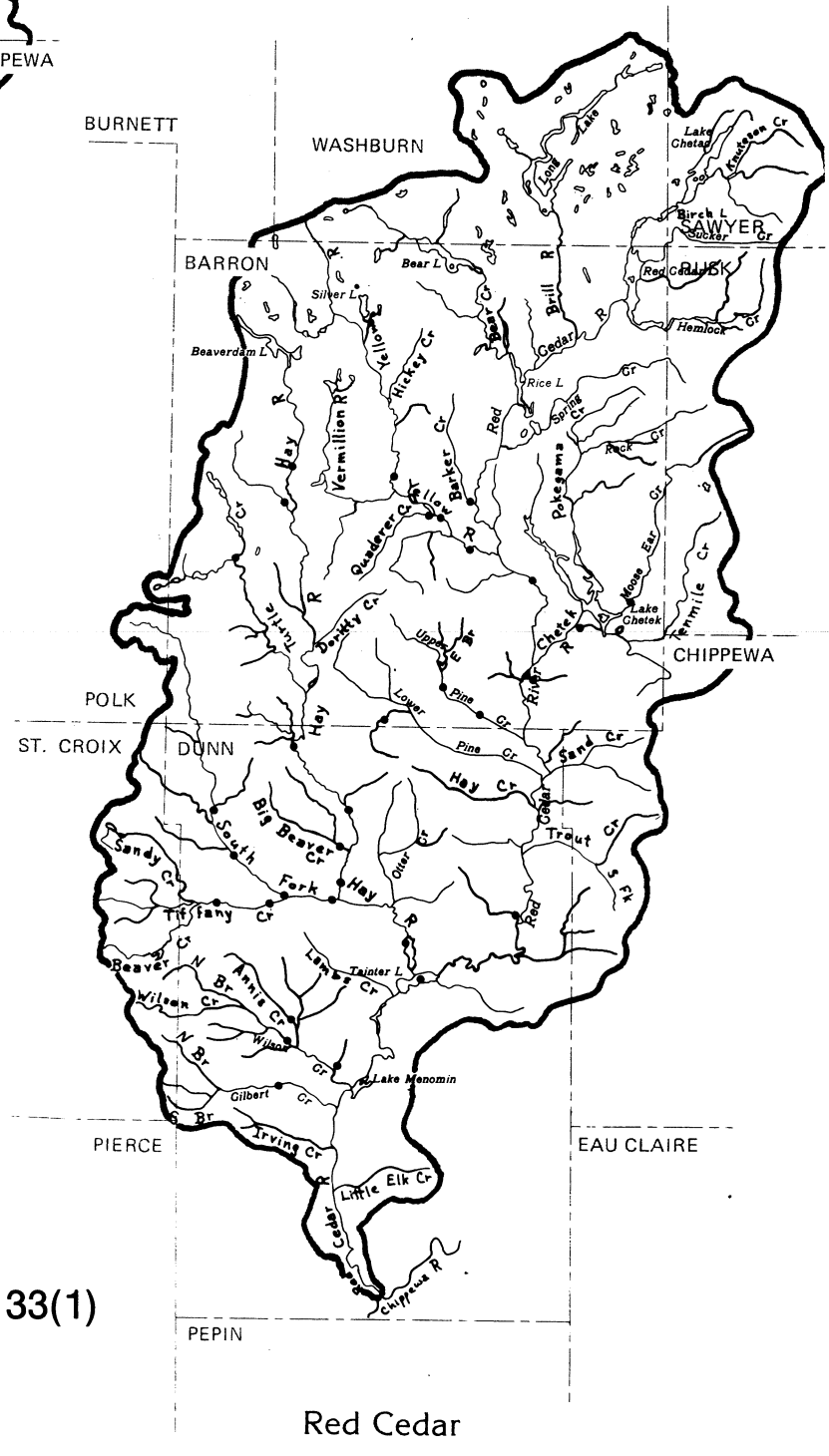
● Emerald shiner 10(2)

Red Cedar



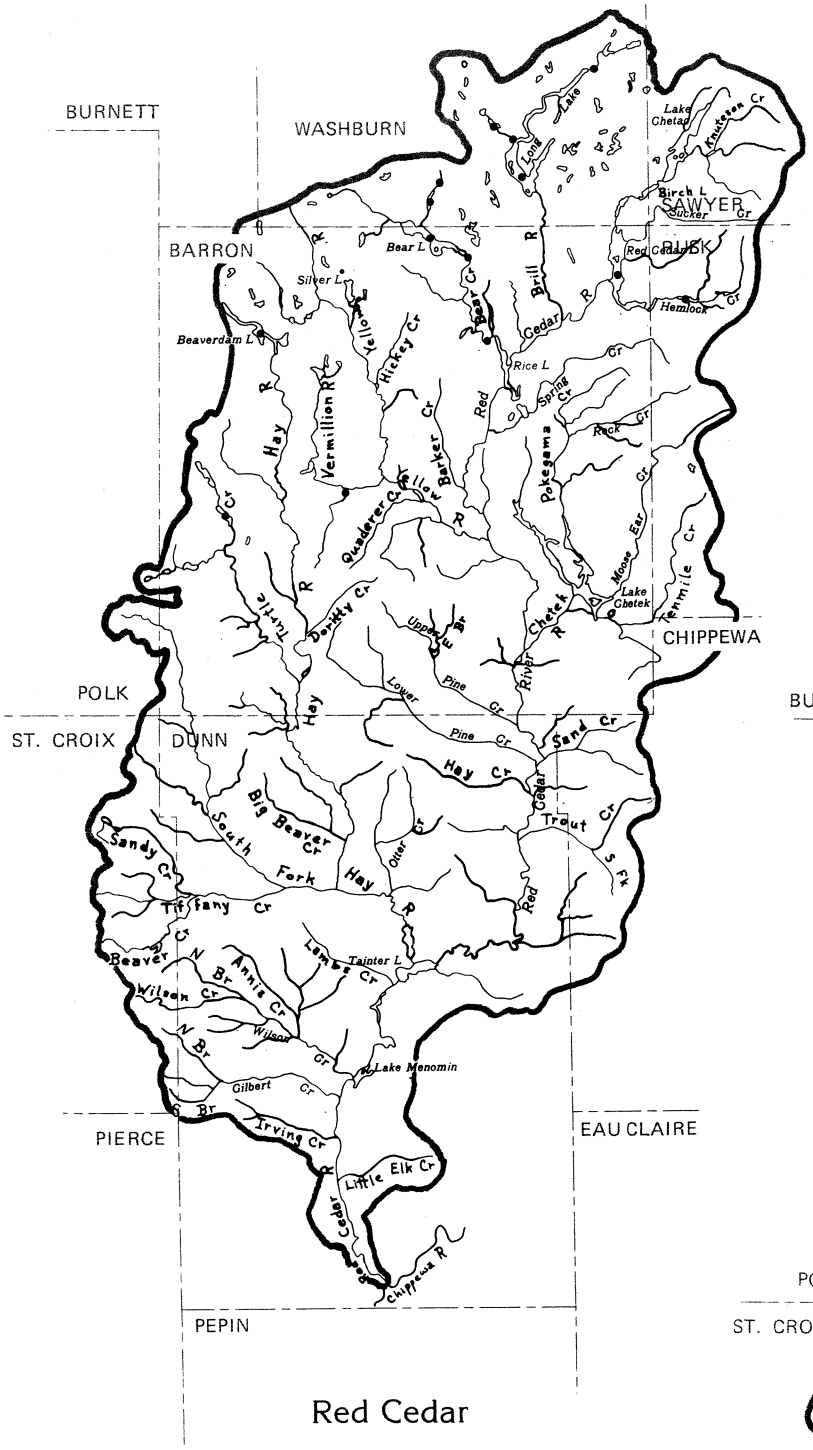
MAP 22

● Common shiner 106(18)



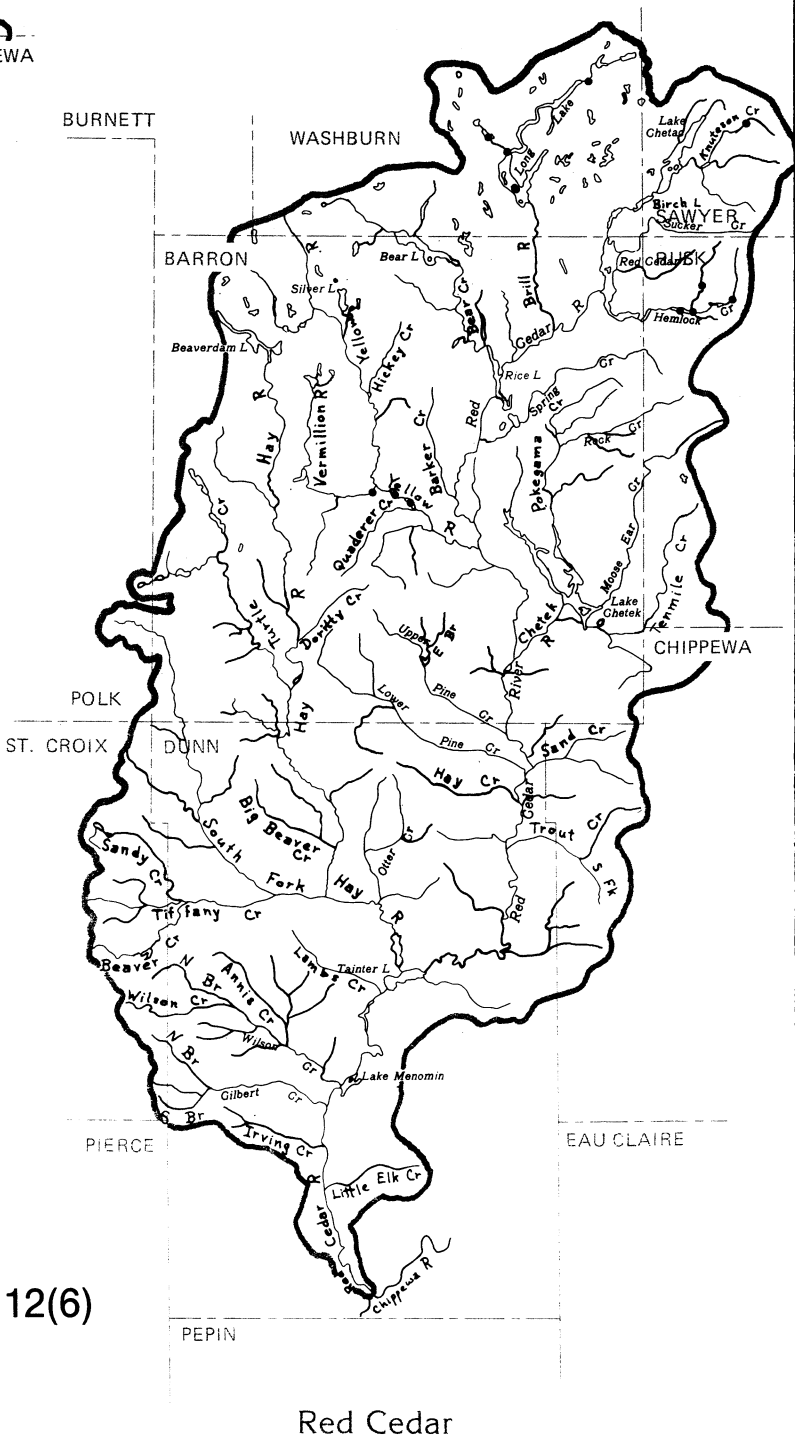
MAP 23

● Bigmouth shiner 33(1)



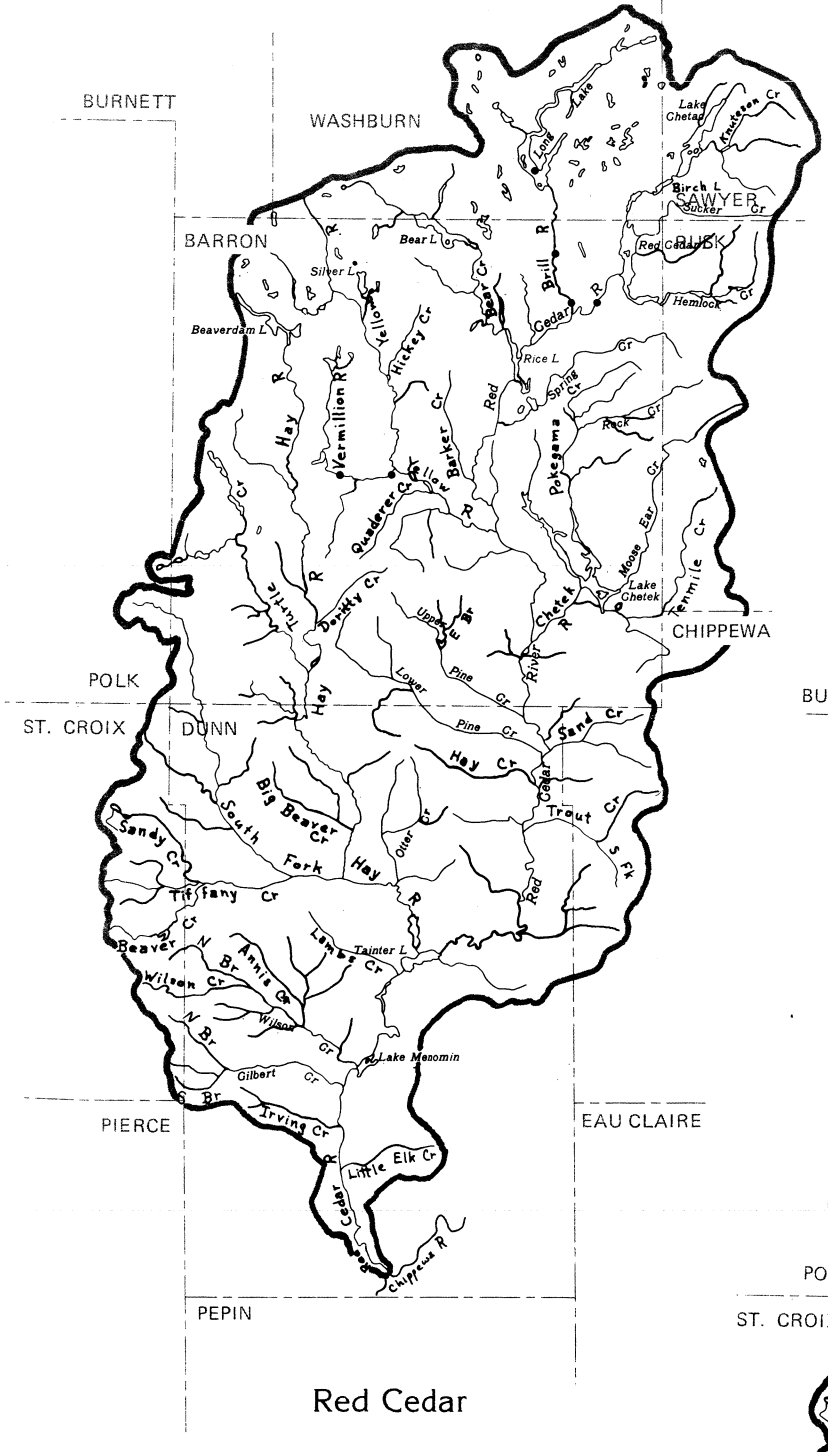
MAP 24

● Blackchin shiner 14(14)



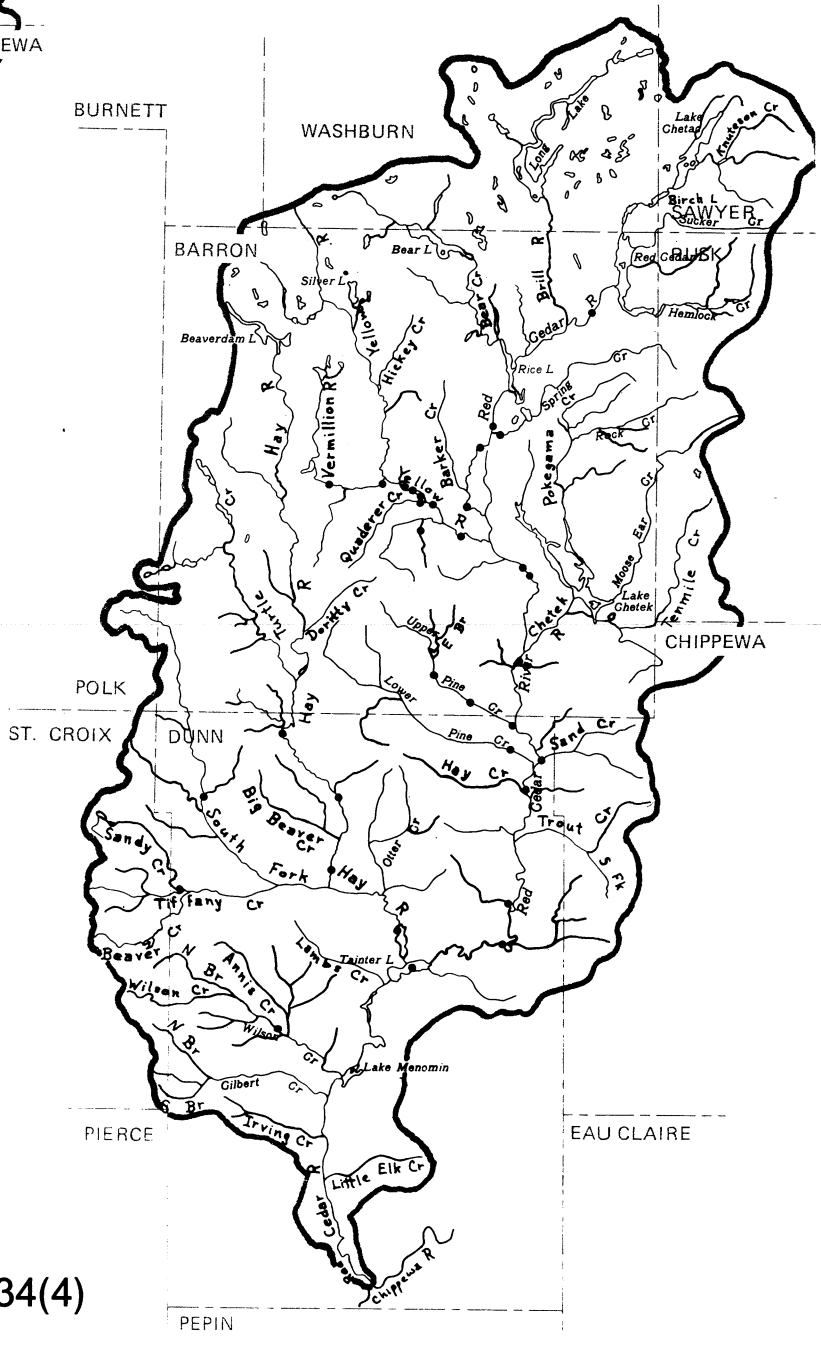
MAP 25

● Blacknose shiner 12(6)



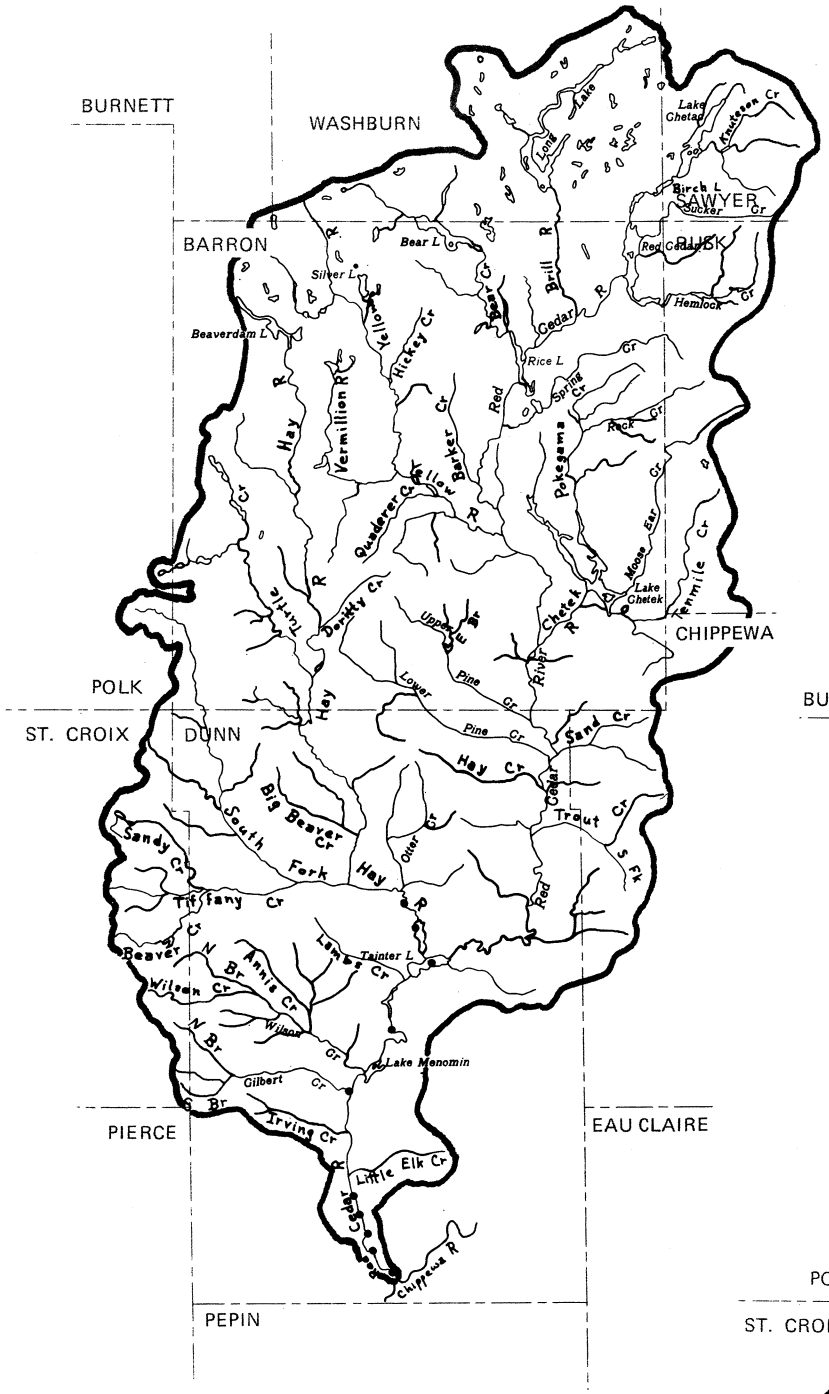
MAP 26

● Ozark minnow 6(1)



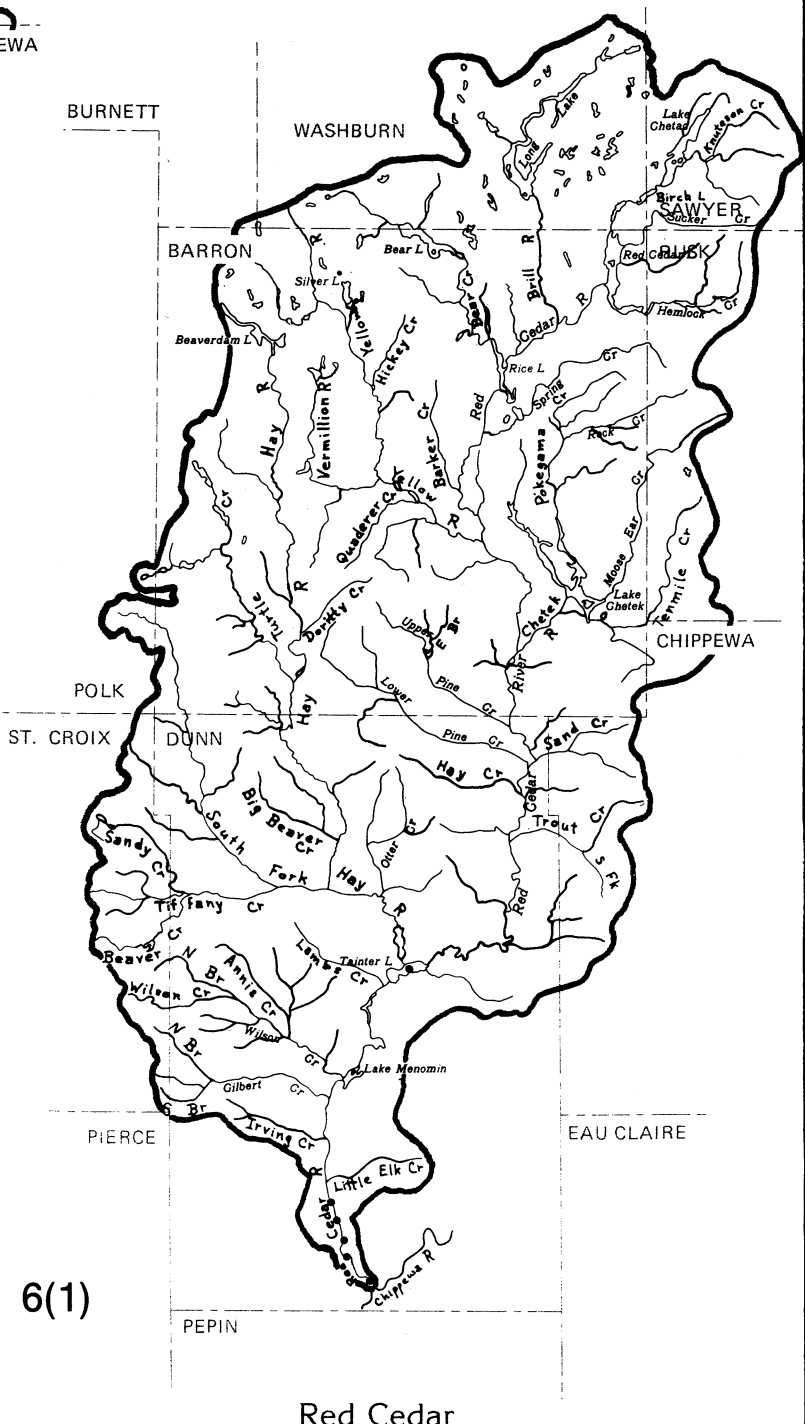
MAP 27

● Rosyface shiner 34(4)



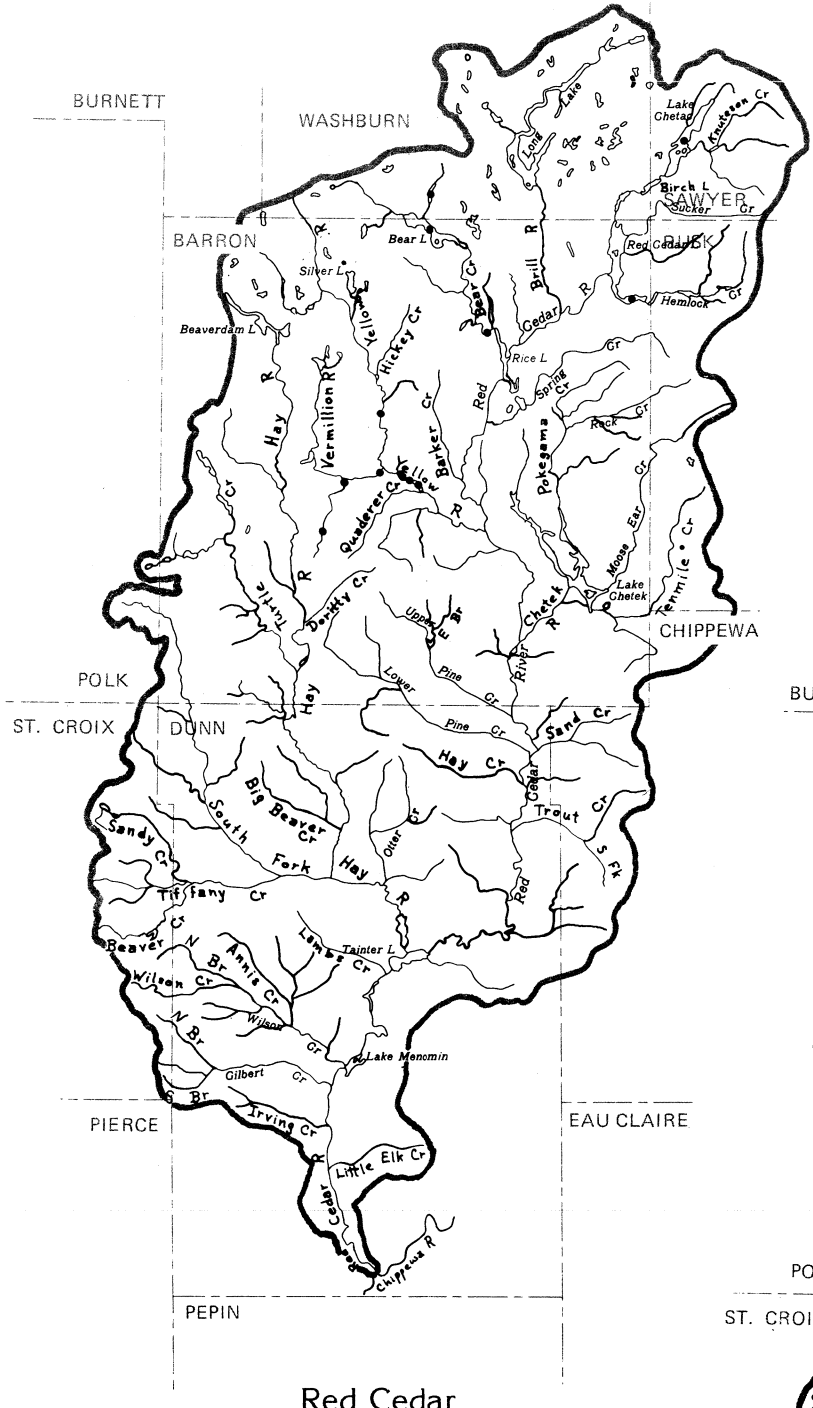
MAP 28

● Spotfin shiner 10(11)



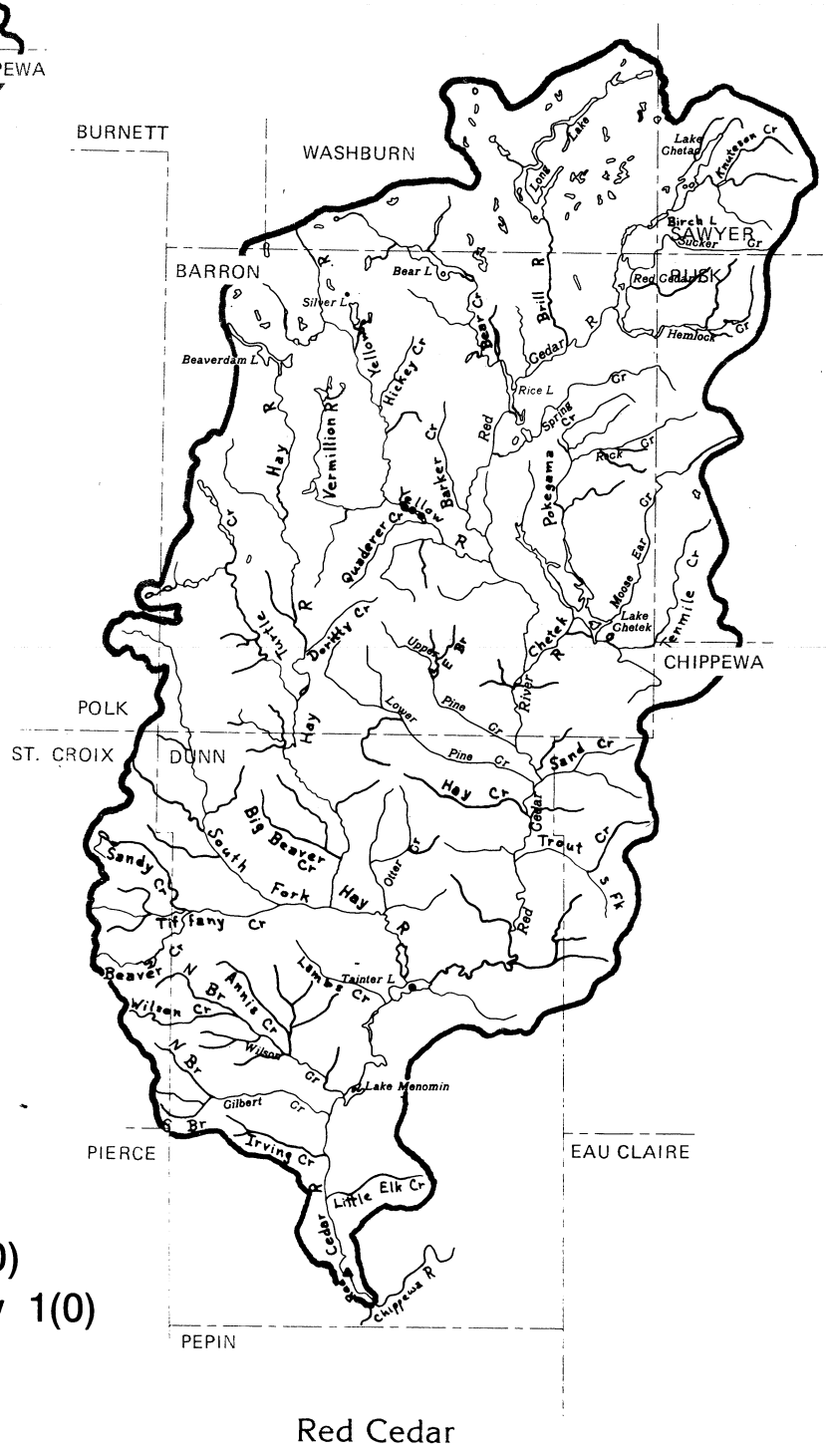
MAP 29

● Sand shiner 6(1)



MAP 30

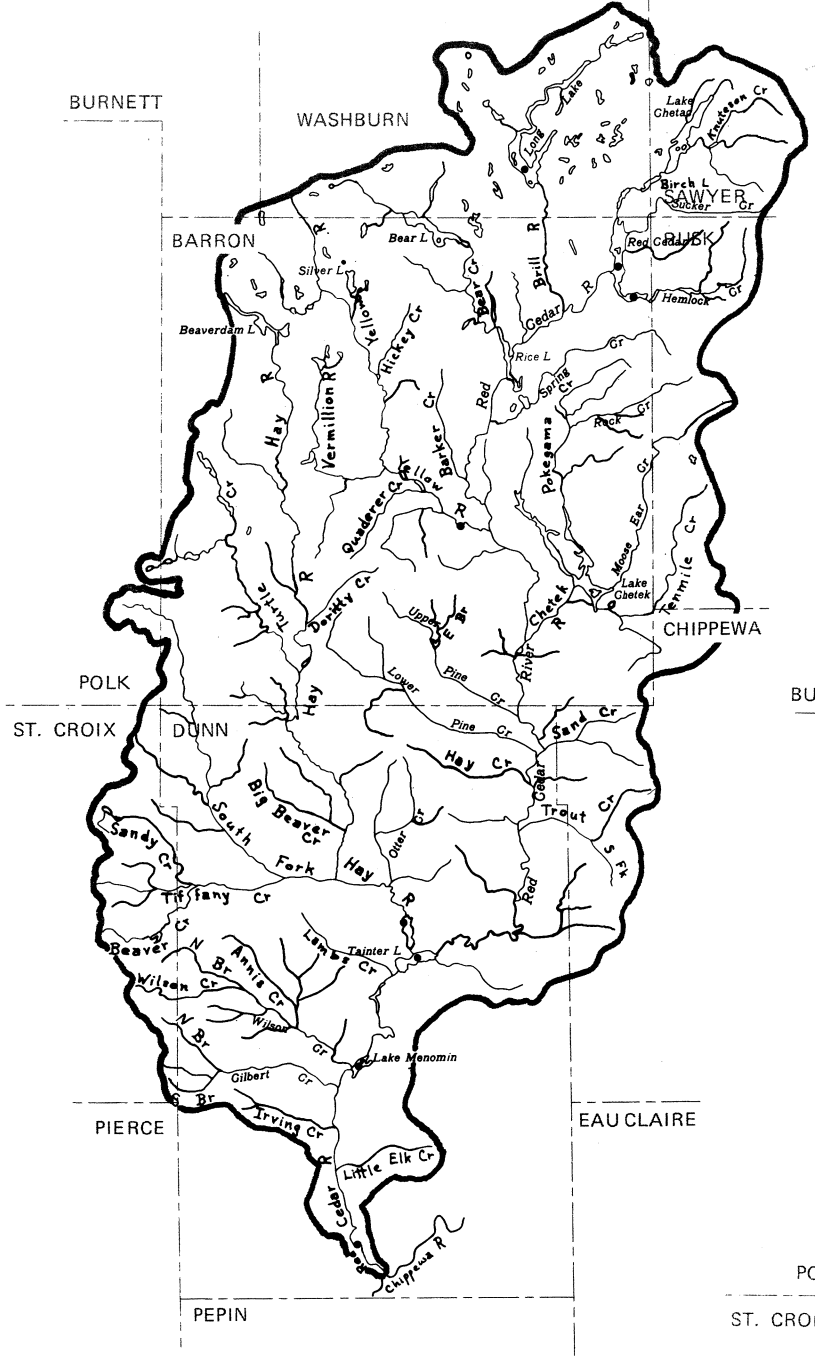
● Weed shiner 12(7)



MAP 31

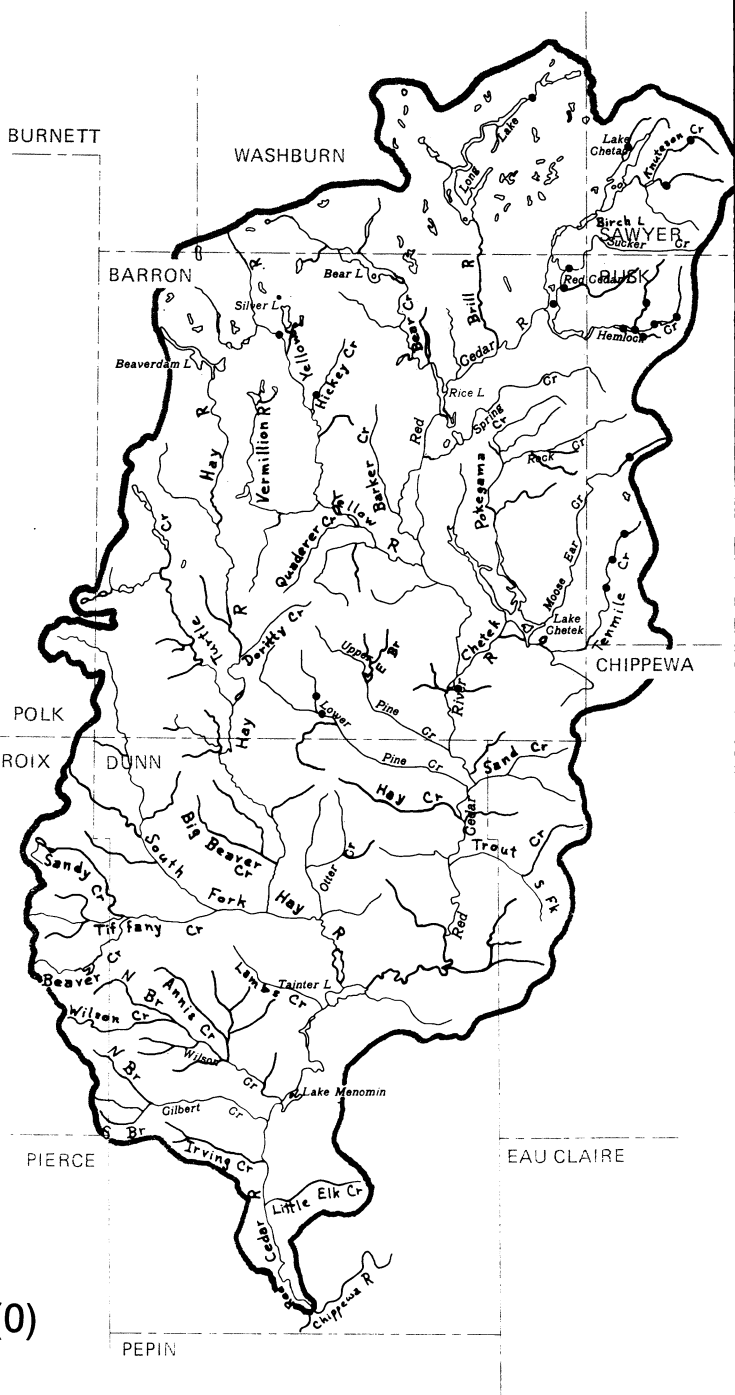
● Redfin shiner 4(0)

▲ Bullhead minnow 1(0)



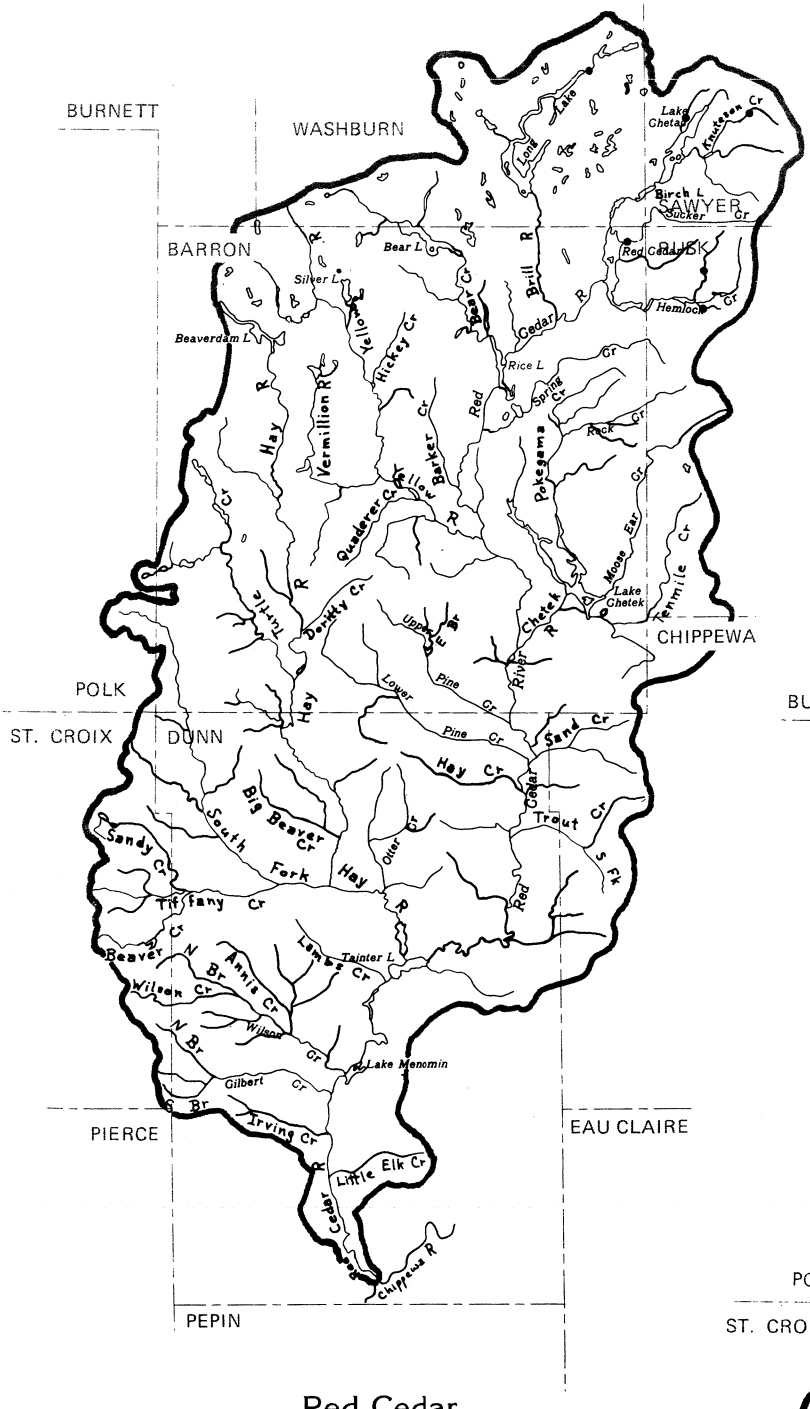
MAP 32

● Mimic shiner 8(22)



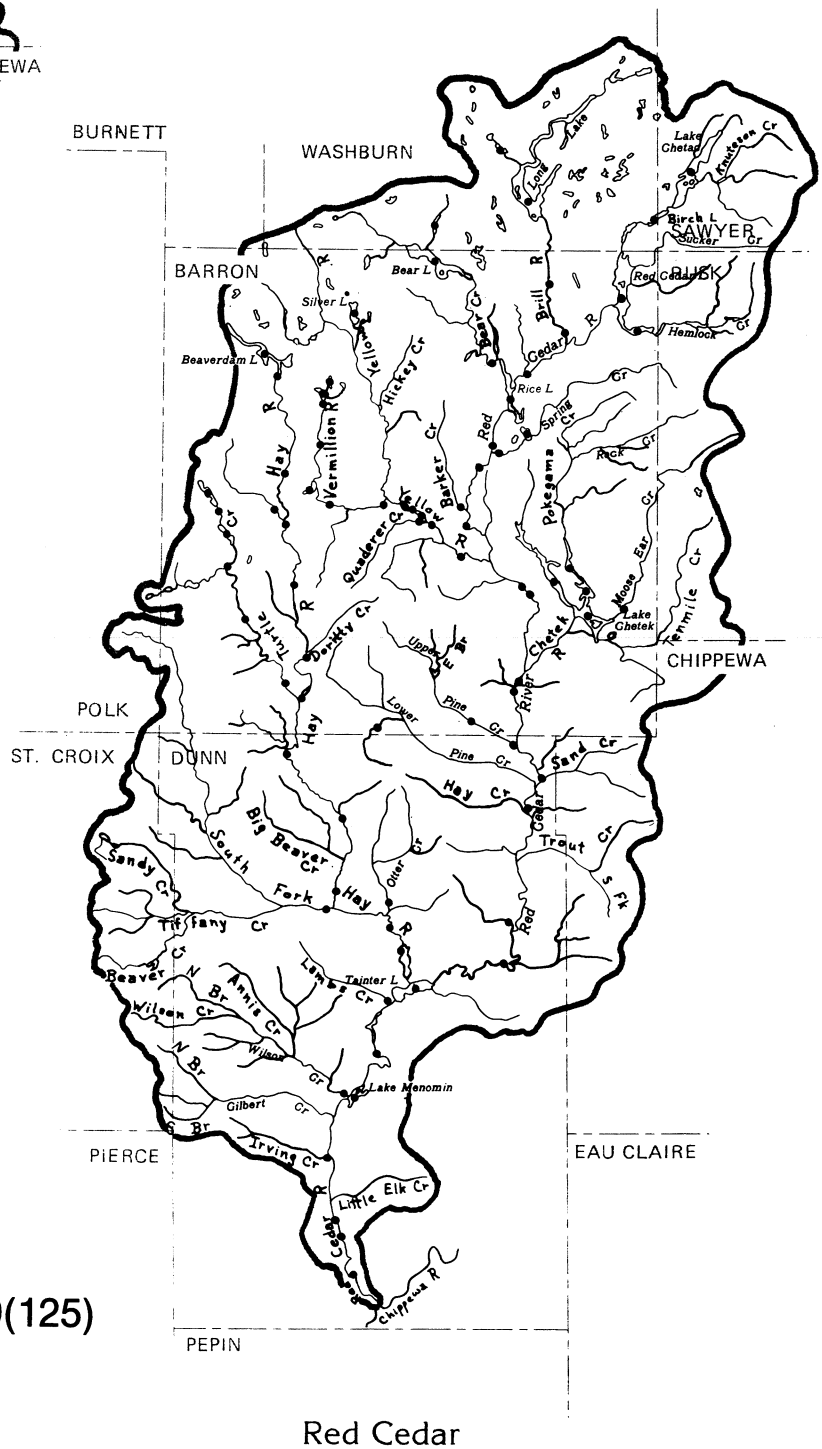
MAP 33

● Northern redbelly dace 22(0)



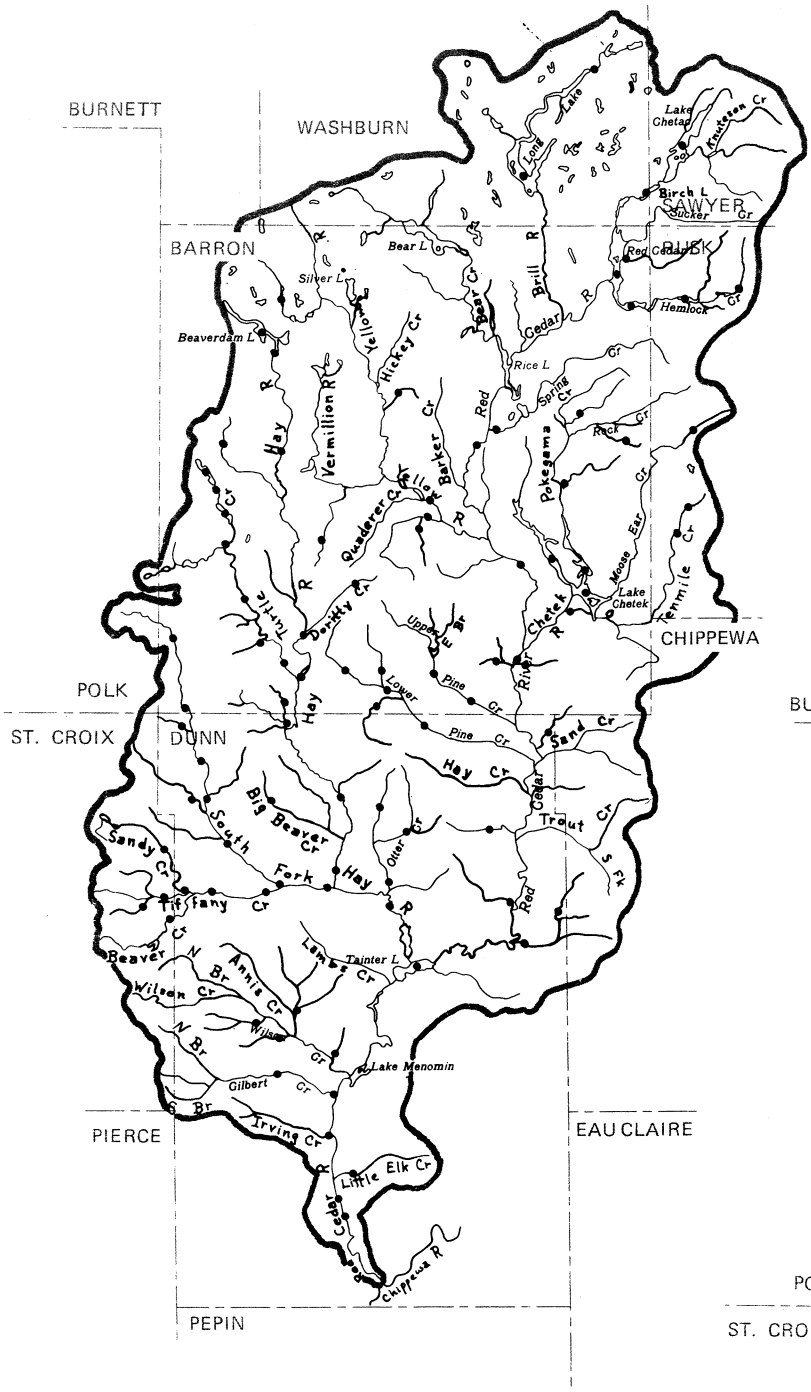
MAP 34

● Finescale dace 6(0)



MAP 35

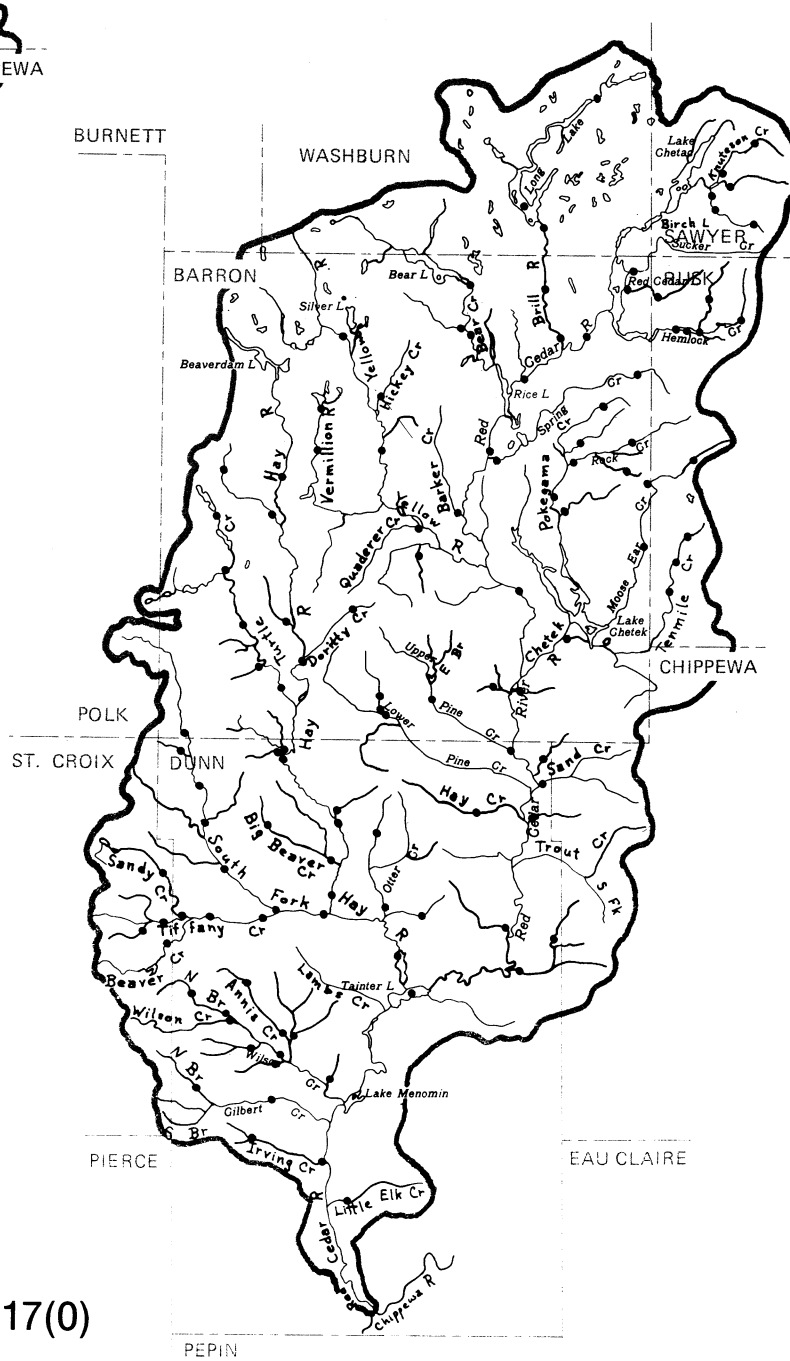
● Bluntnose minnow 79(125)



Red Cedar

MAP 36

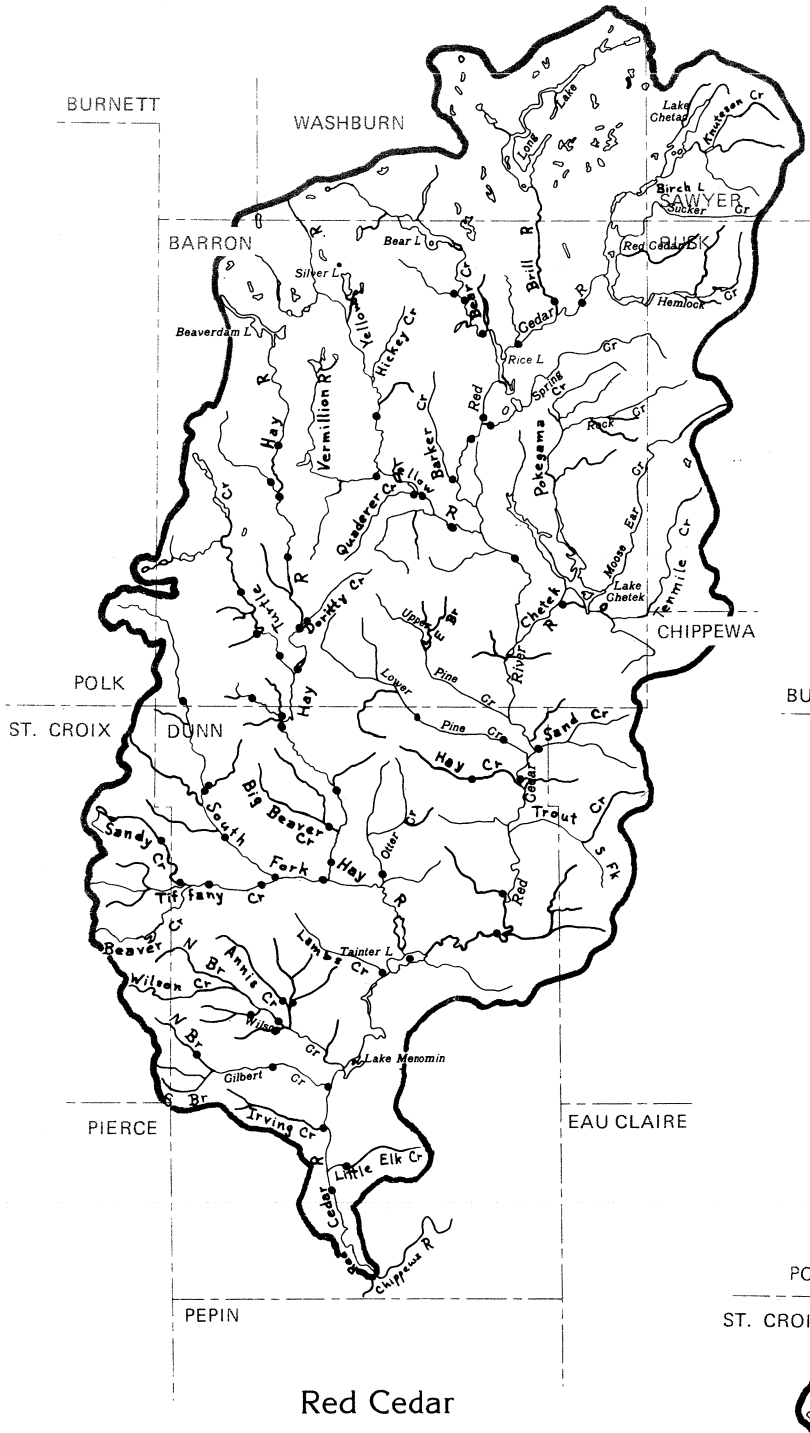
●Fathead minnow 93(21)



Red Cedar

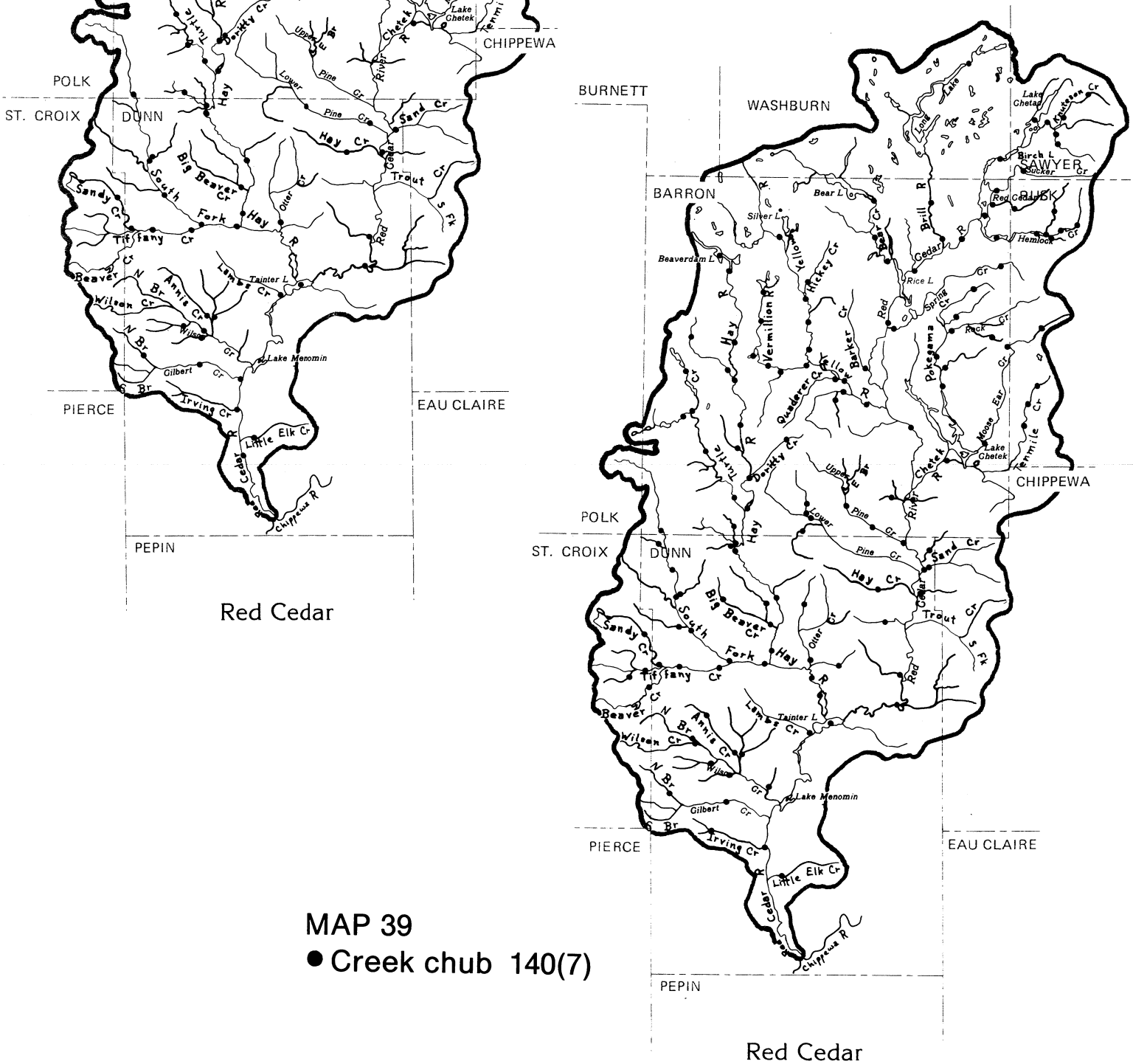
MAP 37

●Blacknose dace 117(0)



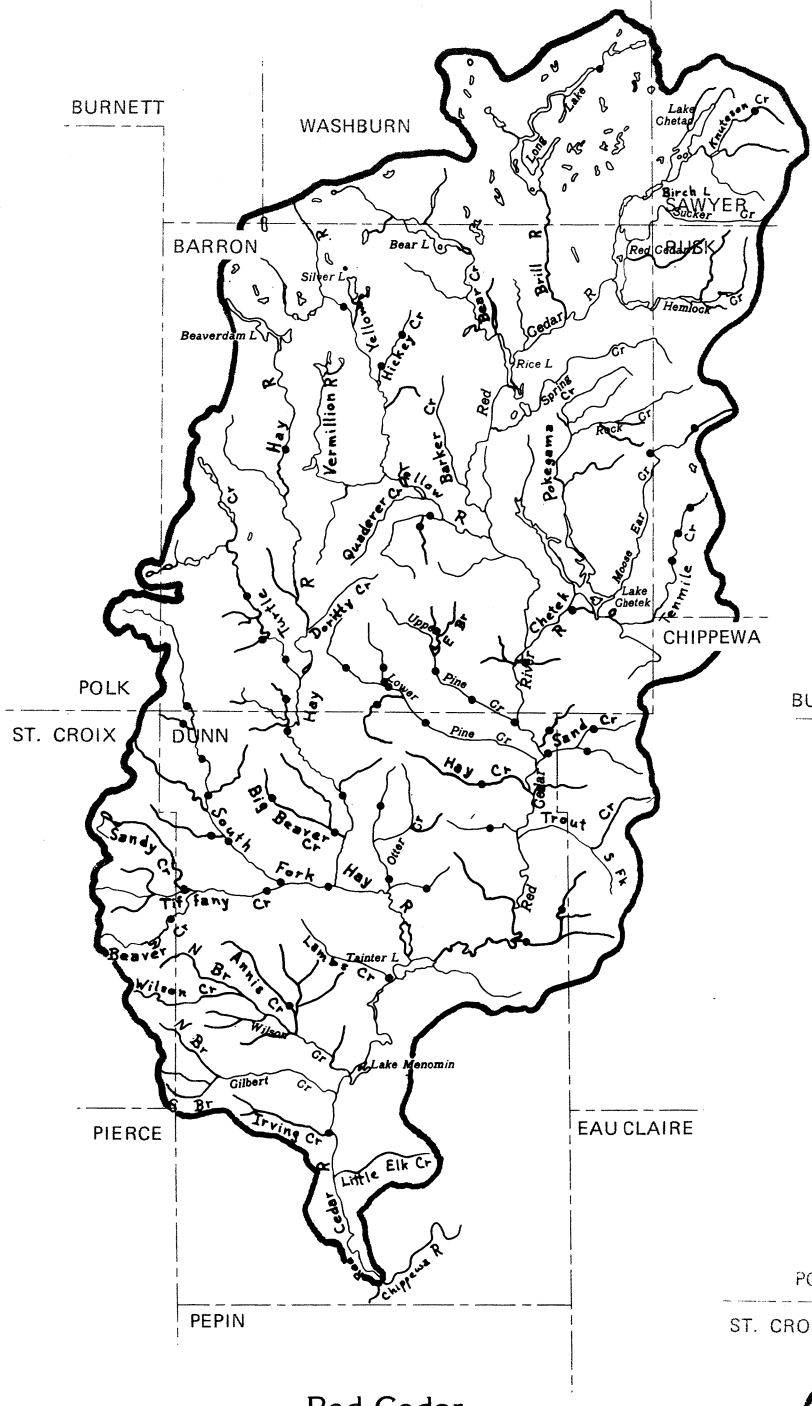
MAP 38

● Longnose dace 64(0)



MAP 39

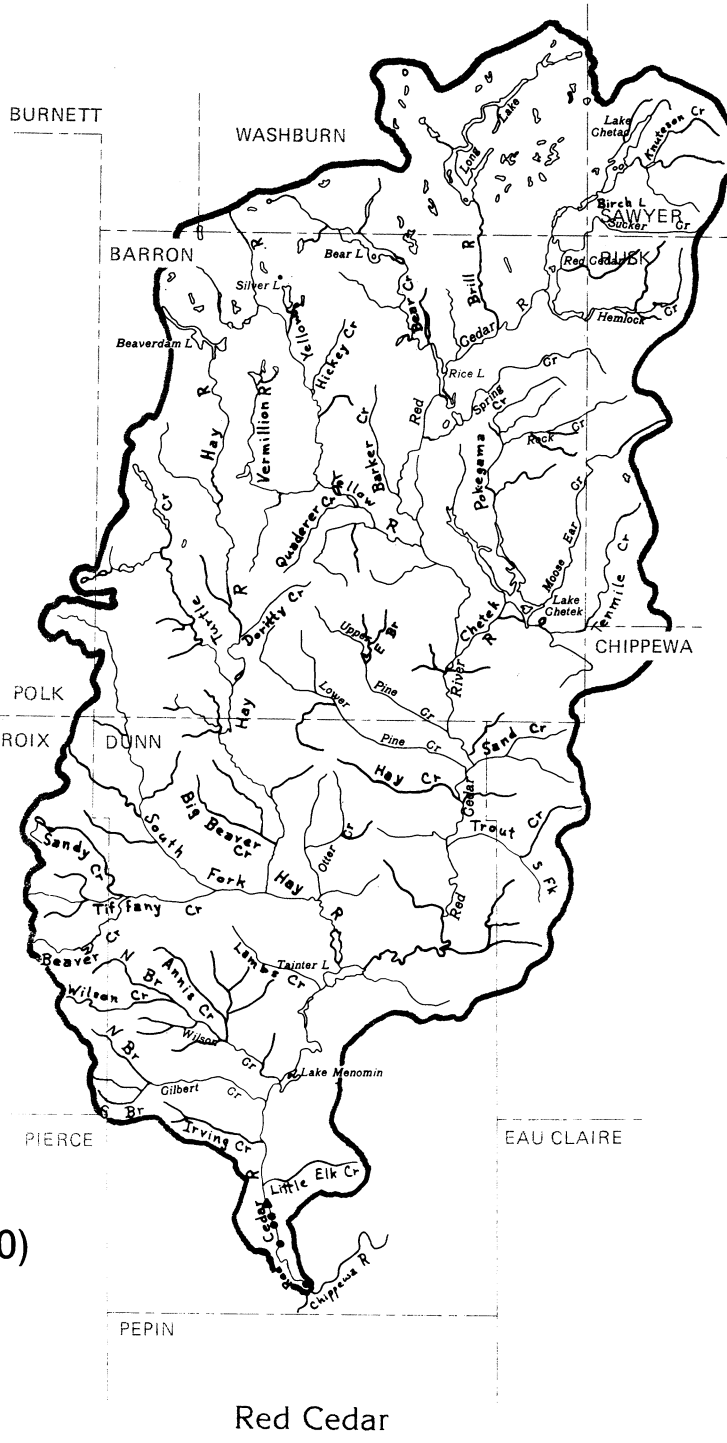
● Creek chub 140(7)



Red Cedar

MAP 40

● Pearl dace 59(0)

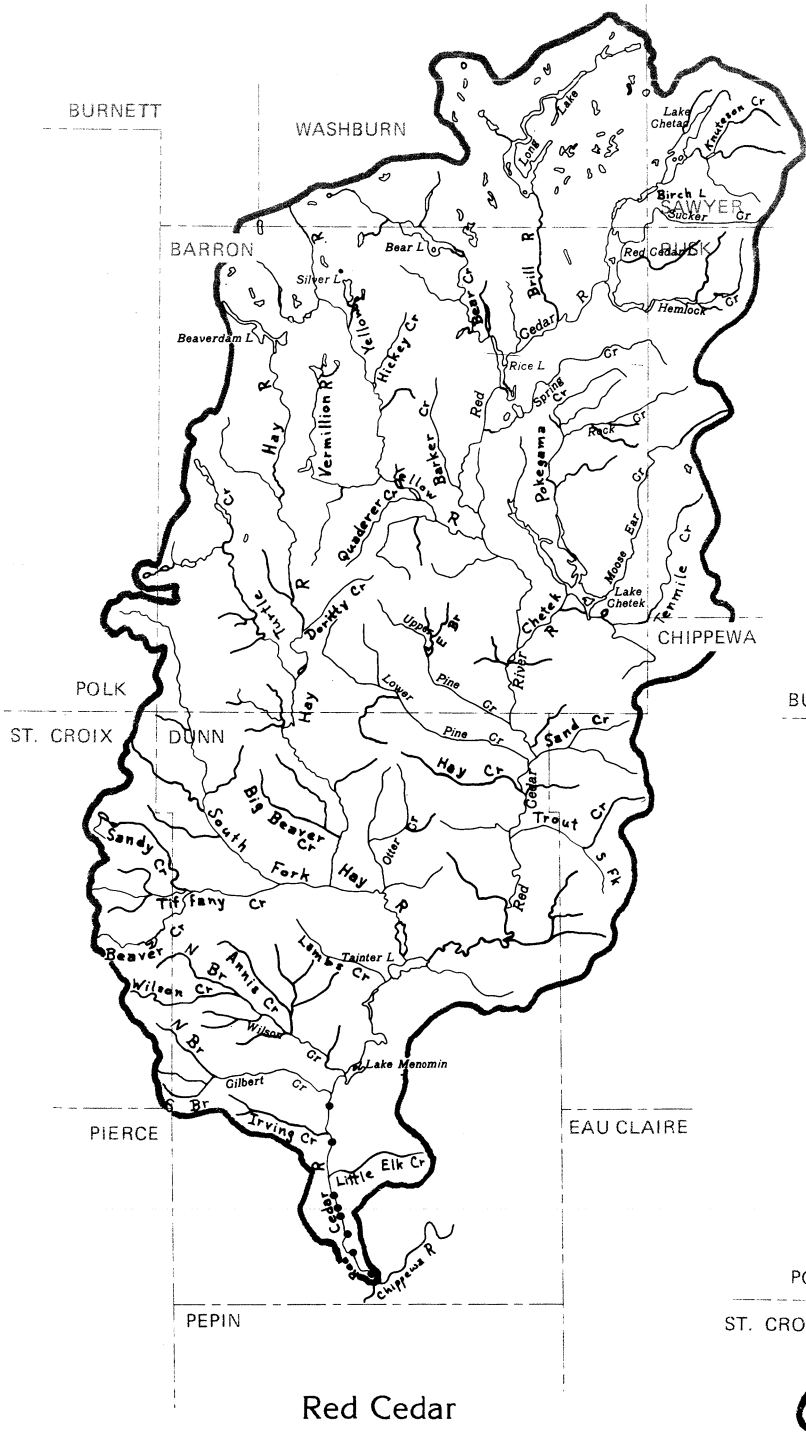


Red Cedar

MAP 41

● Highfin carpsucker 4(0)

▲ River carpsucker 1(0)



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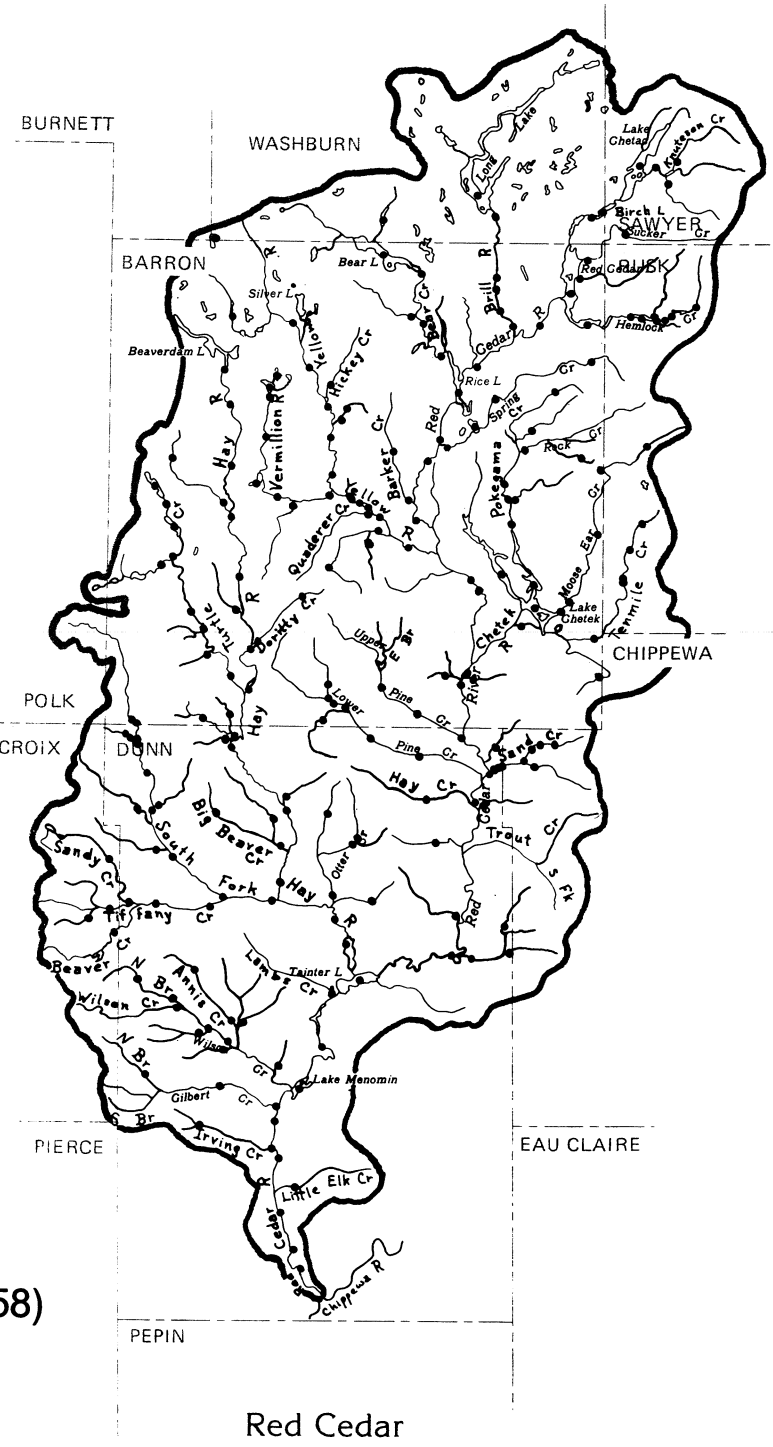
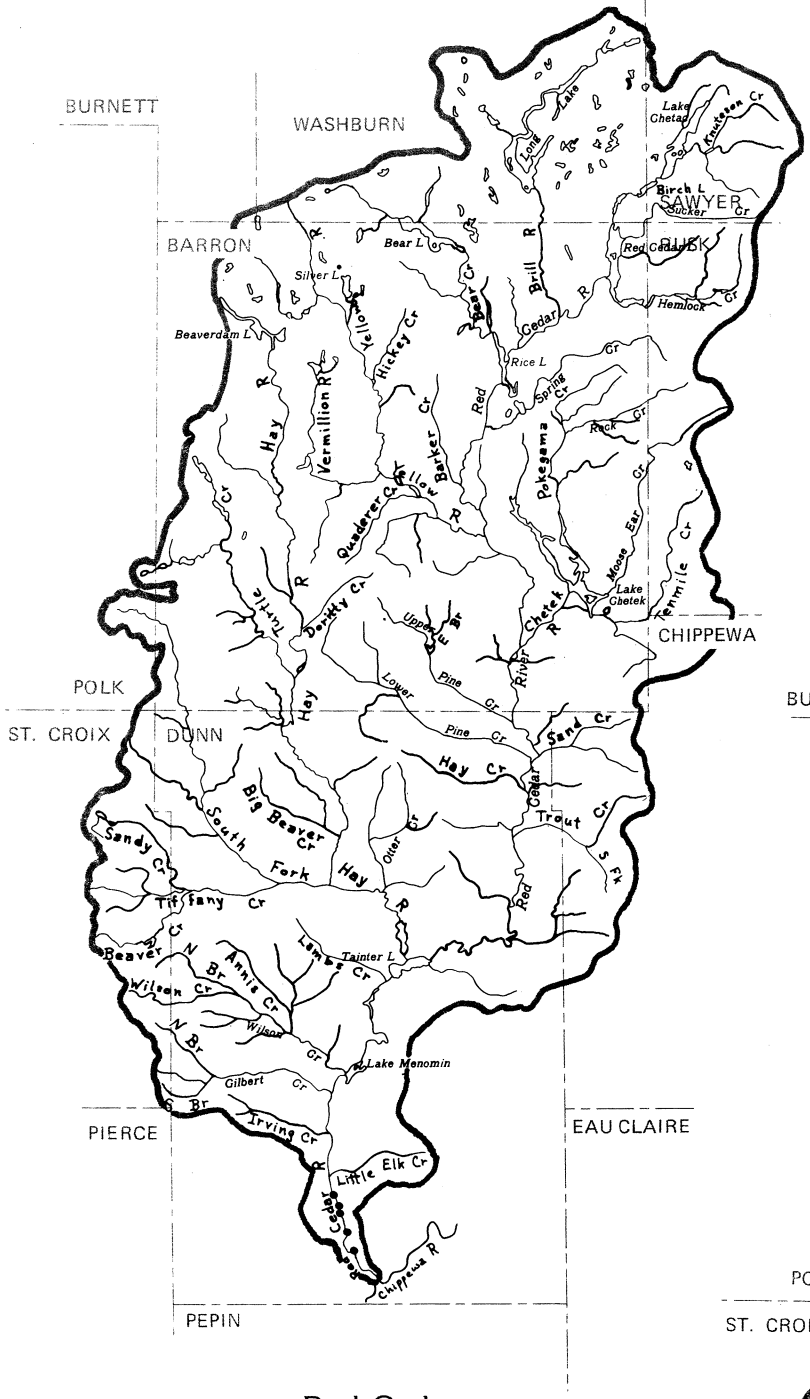
● Quillback 9(0)



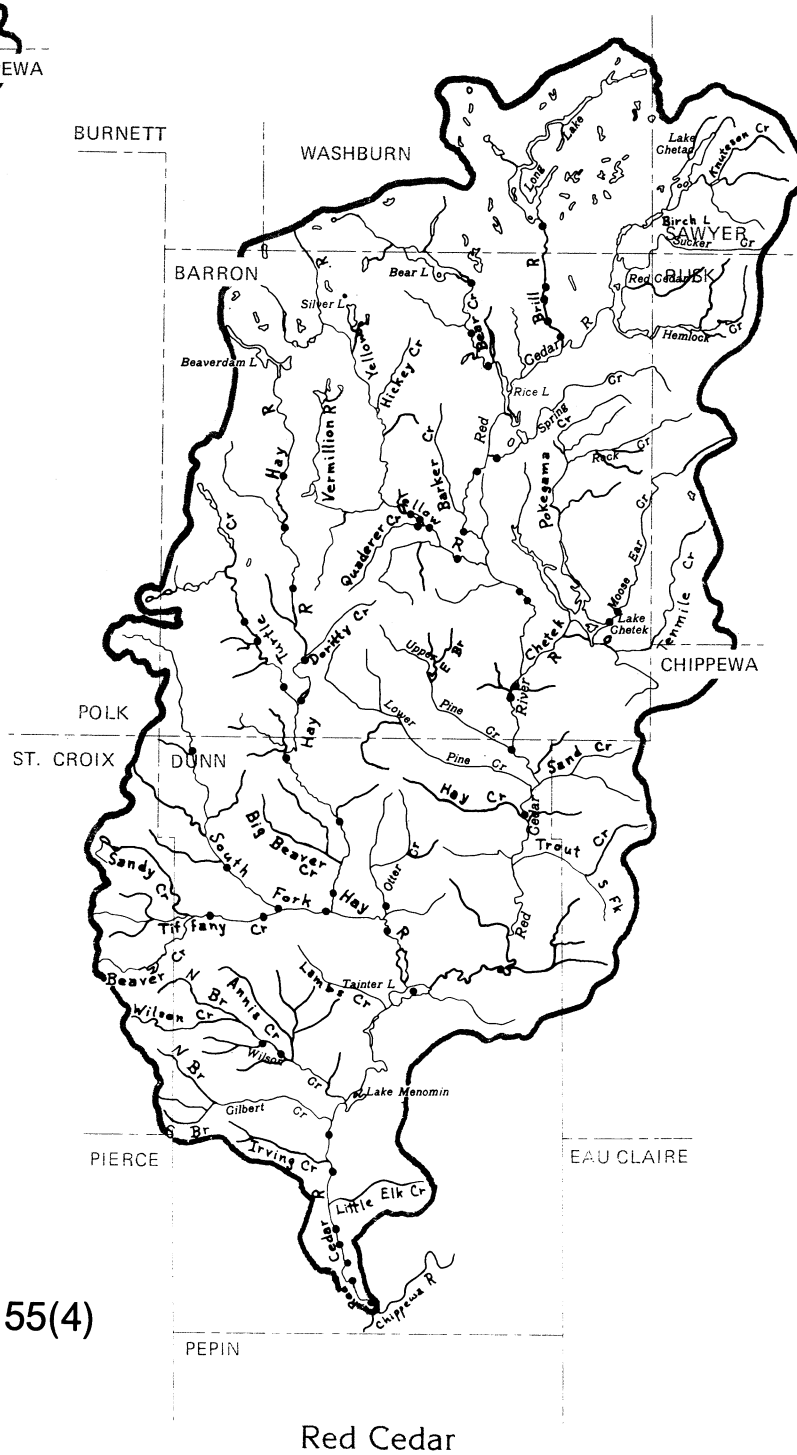
MAP 43

● White sucker 213(58)



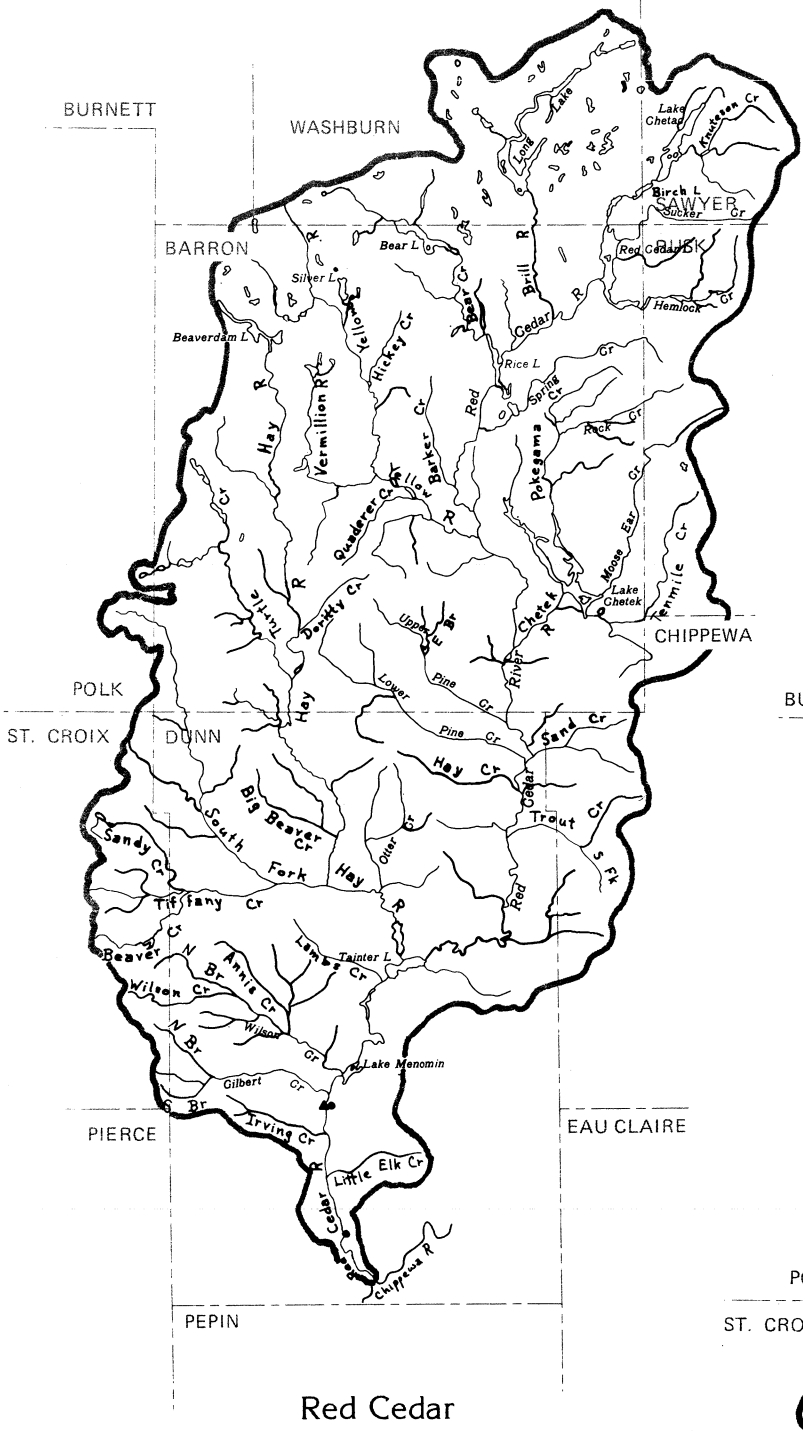
MAP 44

● Blue sucker 5(0)



MAP 45

● Northern hog sucker 55(4)



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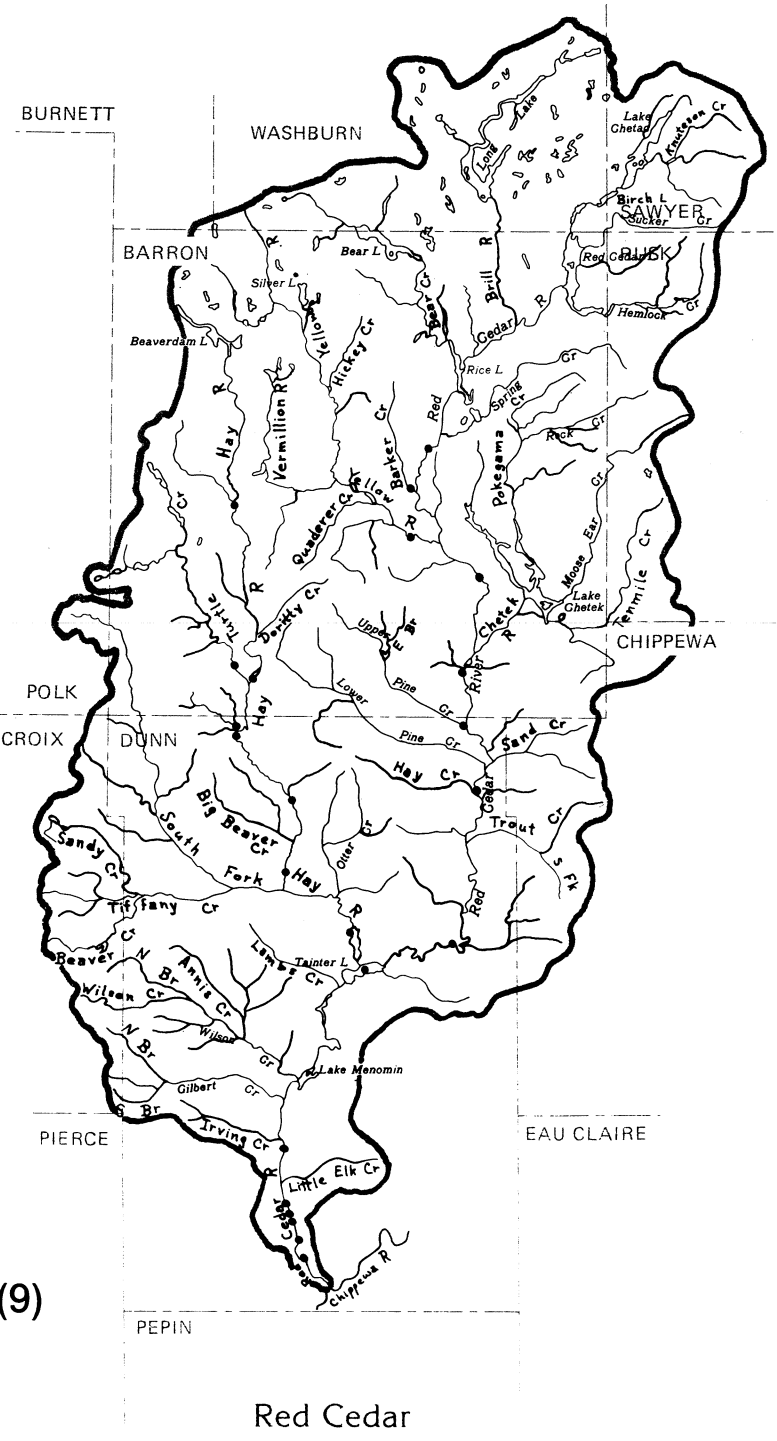
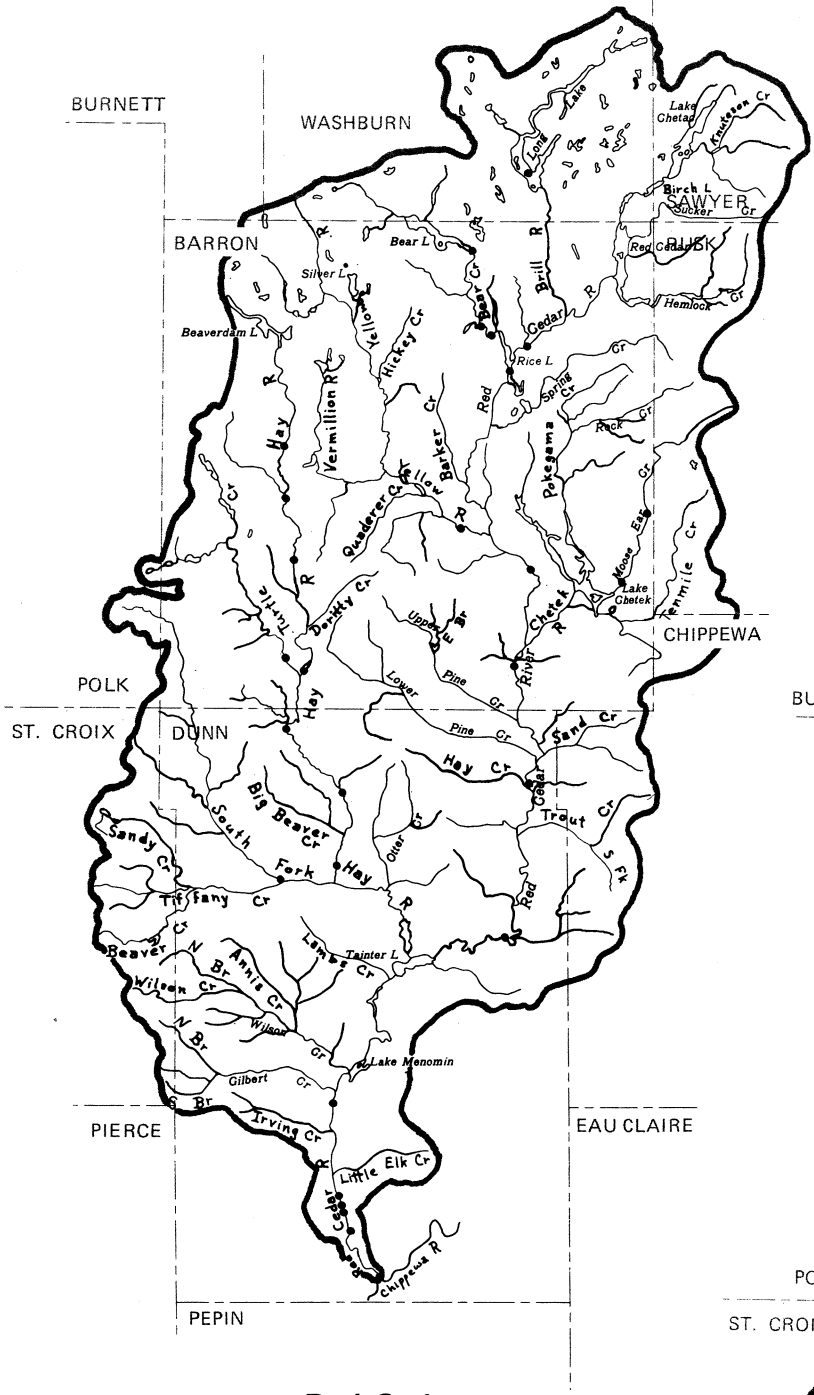
● Bigmouth buffalo 2(0)

▲ Smallmouth buffalo 1(0)



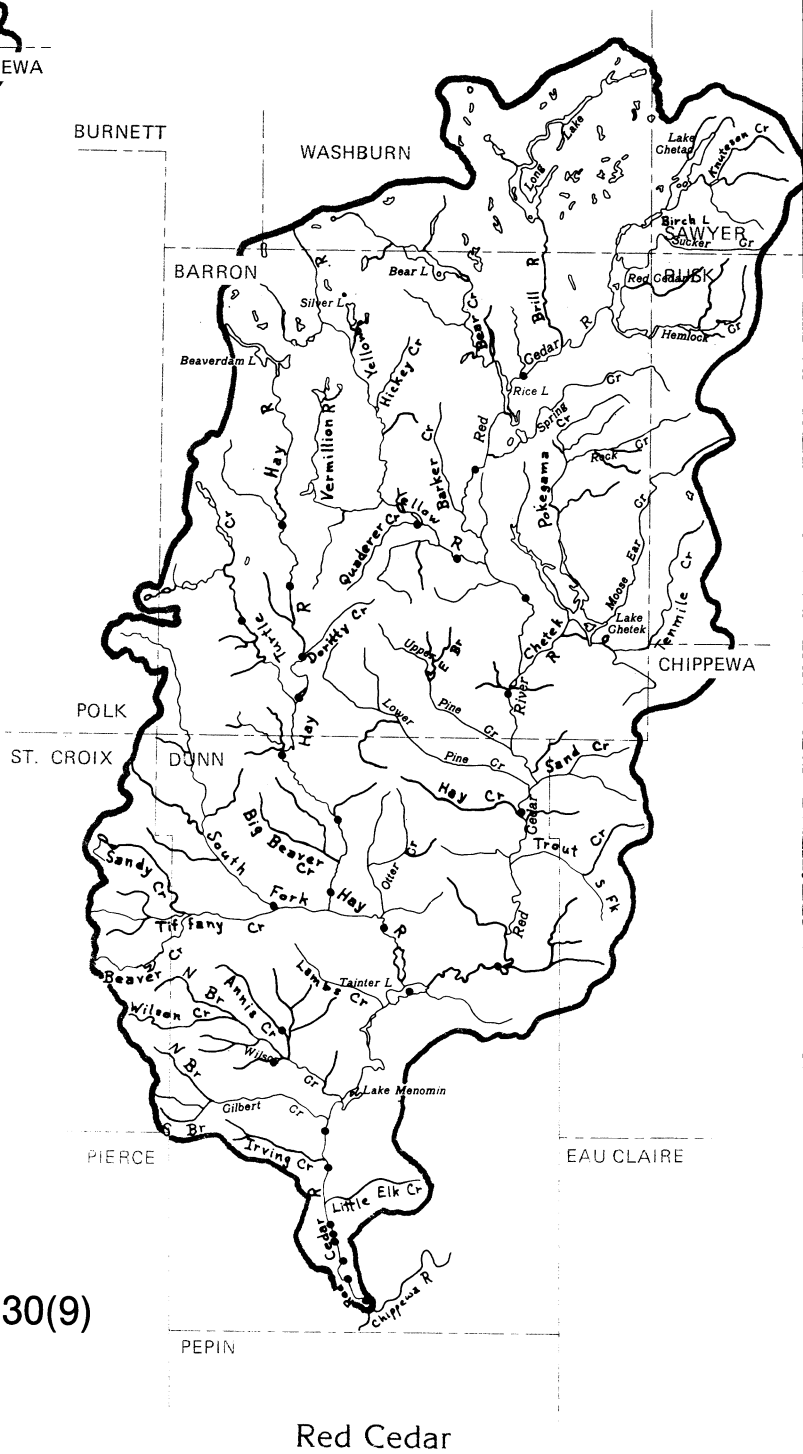
MAP 47

● Silver redhorse 23(9)



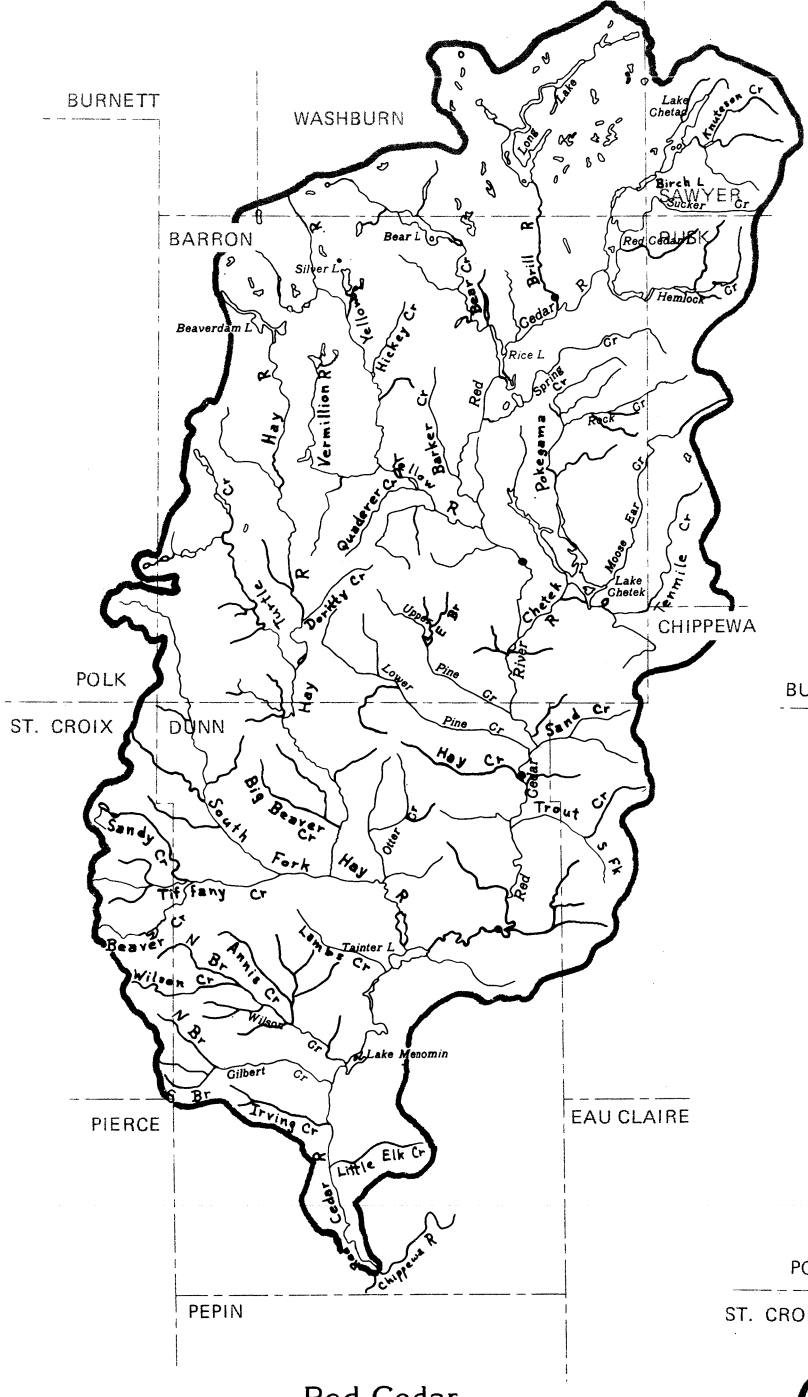
MAP 48

● Golden redhorse 28(1)



MAP 49

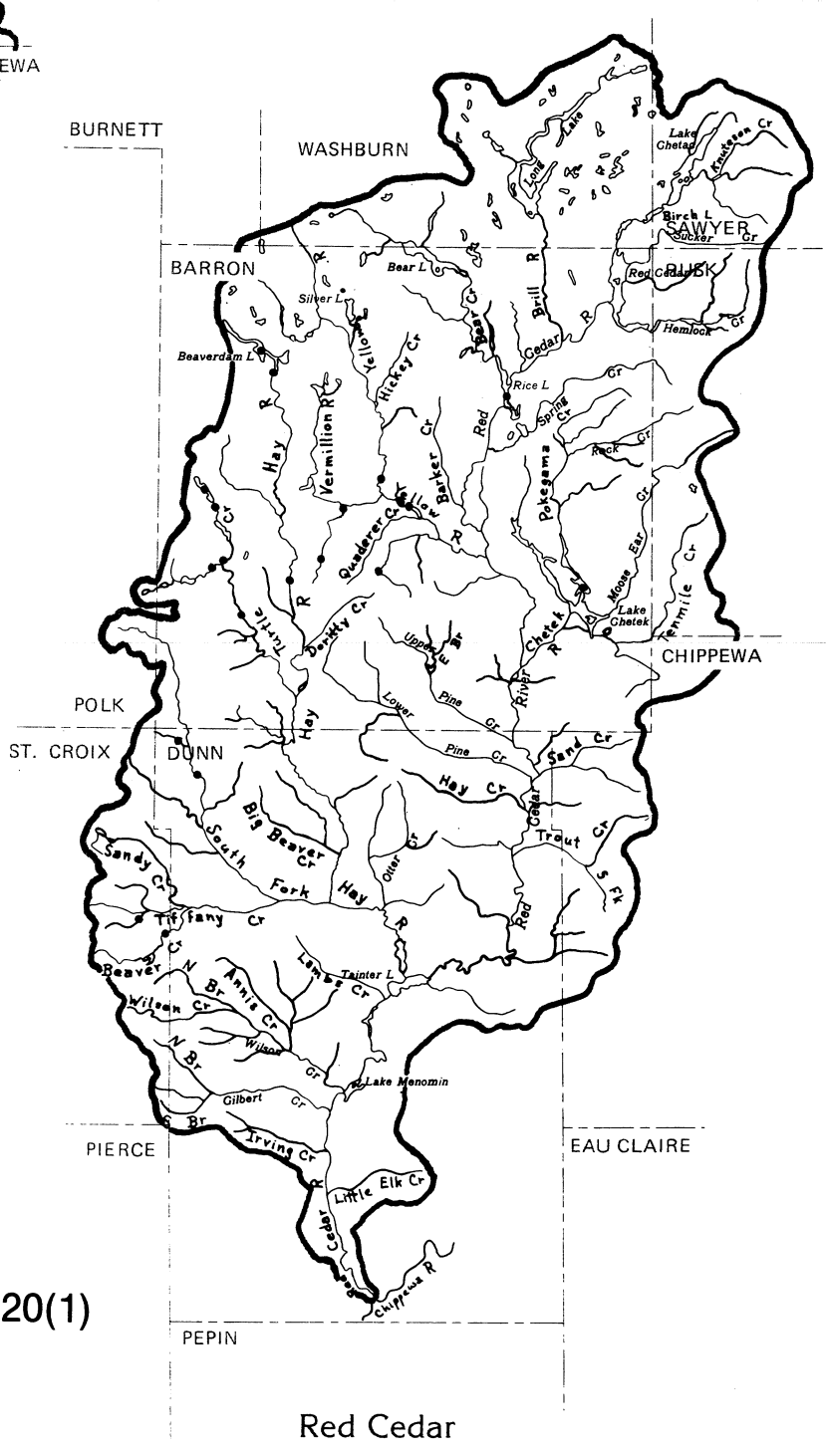
● Shorthead redhorse 30(9)



Red Cedar

MAP 50

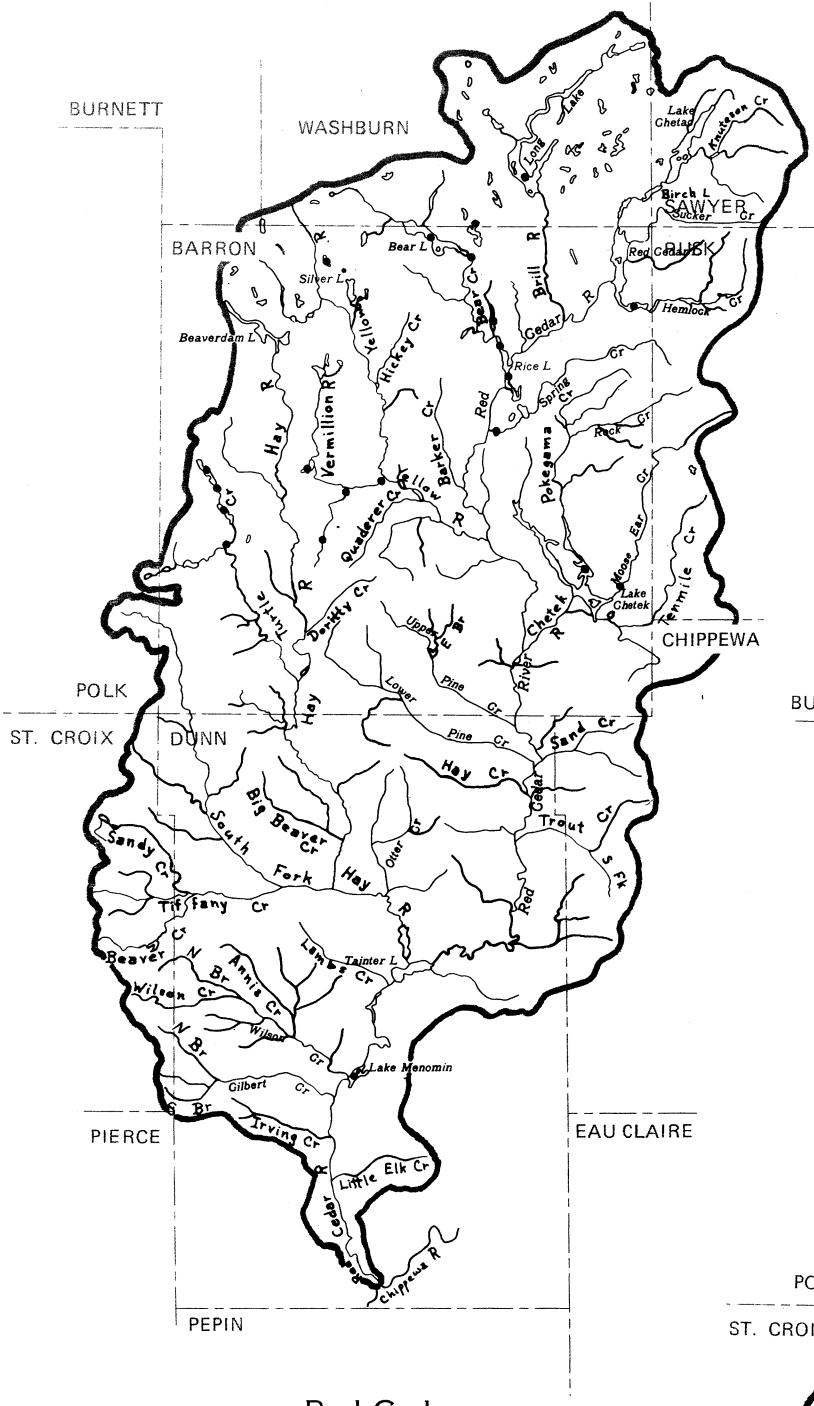
● Greater redhorse 4(0)



Red Cedar

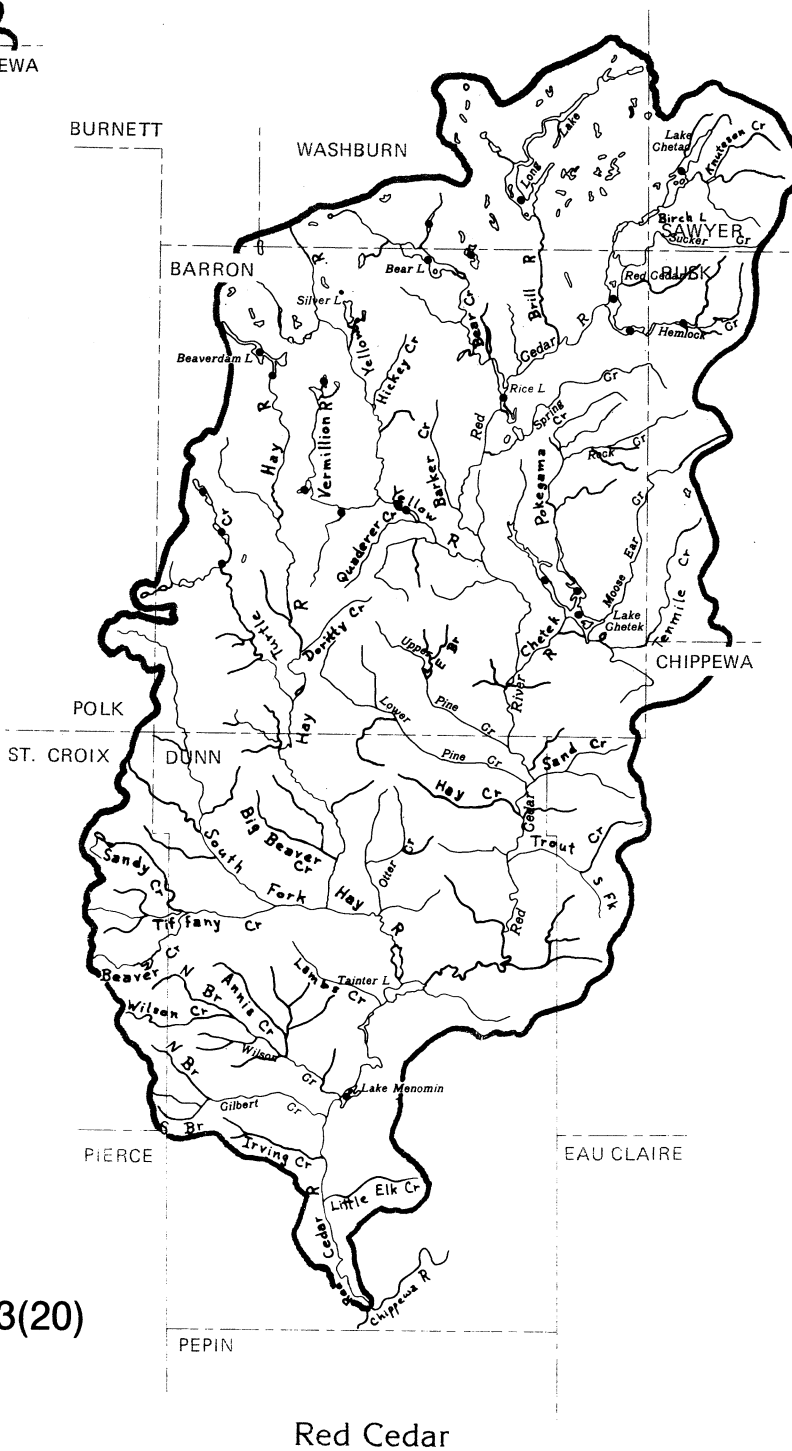
MAP 51

● Black bullhead 20(1)



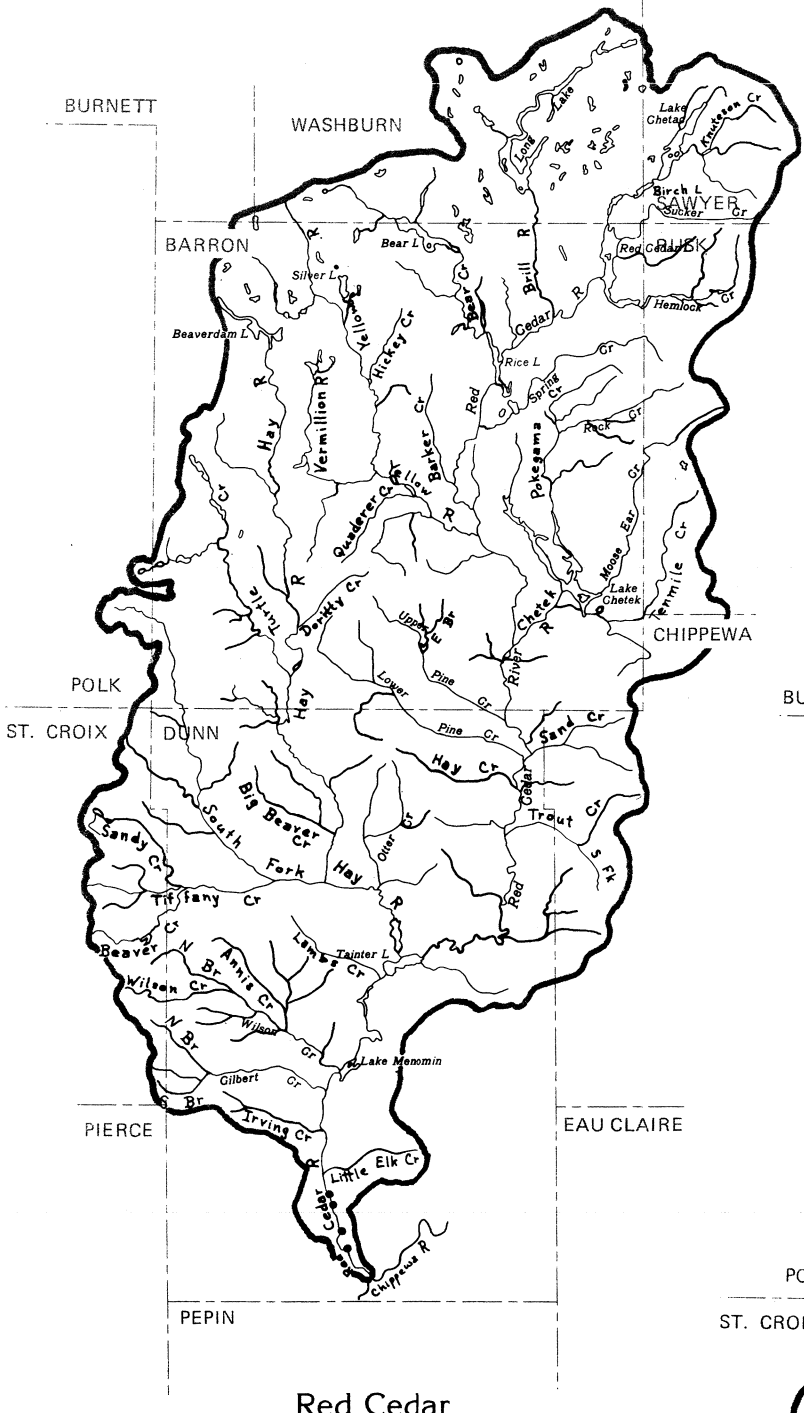
MAP 52

● Yellow bullhead 21(4)



MAP 53

● Brown bullhead 23(20)



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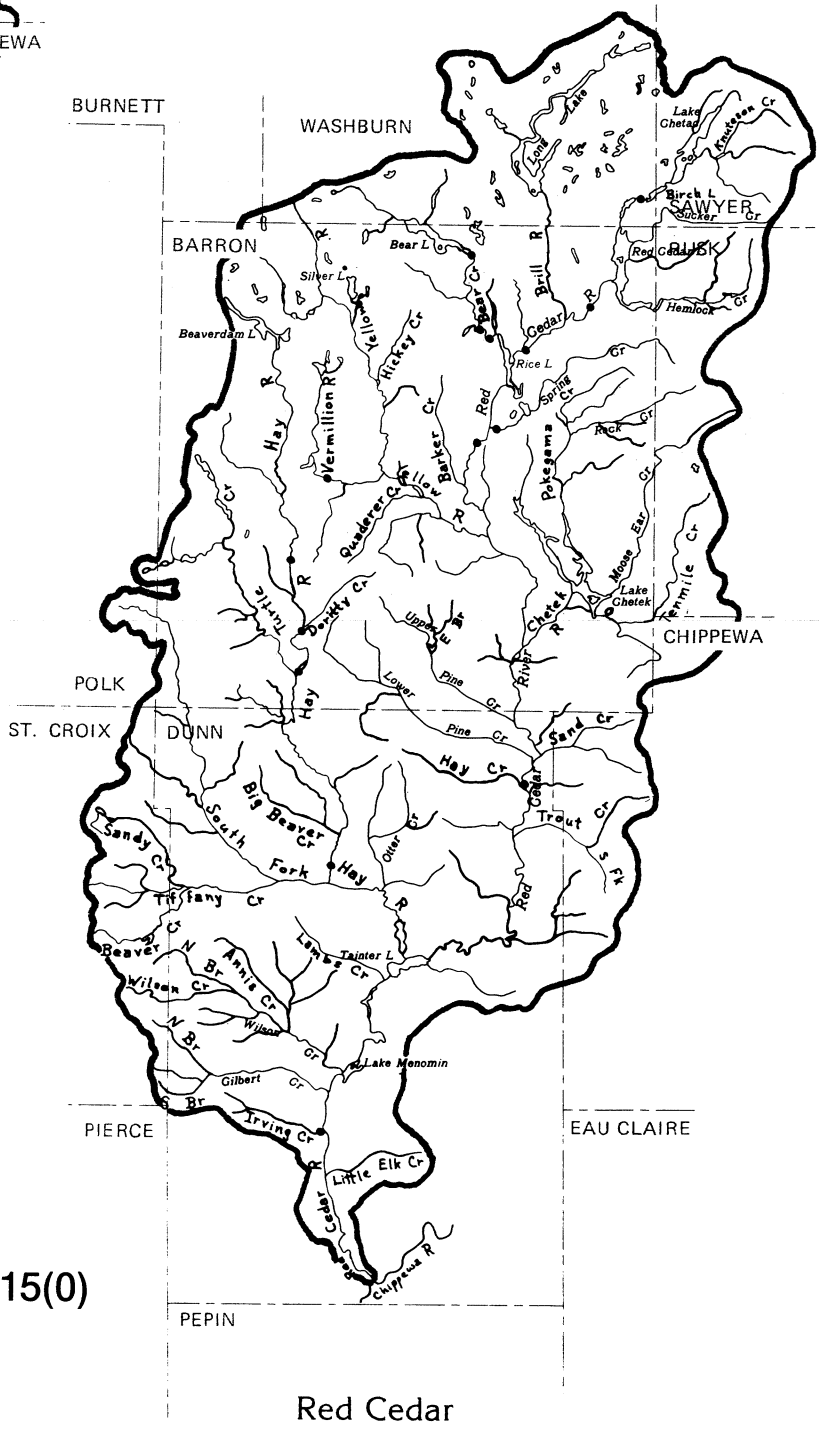
MAP 54

● Channel catfish 4(1)



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MAP 55

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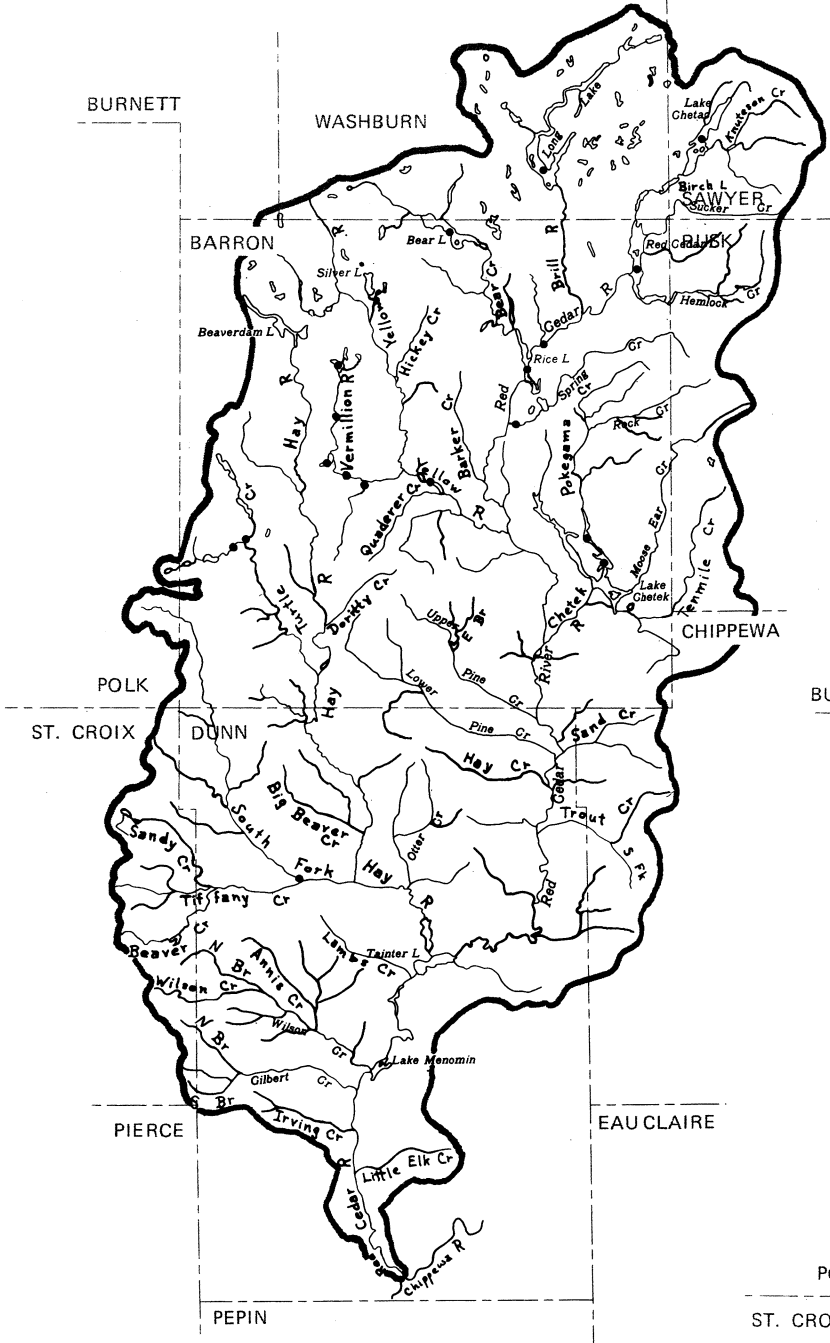

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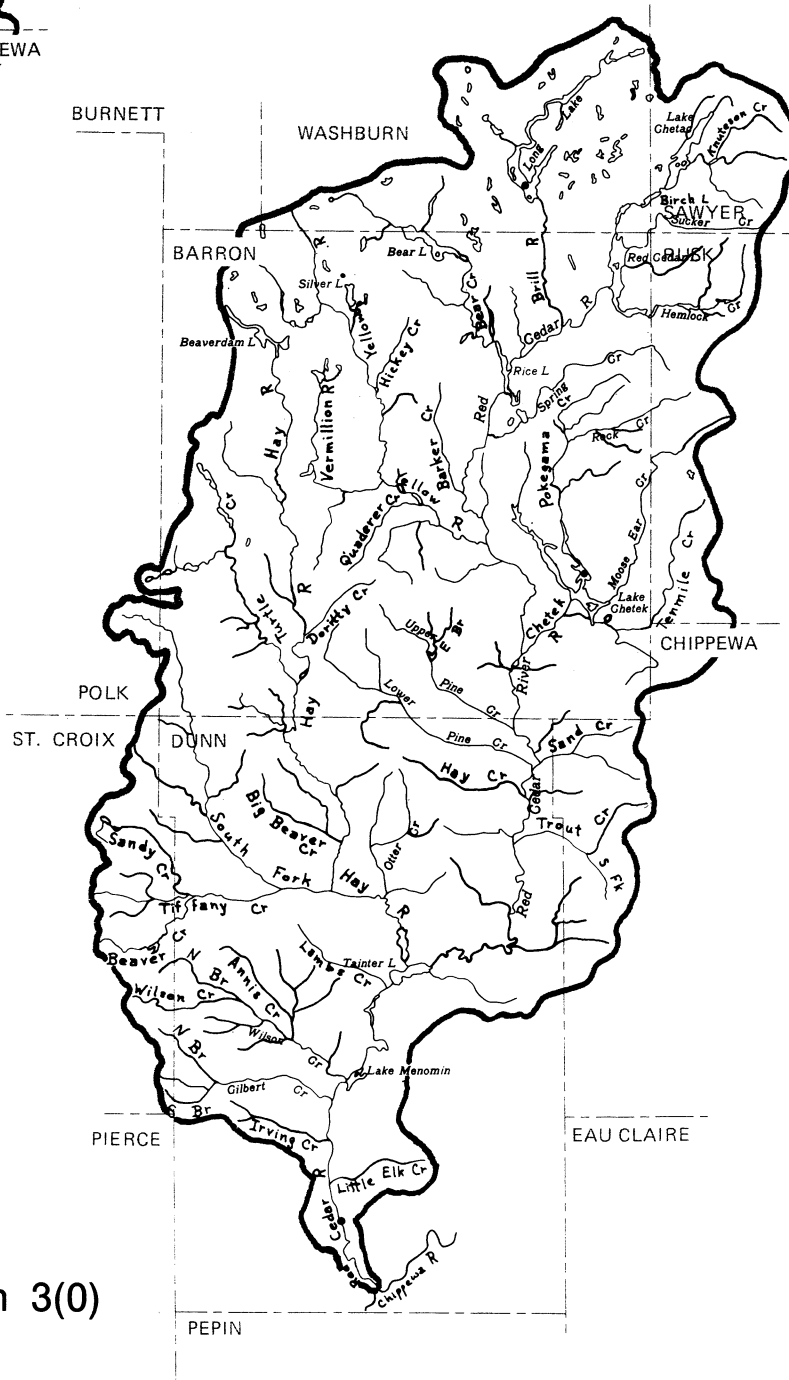
● Tadpole madtom 18(1)



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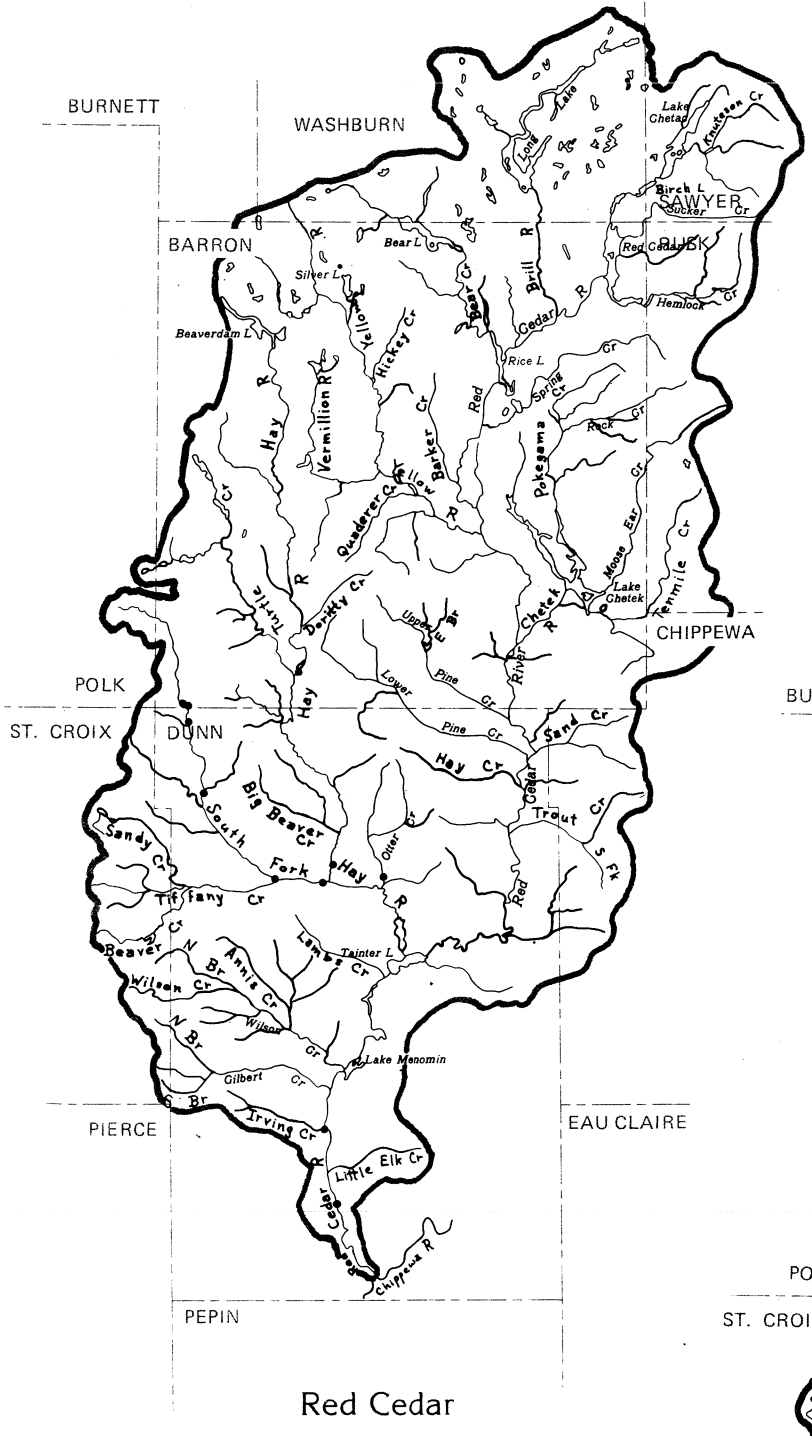
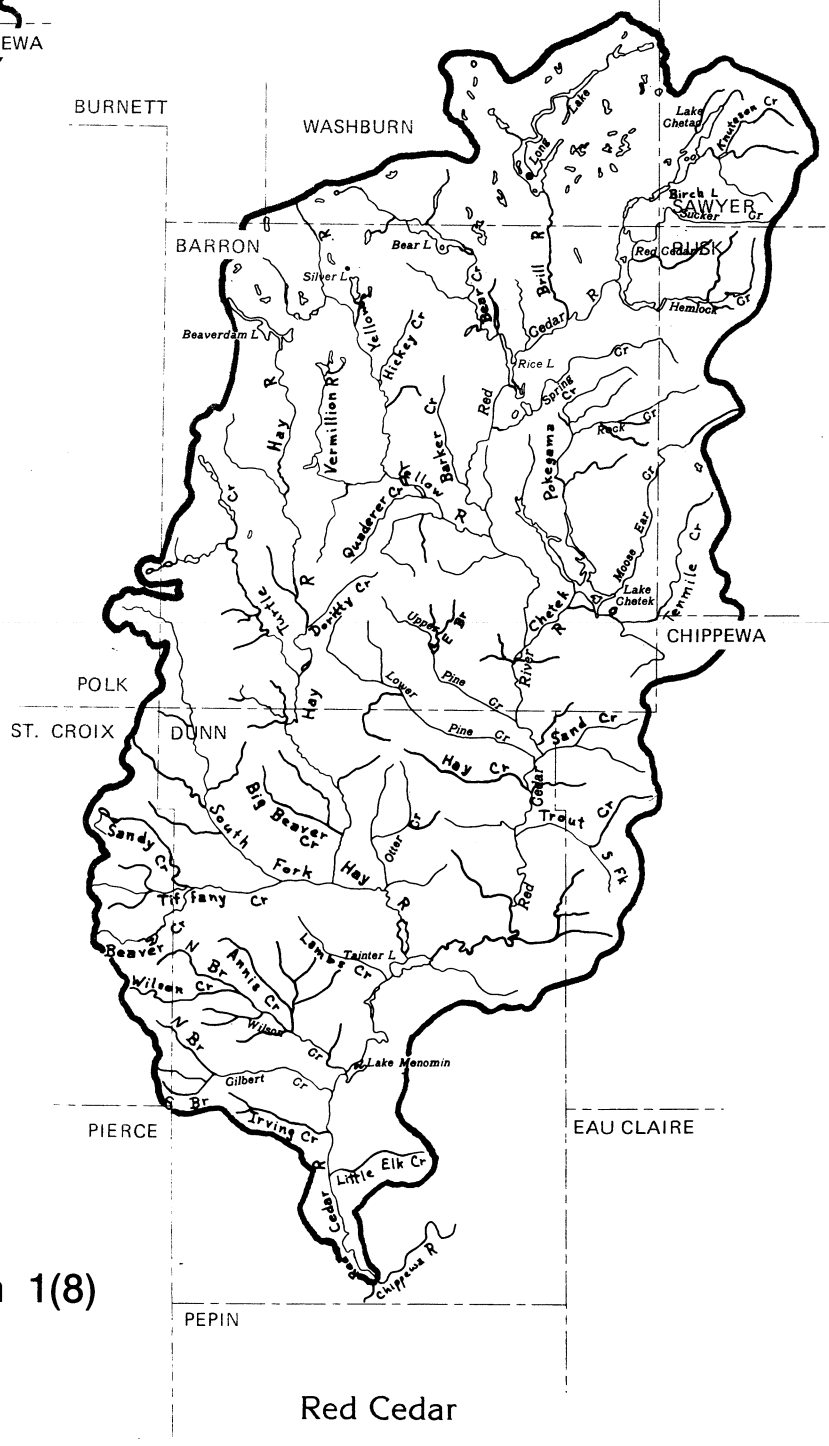
● Trout-perch 3(0)



MAP 58

● Burbot 11(0)



MAP 59

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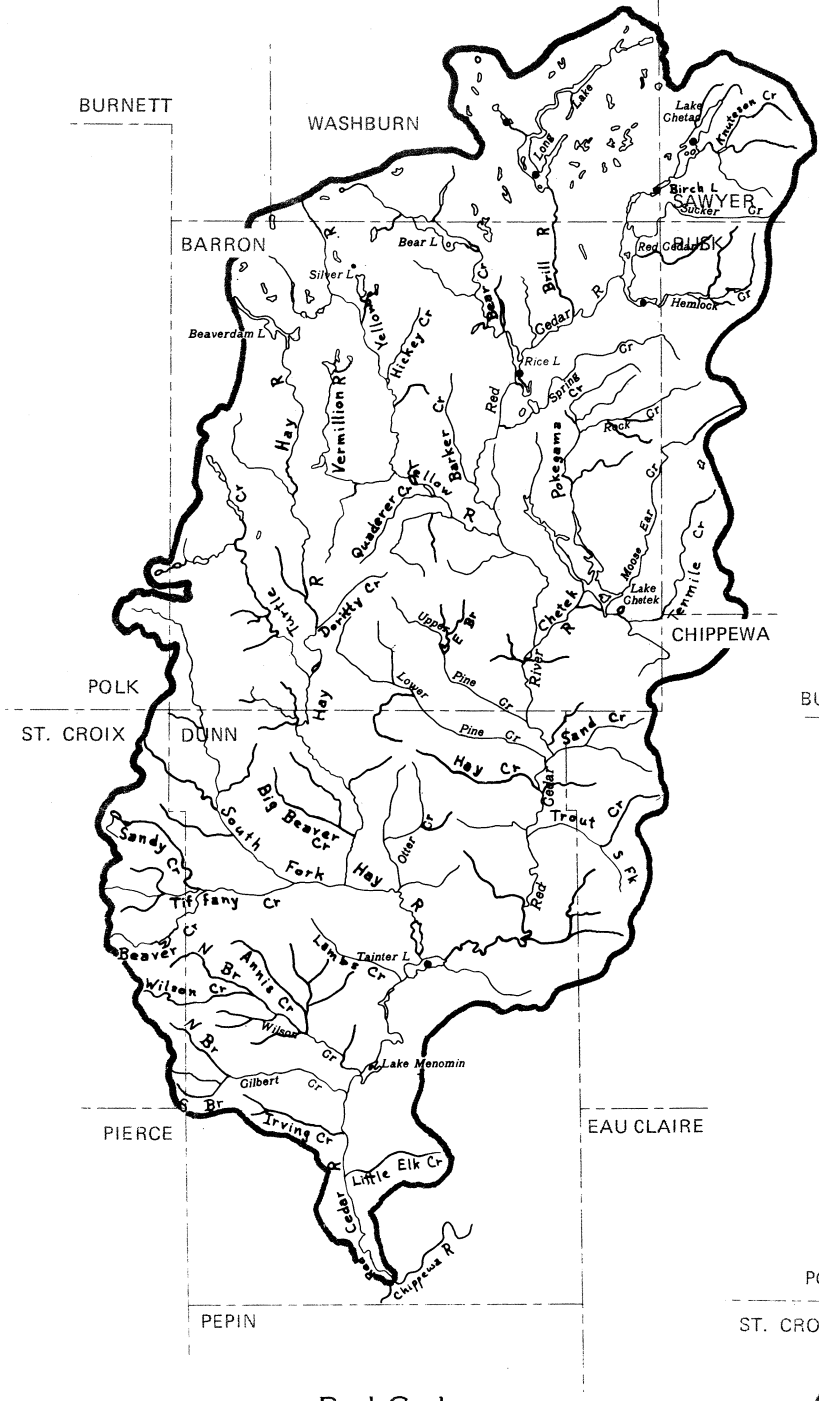
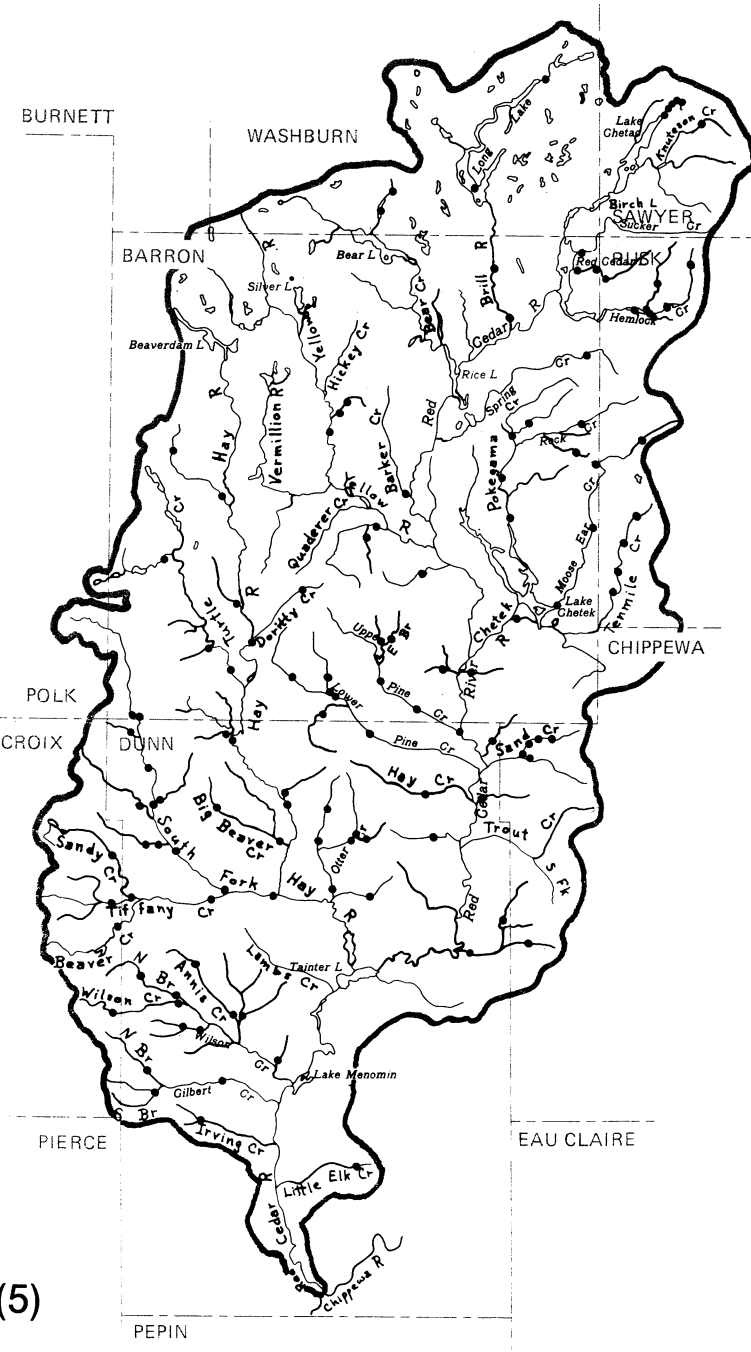


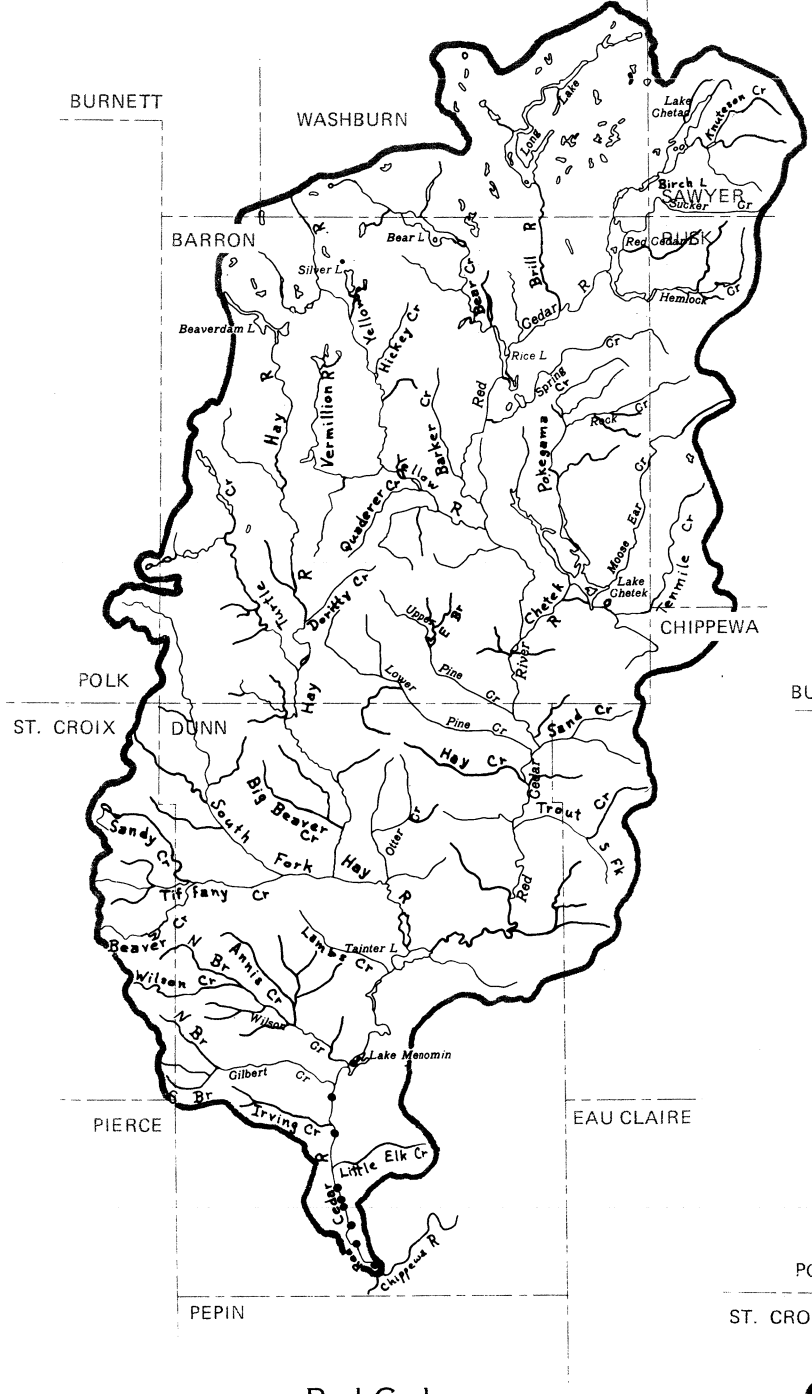
MAP 60

● Brook silverside 7(3)



MAP 61

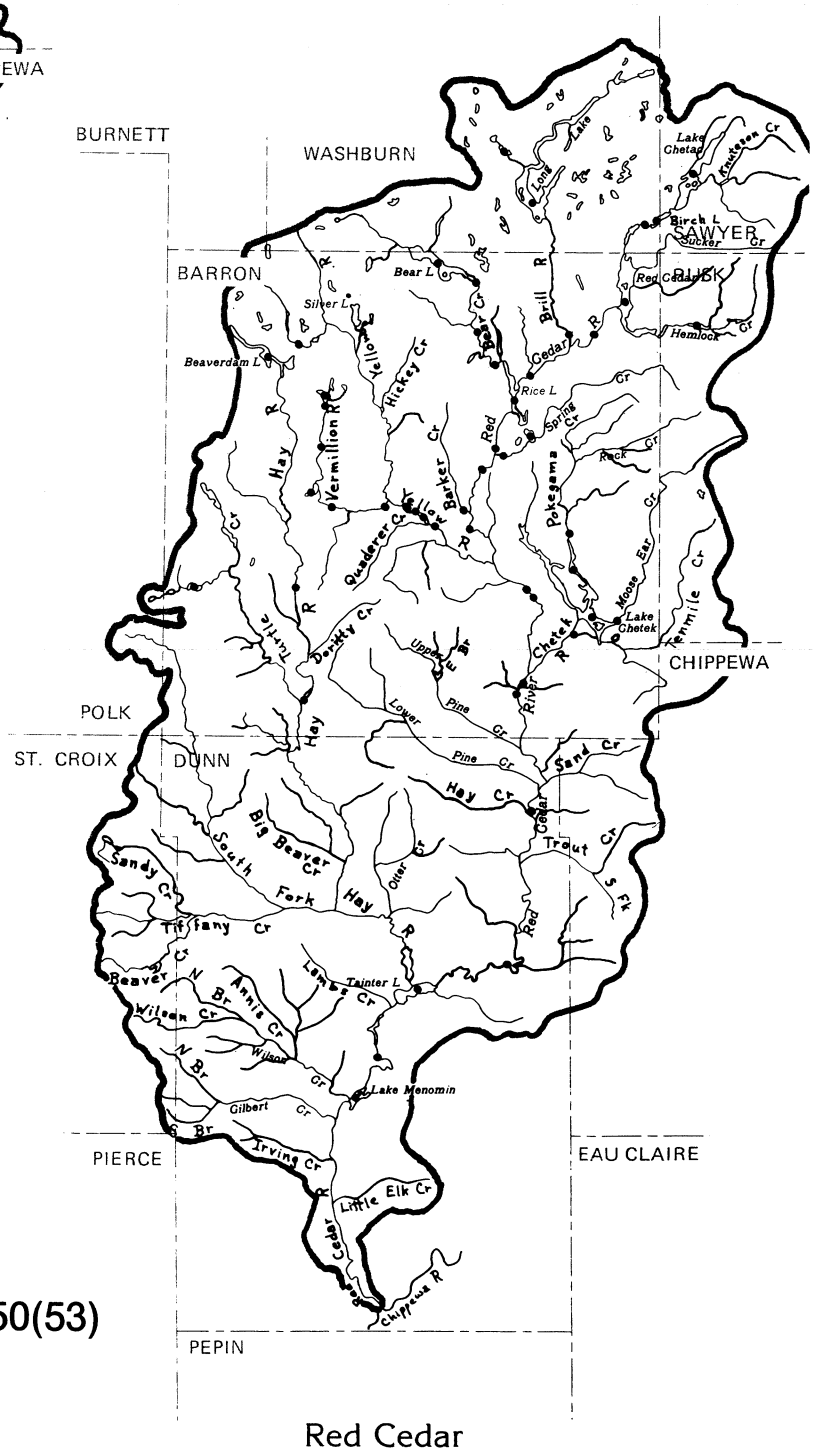
● Brook stickleback 124(5)



MAP 62

● White bass 10(0)

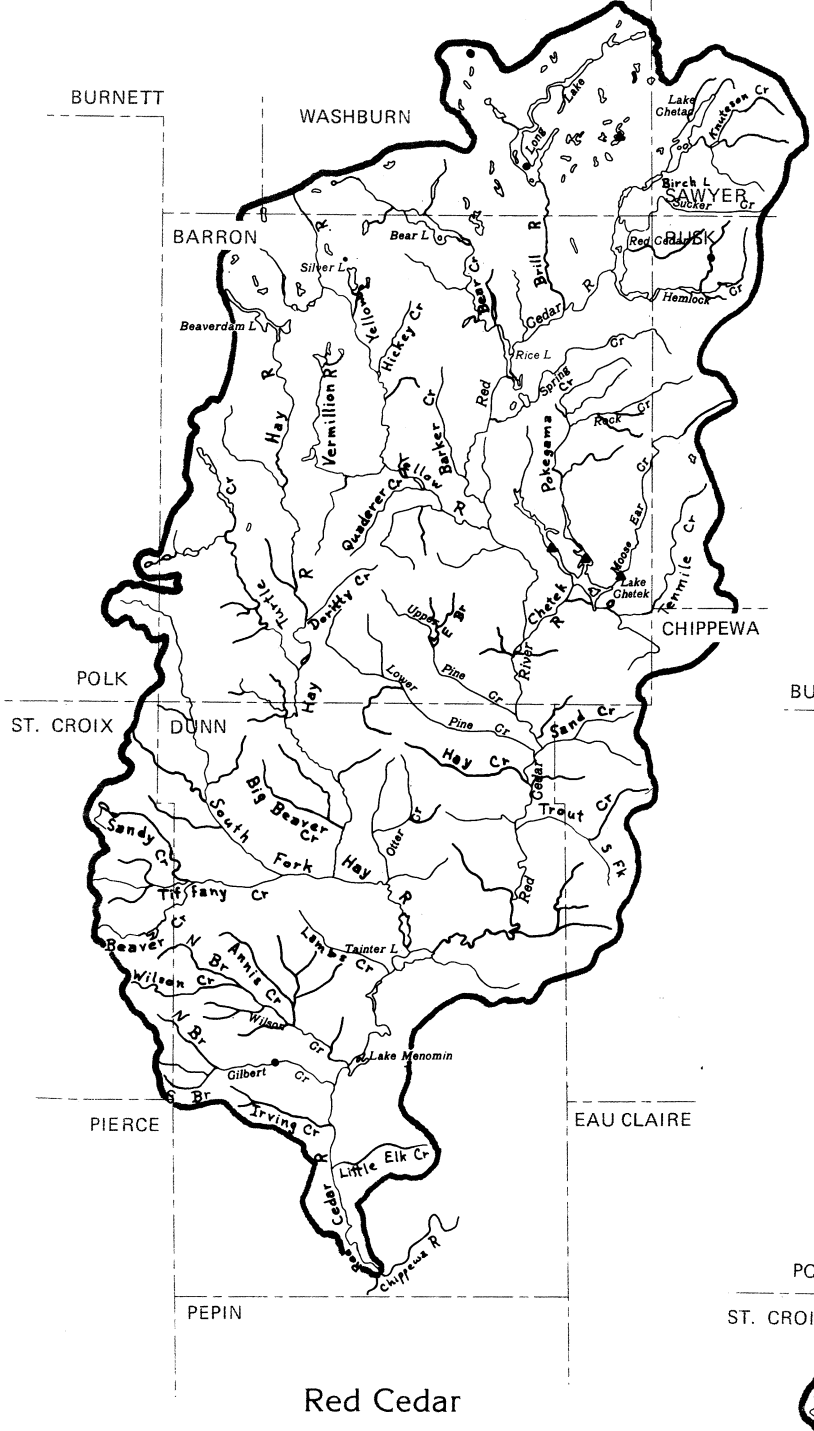
Red Cedar



MAP 63

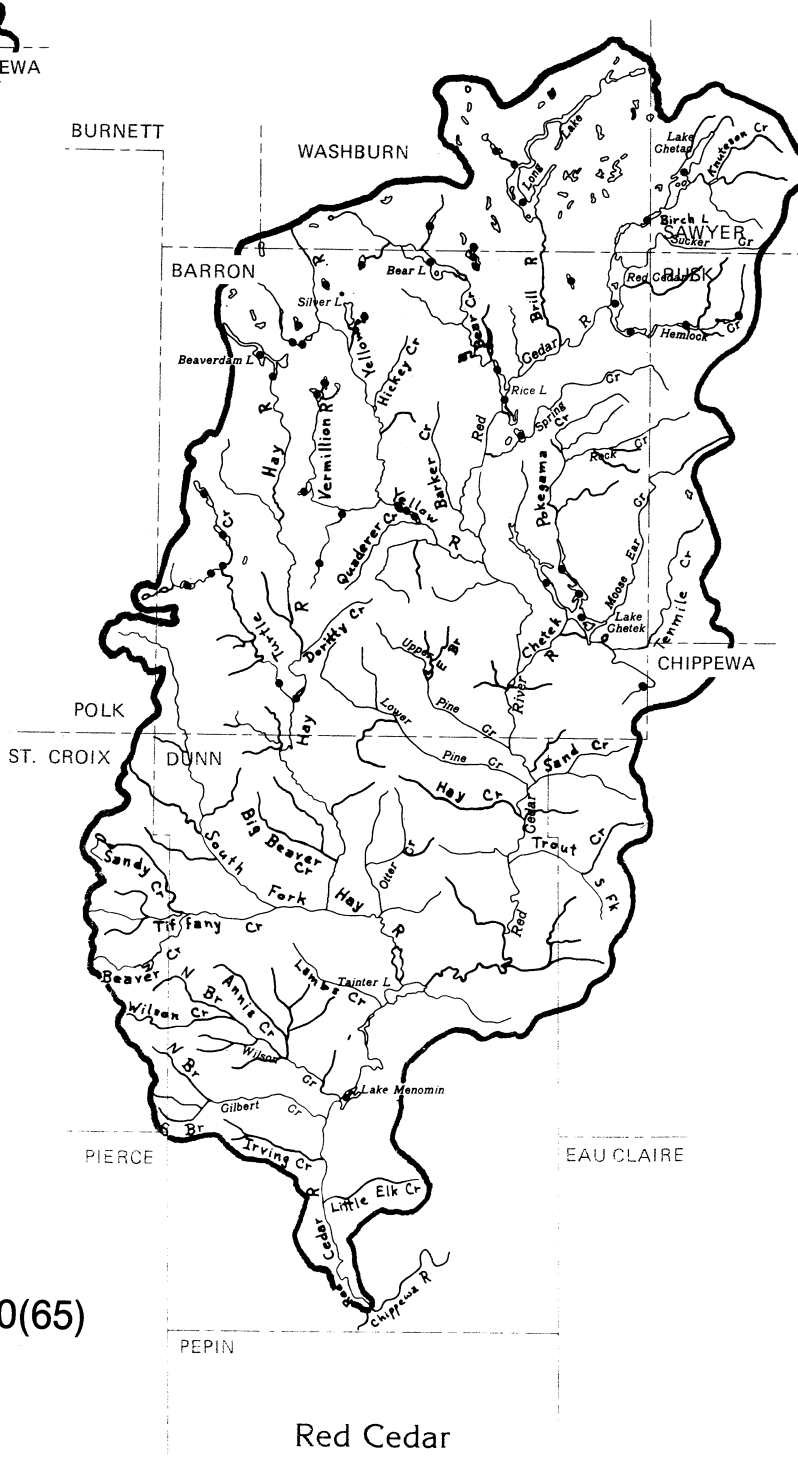
● Rock bass 50(53)

Red Cedar



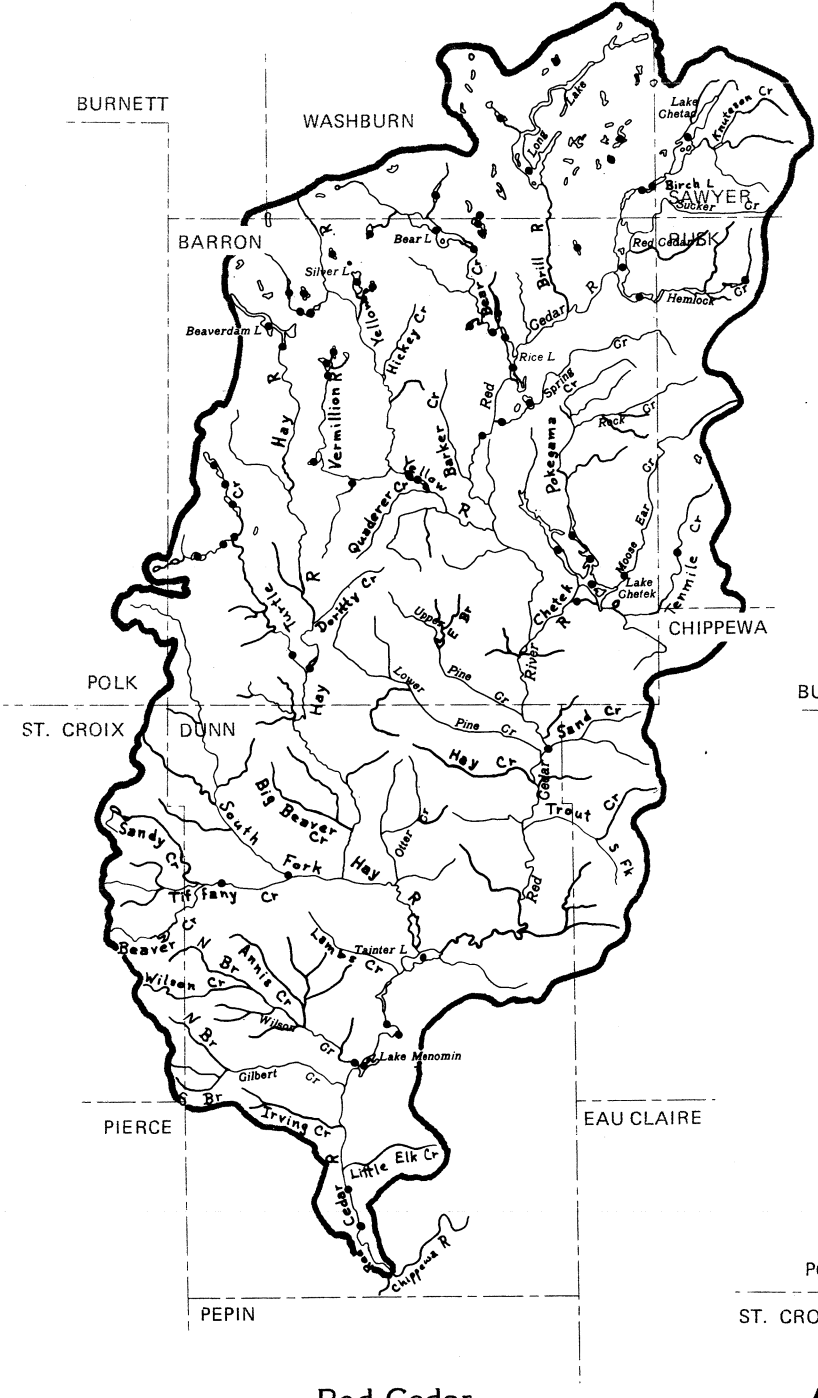
MAP 64

- Green sunfish 4(0)
- Warmouth 4(0)



MAP 65

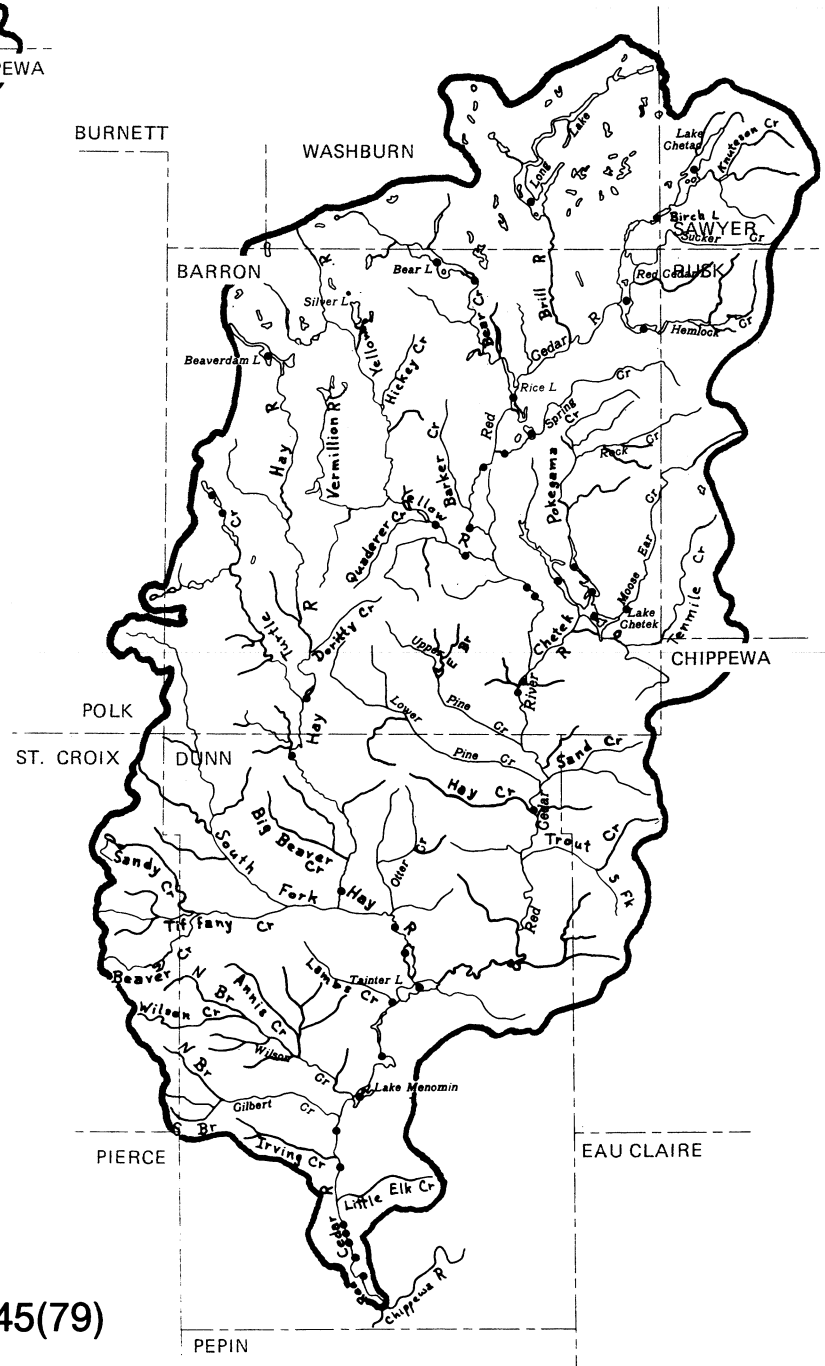
- Pumpkinseed 50(65)



MAP 66

● Bluegill 69(140)

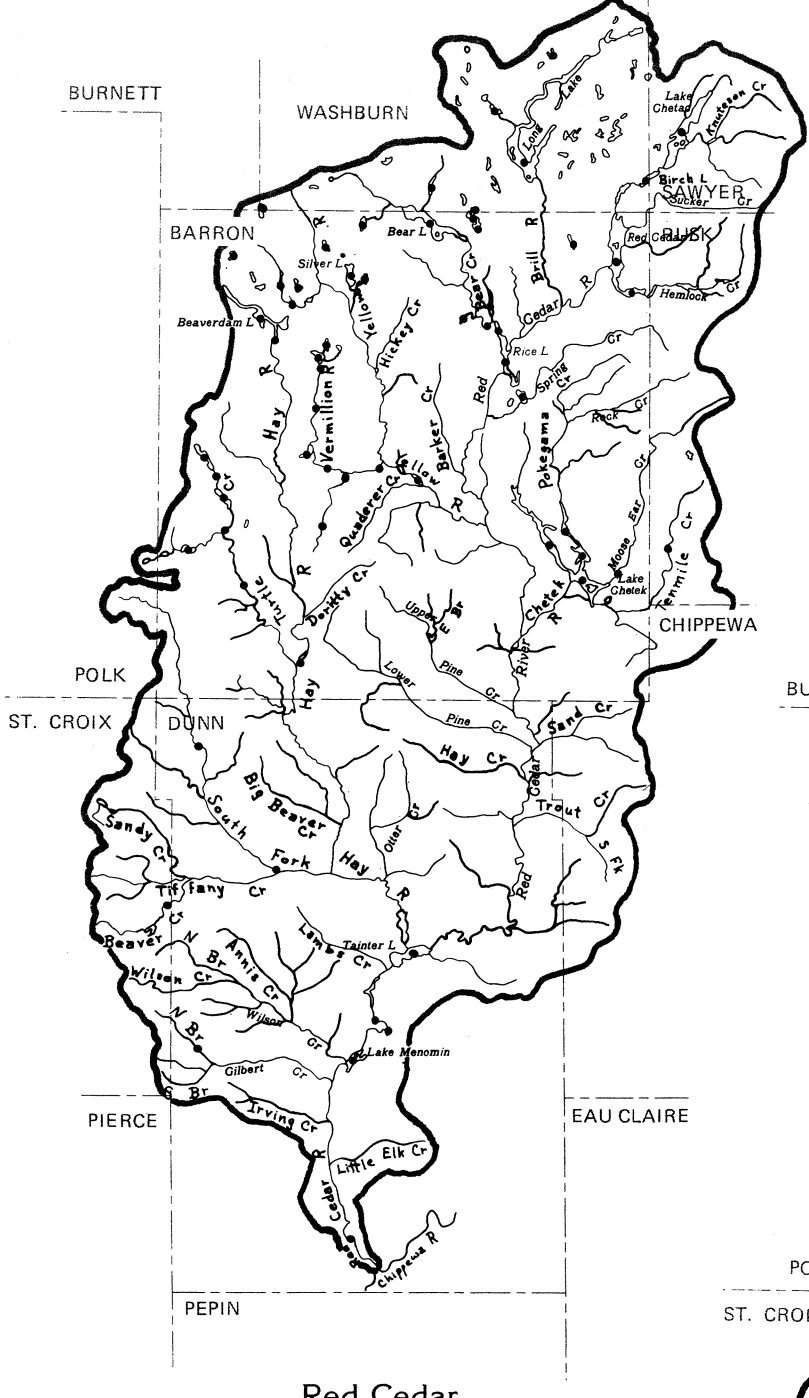
Red Cedar



MAP 67

● Smallmouth bass 45(79)

Red Cedar



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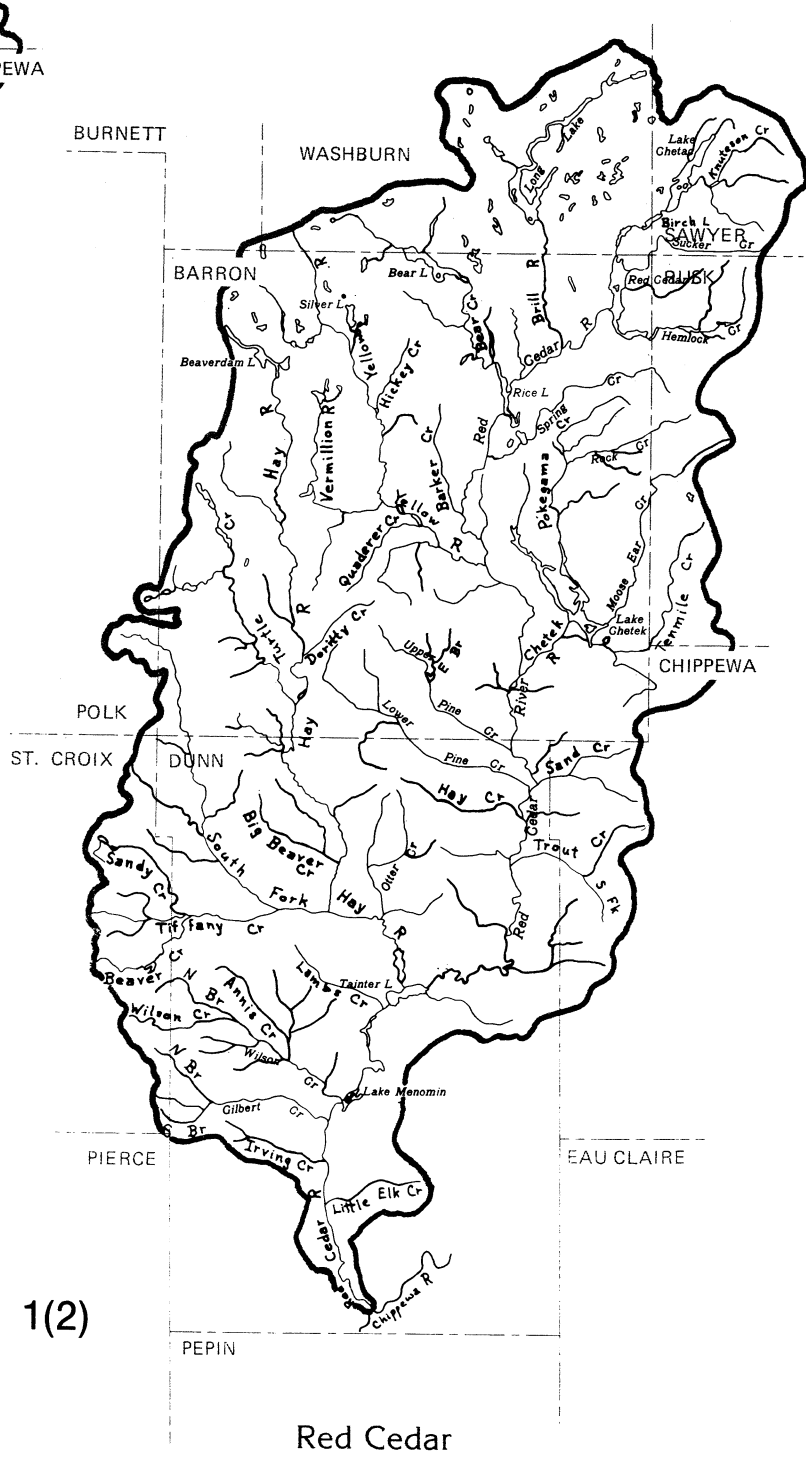
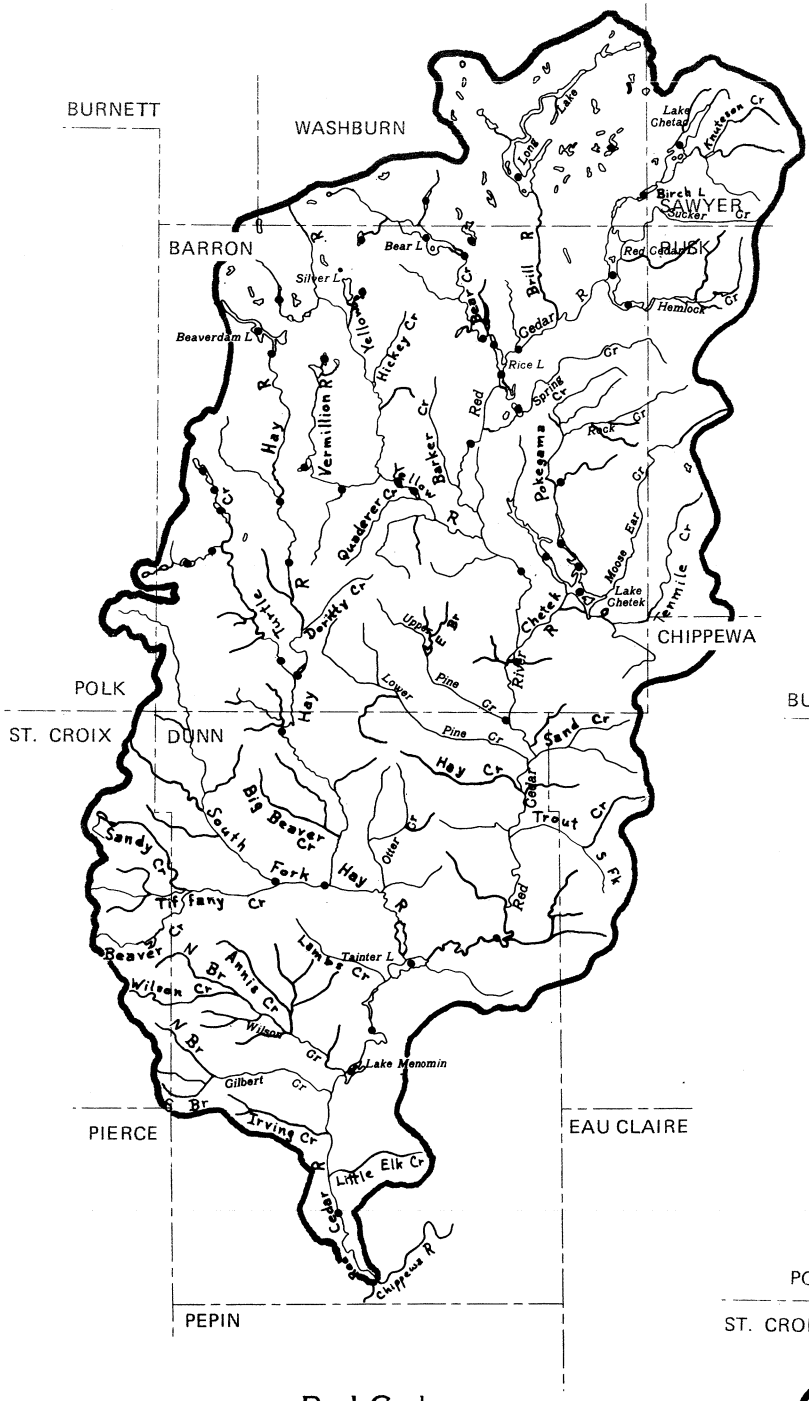
● Largemouth bass 62(139)



MAP 69

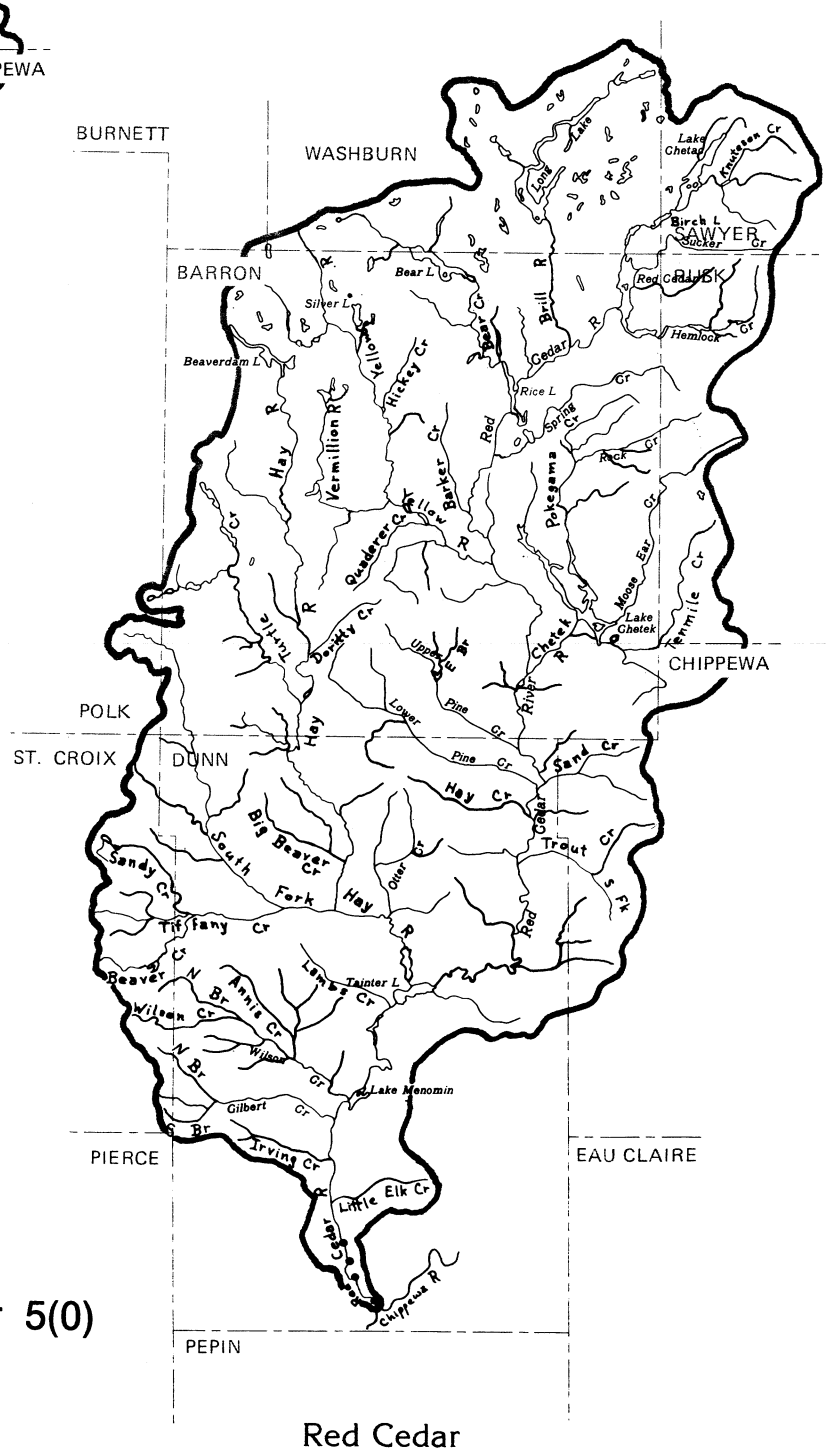
● White crappie 1(2)



MAP 70

● Black crappie 52(70)

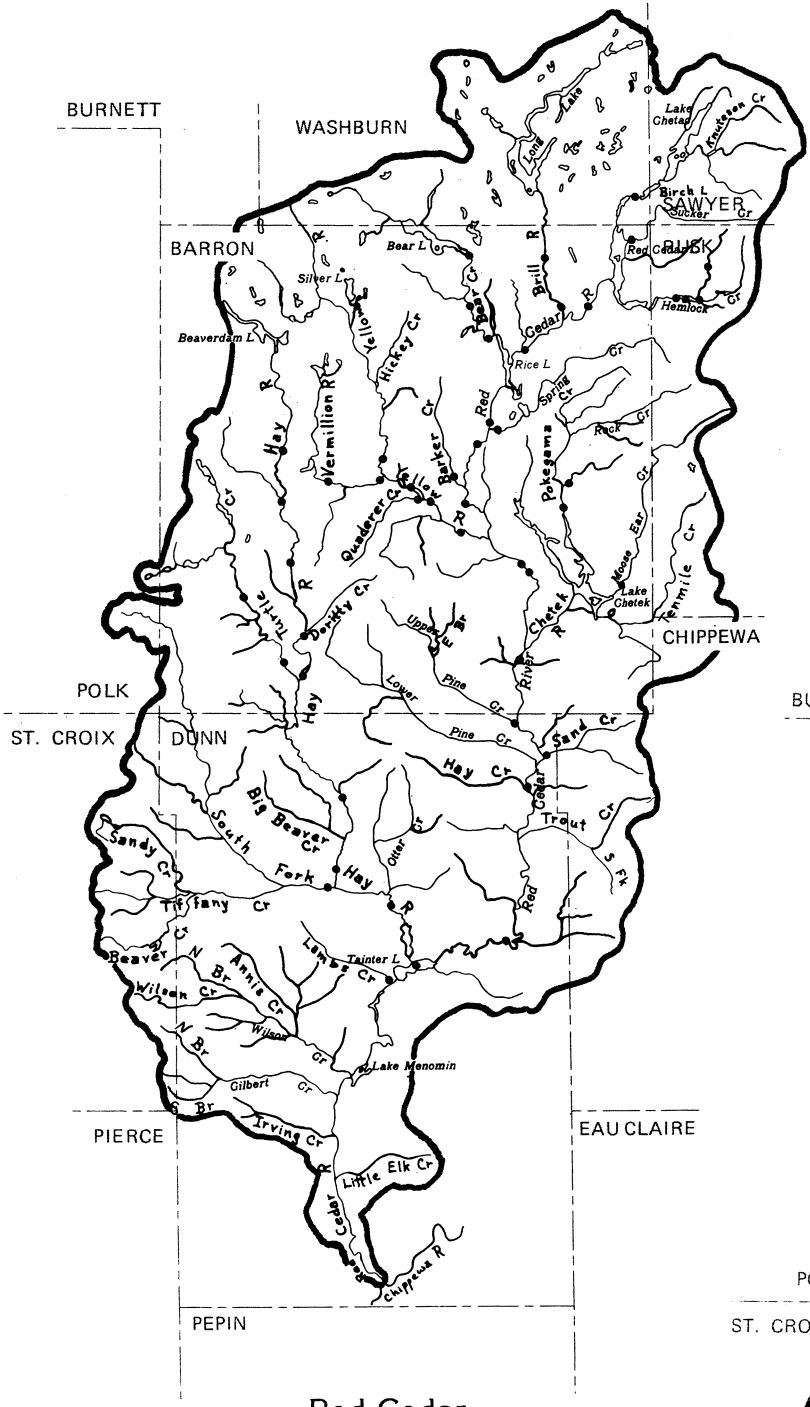
Red Cedar



MAP 71

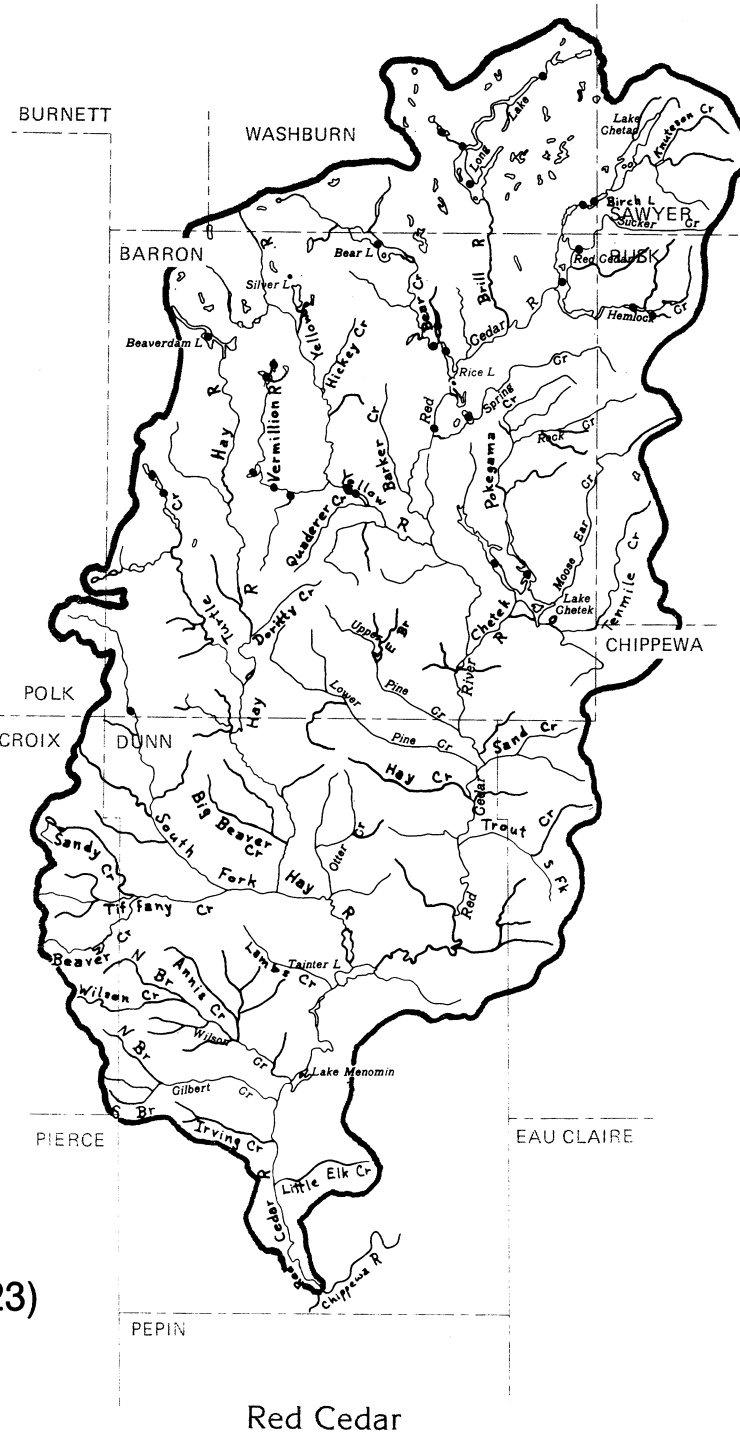
● Crystal darter 5(0)

Red Cedar



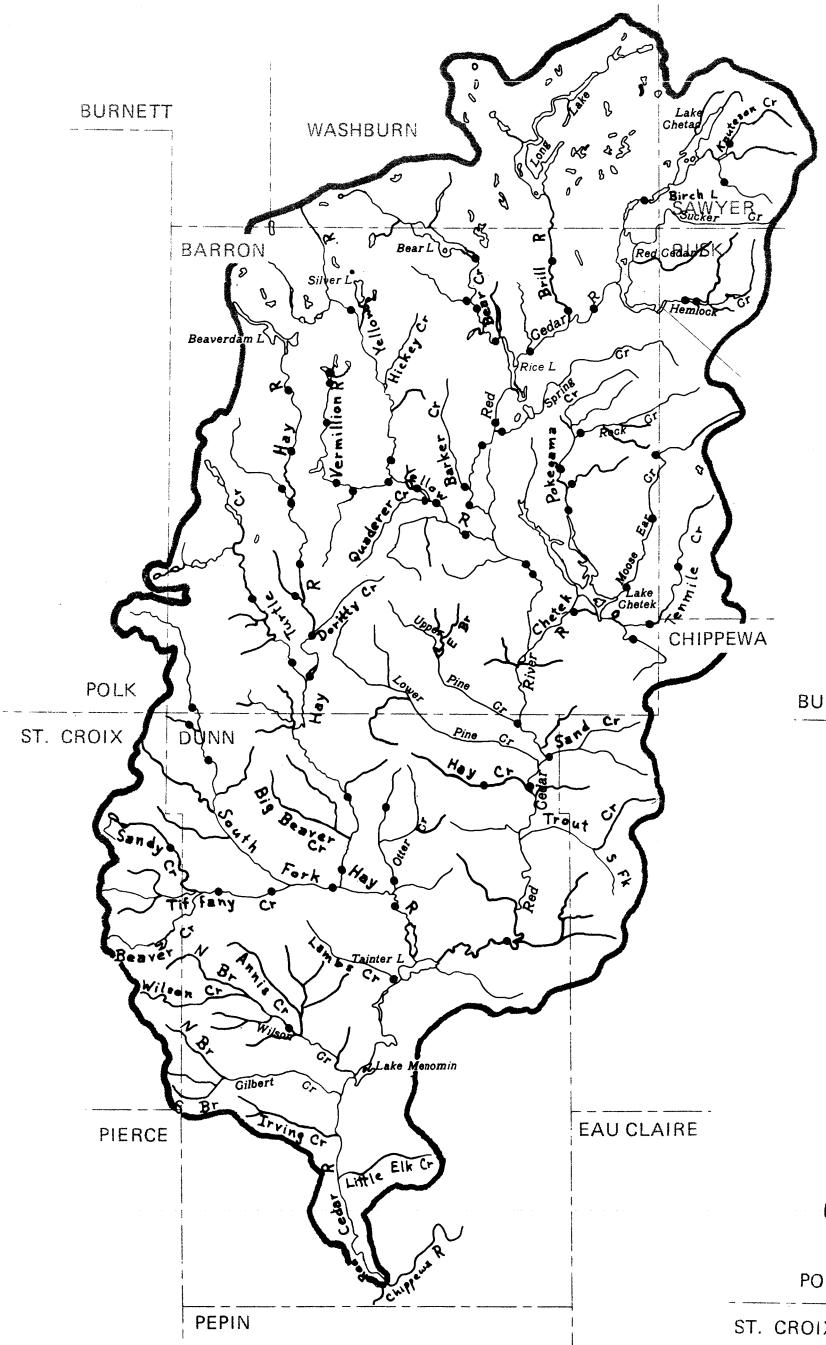
MAP 72

● Rainbow darter 48(0)



MAP 73

● Iowa darter 30(23)



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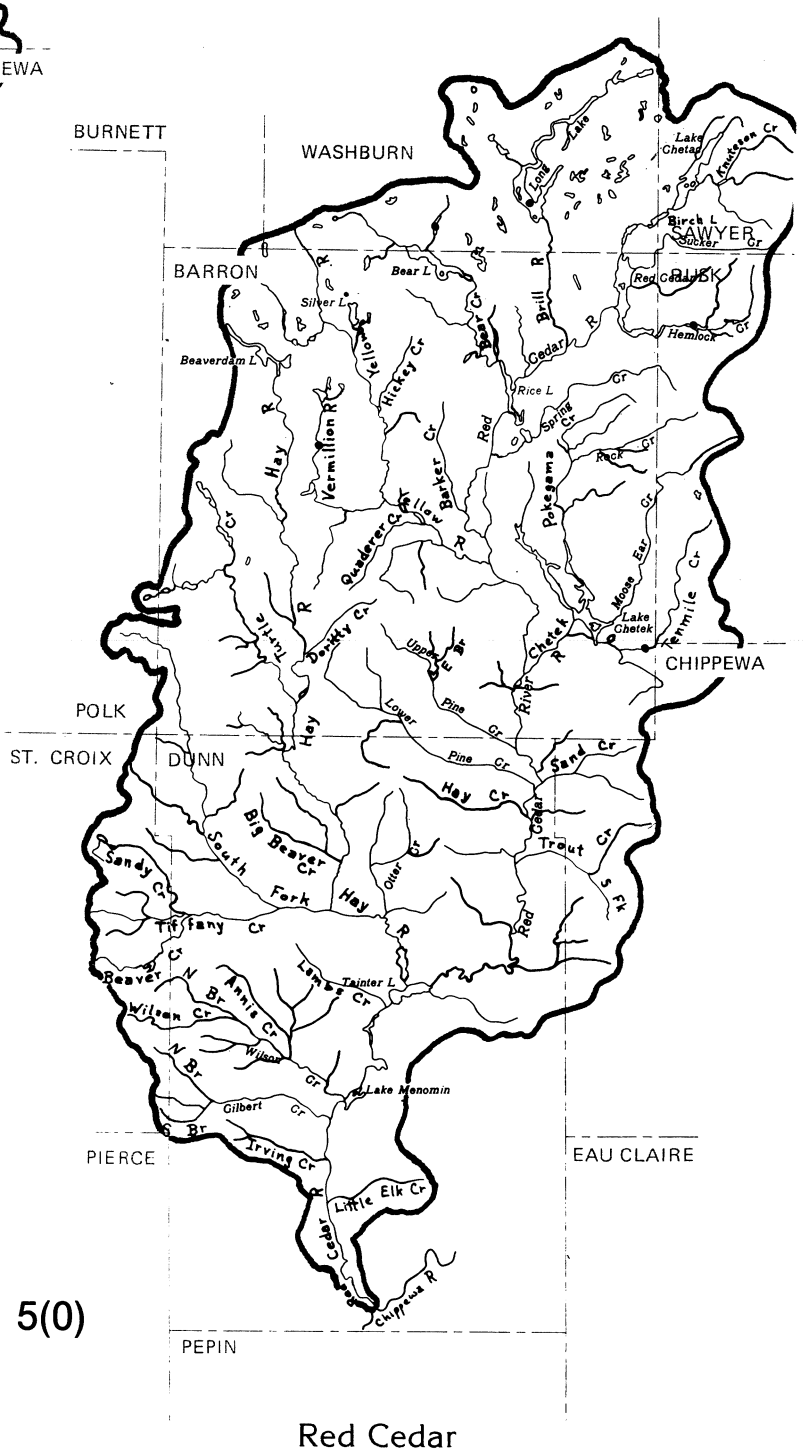
●Fantail darter 72(0)



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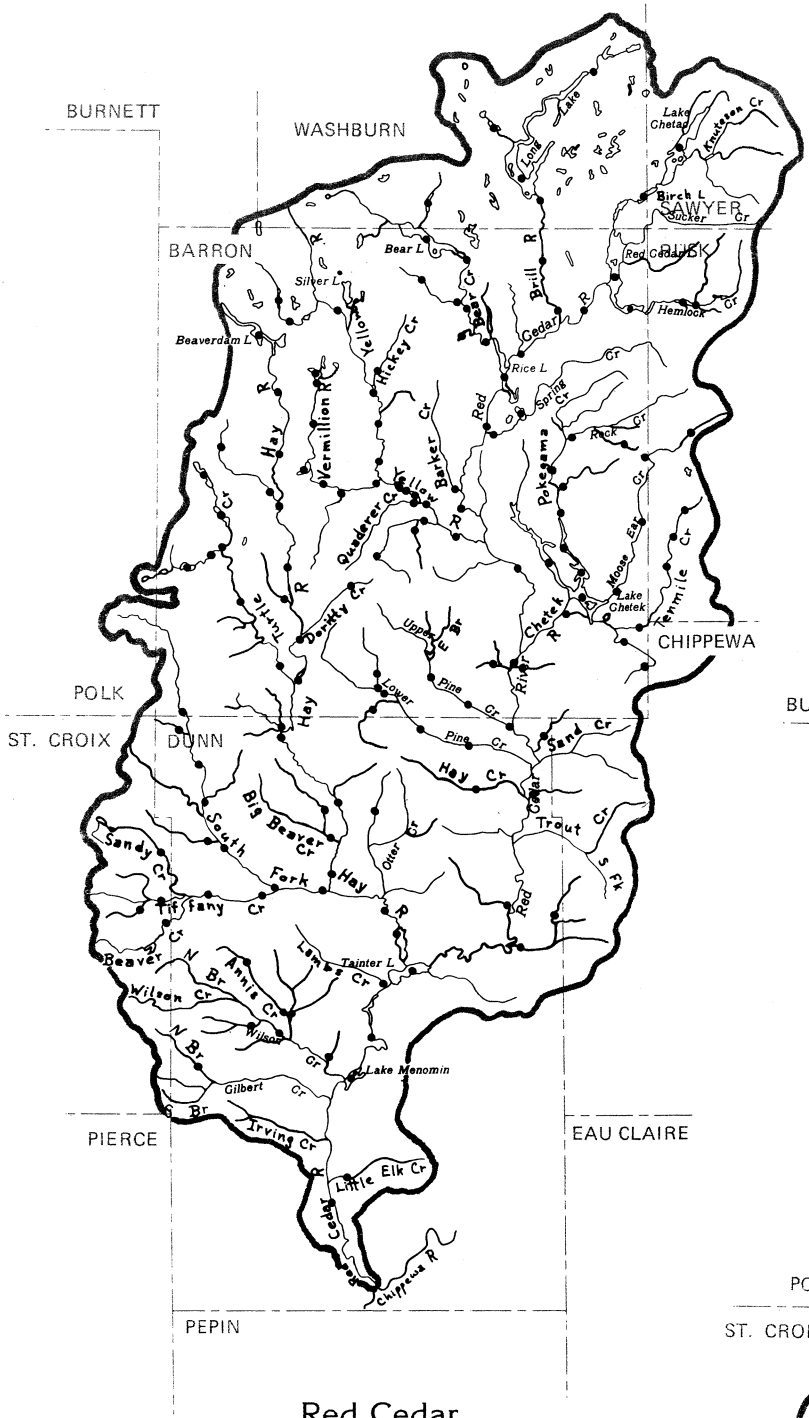

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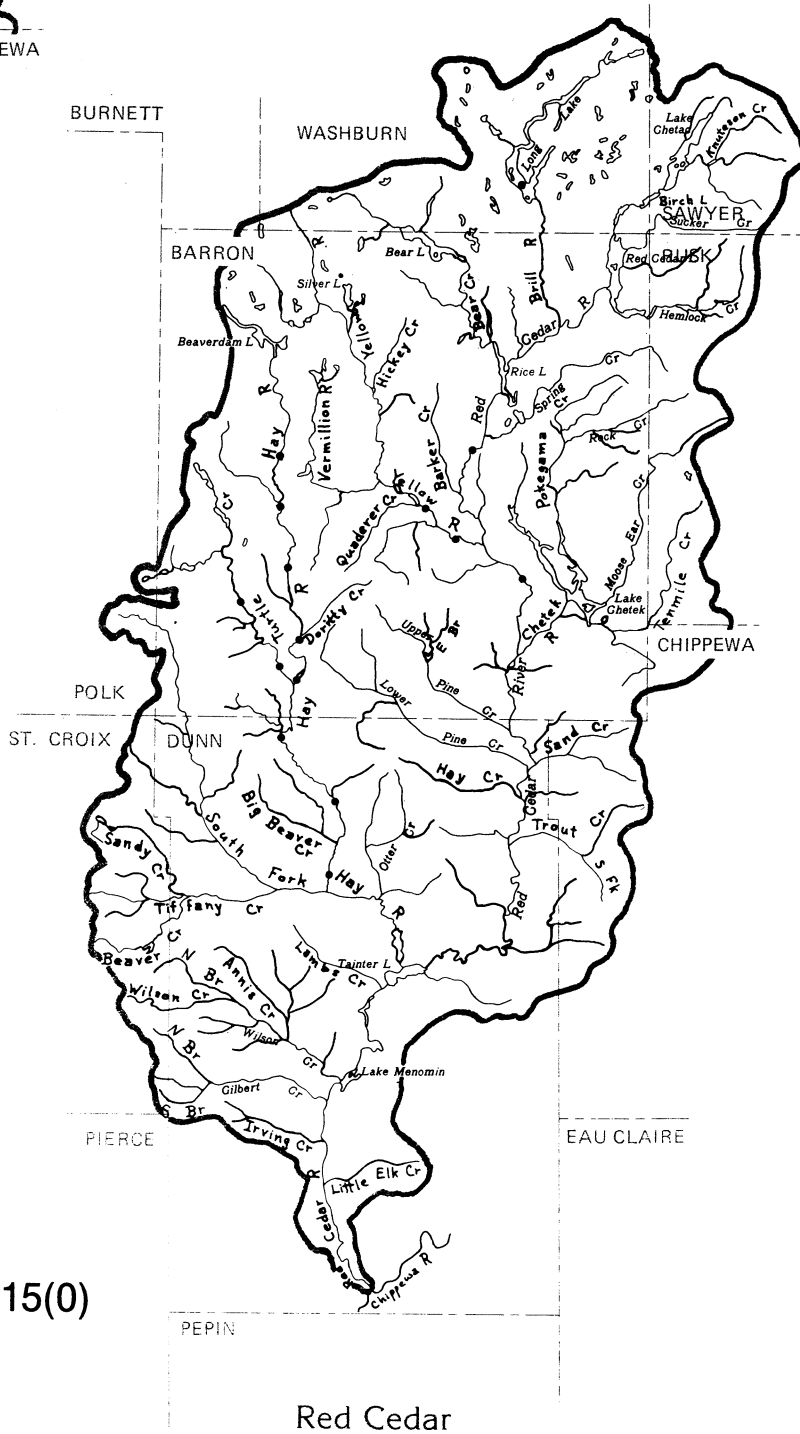
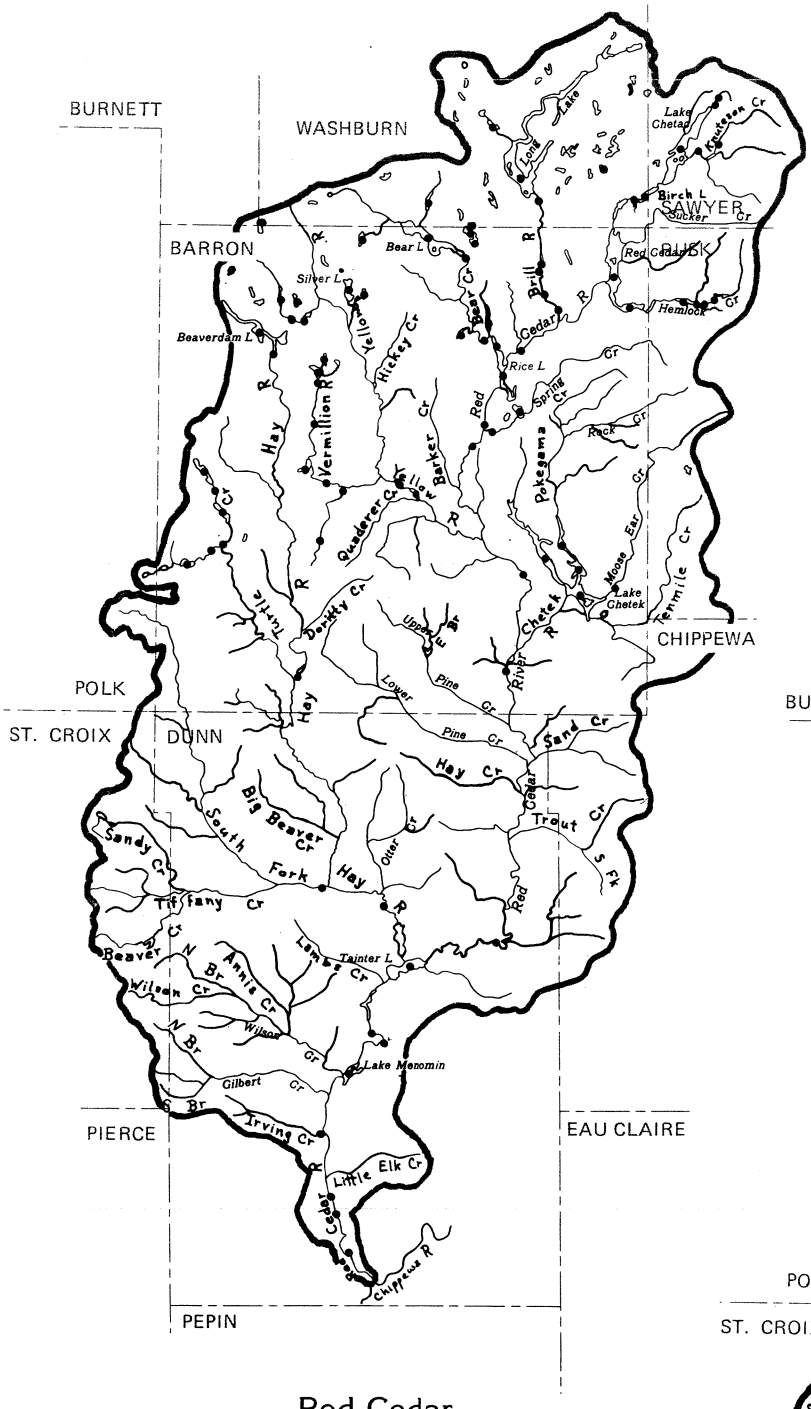


MAP 77

● Banded darter 15(0)



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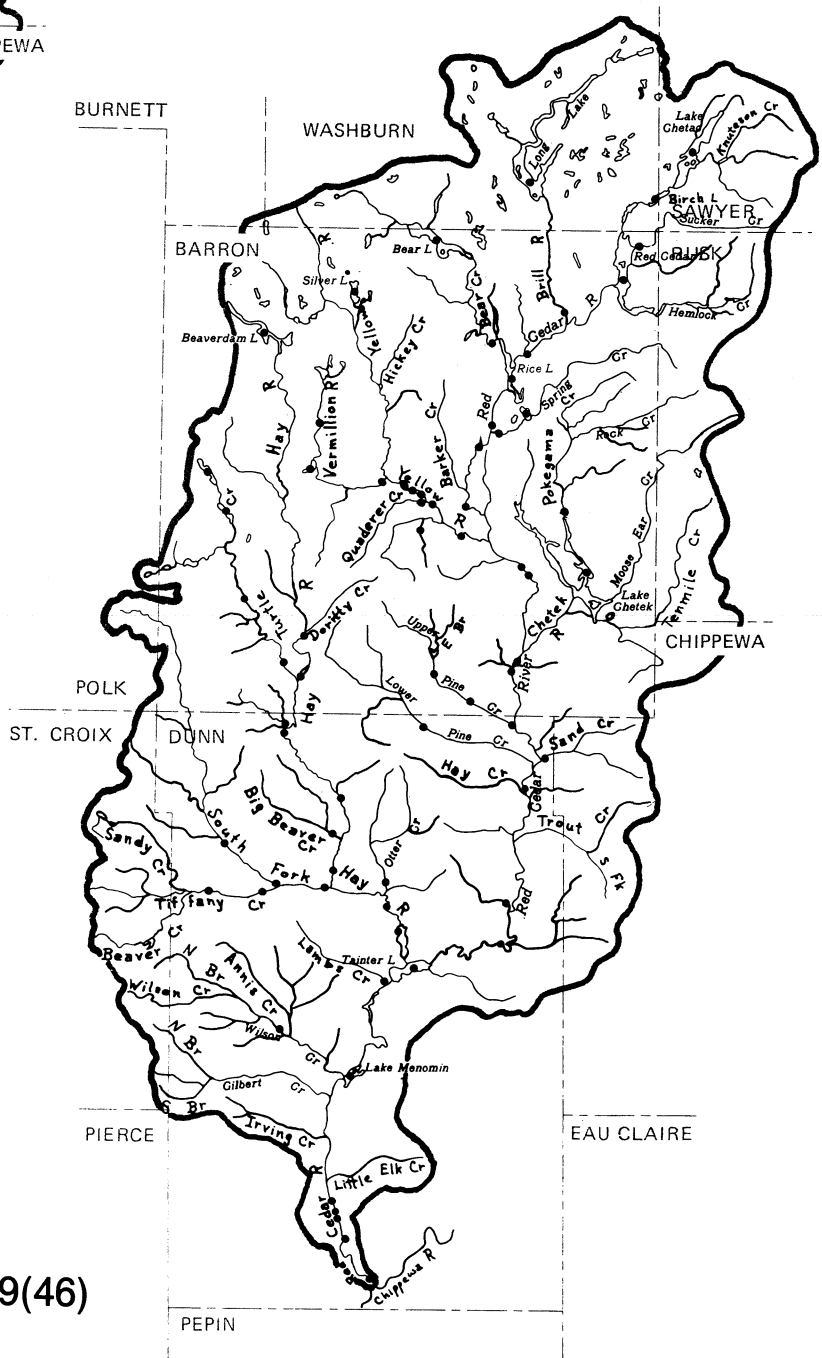
MAP 78

● Yellow perch 83(150)



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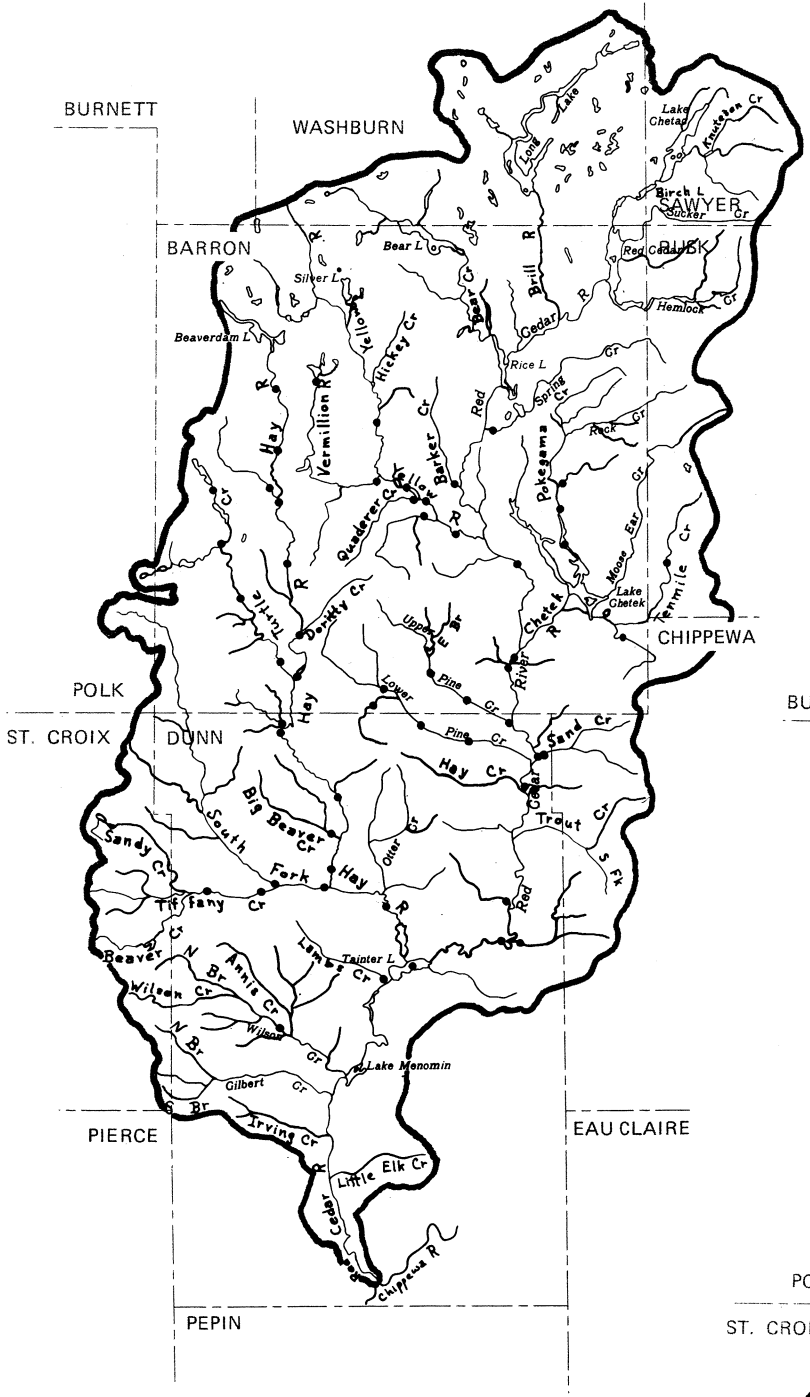
● Logperch 69(46)



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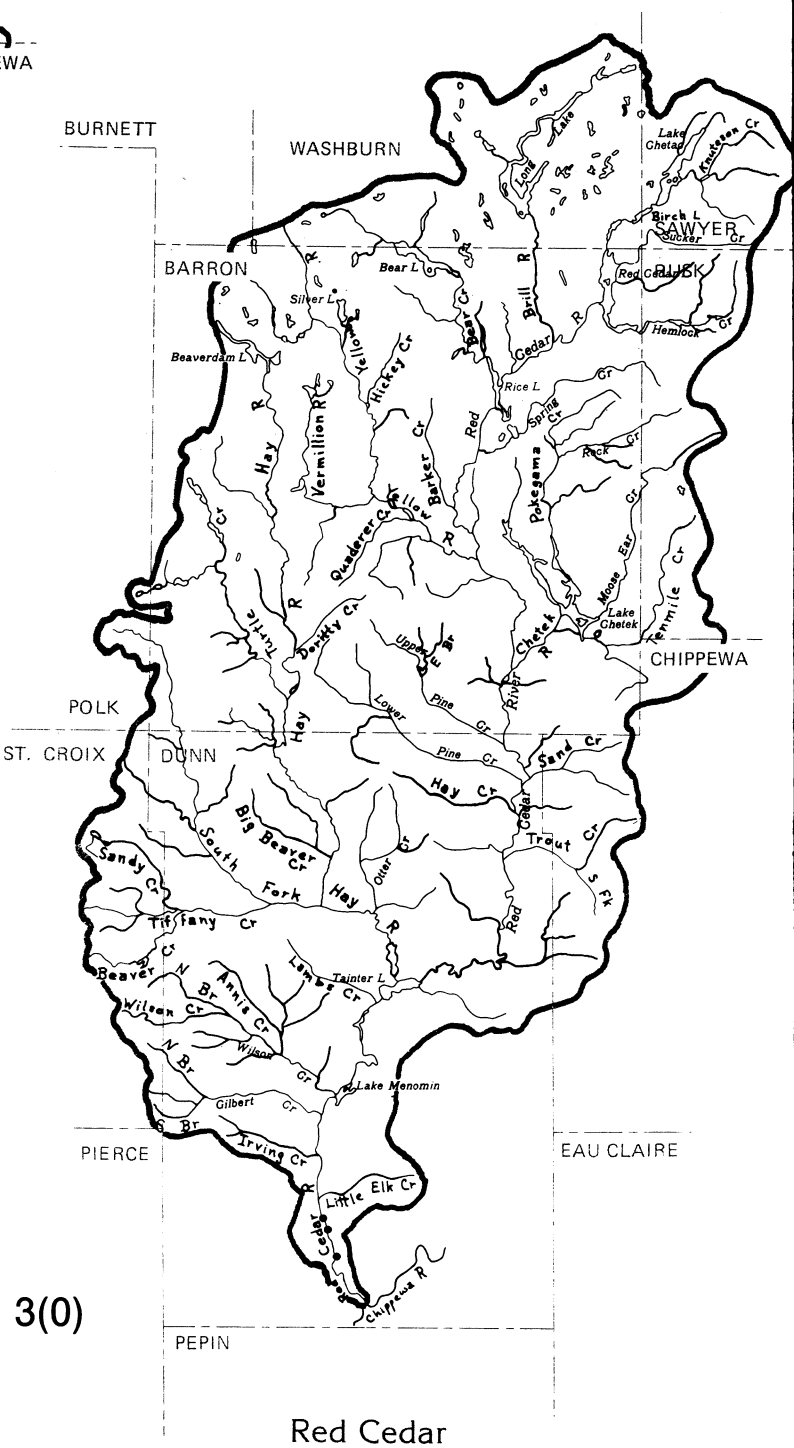

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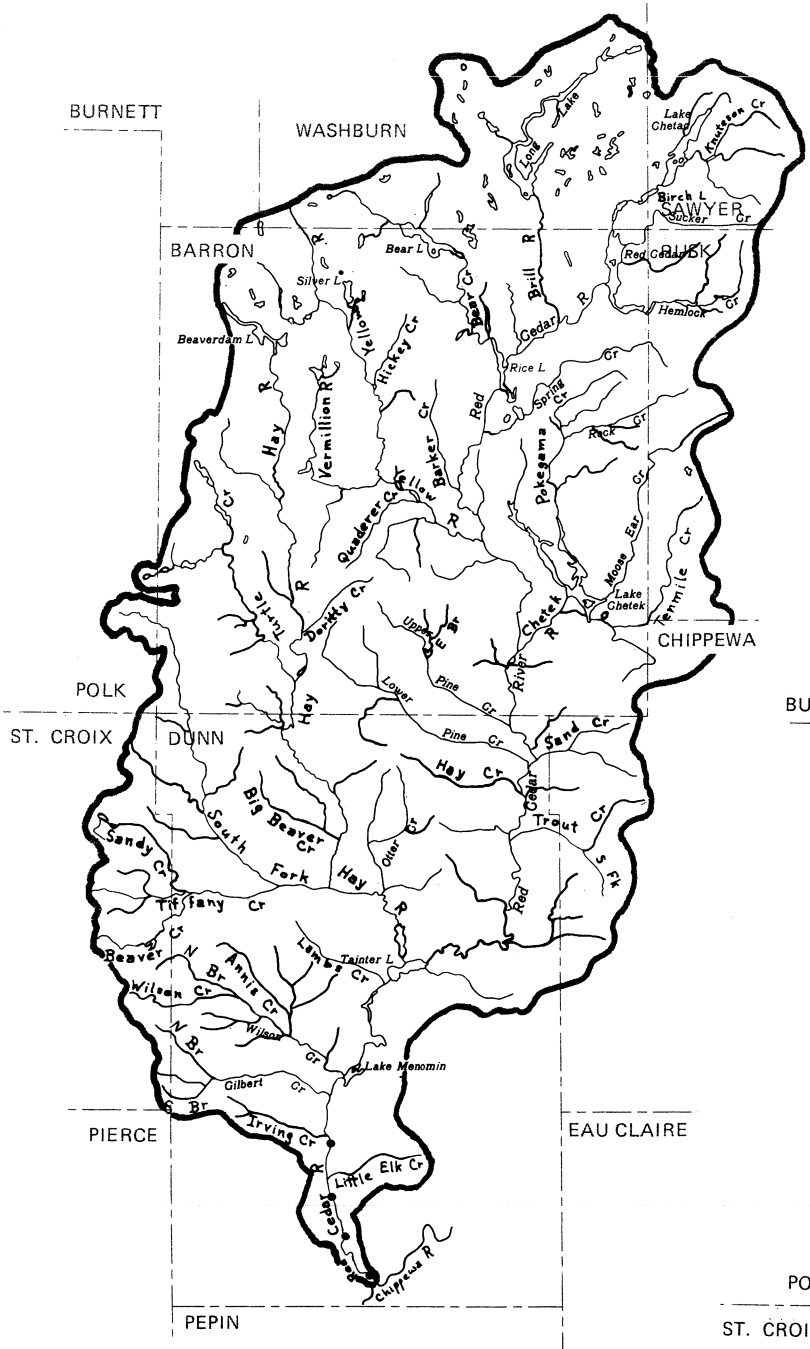
● River darter 3(0)



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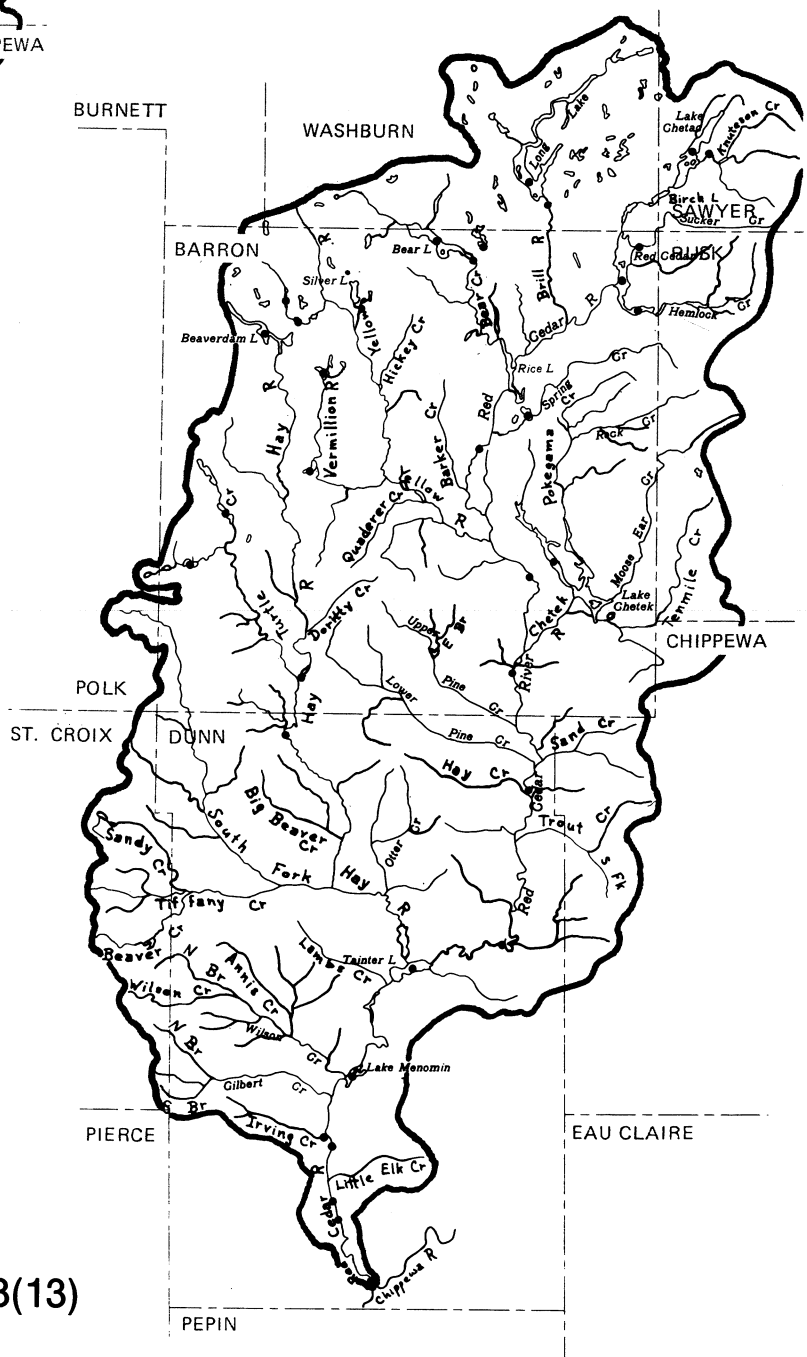

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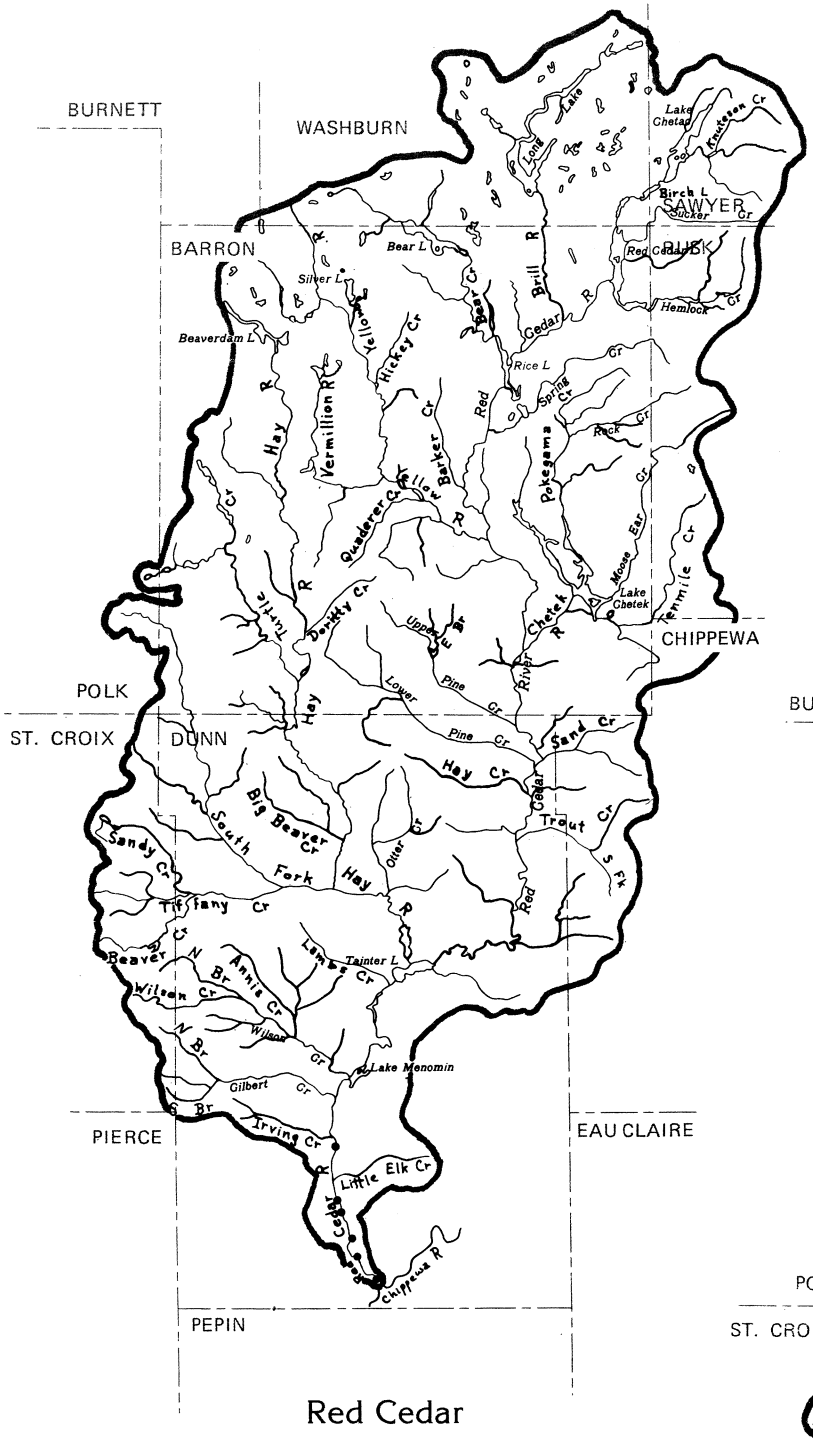

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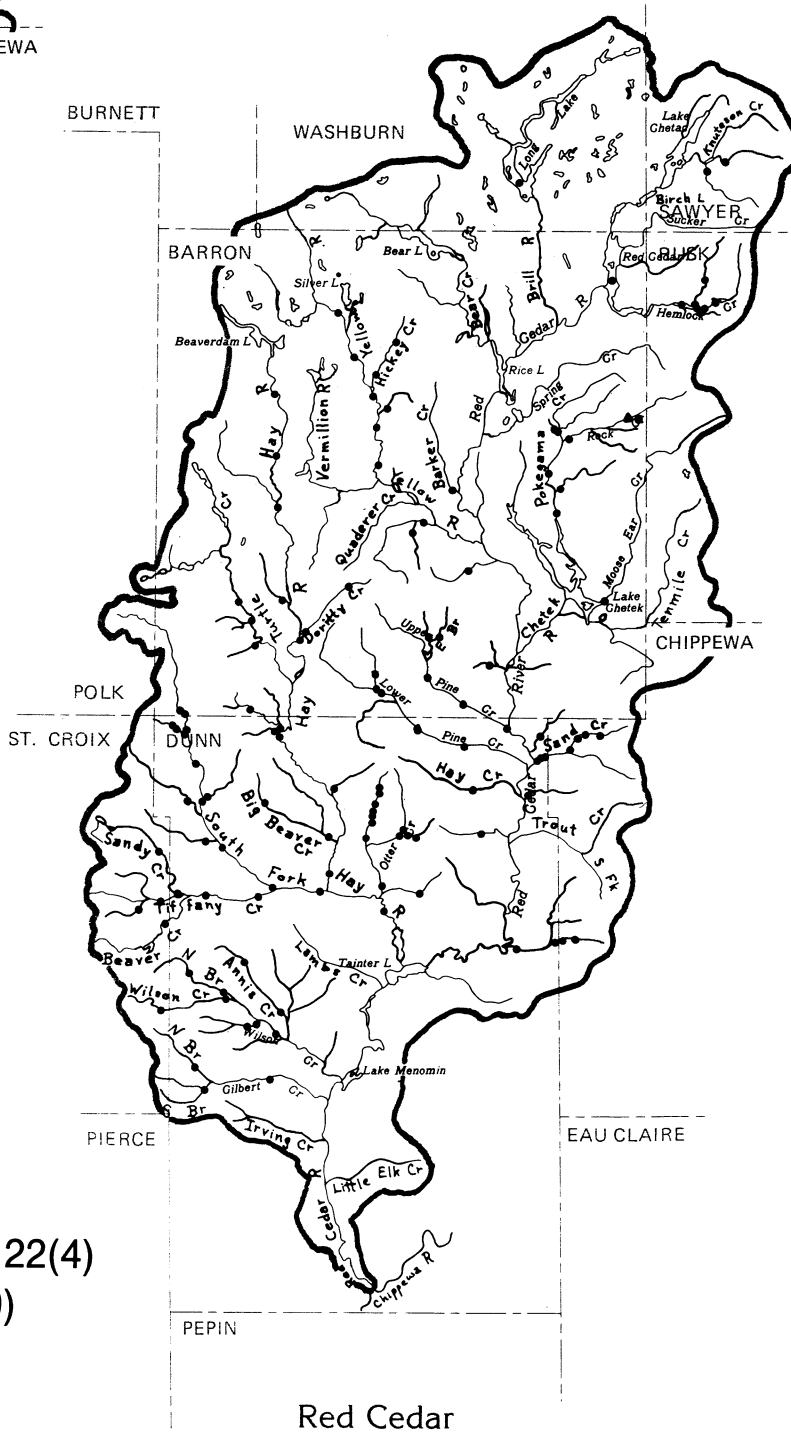
● Freshwater drum 6(0)



MAP 85

● Mottled sculpin 122(4)

▲ Slimy sculpin 1(0)

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METRIC-ENGLISH AND ENGLISH-METRIC CONVERSIONS

1 km = 0.6214 mile
1 km^2 = 0.3861 $miles^2$
1 ha = 2.47 acres
1 cm = 0.3937 inches (0.328 ft)
1 m^3 = 35.21 ft^3

1 ft = 30.48 cm
1 mile = 1.609 km
1 acre = 0.4047 ha

ACKNOWLEDGMENTS

The study of the distribution of fish in the Red Cedar River basin represents the efforts and cooperation of a number of people.

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I am particularly indebted to Dr. George Becker who shared not only his skills in fish taxonomy with members of this study, but also data from fish collections that he and his students had made.

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About the Author

Don Fago is a fisheries biologist with the Bureau of Research who has been in charge of the statewide fish distribution study since its inception in 1974 (DNR, 3911 Fish Hatchery Road, Madison, Wisconsin 53711).

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