Cheesman Dam built 1902

[S. Platte]

Klein

April 20, 1907 - 560,000 whitefish planted.

Great Lakes Whitefish-Coregenus clupeaformis (Mitchill) - caught 11-8-74 at 40ft depth by R. Imler

Tanner ref - ?

D. H. Nolting

August 25, 1961

Fish Management Services

A gill net inventory of Cheeseman Reservoir was made August 14 - 17, 1961. Four graduated nets (3/4 - 2-inch) 125-feet long and 11 level mesh nets 100-feet long were set. Five of the level mesh nets were 2-inch, six 2½-inch. The total catch is listed.

C A T C H

Species	Number Caught	Average Length (Inches)	
Perch	374	6.5 - 7.5	(Age Class III)
Rainbow	7	9 - 23	(1 four lb. and 1 five lb.)
Brown	3	12 - 14	
Native	1	16	
Kokanee	1	17	(mature male)
Cisco = C. artedi	4	18 - 20	
Western White Sucker	87	10 - 15	

Water temperatures and dissolved oxygen determinations were also made.

Depth	Temperature - F	Depth	Temperature - F
Air	78	41	51
Surface	74	42	50
5	70	43	48
10	70	44	47
		45	47
20	68	46	47
30	64	50	45
31	63	60	44
32	63	70	44
33	62	93	42
34	62	150	42
35	61	168	44 (bottom)
36	60		
37	57		
38	55		
39	54		
40	52		

O_2 - Surface - 7.1 ppm.
100 ft. - 3.3 ppm.

Respectfully submitted,

Rex Taliaferro
Fish Management Services

cc: Fish Mgmt. Services
W. D. Klein

Charles Cabiac
Ross 225
UNC
351-2646

Acanthocephs

PHONE CALL

Date

M.

You were called at

By M.

Return the call to 7.50.

The message was + .75 - 1.00 $8.25

Peg called, wish you is doing

Abstract

Ellis - AS36 C629 V 11 1914/1915

Couesius dissimilis - Juday Univ. Colo. Stud. 2:113 (1903)

= Bull. U.S. Fish Comm. for 1904 : 227 (1905) - Boulder Crk.

Univ. spec. St. Vrain, Longmont 1903; Boulder Crk, Boulder 1903.

Jordan 1889 got one specimen Hybopsis tetranemus 4 barbeled chub - at Pueblo - only American minnow w/ more than 2 barbels.

Platygobio - Ark. R.

- table 6 variation R. osculus.

Ptychocheilus lucius - Univ. Mus. - Uncompahgre R. Aug. 1889 (115 mm)

St. Teacher Coll. Mus. Delta -

Notropis scylla Boulder

N. piptolepis N. cayuga.

Phenacobius mirabilis - St. Vrain, Boulder, Lodgepole crks.

Hybognathus nuchalis -

Chrosomus erythrogaster St. Vrain, Boulder, W. Plum, Greeley.

P. plebius alamosae (= prob. C. eos.

G. nigrescens -

Xyrauchen - taken by Mohave Indians near Ft. Mohave - often marketed w/ flannelmouth - Colo. spec. Grand Junction

E. nigrum - many localities - once common Greeley before sugar factories -

- transformation Gunnison flannelmouth - Xyrauchen - bluehead - white & longnose

THESIS

FISHES OF THE SOUTH PLATTE RIVER BASIN

Submitted by

Hiram W. Li

In partial fulfillment of the requirements

for the Degree of Master of Science

Colorado State University

Fort Collins, Colorado

December, 1968

ABSTRACT

The South Platte basin was inventoried during the summers of 1967 and 1968. Twenty-three native species were collected, one salmonid, eleven cyprinids, three catostomids, two ictalurids, two cyprinodonts, two centrarchids and two percids. No member of the genus *Hybopsis* was collected. *Notropis blennius*, *Phenacobius mirabilis*, and *Salmo clarkii stomias* are rare. *Notropis heterolepis*, *Couseus plumbea*, *Chrosomus eos* and *Chrosomus neogaeus* may have been extirpated from the basin. At least twenty-seven exotic fishes have been introduced to the drainage. Most of the introduced species are salmonids and centrarchids. Man has altered the environment of the South Platte River through his activities. Water pollution, stream channelization, irrigation, and water regulation have affected the distribution and species composition of fishes in the South Platte basin.

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December, 1968

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INTRODUCTION

Purpose

Objectives of this study were to inventory the fishes of the South Platte basin, to note their distributions and to clarify as much taxonomic confusion as possible. The inventory is intended to provide information about native species as well as the extent to which introduced fishes have established populations in the basin. The South Platte basin is an example of a system which has been drastically altered from its natural state. The study reveals how these artificial modifications have influenced the distribution of fishes within the river system. The most important objective is to provide the fishery biologist with background information important in management decisions concerning the fishery resource of the river basin.

LITERATURE REVIEW

Geography and Geology

The South Platte River is a tributary of the Missouri River drainage. It is formed in South Park, a broad intermontane basin, near Fairplay, Colorado, and flows in a northeasterly direction, approximately 442 miles to its confluence with the North Platte River at North Platte, Nebraska. The drainage basin of the South Platte River encompasses an area of 24,030 square miles (Fish and Wildlife Task Force, 1967). Most of the drainage lies in a rain shadow and is an arid area averaging 16 inches of rain annually (Bjorkland and Brown, 1957). Major tributaries of the South Platte River are Clear Creek, Boulder Creek, St. Vrain Creek, Big Thompson and Cache la Poudre rivers. Intermittent streams which contribute to the South Platte River in Colorado are Crow, Pawnee, Cedar, Lodgepole, Boxelder, Lost, Kiowa, Bijou, Beaver, and Badger Creeks.

South Park was drained entirely by the Arkansas Basin prior to the late Pliocene (Thornbury, 1965). South Park then was uplifted and tilted to the east because of orogenic movement. The South Platte River began to erode westward and slowly captured the streams of the Arkansas Drainage (Thornbury, 1965). The South Platte system now drains four-fifths of South Park.

Present channel patterns of the South Platte conform closely to patterns earlier in the epoch (Bjorkland and Brown, 1957). Continental glaciation had no effect on the drainage patterns although streams in the headwaters have undoubtedly been affected by mountain glaciation.

Geological Influences on Zoogeography

Geological evidence indicates that the Missouri River was composed of several sections, designated by Todd (1914) and Thornbury (1965) as the Upper Missouri, the Middle Missouri, and the Lower Missouri drainages. The major factor responsible for the past and present drainage patterns of the Missouri basin is continental glaciation. In general, the several glacial advances (Nebraskan, Kansan, Illinoian, and Wisconsin) buried and gouged out the pre-Pleistocene drainages and caused these streams to either seek a new route around the glacier or to have their water temporarily impounded.

Preglacial drainages were drastically different from those of today. The Upper Missouri is hypothesized to have emptied into Hudson Bay (Figure 1). There is some controversy concerning the Middle and Lower Missouri drainages, but it is sufficient to state that two preglacial drainages were existent. The fauna of the South Platte River is linked to the geologic history of the Missouri drainage.

Upper Missouri

There are two major theories purporting to explain the drainage patterns of the Upper Missouri. Todd (1914) hypothesized that the Missouri, Red and Souris Rivers once drained into Hudson Bay, while Leonard (1916) believed that the preglacial drainage pattern was much as it is today. Todd's hypothesis is more widely accepted today due to evidence recently uncovered by further investigation. Warren (1952) thought that the origin of the Missouri River in South Dakota was a fairly recent event, probably occurring during the Illinoian. His argument is based on the fact that the western part of the Missouri

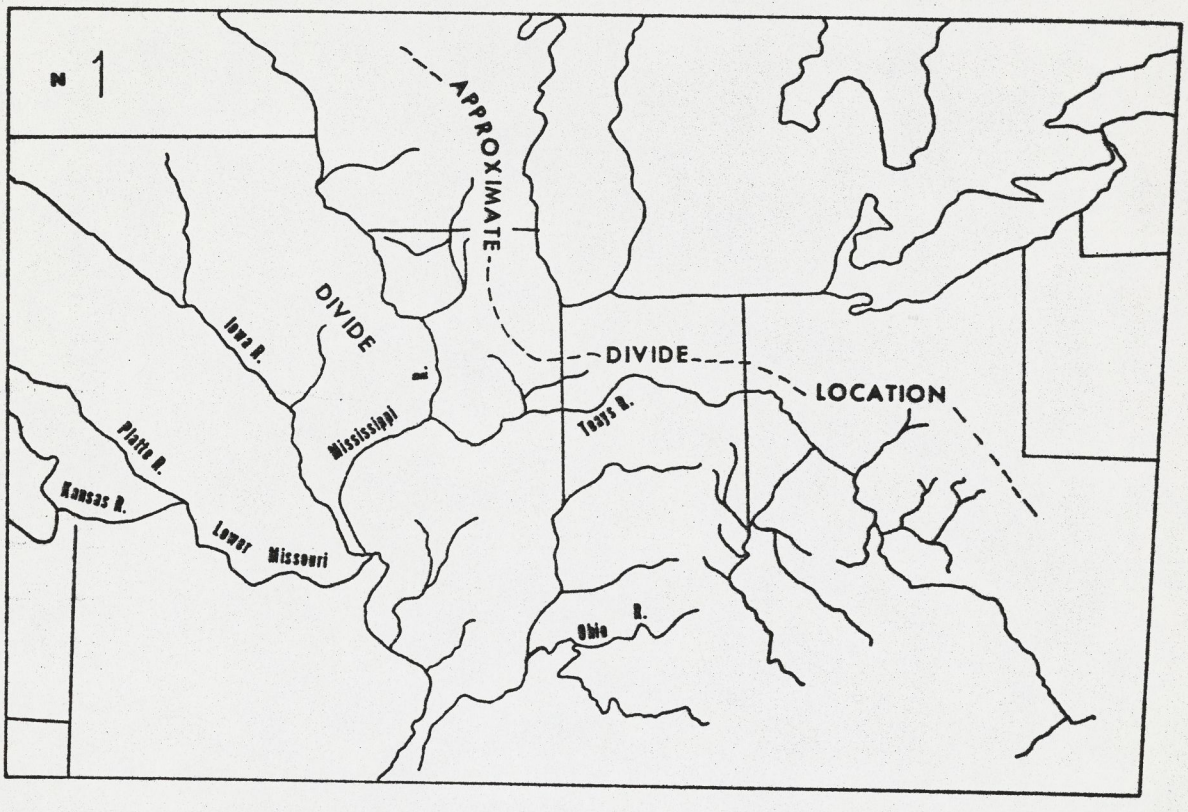


Figure 1. Preglacial drainages of the United States according to Thornbury (1965).

Plateau is deeply dissected. This incise valley is called the Missouri Trench and represents a recent route of the Missouri River caused by glacial diversion. The river does not broaden out (mature) until it reaches northwest Missouri near Kansas City. Later, three geologists: Menely, Christiansen, and Kupsch (1957) reported that they had found a buried valley 12 miles wide which had cut 250 feet into the bedrock in southeast Saskatchewan. This was, they decided, the preglacial Missouri which Todd (1914) had theorized as flowing towards Hudson Bay. Indeed, they traced its circuitous route eastward into Manitoba and found what appeared to be the preglacial Yellowstone River confluent with preglacial Missouri 15 miles north of the boundary between the United States and Canada. The Upper Missouri may have been composed of several components until the late Wisconsin (Thornbury, 1965).

These drainages were subsequently fused when the Keewatin Ice Sheet blocked eastward flowing streams and diverted them south along its western boundary. The diversion southward accounts for the flow of water contrary to the regional slope (Russell, 1929). The southern and western-most limit of glacial advance was made by the Dakota Ice Sheet to West Point, Nebraska (Todd, 1914). The continental glacier overrode the preglacial Missouri, diverted it south from Hudson Bay and buried it with glacial till.

The diversion allowed the fishes of the Hudson Bay drainage to invade the South Platte basin and other parts of the Middle and Lower Missouri basins. *Pantosteus platyrhynchus*, *Semotilus margarita*, *Chrosomus eos*, *C. neogaeus*, *Catostomus catostomus*, and *Couesius plumbea* are fishes which probably have invaded south from Hudson Bay as they have relict patterns of distribution extending from Colorado and Wyoming

into the Canadian Northwest Territories (Bailey and Allum, 1962). Except for *Pantosteus platyrhynchus* and *Semotilus margarita* all these species have been recorded in the South Platte basin. *Pimephales promelas*, *Catostomus commersoni*, and *Rhinichthys cataractae* are species which may have been widespread in the preglacial upper sections of the Missouri and are presently found in the South Platte basin.

Middle and Lower Missouri

There are two theories concerning the Middle and Lower Missouri drainages. Greene (1921) concluded that the preglacial Kansas was a tributary of the Platte River and became confluent with it in northwest Missouri. The Platte emptied into the Missouri River. This theory is favored by Horberg and Anderson (1956), and Thornbury (1965).

Metcalf (1966) found evidence to show that the Platte and Kansas rivers were part of a Preglacial Plains Stream. This stream flowed south across Kansas and penetrated into Oklahoma. The crux of his argument is that no geologic evidence has been found to indicate an eastern drainage (Figure 2). Studies of Ozark fluvial benches and disjunct populations of *Etheostoma spectabile*, *Fundulus kansae*, and *Phenacobium mirabilis* in the Brazos, Pecos and Colorado rivers of Texas and tributaries of the lower Missouri tend to substantiate his theory. Williams (1954) theorized that a connection between the Platte, Kansas, Arkansas, and the western Ozark streams could explain the distribution of the crayfish, *Orconectes neglectus neglectus*.

Metcalf (1966) considered the mature section of the Missouri drainage (which Greene [1929] concluded was the Platte River) as the eastern part of the Kansas River system which flowed into the

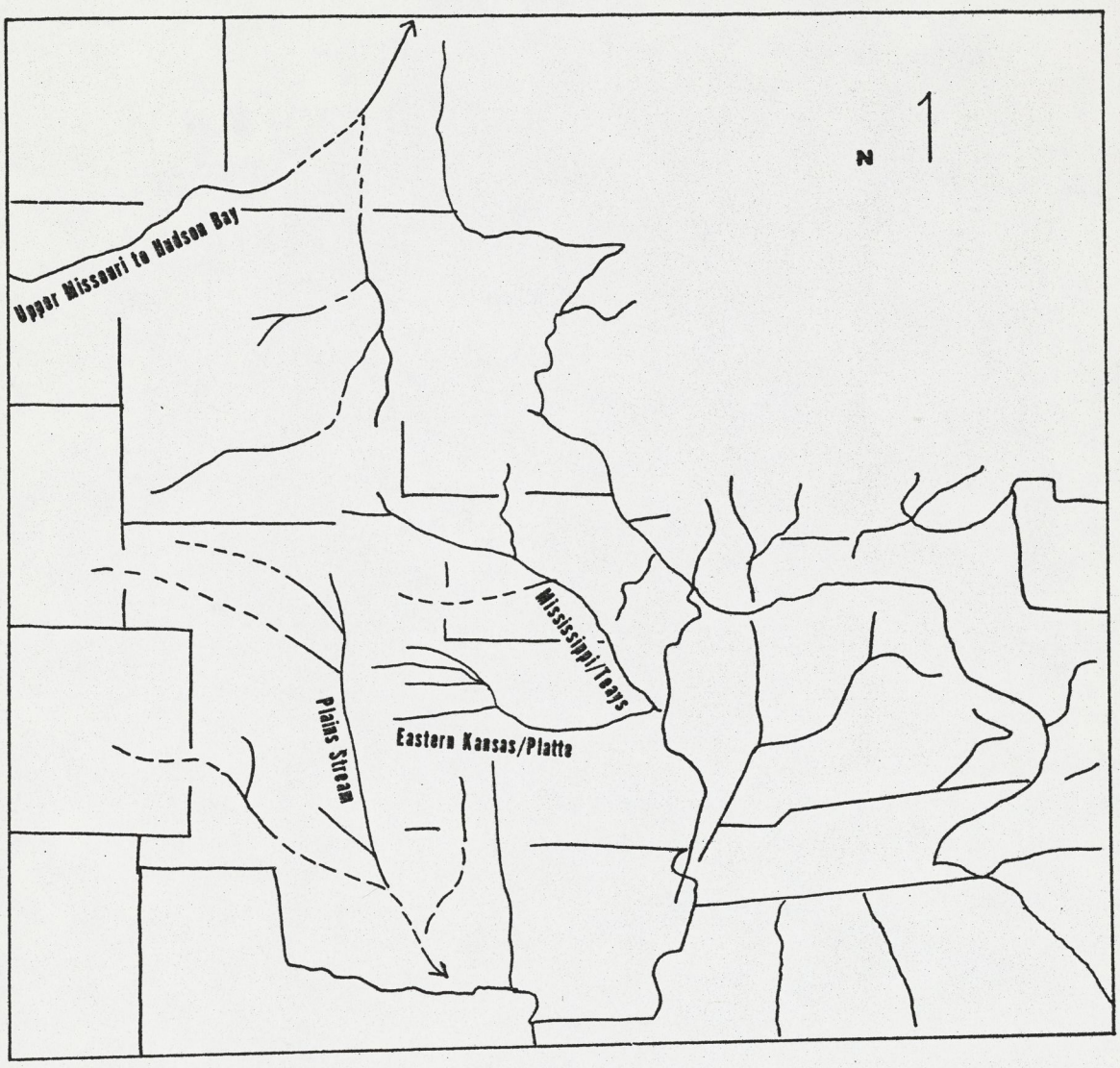


Figure 2. Preglacial drainages of the United States according to Metcalf (1966).

Teays/Mississippi. He explained that the retreat of the continental ice sheet made it possible for headwater extension westward by eastern streams of the Teays/Mississippi system. The competence of the Plains Stream basin was lowered and became an aggrading system. Headwater capture by eastern streams ensued.

Fish of the Middle Missouri basin show a similar pattern with the upper basin. Big river fauna has an eastern (Mississippian) origin. Certain species of northern (Hudsonian) origin have filtered down from the Upper Missouri. The number of species decreases from east to west, or away from the Missouri River proper. This is demonstrated by the distribution maps of Cross (1967), Johnson (unpublished Ph.D. thesis, University of Michigan) and Metcalf (1966). Diversity of species increases as one moves towards the Lower Missouri basin as it is heavily influenced by the Mississippi River. The Ozark region has contributed many fishes, especially of the genus *Notropis* and darters. Species composition typical of Ozark fauna becomes less complex and is drastically reduced before one reaches central Kansas. This phenomenon is observable in the Neosho, Springs, and Kansas rivers. The lower Missouri acted as the access route for fishes from the Mississippi drainage to the rest of the Missouri Basin.

Bailey and Allum (1962) have categorized two types of invading fishes: fishes of high vagility which inhabit large rivers (such as the Missouri River), and what Metcalf (1966) has termed tributary jumpers, fishes which live in small tributaries but use the big rivers to jump from one tributary to another. Examples of big river fish are sturgeons, gars and paddlefish; whereas darters and killifish are illustrations of tributary jumpers. Distribution maps of Cross (1967) and Johnson

(unpublished Ph.D. thesis, University of Michigan, 1942) indicate that big river fishes are seldom found in the upper reaches of the Missouri River tributaries. Rather, they are found near the confluence of the tributaries and the Missouri River, and in the Missouri River proper.

One of the faunal characteristics of the South Platte basin is the scarcity of big river fishes. Increasing degrees of aridity westward from the mouth of the Platte River may be the ecological barrier prohibiting these species from inhabiting the South Platte basin. To illustrate the lack of water in the South Platte basin, a comparison with the Missouri and Platte rivers is useful. At Bismark, North Dakota, the Missouri River has averaged 20,550 cfs (14,880,000 acre-ft./yr.) for 38 years (U.S.G.S. Water Resources Division, 1966b). The Platte River at Grand Island, Nebraska, (includes water from the North Platte River) had a maximum discharge of 2,814 cfs in 1966 (U.S.G.S. Water Resources Division, 1966a). The South Platte River at Julesburg, Colorado, (near the Nebraska border) has had an average discharge of 458 cfs (331,000 acre-ft./yr.) for 59 years (U.S.G.S. Water Resources Division, 1961). Continuing in a westerly direction, the South Platte River at Denver has had an average discharge of 345 cfs (249,800 acre-ft./yr.) for 66 years (U.S.G.S. Water Resources Division, 1961).

The Effect of Man on the South Platte River

Agriculture has had a profound influence on the characteristics of the South Platte River. Approximately 781,000 acres of land in the South Platte basin are under irrigation (U.S.DI. Federal Water Pollution Control Administration, 1967). Principal crops raised are corn, sugar beets, grains and alfalfa.

The South Platte River has changed from an intermittent stream to a perennial one. F.V. Hayden (1869), while exploring Colorado, observed that, "In Autumn, nearly all smaller streams dry up entirely, and in several seasons the Platte has been known to become so low as to have no continuous current." Jordan (1891) reported that the characteristics of the South Platte River were being dramatically altered because of extensive farming. Prior to irrigation, the South Platte was often reported to be dry in the lower Platte Valley (Bjorkland and Brown, 1957:52). This change is due to ground-water recharge from seepage of irrigation canals and reservoirs which raises the water table near these sites during the irrigation season (Bjorkland and Brown, 1957:43). The South Platte is a gaining stream; in other words, the stream lies below the water table and gains water from it as it flows downstream.

Reservoirs and water diversion structures are ramifications of intensive irrigation. They contribute to the change by controlling the discharge of the stream. The stream bed changes from a wide, shallow river, braided with sandbars to one which is narrow, deep and steeply banked. Siltation increases and a thick layer of mud covers what was once a sandy river bottom.

Dewatering is severe in the Platte Valley and reduces the flow of the stream (Fish and Wildlife Task Force, 1967). The first wells were sunk in 1910, and now there are over 9,600 wells withdrawing an estimated 1.22 million acre-feet per year (U.S.D.I. Federal Water Pollution Control Administration, 1967). Dewatering is so intense that water from the Colorado River is imported via the Alva B. Adams Tunnel

constructed in 1947. Water is also imported from the North Platte drainage to the South Platte drainage in North Park via the Cameron Pass Ditch, Michigan Ditch, Skyline Ditch, Laramie-Poudre Tunnel, and Wilson Supply Ditch.

Irrigation is not the only agent affecting changes. The South Platte River is notorious for its polluted waters. The Fish and Wildlife Task Force (1967) studying the Platte basin, estimates 229 miles of the South Platte River proper are badly degraded. Major tributaries and their respective miles of degraded stream are as follows:

Cache la Poudre River . . . . . 20 miles

Big Thompson River. . . . . 12 miles

St. Vrain Creek . . . . . 15 miles

Clear Creek. . . . . 20 miles

Boulder Creek. . . . . 17 miles

Pollution comes from many sources. As early as 1909 fish kills were attributed to mine wastes in Boulder Creek (Ellis, 1914). Petroleum fields produce 3,480 acre-feet of water with high concentrations of sodium (956 - 4,480 mg./l.), chlorides (650 - 7,000 mg./l.), and bicarbonates (2,960 - 12,400 mg./l.) (U.S.D.I. Federal Water Pollution Control Administration, 1967:12). A Logan County oil field once discharged 50 gallons per minute of this saline water into the South Platte River. Some companies store water in holding ponds. Unfortunately, these ponds are sometimes located in permeable soil and bedrock, allowing seepage of saline water into the water table. High concentrations of alkyl benzene sulfonate are found near the municipalities. The U.S. Department of Interior estimates that pollution by this type of

detergent will last for several decades; although its manufacture has ceased it exists in the drainage at very high concentrations (U.S.D.I. Federal Water Pollution Control Administration, 1967). Nitrates often exceed the 45 mg./l. upper limit set by the U.S. Public Health Board as potable water. Water returned from irrigated fields has been the major source of nitrates in the drainage. Municipalities so befoul the river that the South Platte Valley is virtually an open sewer between Denver and Kersey, Colorado, (U.S.D.I. Federal Water Pollution Control Administration, 1967:20). Feedlots, sugar beet processing mills and meat packing plants are important sources of pollution in localized areas.

Fish habitat has been reduced further by another insidious process: stream channelization. Meanders, pools and cover have been eliminated; a smooth, uniform bottom and a monotonous environment exists in their stead. A good example of stream channelization exists in the Cache la Poudre River, north of Fort Collins before entering the Poudre Canyon.

The result of Man's degradation of the South Platte River is dramatically illustrated by a quote from the Fish and Wildlife Task Force (1967), "Native trout originally ranged far downstream from Denver and as late as the 1920's, the newspapers carried photographs of trout catches within the city." This stretch of water is now almost barren of fish.

Historical Records

The fishes of the South Platte basin have not been well documented. The earliest scientific collection was undertaken by Jordan (1891) in 1889. (see Table 1). He collected specimens from four sites: the South

Table 1. Jordan's (1891) collection of South Platte fishes

Jordan	Present nomenclature and corrections of misidentified fishes
Catostomus griseus	*Catostomus catostomus*
Catostomus teres sucklei	*Catostomus commersoni*
*Hybognathus nuchalis**	*Hybognathus hankinsoni*
Notropis scylla	*Notropis stramineus missuriensis*
Notropis gilberti	*Notropis dorsalis*
Notropis megalops	*Notropis cornutus*
Notropis lutrensis	
Semotilus atromaculatus	
Rhinichthys dulcis	*Rhinichthys cataractae*
Zygonectes floripinnis	*Fundulus sciadicus*
Etheostoma nigrum	
Salmo mykiss stomias	*Salmo clarkii stomias*

* Jordan probably misidentified *H. hankinsoni*. He stated that identification of species within the genus *Hybognathus* was difficult and was in need of further study. He described the specimens as having a lateral band which are found only on *H. hankinsoni*.

Collection sites: Hartsel's Hot Spring (South Park)

Denver (South Platte River)

Bear Creek above Morrison

Middle Boulder Creek

Platte River at Hartsel's Hot Springs, South Platte River in Denver, Bear Creek above Morrison, and Middle Boulder Creek. Sampling was not comprehensive as three of the four sites were montane habitats. The South Platte River at Denver was the only plains station sampled.

Few studies were conducted in following years. Collections were made around Boulder County near the turn of the century. Juday (1904, 1905) published two papers on the fishes in Boulder County (see Table 2). Cockerell (1908, 1909, and 1911) did little original research on Colorado's present ichthyofauna as he was interested in paleontology. He further confused the taxonomy of the genus *Notropis* by describing two species of doubtful status: *N. horatii* Cockerell, and *N. universitatus* Evermann and Cockerell. Ellis' (1914) compilation of collection reports on Colorado fishes is the most important early document. It is uneven as little personal investigation was involved (see Table 3). Information concerning species distribution is negligible because no systematic analysis was attempted. Hendricks (unpublished Master's thesis, University of Colorado, 1950) assayed the faunal changes of Boulder County from 1904 to 1950 (see Table 4). He noted that several species had been eliminated. The latest publication concerning Colorado fishes is a check list that Beckman (1952) compiled from the literature and from his personal collection (see Table 5). No study of species distribution was attempted by him. Recent systematic studies have uncovered new information which needs to be incorporated to prevent perpetuation of errors.

Fortunately, some estimate of species distribution and composition can be assessed from studies of other tributaries of the Missouri River system. Bailey and Allum (1962) discussed the fauna and zoogeography of

Table 2. Juday's (1904) collection of fishes in Boulder County, Colorado

Juday (1904)	Present nomenclature and corrections of misidentified fishes
*Carpiodes velifer**	*Carpiodes carpio carpio*
Catostomus grieseus	*Catostomus catostomus*
Campostoma anomalum	
*Chrosomus erythorgaster**	*Chrosomus eos*
Hybognathus nuchalis	
Pimephales promelas	
Leuciscus sp.	*Semotilus atromaculatus*
Notropis cayuga	*Notropis heterolepis*
Notropis scylla	*Notropis stramineus missuriensis*
Notropis piptolepis	*Notropis dorsalis*
Notropis lutrensis	
Notropis cornutus	
Phenacobius scopifer	*Phenacobius mirabilis*
Rhinichthys cataractae	*Rhinichthys cataractae pullum*
Hybopsis kentuckiensis	*Hybopsis biguttata*
Fundulus zebrinus	*Fundulus kansae*
Pomoxis spariodes	*Pomoxis annularis*
Apomotis cyanellus	*Lepomis cyanellus*
Micropterus salmoides	
Boleosoma nigrum	*Etheostoma nigrum*
Etheostoma iowae	*Etheostoma exile*

* misidentification corrected on the basis of comparison of given characters with known species or examination of specimens

Collection Sites: St. Vrain Creek

Boulder Creek

Table 3. Ellis' (1914) list of fishes of the South Platte River

Ellis (1914)	Present nomenclature and correction of misidentified fishes
Ameiurus melas n	*Ictalurus melas*
Ameiurus nebulosus i	*Ictalurus nebulosus*
Ictalurus punctatus n	
*Carpiodes velifer** n	*Carpiodes carpio carpio*
Catostomus commersoni sucklii n	*Catostomus commersoni*
Catostomus griseus n	*Catostomus catostomus*
Cyprinus carpio i	
Carassius auratus i	
Campostoma anomalum n	*Campostoma anomalum pullum*
*Chrosomus erythrogaster dakotensis** n	*Chrosomus eos*
Pimephales promelas n	
*Richardsonius evermanni** n	*Semotilus atromaculatus*
Notropis cayuga n	*Notropis heterolepis*
Notropis piptolepis n	*Notropis dorsalis*
Notropis scylla n	*Notropis stramineus missuriensis*
Notropis horatii n	*Notropis dorsalis*
Notropis cornutus n	
Notropis universitatus n	*Notropis cornutus*
Notropis lutrensis n	
Semotilus atromaculatus n	
Cousieus dissimilis n	*Cousieus plumbea*
Hybopsis kentuckiensis n	*Hybopsis biguttata*
Rhinichthys cataractae dulcis n	
Thymallus montanus i	*Thymallus arcticus*
Salmo gairdneri i	
Salmo trutta i	
Salvelinus fontinalis i	
Salmo clarkii subsp. i	
Salmo clarkii stomias n	
Fundulus floripinnis n	*Fundulus sciadicus*
Fundulus zebrinus n	*Fundulus kansae*
Pomoxis spariodes i	*Pomoxis annularis*
Lepomis cyanellus n	
Micropterus salmoides i	
Boleosoma nigrum n	*Etheostoma nigrum nigrum*
Etheostoma iowae n	*Etheostoma exile*
Stizostedion vitreum i	
Perca flavescens i	

* misidentification corrected on the basis of comparison of given characters with known species or examination of specimens

i = introduced species; n = native species

Table 4. Hendrick's (1950) collection of fishes in Boulder County, Colorado

Hendricks (1950)	Present nomenclature and corrections of misidentified fishes
Ictalurus lacustris punctatus	*Ictalurus punctatus*
Ameiurus melas melas	*Ictalurus melas*
Plancterus kansae	*Fundulus sciadicus*
Semotilus atromaculatus atromaculatus	*Semotilus atromaculatus*
Rhinichthys cataractae dulcis	
*Chrosomus erythrogaster**	*Chrosomus eos*
Campostoma anomalum	*Campostoma anomalum pullum*
Pimephales promelas promelas	*Pimephales promelas*
*Hybognathus nuchalis nuchalis**	*Hybognathus hankinsoni*
Phenacobius mirabilis	
Notropis cornutus	
Notropis lutrensis lutrensis	
Notropis dorsalis piptolepis	
Notropis deliciosus missuriensis	*Notropis stramineus missuriensis*
Notropis bifrenatus	*Notropis heterolepis*
Catostomus commersonii sucklii	*Catostomus commersoni*
Catostomus catostomus griseus	
Lepomis cyanellus	
Boleosoma nigrum mesaeum	*Etheostoma nigrum nigrum*
Poecilichthys exilis	*Etheostoma exile*

* probable misidentification, records above listed outside of known range. Suspect that nomenclatural errors of past collectors incorporated by Hendricks. Description in thesis inadequate for absolute decision about validity.

Table 5. Addition of fishes to native faunal records

Beckman (1952)	Present nomenclature and corrections of misidentified fishes
Carpiodes forbesi	*Corpiodes cyprinus*
Moxostoma aureolum	*Moxostoma macrolepidotum*
Pantosteus jordani	*Pantosteus platyrhynchus*
Hybopsis storeiana	
Notropis blennius	
Hybognathus placita placita	*Hybognathus placitus*
Noturus flavus	
Lepomis humilis	
Etheostoma spectabile pulchellum	

of the Kansas River system was thoroughly examined by Metcalf (1966). Cross (1967) published a book on the systematics, natural history, and distribution of fishes in the state of Kansas. Johnson (unpublished Ph.D. thesis, University of Michigan, 1942) investigated the composition and distributional patterns of the ichthyofauna in Nebraska. Morris (unpublished Master's thesis, University of Missouri, 1960) was involved with the same questions concerning the Platte River in Nebraska. Johnson's dissertation was oriented toward systematic biology, while Morris was interested in the ecological basis for the patterns of dispersal.

METHODS

Collection Sites

The number of collection sites was governed by the accessibility of the stream, stream conditions and time limitations; there were no predetermined stations. Efforts were made to sample the spectrum of habitat types. In general, the sites were approximately 20 miles apart. Several streams were found to be dry: Bijou Creek, Cherry Creek, Kiowa Creek, and Badger Creek. An attempt was made to sample each stream at several different locations. Because the fauna of streams at higher elevations are both well known and low in diversity, streams at lower elevations were sampled more intensively. Several springs were investigated with the hope that refuge was offered to fishes intolerant of pollution and silt. A section of the South Platte River, from Littleton to Brighton, Colorado, was not sampled extensively because it is horribly degraded.

Collecting Equipment

Specimens were collected using a 10 foot seine, a 15 foot seine and a bag seine 30 feet long. Fish toxicants were rarely used because the South Platte basin is predominantly shallow and easily seined. Electrofishing was confined to mountain and foothill waters because the available generators were not designed to operate in the highly conductive waters of the plains. Collection sheets were used to record field notes concerning stream bottom composition, current, turbidity, width, depth, temperature and field identification of specimens collected.

Specimens were fixed with 10% formalin in the field. A grease pencil marked the top of jar lids with a collection number which

corresponded to one on a collection sheet. Specimens under 4 inches long were allowed to soak in 10% formalin for one day, after which they were placed in several rinses of water for two days. The water was subsequently replaced by 70% ethyl or 40% isopropyl alcohol. Specimens over 4 inches long were slit on the right side to allow formalin to penetrate into the body cavity. They were kept in formalin for 5 days before they were put in changes of water and finally preserved in alcohol.

Laboratory Analysis

Specimens were reidentified, segregated by species and placed in labeled jars. Meristic counts were taken from specimens using procedures given in Hubbs and Lagler (1948). Specimens of *Notropis dorsalis* were stained with alizarin in order to study the degree of predorsal scaling in different populations. Distribution maps were made and compared with those of the literature.

ANNOTATED LIST OF SPECIES

Mayr's (1942) definitions of species and subspecies are used in the text.

Clupeidae

Dorosoma cepedianum (LeSueur)

The gizzard shad, native to the large tributaries of the Missouri River, is not native to Colorado, but has been introduced as a forage fish in reservoirs (Trautman, 1957; Metcalf, 1966). One specimen was collected in the South Platte River at Sterling, Colorado.

Salmonidae

Salmo clarkii stomias Cope is the only native salmonid in the South Platte basin and the only species not directly derived from the Missouri drainage. There are no native trout in the North Platte River and other Missouri basin tributaries below the juncture of the Yellowstone River. Thus, most logically, *Salmo clarkii stomias* in the South Platte and Arkansas headwaters was derived from cutthroat stock crossing over from the Colorado drainage via headwater transfer. *Salmo trutta*, various species of *Salmo clarkii*, *Salmo gairdneri*, *Salmo aguabonita*, *Salvelinus fontinalis*, *Salvelinus namaycush*, *Oncorhynchus kisutch*, *Oncorhynchus nerka*, *Thymallus arcticus* and *Prosopium williamsoni* have been introduced in Colorado.

Salmo clarkii stomias Cope

Once widespread and common in the headwaters of the South Platte and Arkansas basins, the greenback cutthroat trout is an endangered fish. A small population inhabits Black Hollow Creek, another tributary

of the Cache la Poudre River (Dieffenbach, 1966). Hourglass Creek, another tributary within the same drainage, was stocked with 56 fish from Black Hollow Creek by the Colorado Cooperative Fishery Unit in October, 1966.

The nomenclature of the greenback trout is a taxonomic puzzle. Cope (1871) described *Salmo* (*Salar*) *stomias* based on specimens received from Dr. Hammond. Dr. Hammond collected specimens while touring with a U.S. Army survey in 1856 from Fort Riley, Kansas, to Fort Bridger, Wyoming, and back (Oland and Cross, 1961). The type locality was given as the Platte River, Fort Riley, Kansas. This was typical of the inaccuracy in labeling by Hammond; the Platte River does not flow through Kansas. Metcalf (1966), and Oland and Cross (1961) discuss other errors in labeling in more detail. Jordan (1891) stated that the type locality was most likely in error because no trout live within 500 miles of Fort Riley. He ascribed the name *Salmo mykiss stomias* Cope to the cutthroat trout of the Platte drainage. Evermann and Cox (1896) speculated that the type locality was in the headwaters of the South Platte drainage. Studies on other possible native populations of cutthroat trout are being conducted by Dr. Robert Behnke (Colorado Cooperative Fishery Unit, Colorado State University, Ft. Collins).

Esoscidae

The northern pike, *Esox lucius*, has been introduced in Boyd Reservoir east of Loveland and other reservoirs.

Cyprinidae

The cyprinid fauna of the South Platte River is depauperate. Metcalf (1966) recorded 27 native cyprinids from the Kansas River system

and Morris (1960) listed 17 native species from the Platte River in Nebraska. A check list of Wyoming fishes (Dr. George Baxter, unpublished) lists 19 minnows native to the Missouri drainage. In contrast, my investigation found only 11 native species in the South Platte River of Colorado. No members of the genus *Hybopsis* were collected. Three introduced species are definitely known from the drainage, *Cyprinus carpio*, *Tinca tinca*, and *Notemigonus crysoleucas*. A fourth species, *Carassium auratus*, the goldfish probably exists in feral populations.

Semotilus atromaculatus (Mitchill)

Perhaps the most ubiquitous cyprinid in the drainage, this fish has been collected from slow, turbid plains streams and in swifter waters of the foothills. The creek chub has been collected at South Park in Eleven Mile Reservoir by Kent Andrews, a graduate research assistant at Colorado State University, at an elevation of approximately 8,000 feet. Metcalf (1966) stated that the creek chub shows a clinal variation and that the southwestern populations are subtly different from other populations, but subspecific partitioning is not realistic nor warranted. See Map 1 for distribution.

Chrosomus eos Cope

A mangled specimen from the collection at the University of Colorado was recognized as a member of the genus *Chrosomus*, but could not be keyed to species. Its locality was listed as West Plum Creek near Castle Rock, Colorado. An examination of this specific site and adjoining areas was not fruitful, the creek was virtually dry. Metcalf and Cross collected a hybrid suspected of being a hybrid between *C. eos* and *C. neogaeus* in the Big Thompson River west of Loveland, Colorado,

near highway 34 (Bailey and Allum, 1962:40). This site was seined but no results were obtained. Cross (1967:82) stated that *C. eos* is common near sources of springs and is adversely affected by modifications to the environment caused by livestock use and agriculture. Several springs in eastern Colorado were seined and no specimens were obtained. *Chrosomus eos* and *C. neogaeus* may be extirpated from the South Platte drainage. Eastern Colorado is so arid that choice farms are located near springs. All springs which were examined showed signs of pollution from agricultural runoff.

Chrosomus neogaeus (Cope)

Evidence of its occurrence in the South Platte basin comes from the hybrid captured in the Big Thompson River by Cross and Metcalf (Bailey and Allum, 1962). Neither Johnson (1942) nor Morris (1960) collected *C. neogaeus* or *C. eos* in the Platte basin, but Baxter (unpublished check list) recorded both species from Wyoming.

Chrosomus erythrogaster (Rafinesque)

Chrosomus erythrogaster dakotensis is listed by Ellis (1914). Metcalf (1966) stated that *C. erythrogaster* does not, to his knowledge, occur north of the Kansas River system. Bailey and Allum (1962) listed *C. dakotensis* as a synonym of *C. eos*. Hendricks (1950) said that he had collected 7 specimens of *C. erythrogaster* in a few deep pools in eastern Boulder County, Colorado. Ellis used the synonym of *C. eos*; whereas, Hendricks may not have been aware of the synonymy and used *C. erythrogaster* after he dropped *dakotensis* from the name. He probably decided *dakotensis* was not a valid subspecies of *C. erythrogaster* and did not consider other possibilities.

Hybopsis gracilis (Richardson)

No specimen of the flathead chub was collected. Ellis (1914:62) stated, "A single species is here listed from the Arkansas River." He further stated that the flathead chub may possibly occur in the South Platte River. It has been taken in Wyoming (Baxter, unpublished check list), but is rare in Kansas (Cross, 1967; Metcalf, 1966). Morris (1960) found that 86 percent of all specimens were captured in streams flowing at a surface velocity of 1.5 ft./sec. The flathead chub is a big river fish, which prefers a habitat that the South Platte basin may not afford.

Hybopsis biguttata (Kirtland)

Beckman (1952) stated that the hornyheaded chub is uncommon in Colorado. Hendricks (1950) reported that *Nocomis biguttata* (*Nocomis* is presently the subgeneric name) was missing from Boulder County, Colorado. Cross (1967) noted the declining abundance of this species in Kansas and attributed the decline to effects of irrigation, siltation over spawning beds and low flows. My study failed to collect any specimen; Morris (1960) also failed to collect this fish. However, it has been recorded from the Platte drainage of Nebraska and from Wyoming (Johnson, 1942; Baxter, unpublished check list). The subgeneric name *Nocomis* may be elevated to generic status by the committee on Names of Fishes of the American Fisheries Society (personal communication with Dr. Robert Behnke).

Couseus plumbea (Agassiz)

Three specimens from the University of Colorado collection were examined. The specimens were collected by Juday in 1903 from Boulder Creek; they were listed in Ellis (1914) as *C. dissimilis*. Hendricks

(1950) reported this species missing from Boulder County, Colorado. Beckman (1952) stated that the lake chub was common in the South Platte drainage; yet my survey and two inventories in Nebraska failed to find specimens in the Platte drainage (Johnson, 1942; Morris, 1960). Dr. George Baxter, University of Wyoming, believes that this is the southernmost record of this species (personal communication with Dr. Baxter). It is listed as *Couseus* instead of *Hybopsis* following the advice of Dr. Reeve Bailey, University of Michigan (from personal communication with Dr. Baxter). Dr. Robert Behnke (personal communication) believes that this fish may eventually be placed in the genus *Semotilus*.

Rhinichthys cataractae (Valenciennes)

The longnose dace is quite common in clear, gravel bottomed, montane streams. It is found in riffles and under large boulders. This species is rarely collected in plains streams except during spring runoff. Although a headwater fish, it, curiously enough, does not extend as far upstream as the white or longnose sucker in the Cache la Poudre River (Miller, unpublished Master's thesis, Colorado State University, 1964). See Map 2 for distribution.

Phenacobius mirabilis (Girard)

The suckermouth minnow is quite rare in Colorado. Four specimens were collected from the South Platte River near Julesburg and south of Ovid, Colorado. The river was clear, shallow, 1.5 feet deep at most, flowing over a sandy bottom. The scarcity of this fish is puzzling as it is one of the most widespread cyprinids in Kansas (Metcalf, 1966) and quite tolerant of adverse water conditions (Cross, 1967). See Map 3 for sites of collection.

Notropis cornutus (Mitchill)

The common shiner, becoming increasingly rare, is found only in permanent streams which are clear and relatively unpolluted. Specimens were collected at only seven sites. It is disappearing from Ohio and Kansas (Trautman, 1957; Cross, 1967). Siltation of gravel bottoms which are potential nesting sites may be a major cause of its decreasing abundance (Cross, 1967). See Map 4 for distribution.

Notropis lutrensis lutrensis (Baird and Girard)

The red shiner is uniquitous, although not the most abundant shiner in the South Platte River. It is especially numerous in intermittent streams. See Map 5 for distribution.

Notropis blennius (Girard)

One specimen was examined from the collection of Kent Andrews, a graduate research assistant at Colorado State University. He collected the specimen from the South Platte River near Watertown, Colorado. Beckman (1952) observed that the river shiner was rare in Colorado. The river shiner has been recorded from the Platte drainage in Nebraska (Johnson, 1942; Morris, 1960). See Map 6 for collection site.

Notropis dorsalis (Agassiz)

Two morphologic varieties of *Notropis dorsalis* have been referred to as subspecies, *N. d. dorsalis* and *N. d. piptolepis*. *N. d. dorsalis* has been described being fully scaled; whereas, *N. d. piptolepis* has been described scaleless from the nape to the origin of the dorsal fin. Specimens of the big-mouth shiner collected in the South Platte basin range from the fully scaled forms through a series of intermediate

varieties of the scaleless naped form. Johnson (1942) found few pure populations of either variety in Nebraska. In fact, his distribution map shows almost all intergrades between the two varieties in the Platte basin. Hubbs and Lagler (1958:83) said that the two subspecies have a wide and indefinite band of integradation. Mayr's (1942) definition of a subspecies is, in essence, a geographically isolated gene pool of a polymorphic species. If all populations of big-mouth shiners are exchanging genes, by definition, subspecies designation is not valid. If two distinct populations do exist, it must be determined if separating characters reflect genetic differences.

Underhill and Merrell (1959) concluded that high levels of intrabasin variations between populations of the big-mouth shiner were reflections of complex interbasin and annual variations. Distinct annual variations of meristic characters were found in populations of big-mouth shiners from sampling stations. Underhill and Merrell (1959) found many microgeographic races in streams of the Upper Missouri basin in Minnesota. Whether statistical differences were caused by responses to environmental influences or by genetic drift and selection was not determined. Scaleless, or near scaleless, naped big-mouth shiners were collected far outside the known range of the scaleless subspecies, *N. d. piptolepis*. It was found that the predorsal scaling was variable; the range of predorsal scales was 8 to 28 scales. The range of sample means was 18.61 ± 1.05 to 24.31 ± .42 and the range of the coefficient of variation was 7.0 to 13.3.

The western subspecies was described by Cope (1871) as *Photogenis piptolepis* from the North Platte River. He said in reference to this fish, "In two smaller specimens, apparently of this species, there are

some peculiar differences. In one the back of half scaled, the other entirely scaled." The two smaller specimens were collected at Red Cloud Creek. It is interesting to note that three varieties were included in the description of the scaleless naped form. The validity of predorsal scaling as a separating character is questionable.

A comparison of known eastern, fully scaled specimens with western forms is being conducted by the author. The pattern of intergradation must also be better defined through further study before conclusions are made concerning the validity of the subspecific designation of the bigmouth shiner. See Map 7 for distribution.

Notropis heterolepis Eigenmann and Eigenmann

The account of the blacknose shiner by Ellis (1914), listed as *N. cayuga*, appears authentic. Hendricks (1950) did not collect any specimen from Boulder County, Colorado. It is being extirpated from Ohio, South Dakota, and Kansas caused by effects of agricultural water demands (Trautman, 1957; Bailey and Allum, 1962; Cross, 1967). The blacknose shiner may no longer exist in Colorado.

Notropis sp.

Two specimens of fish belonging to the genus *Notropis* were collected from the Cache la Poudre River in Fort Collins. They superficially resembled the sandshiner in many respects, but a closer examination revealed a more terminal and fleshy mouth and a blunt head similar to *Pimephales tenellus*. Dr. Frank B. Cross, University of Kansas, examined these specimens and could not identify them although he said they were not *N. stramineus* (personal communication). He suggested that it may be a hybrid of *N. stramineus*, although he could not be sure of a suitable

partner. It is possible that these specimens represent a new species or perhaps fit one of the doubtful species recorded in old records. A thorough examination with more specimens is in order before any decisive statement can be made.

Notropis stramineus missuriensis (Cope)

The taxonomy of the sandshiner has recently been revised by Bailey and Allum (1962:64). The name *N. deliciosus*, used by Beckman (1952) for the sandshiner is a synonym for *N. texanus* as demonstrated by Suttkus (1958). Thus *Notropis stramineus* becomes the name of the sandshiner. It is also the most abundant shiner in the South Platte basin. Specimens have even been collected in Glacier Lake south of Ward at an elevation of 9,100 feet. It is an unusual record as the sand shiner is a plains species. See Map 8 for distribution.

Hybognathus hankinsoni (Hubbs)

The brassy minnow is uncommon. Specimens have been collected from only 7 localities. Jordan (1891) commented that *H. nuchalis* was scarce. He was most likely referring to the brassy minnow as his record was far outside the known range of the silvery minnow, and his description best suited *H. hankinsoni*. Hendricks (1950) caught 7 specimens of *Hybognathus* in Boulder County under the name *H. n. nuchalis*. His description included an observation of a lateral band found only on *H. hankinsoni*. The brassy minnow, *H. hankinsoni*, is distinguishable from *H. nuchalis* by the rounded tip of the dorsal fin and uniformly pigmented caudal fin. *H. nuchalis* has a pointed tip on its dorsal fin and an unpigmented ventral segment of the caudal fin (Cross, 1967). All specimens of *Hybognathus* taken in this study were identified as *H. hankinsoni*. (See Map 9).

Hybognathus placitus Girard

No specimens were collected in this study nor by Hendricks (1950) in the South Platte Basin. Morris (1950) did not report it from the Platte drainage in Nebraska. Beckman (1952) stated that the plains minnow is common. The identification of this species was difficult until Uyeno, and Moore and Niazzi independently found the basioccipital of the plains minnow without expanded lateral processes typical of the genus (Bailey and Allum, 1962). Consequently old records are of doubtful reliability (Metcalf, 1966). The examination of the basioccipital of specimens of the genus *Hybognathus* in the South Platte drainage revealed no narrow and blade-like structures.

Hybognathus nuchalis Agassiz

The silvery minnow has been mentioned in the old records of Colorado. Confusion has occurred because Jordan's (1891) description of *H. placitus* was under the name of *H. nuchalis*.

Pimephales promelas Rafinesque

The fathead minnow is the most abundant and widespread fish in the South Platte River. The designation of subspecific names has been deemed unrealistic by Vandermeer (1966). Several clines exist and very few populations are distinct enough to warrant subspecific designation. Kent Andrews, a graduate research assistant at Colorado State University, is currently studying the ecology of the fathead minnow. See Map 10 for distribution.

Campostoma anomalum pullum (Agassiz)

Metcalf (1966) decided that the differences between *C. a. pullum* and *C. a. plumbeum* were too slight to justify naming races. *C. a. plumbeum* was placed in a synonym of *C. a. pullum*. The stoneroller is found more commonly in the cool, clear foothill streams than in the plains. See Map 11 for distribution.

Catostomidae

Three species of catostomid fish have been collected from the South Platte River: *Catostomus catostomus*, *C. commersoni*, *Carpiodes cyprinus*. Two other species, *Carpiodes carpio carpio* and *Moxostoma macrolepidotum* may be in the drainage. The carpsuckers, *Carpiodes*, are in need of much systematic work as indicated by Bailey and Allum (1962) and Metcalf, (1966).

Catostomus catostomus (Forster)

The longnose sucker is widespread in mountain and foothill streams and is occasionally found in the South Platte River as far downstream as Sterling, Colorado, during the spring runoff. Generally, the longnose sucker is found at higher elevations while the white sucker is found at lower elevations. See Map 12 for distribution.

Catostomus commersoni (Lacépède)

The white sucker is widespread in the plains streams. It is very tolerant of silty waters. Metcalf (1966) discovered that a series of clines exist in populations of white suckers. Lateral line scales on the fish become smaller in southern populations; the row of papillae on

the upper lip increases in western populations and the body form becomes stockier in southwestern populations. He suggests that the subspecific division is meaningless. See Map 13 for distribution.

Catostomus (Pantosteus) platyrhynchus (Cope)

Beckman (1952) stated that *P. jordani* (a synonym of *P. platyrhynchus*) was found in the Platte drainage. The only record of this fish in the Platte system is from the Sweetwater River drainage, a tributary of the North Platte River (Smith, 1966). Smith (1966) commented that the specimen recorded by Beckman (1952) in Antero Reservoir was *C. plebeius* and was probably introduced there.

Carpiodes cyprinus (LeSueur)

The specimens of carpsucker collected fit the description of *C. cyprinus* rather than the nominal species, *C. forbesi* Hubbs. Specimens were obtained from the reservoirs of eastern Colorado. The carpsuckers are big-water fish and are probably limited to these impoundments. See Map 14 for distribution.

Carpiodes carpio carpio (Rafinesque)

Ellis (1914) mentions the occurrence of *C. velifer* in the Cache la Poudre River. Ellis' description of meristic characters of the highfin carpsucker best fit *C. carpio*, the river carpsucker. No specimens were taken by this inventory, but it is likely that it inhabits some of the reservoirs in eastern Colorado. Specimens of *C. carpio carpio* from Lake McConaughy, Nebraska, were examined. It is widespread in Nebraska (Morris, 1960; Johnson, 1942).

Carpiodes velifer (Rafinesque)

No specimens of the highfin carpsucker were collected. Although listed by Ellis (1914), it is most likely based on misidentification of *C. carpio carpio* as mentioned previously. Bailey and Allum (1962) believe that there are no records for its occurrence in the Middle or Upper Missouri drainage.

Moxostoma macrolepidotum (LeSueur)

One specimen of the northern redhorse sucker has been examined. It was collected by Monte Madsen, Nebraska Game and Fish, from Lake McConaughy, Nebraska, a reservoir on the North Platte River. Beckman (1952) listed the northern redhorse as a species which occasionally is found in Colorado, preferring swift streams.

Ictaluridae

Only two species of ictalurids were collected: *Ictalurus melas* and *Ictalurus punctatus*. The channel catfish, *I. punctatus*, is stocked in Sterling Reservoir near Sterling, Colorado, and at Horseshoe Reservoir east of Loveland, Colorado (Colorado Game, Fish and Parks Department, unpublished mimeograph).

Ictalurus punctatus (Rafinesque)

Only two specimens were collected. They were taken at Julesburg and at Ovid, Colorado, in the South Platte River. The channel catfish is an old resident, inhabiting the plains during the Pliocene and Pleistocene (Smith, C.L., 1962). The native population has been declining because of the siltation and dewatering of the system. Ellis (1914) observed the same phenomenon in the Arkansas River. See Map 15 for collection sites.

Ictalurus melas (Rafinesque)

The black bullhead is common in small, muddy creeks. It seems to thrive in stagnant, intermittent streams. The subspecific designation has been dropped because clines have been noted without distinct geographic separation between populations (Metcalf, 1966). See Map 16 for distribution.

Noturus flavus Rafinesque

The stonecat is a doubtful inhabitant of the drainage. It is intolerant of siltation and pollution. The stonecat is rare in the Platte River of Nebraska (Morris, 1960). Beckman (1952) listed the stonecat as a rare fish.

Anguillidae

Gordon Land (1877) recorded *Anguilla rostrata* from a tributary of the South Platte River near Denver, Colorado. This investigator did not collect any specimen.

Cyprinodontidae

Fundulus kansae Garman

The plains killifish is abundant in shallow, highly alkaline water. It seems to be well adapted to the warm, silty, intermittent streams of the plains. See Map 17 for distribution.

Fundulus sciadicus (Cope)

The plains topminnow is uncommon, although not rare. It has been observed to prefer spring seeps and clear waters. See Map 18 for distribution.

Centrarchidae

Two native centrarchids inhabit the South Platte basin, *Lepomis cyanellus* and *Lepomis humilis*. Several species of introduced centrarchids were collected including: *Lepomis gibbosus*, *Lepomis macrochirus*, *Pomoxis annularis*, *Pomoxis nigromaculatus* and *Micropterus salmoides*.

Lepomis cyanellus Rafinesque

The green sunfish is found throughout the lower South Platte drainage. It is extremely tolerant of conditions associated with intermittent streams: warm water, oxygen depletion and siltation. See Map 19 for distribution.

Lepomis humilis (Girard)

The orangespotted sunfish is a species which thrives in agricultural areas. Its habitat preferences are similar to that of the green sunfish. It prefers small, slow moving streams and quiet water. See Map 20 for distribution.

Serranidae

The white bass, *Roccus chrysops*, has been introduced in Sterling Reservoir, northwest of Sterling, Colorado, (Colorado Game, Fish and Parks Department, unpublished mimeograph). The striped bass, *Roccus saxatilus* has also been introduced to Colorado (personal communication with Dr. Robert Behnke)

Percidae

Darters are the only native percids of Colorado. The walleye, *Stizostedion vitreum* and the yellow perch, *Perca flavescens*, have been stocked in the reservoirs of eastern Colorado.

Etheostoma exile (Baird and Girard)

The Iowa darter is rare in Colorado. It has been collected from cool, clear, slow-moving waters. Morris (1960) failed to collect any specimens from the Platte River in Nebraska where Johnson had taken them in 1942. The Iowa darter may be disappearing from the South Platte basin. See Map 21 for distribution.

Etheostoma nigrum nigrum Rafinesque

The johnny darter is found in slow-moving waters. It has been taken in the tributaries, but not in the South Platte River proper. See Map 22 for distribution.

Etheostoma spectabile pulchellum Girard

No specimen of the orange-throated darter was found. Beckman (1952) listed it as a rare fish in Colorado. This fish is widespread in eastern Kansas (Cross, 1967) and has been collected in the Platte River in Nebraska (Morris, 1960); but it is not likely to be found in the South Platte drainage, as it requires unpolluted water to live in.

Sciaenidae

The freshwater drum, *Aplodinotus grunniens*, has been introduced to Sloans Lake in Denver (Colorado Game, Fish and Parks Department, unpublished mimeograph).

CONCLUSIONS AND SUMMARY

Species composition and distributions of fishes in a river basin can be attributed to many factors. One of them is geologic history. At one time, the Missouri basin was composed of several isolated drainages, each with a characteristic fauna. Faunal elements had the opportunity to invade the South Platte basin when geologic barriers had been removed and the separate drainages joined to form the present Missouri system.

Yet, the South Platte River contains a small fraction of the total numbers of species which are found in the Missouri River system. The barriers to the many species which are found in the South Platte basin are probably ecologic ones. Ecologic barriers are most likely related to the amount of water in the system. The amount and variety of habitats may be directly proportional to the quantity of water in a basin. A larger system is very likely more stable than a smaller one because the fluctuation of water levels from season to season may be less drastic. For instance, in 1966, the Missouri River at Bismark, South Dakota, had a maximum monthly flow measured at 33,950 cfs and a minimum flow measured at 10,900 cfs (U.S.G.S. Water Resources Division, 1966b). In 1961, the South Platte River at Julesburg had maximum and minimum monthly flows measured at 3,010 cfs and 70.6 cfs respectively (U.S.G.S. Water Resources Division, 1961). Before water regulation, the South Platte basin was probably torrential during spring runoff and virtually stagnant and intermittent during late summer. It seems reasonable to assume that a larger system has more energy entering its system in the form of allochthonous organic material than its smaller tributary. The amount of energy fixed by autochthonous organic matter

is probably higher also. Therefore, a larger system has more energy which can be exploited and can provide for a greater variety of niches (although realistically, there are no "potential niches" as niches are described after the fact).

The most successful species in the eastern plains of Colorado are those highly adaptable to extreme fluctuations in flow and to intermittent stream conditions. There are very few species occupying a highly specialized niche in the South Platte basin. Furthermore, specialized fishes are less common than those which are adaptable in food gathering. Darters, *Etheostoma*, and suckermouth minnows, *Phenacobius mirabilis*, are examples of highly specialized fishes which are uncommon in the South Platte basin. Eminently successful are the black bullhead, *Ictalurus melas*; fathead minnow, *Pimephales promelas*: green sunfish, *Lepomis cyanellus*; sand shiner, *Notropis stramineus*, and the big-mouth shiner, *Notropis dorsalis*. Mountain streams in the South Platte basin are habitats atypical of most of the Missouri drainage. The presence of mountain streams have made possible diversified niche structure; for instance, the longnose sucker, *Catostomus catostomus* and the white sucker, *Catostomus commersoni* have essentially the same type of morphology. The suckers are allopatric to a large extent. The longnose sucker occupies the fast water, cool mountain stream, bottom feeding niche and the white sucker occupies the warmer, slower, plains stream bottom feeding niche.

Man has altered and affected the distribution of fishes. The most important alteration was to change water chemistry by pollution. Fishes which are both sensitive to pollution and adapted to a plains habitat are seldom found in the South Platte River proper; they are restricted

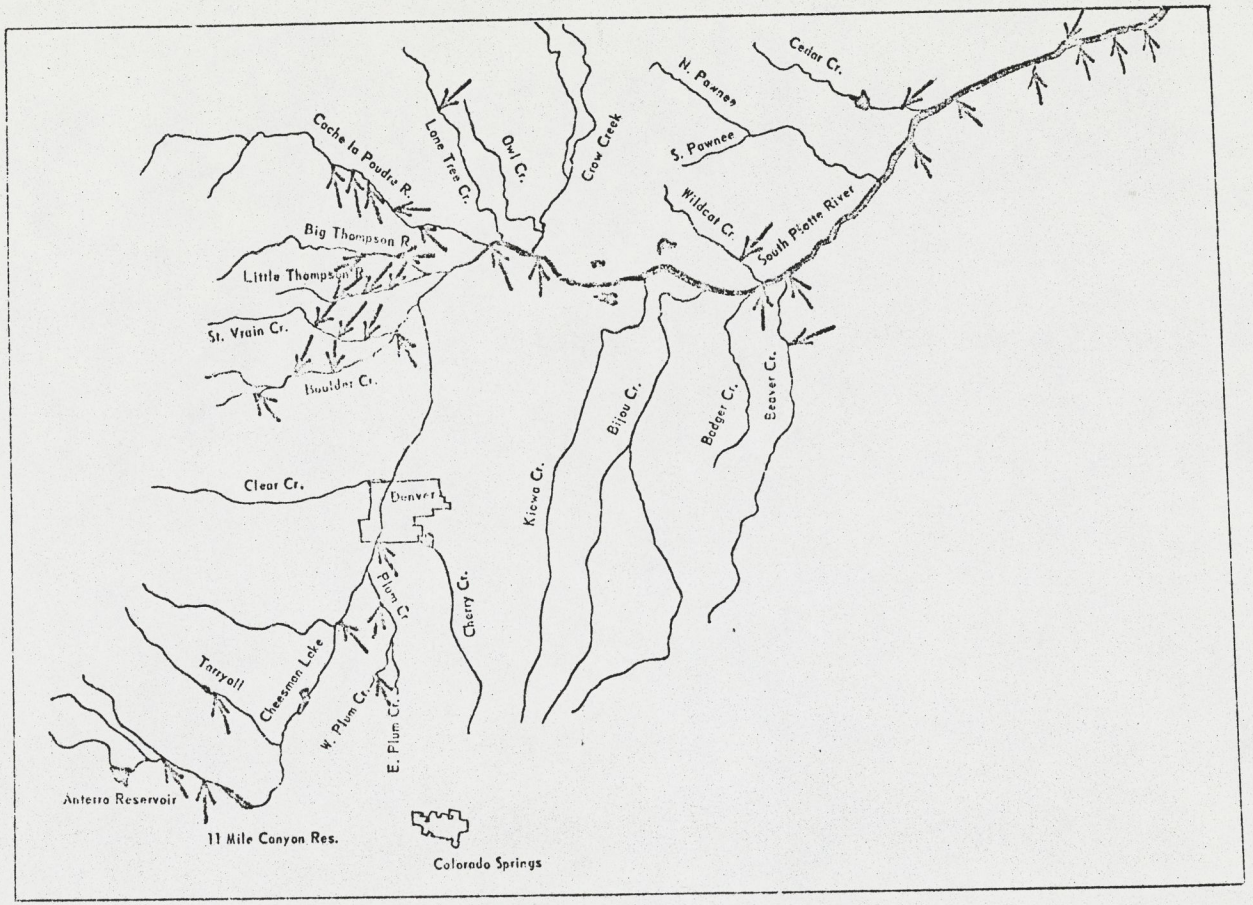
almost entirely to small stretches of water in permanent streams such as Boulder Creek, St. Vrain Creek, Big Thompson River, and Cache la Poudre River. These fishes are found in stretches of streams above nearby cities or in those portions which have recovered from the outflow of domestic sewage. Fishes in this category are the common shiner, *Notropis cornutus*; johnny darter, *Etheostoma nigrum* and Iowa darter, *Etheostoma exile*. Four species of fish which may have been extirpated because of pollution are the northern redbelly dace, *Chrosomus eos*; finescale dace, *C. neogaeus*; lake chub, *Couseus plumbea*, and blacknose shiner, *Notropis heterolepis*. Large sections of foothill streams have been channelized, further restricting abundance of fishes. Cool springs have been altered by farmers, eliminating more habitat space.

Certain fishes have been favored by environmental modifications. Hardy, pollution tolerant fishes such as the creek chub, *Semotilus atromaculatus*; fathead minnow, *Pimephales promelas*; and carp, *Cyprinus carpio* are found in abundance in poor quality water. Irrigation has favored fishes adapted to intermittent streams such as the green sunfish, *Lepomis cyanellus*; orangespotted sunfish, *Lepomis humilis*, and black bullhead, *Ictalurus melas*. These fishes thrive in irrigation ditches in addition to turbid waters.

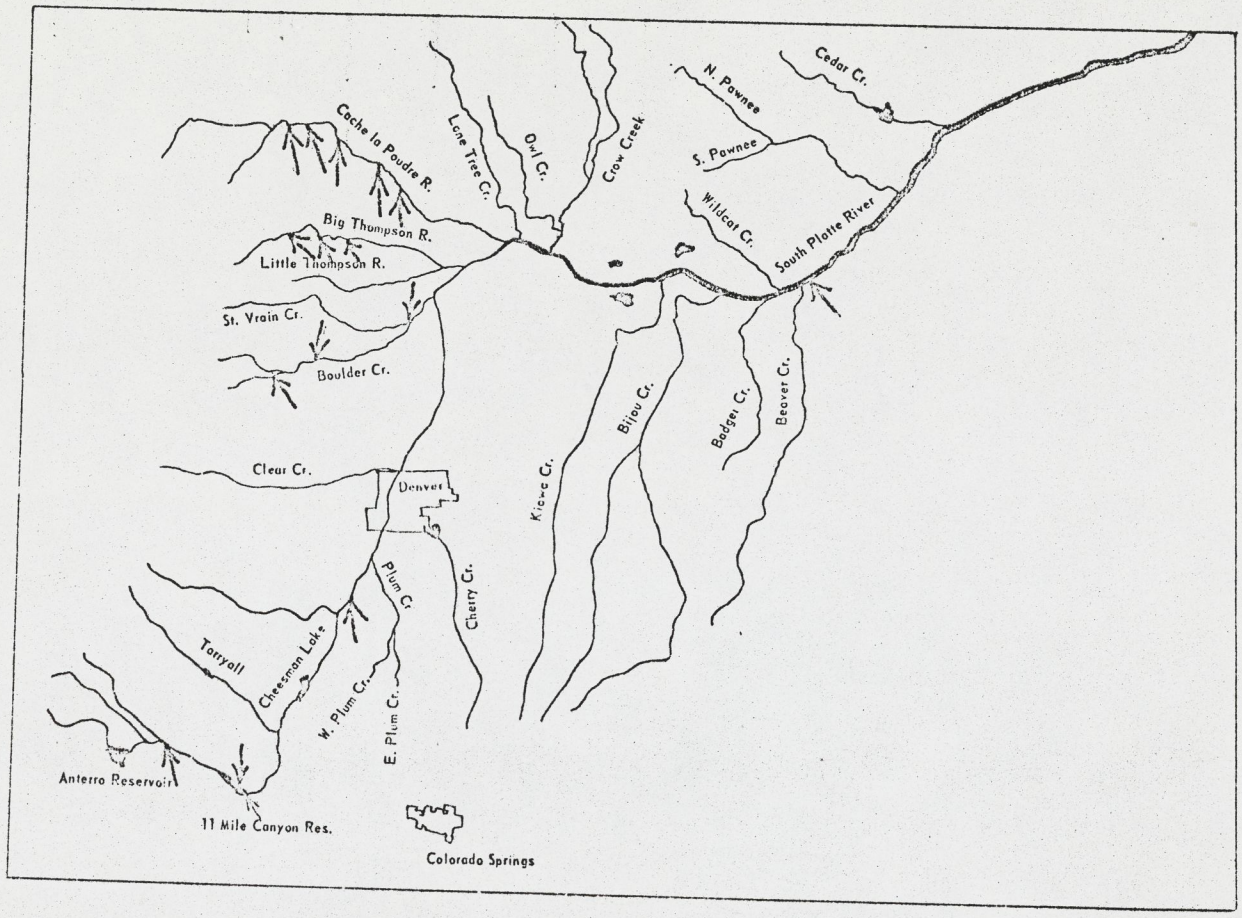
Man has built reservoirs in areas where large natural impoundments are not found. He has introduced a new type of ecosystem to the basin. Exotic fishes have been planted in these impoundments. The presence of reservoirs is the reason that the South Platte drainage can support a larger number of species than it did prior to Man's introduction of

exotic fishes. Generally, exotic species are not very successful in streams as they must compete with established species adapted to the drainage. Exceptions to this generality are the introduced salmonids and the carp, *Cyprinus carpio*.

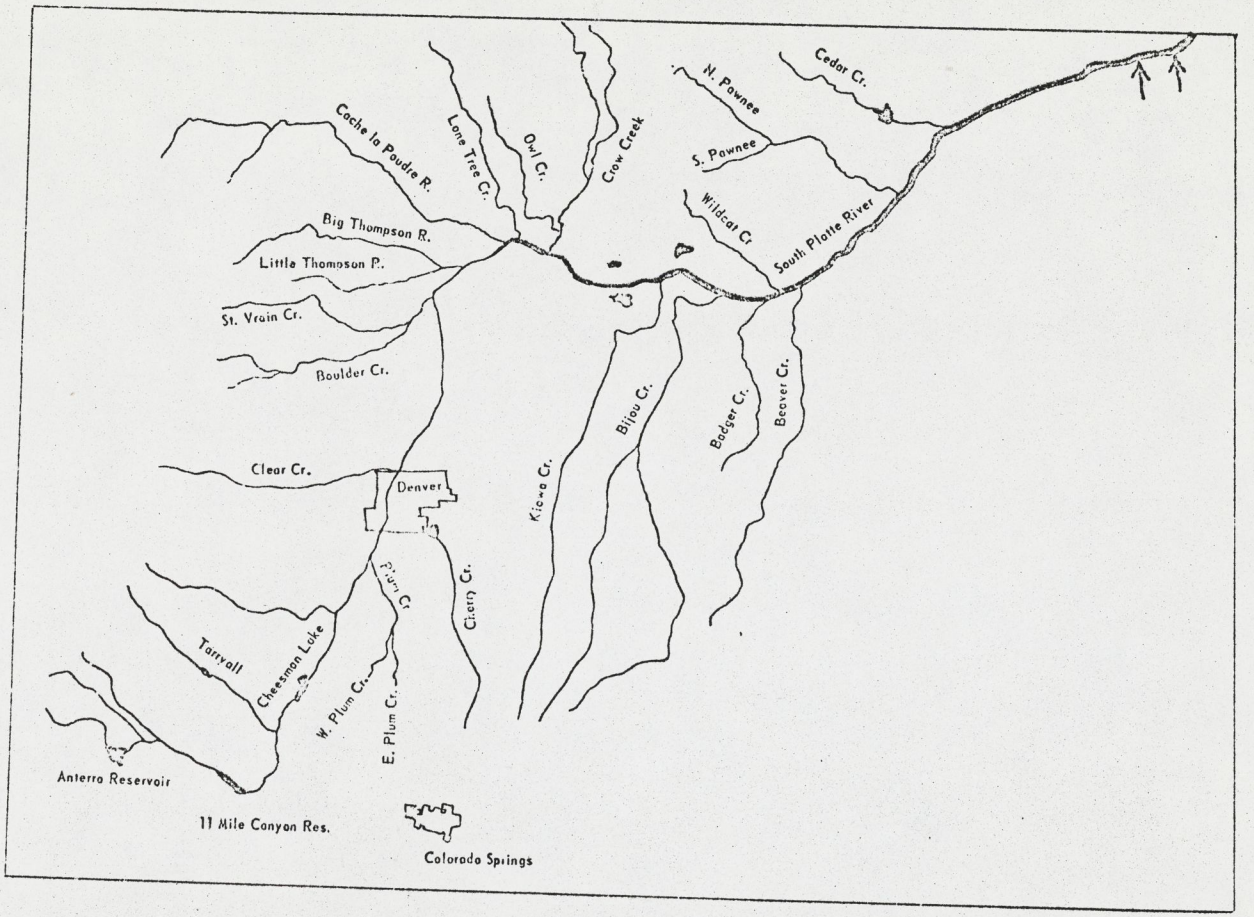
The stream environment is labile. Conditions may differ seasonally and yearly. Species abundance and composition at each site changes with stream conditions because fishes migrate. Therefore, no sample at any instant is representative for the entire year at any particular site. Distribution maps must be studied with this factor in mind.



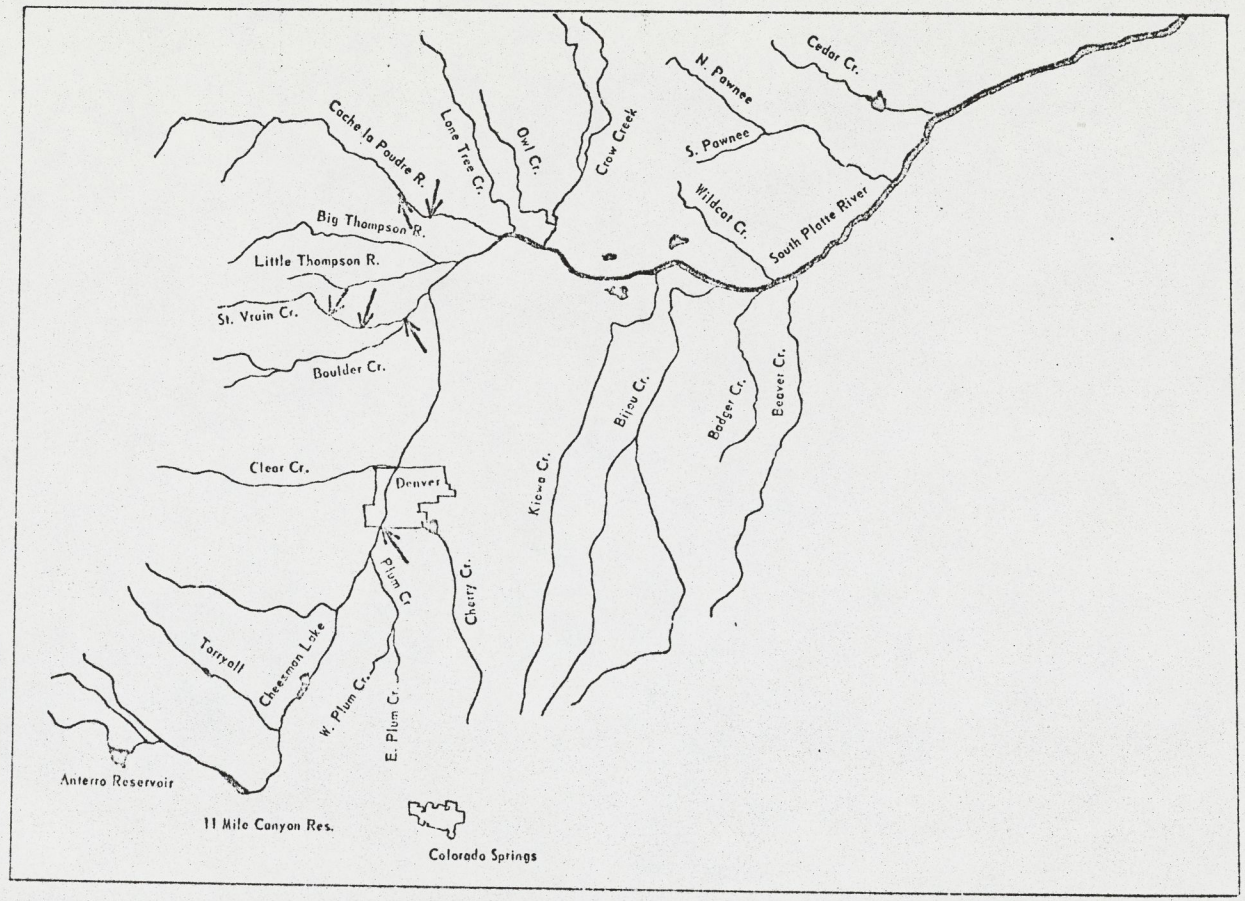
Map 1. *Semotilus atromaculatus*



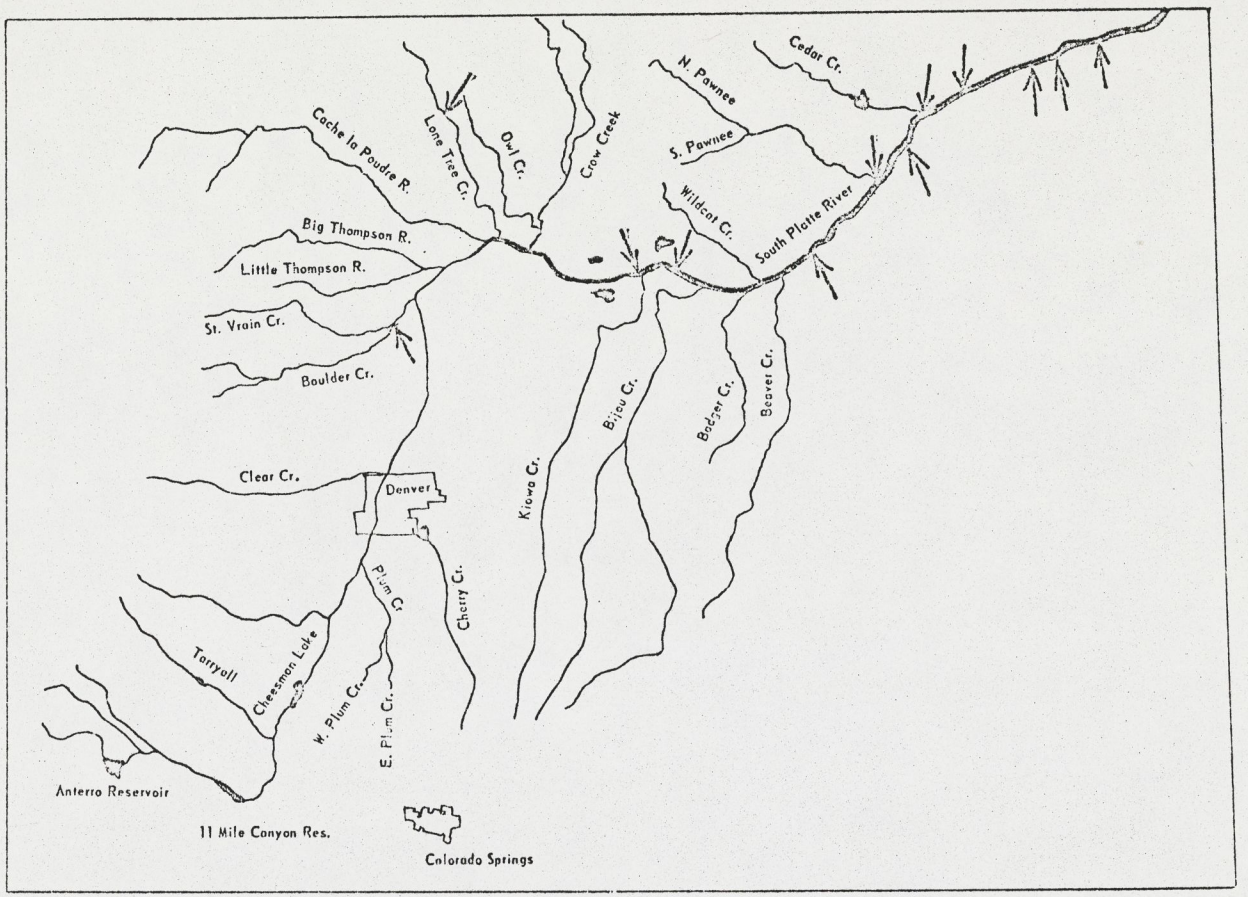
Map 2. *Rhinichthys cataractae*



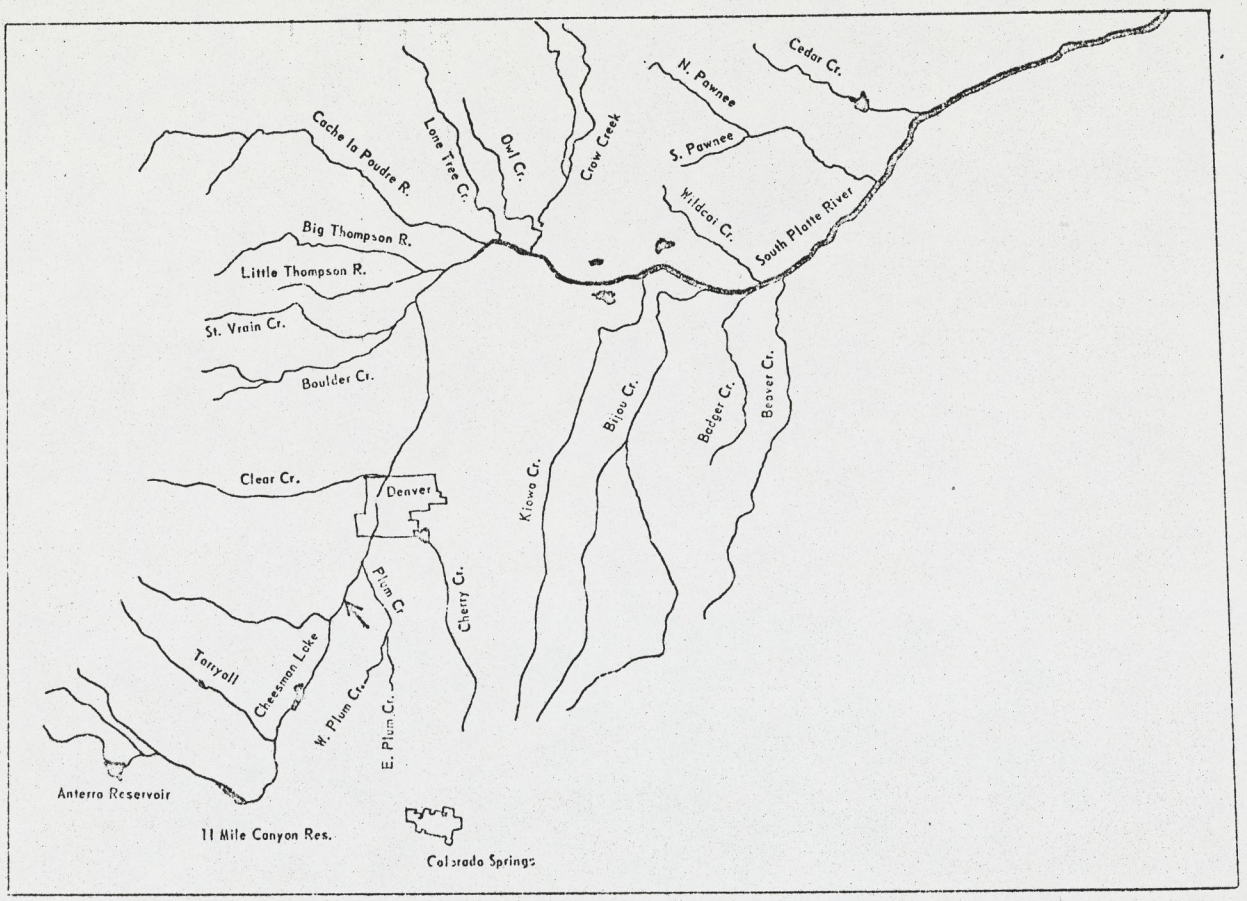
Map 3. *Phenacobius mirabilis*



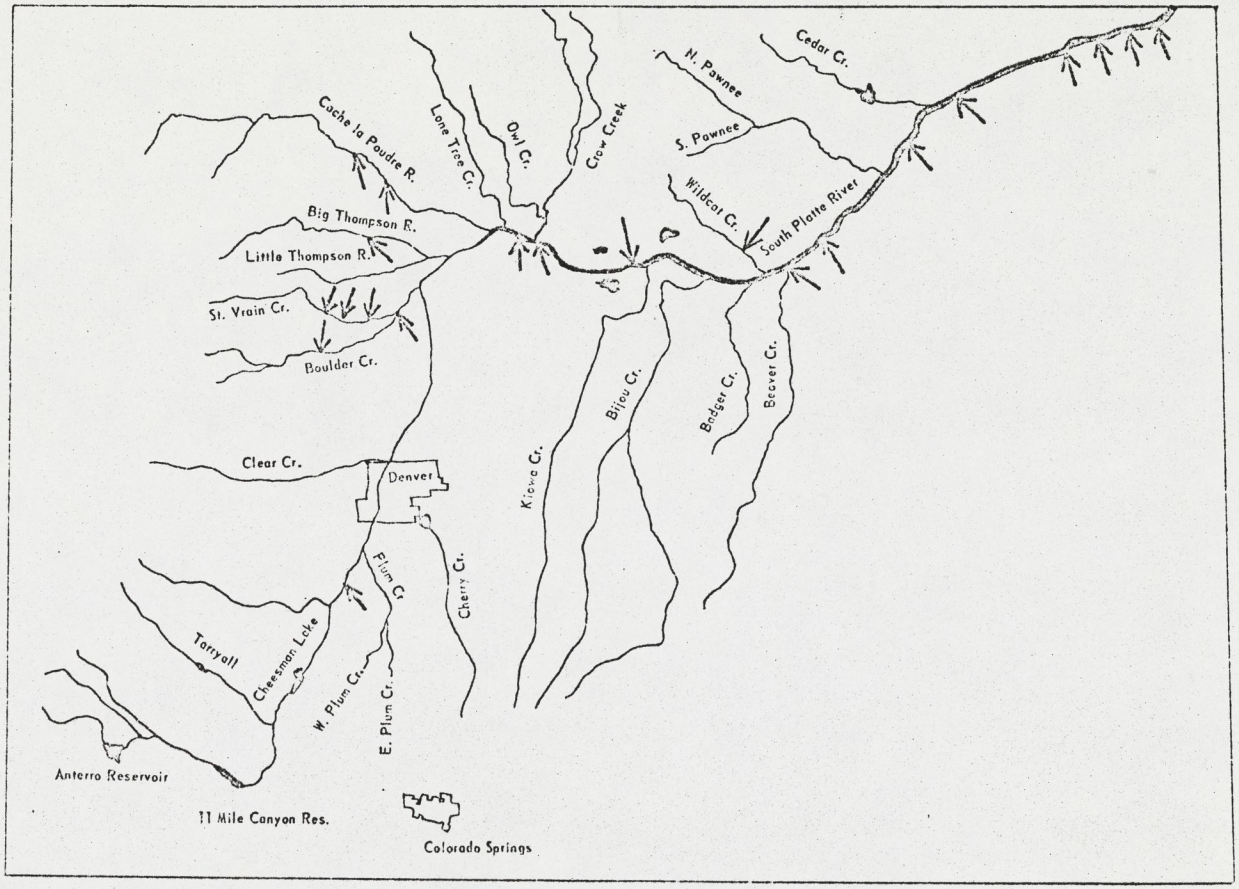
Map 4. *Notropis cornutus*



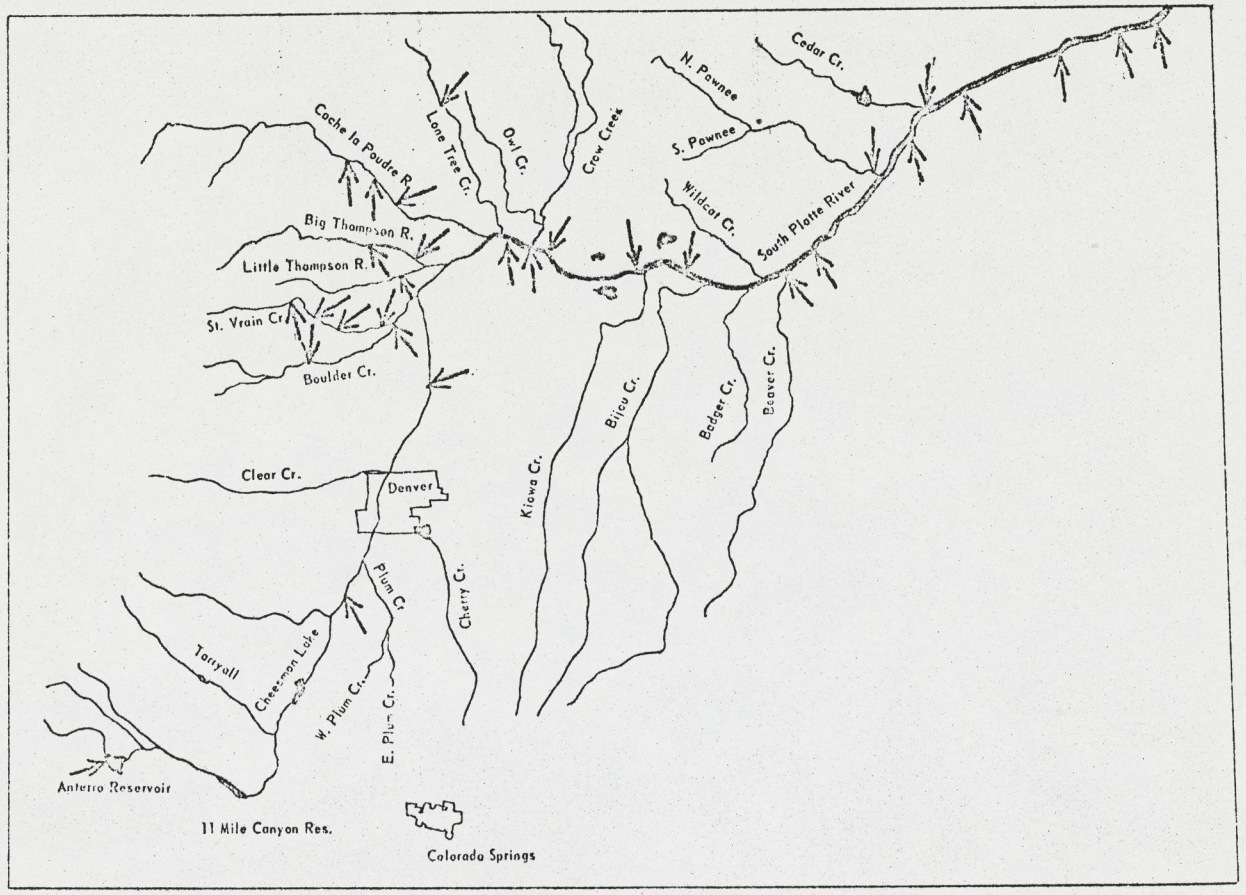
Map 5. *Notropis lutrensis*



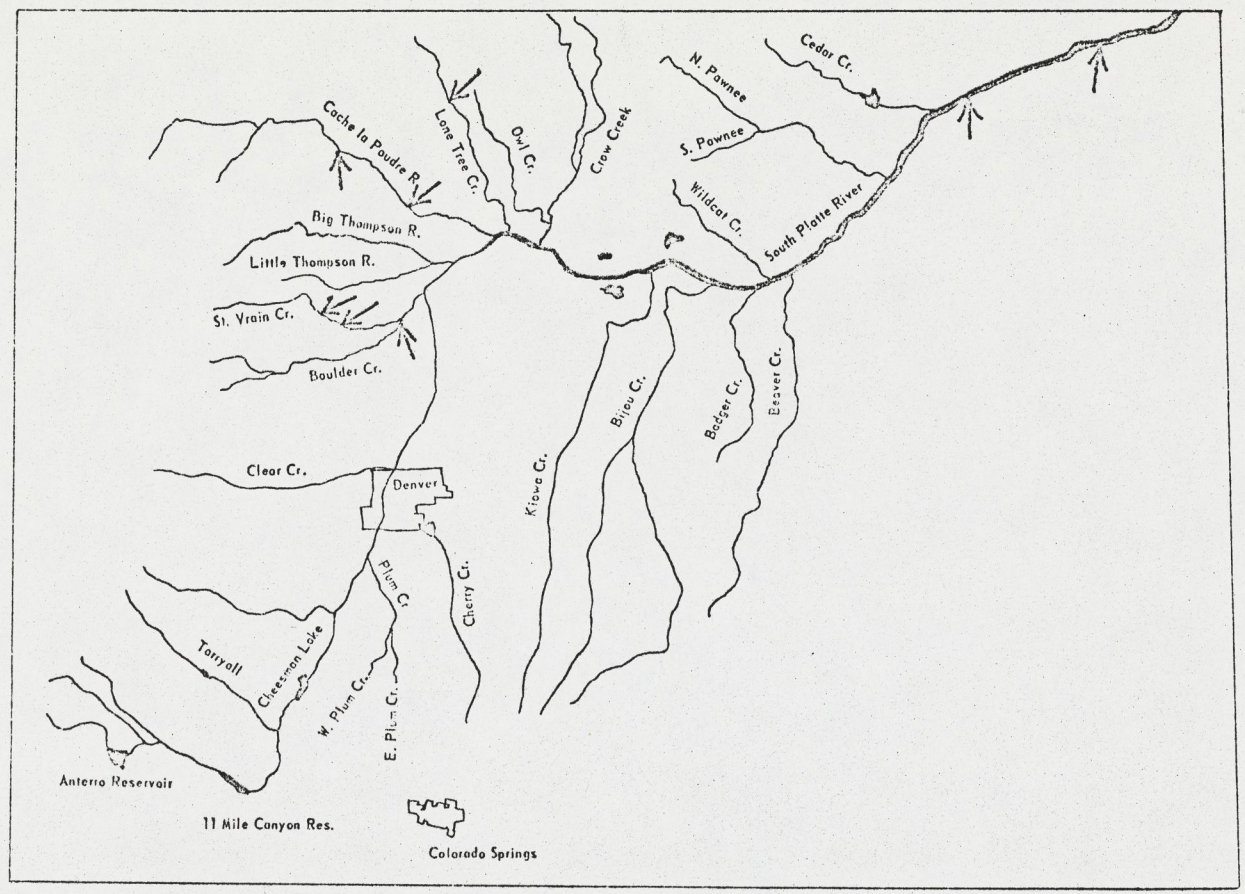
Map 6. *Notropis blennius*



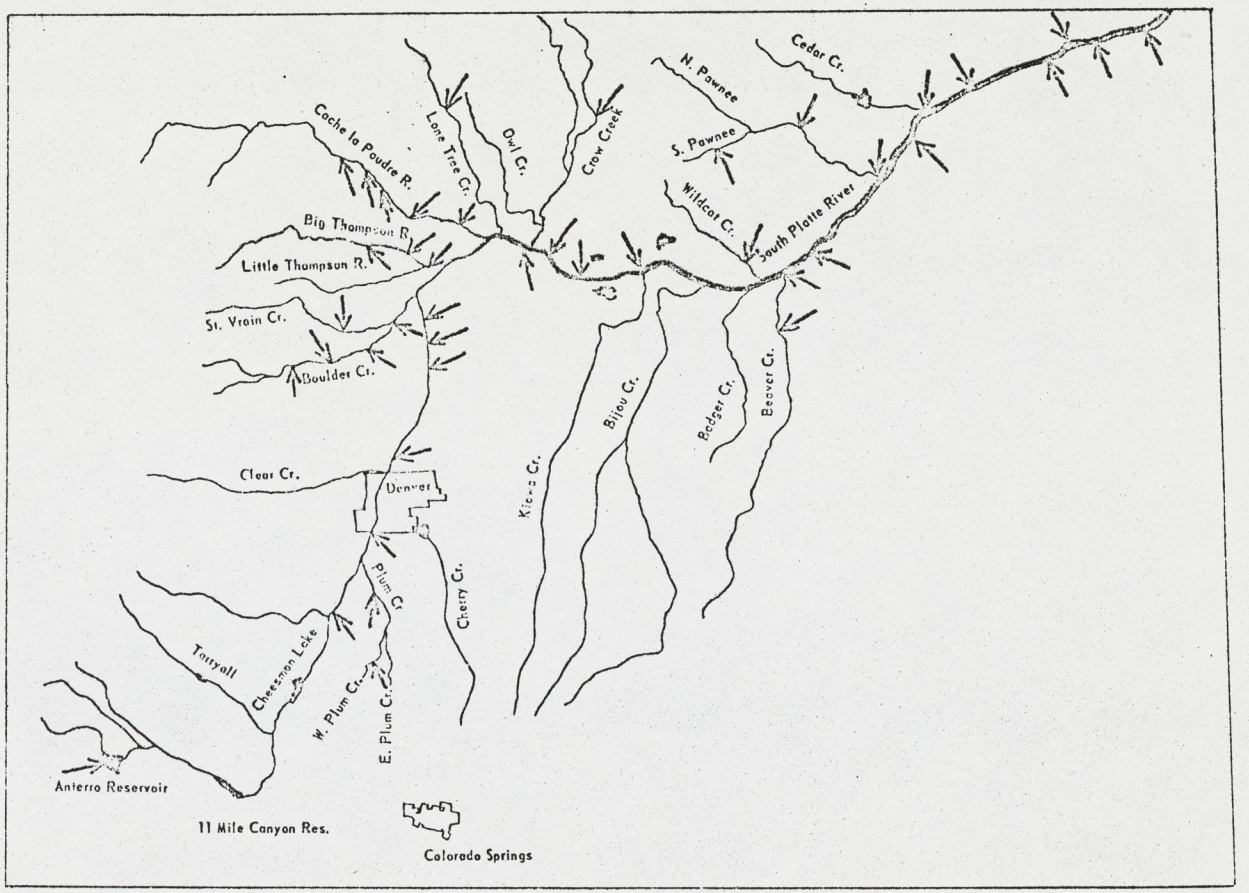
Map 7. *Notropis dorsalis*



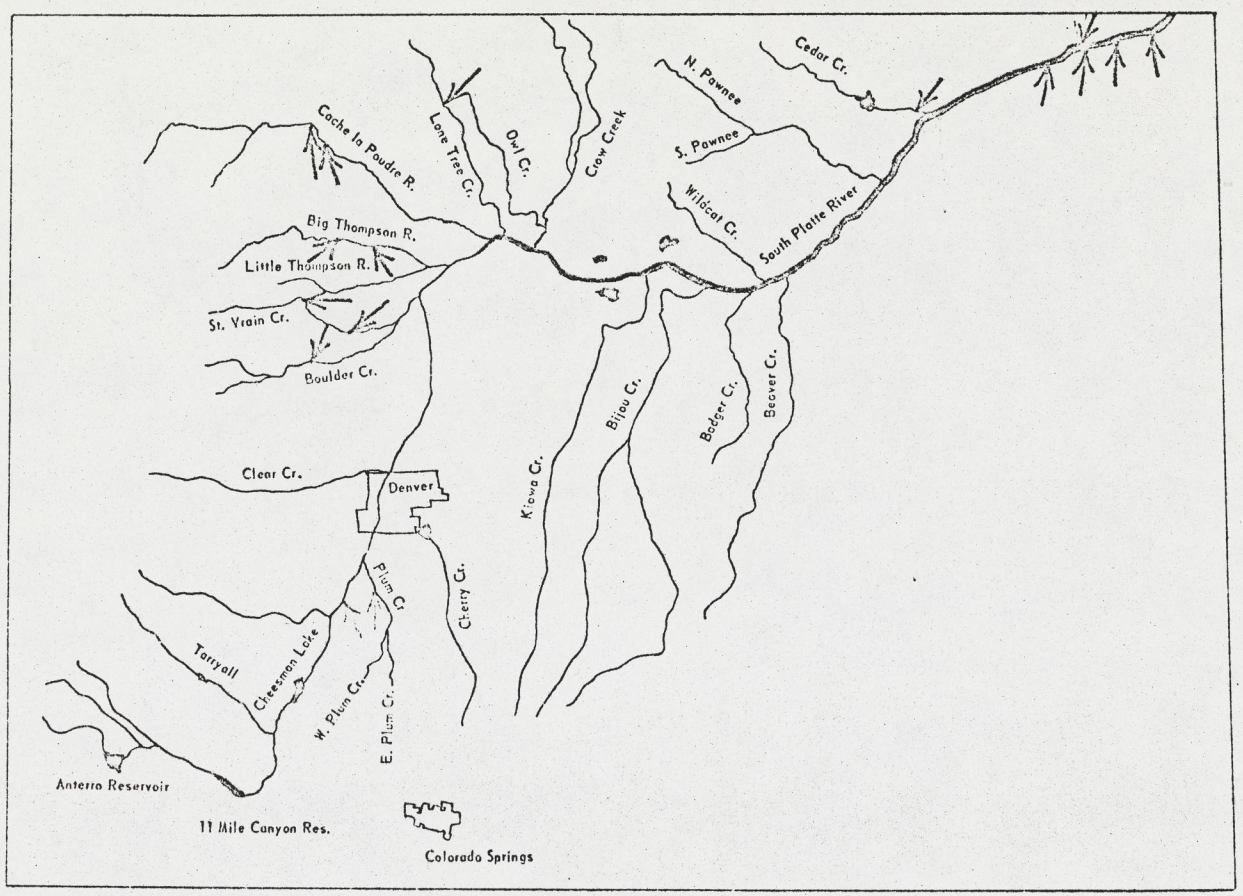
Map 8. *Notropis stramineus*



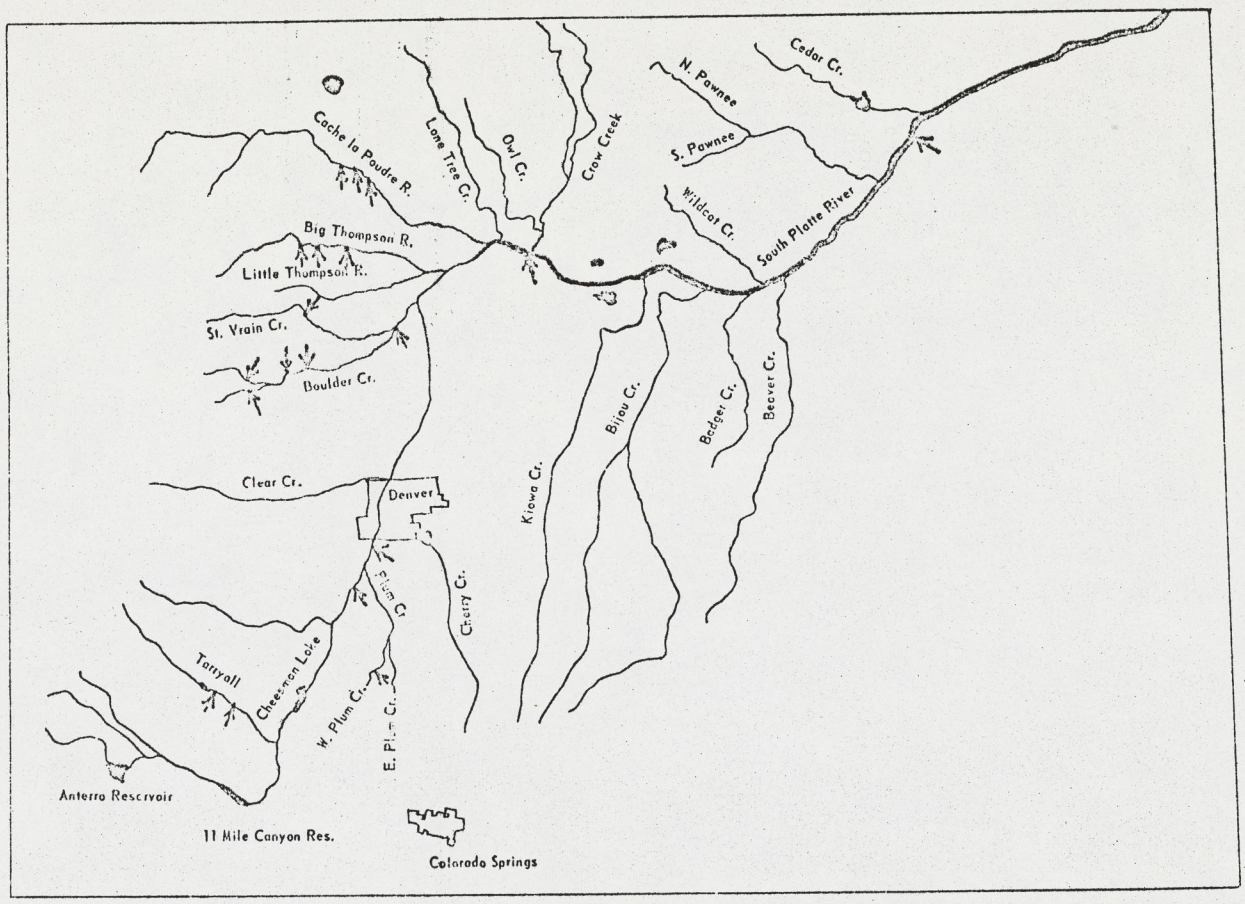
Map 9. *Hybognathus hankinsoni*



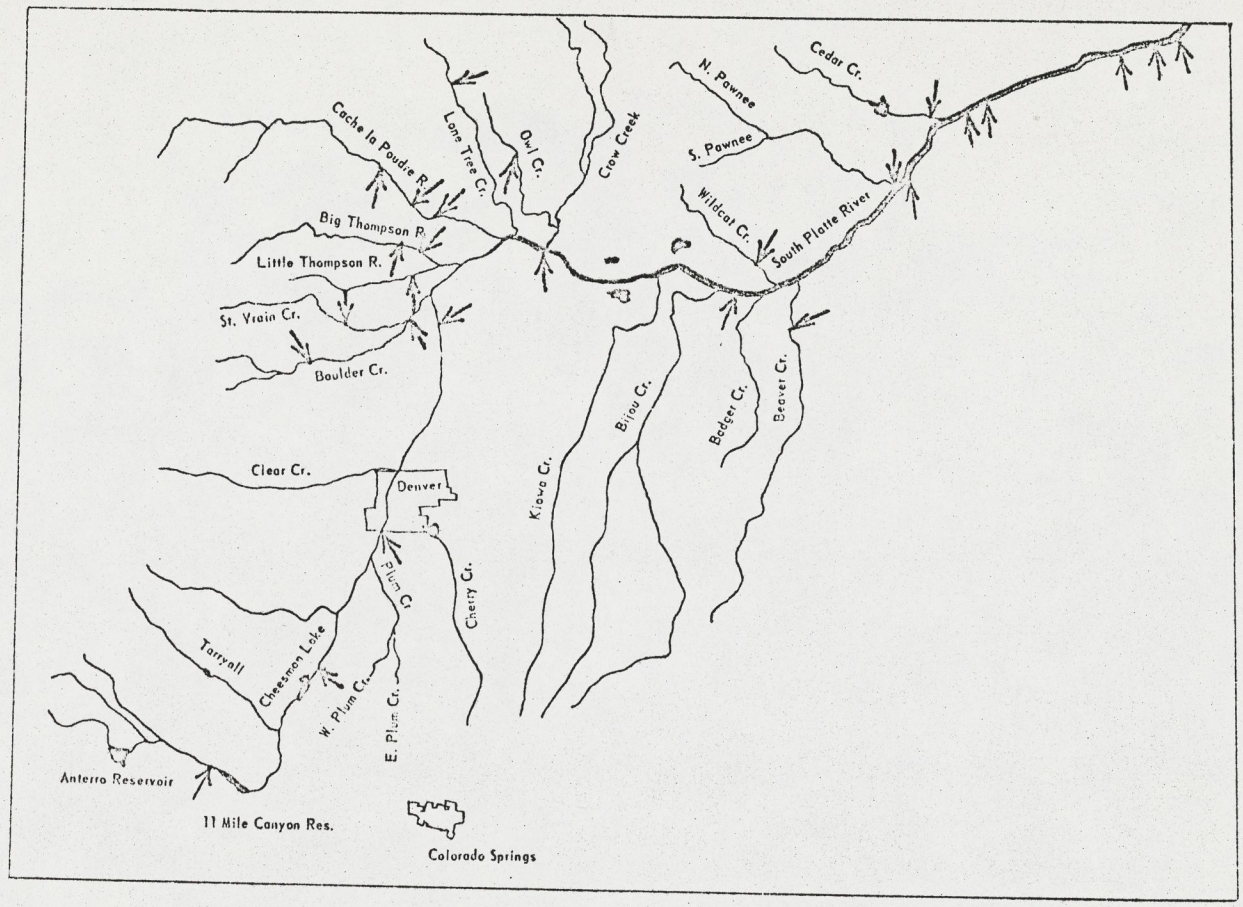
Map 10. *Pimephales promelas*



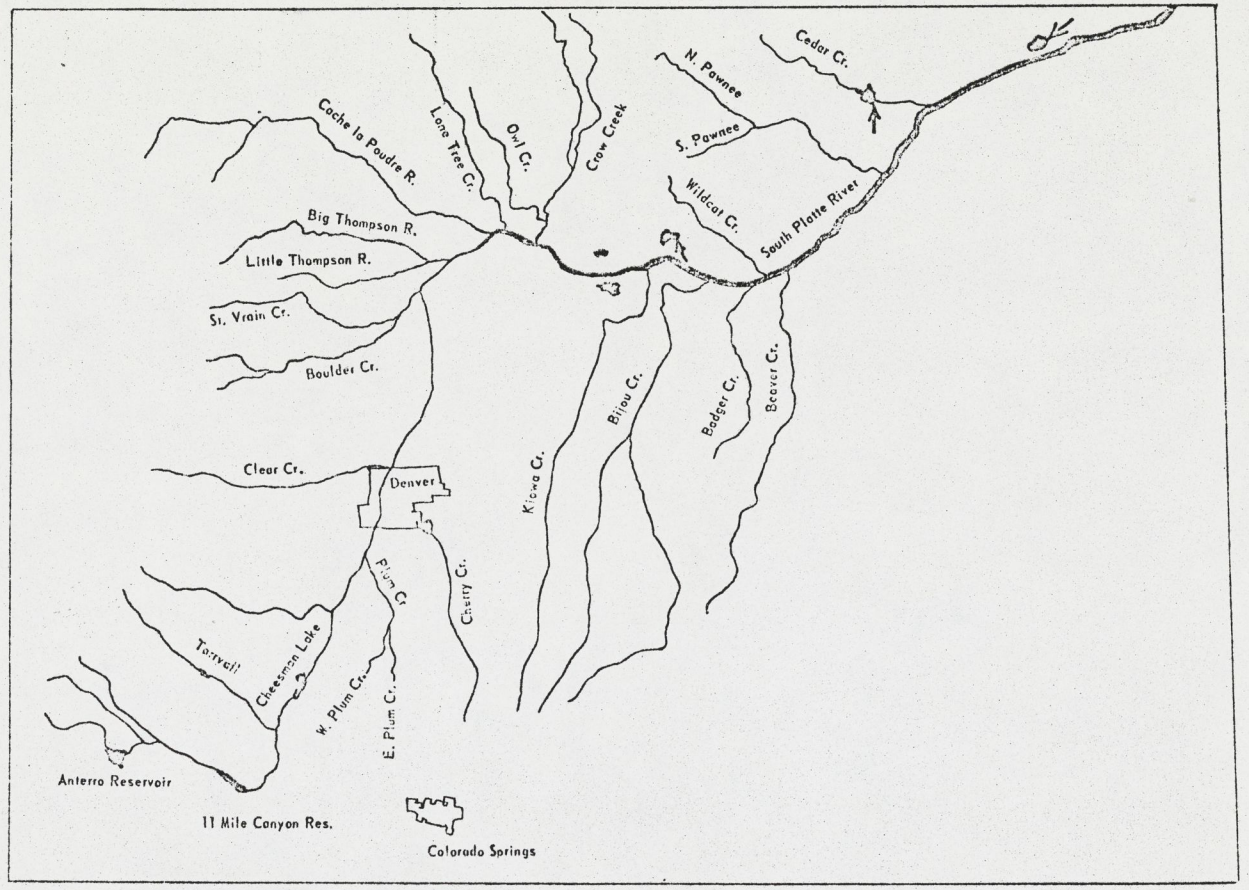
Map 11. *Campostoma anomalum*



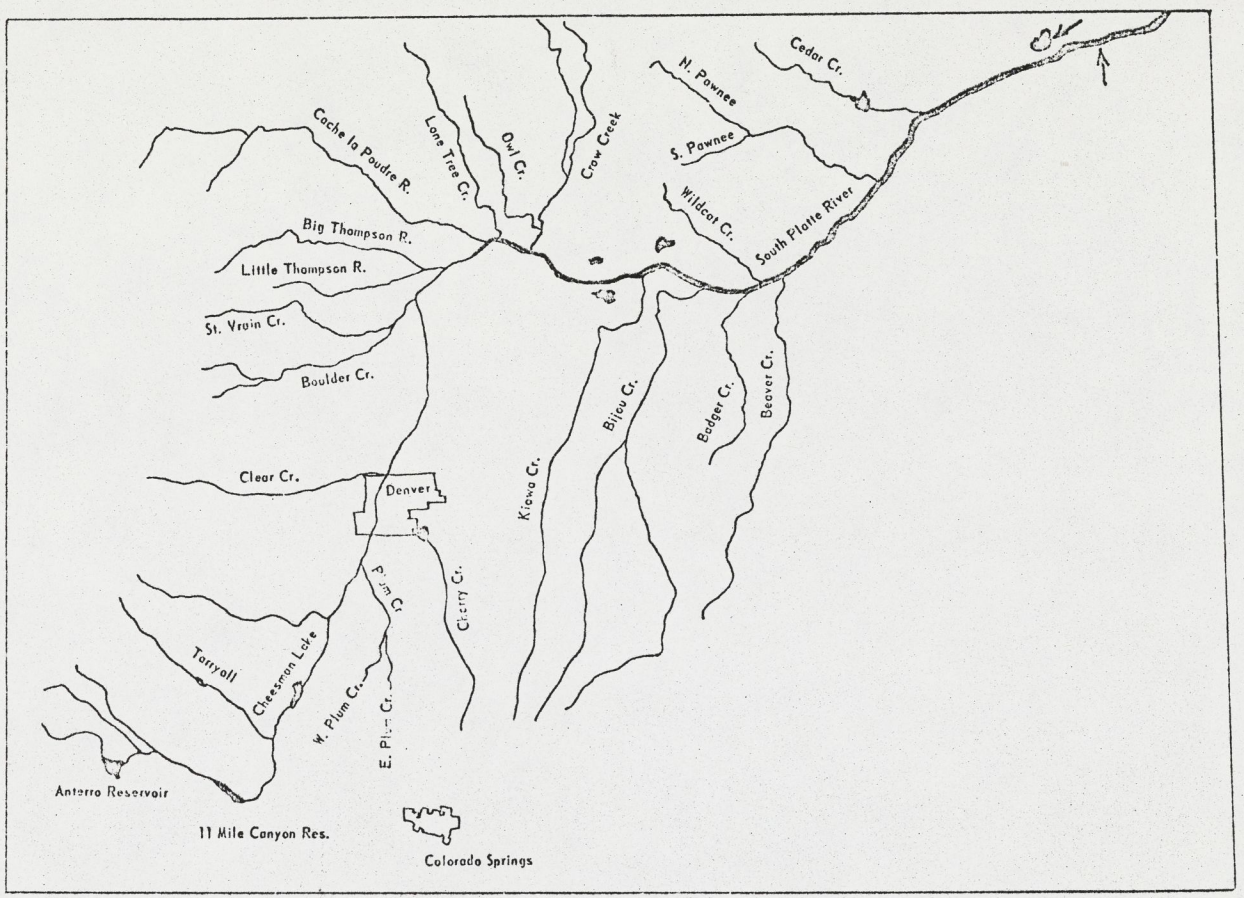
Map 12. *Catostomus catostomus*



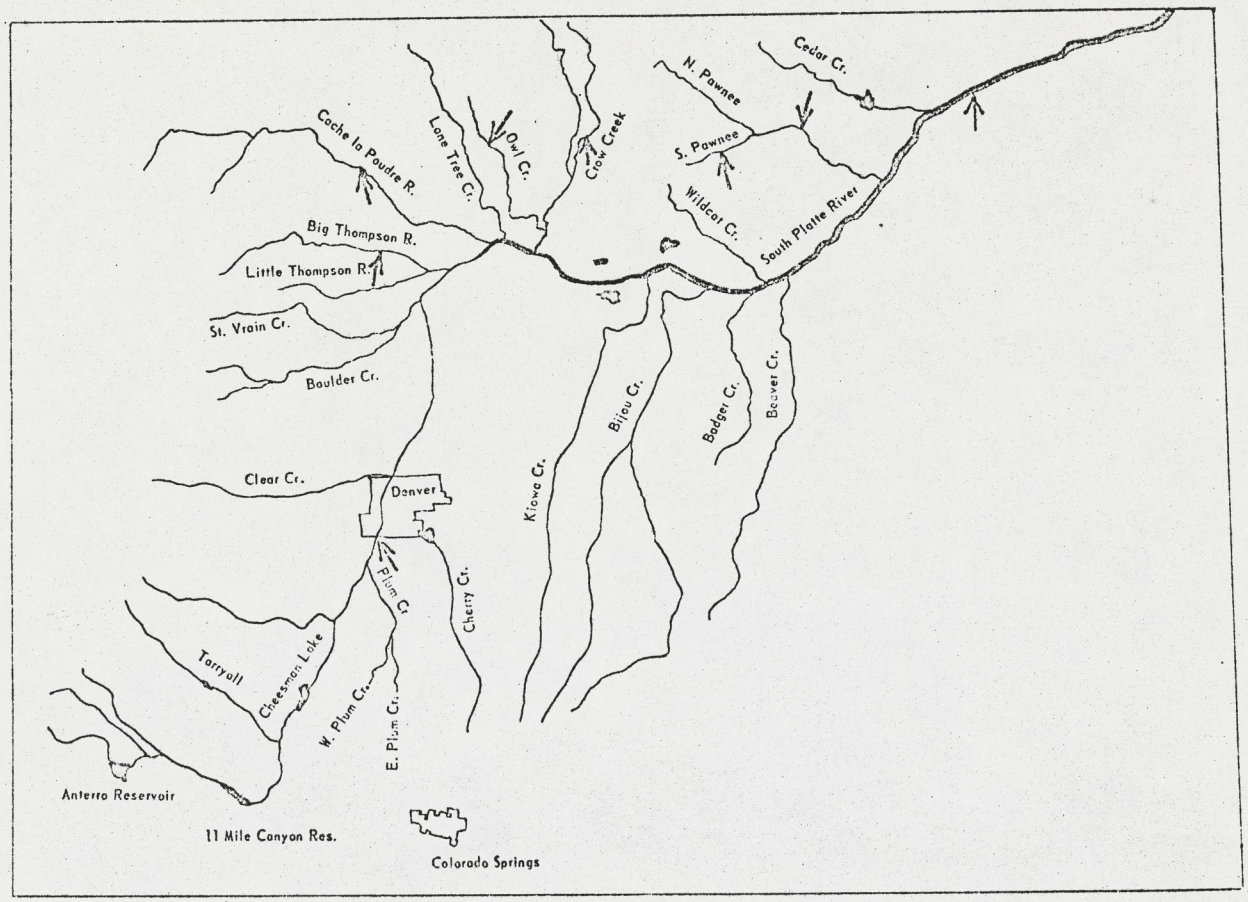
Map 13. *Catostomus commersoni*



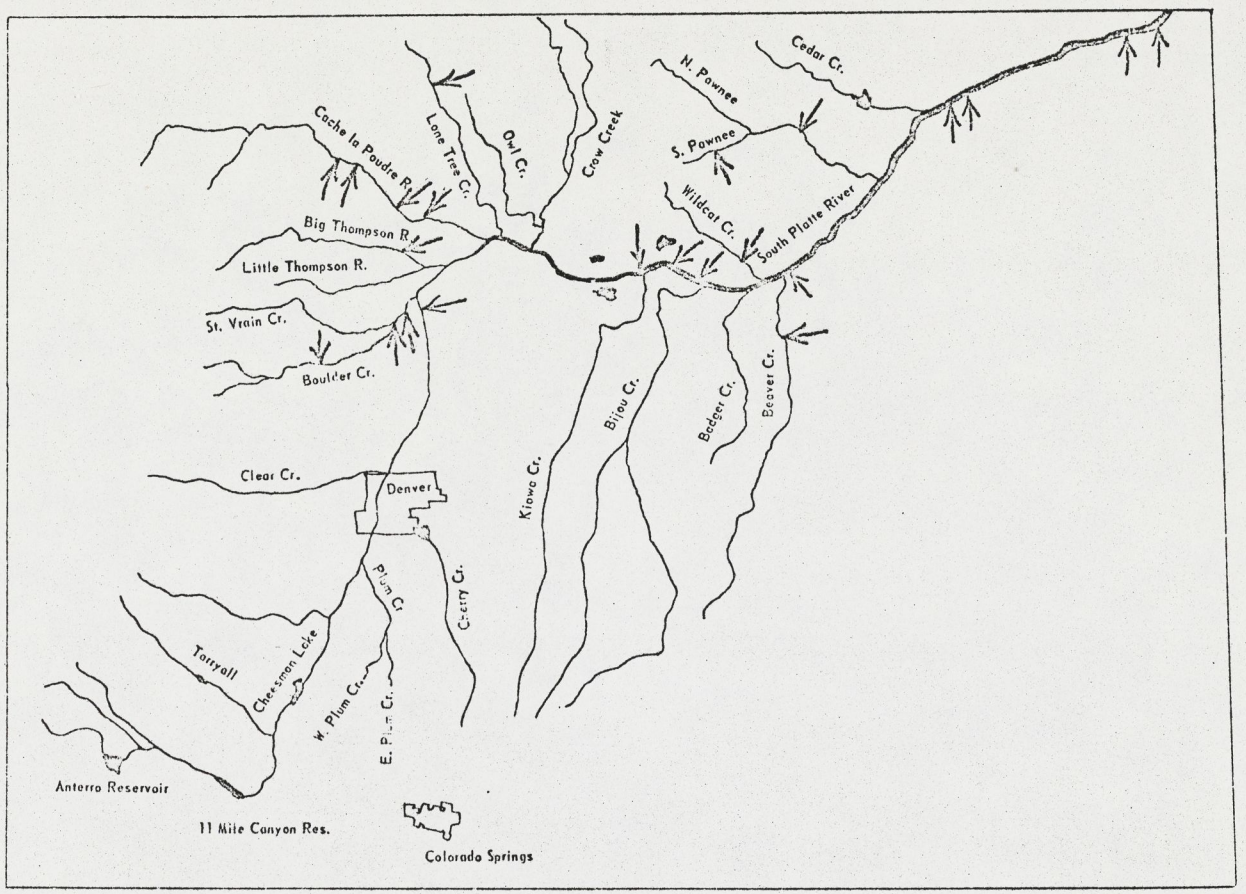
Map 14. *Cyprinus carpio*



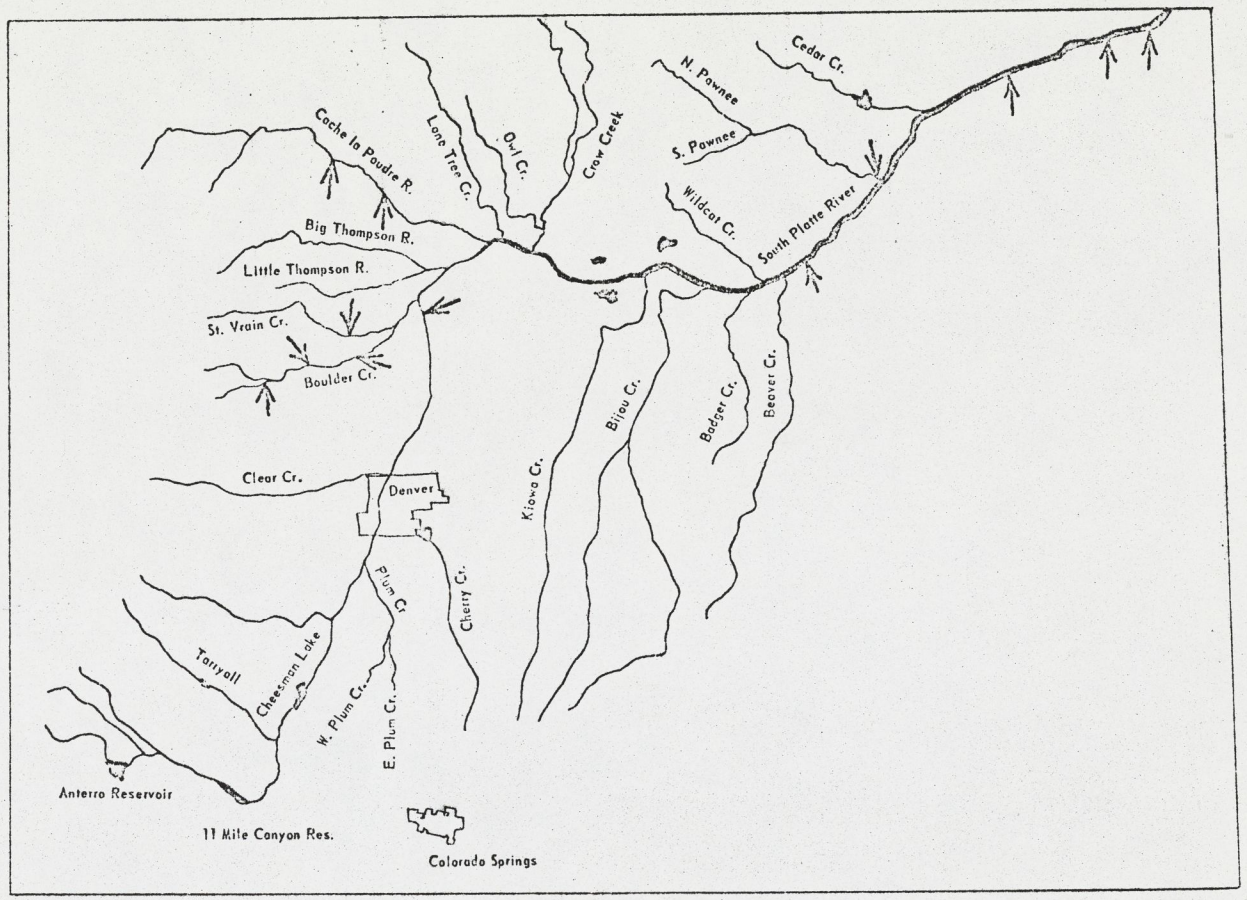
Map 15. *Ictalurus punctatus*



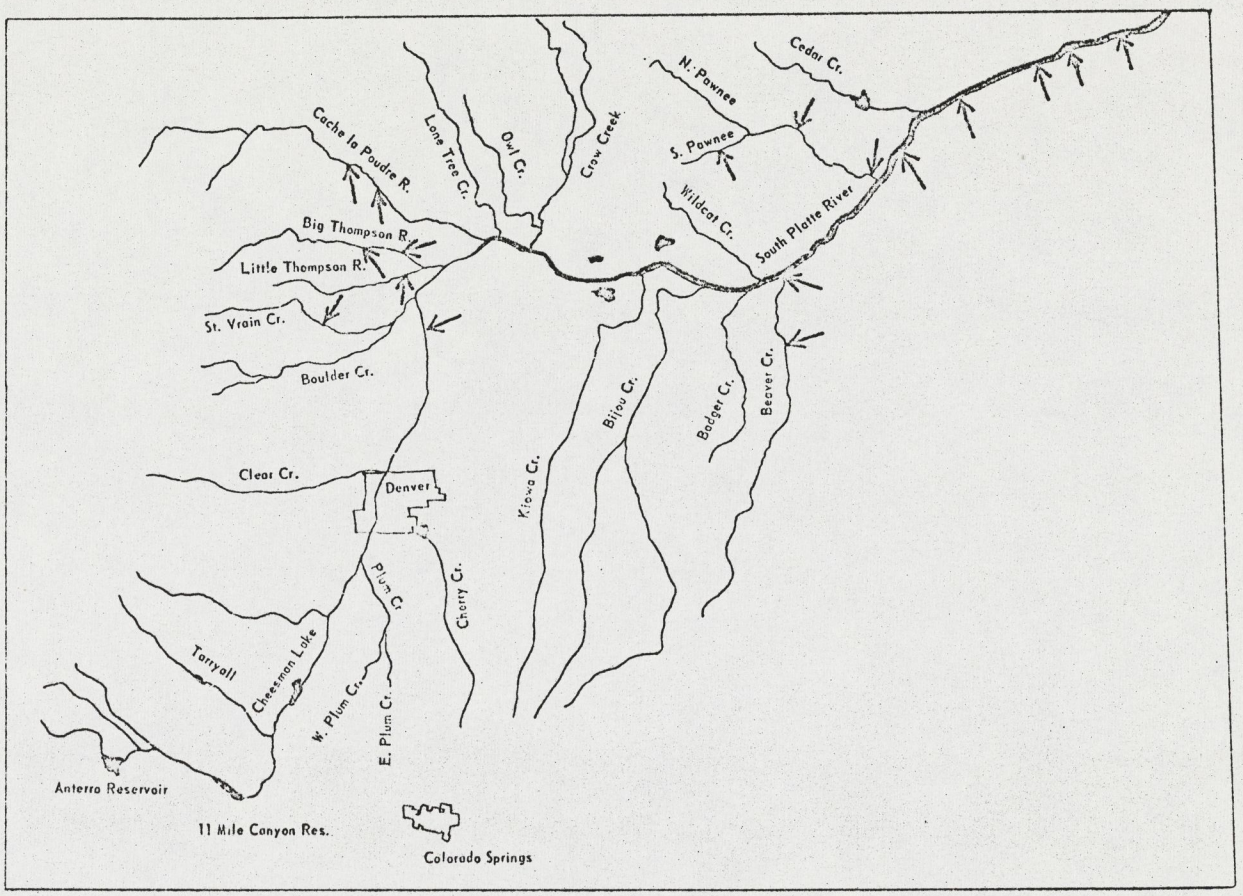
Map 16. *Ictalurus melas*



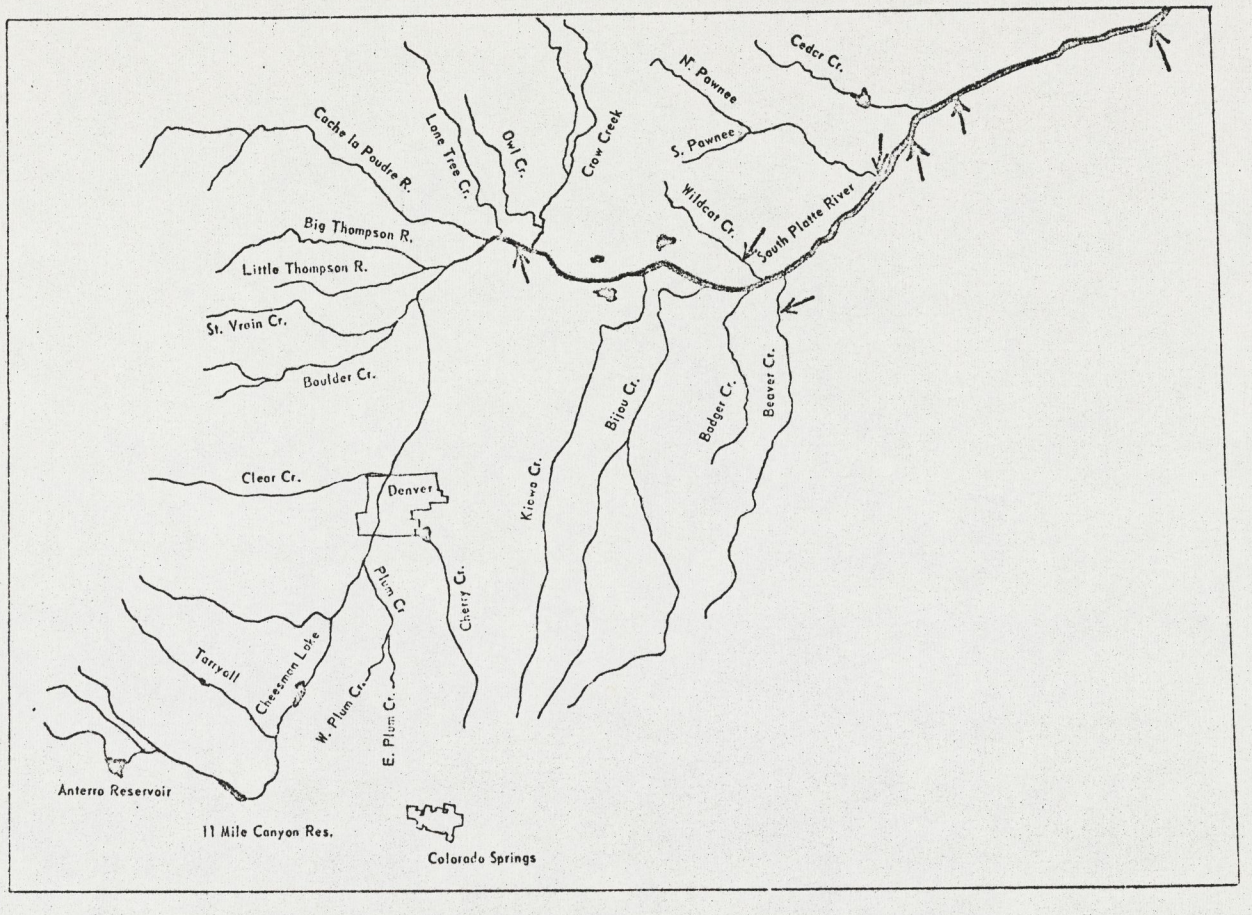
Map 17. *Fundulus kansae*



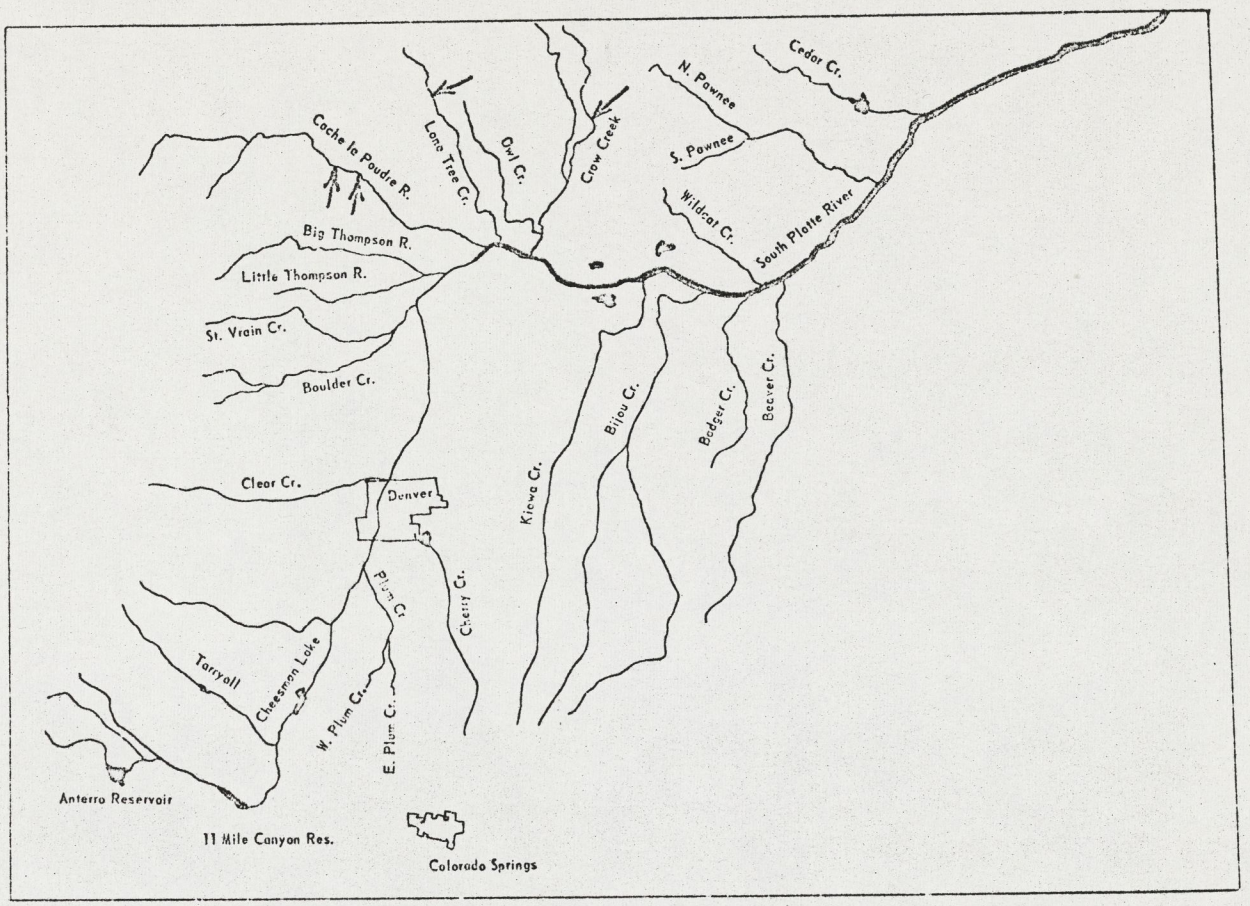
Map 18. *Fundulus sciadicus*



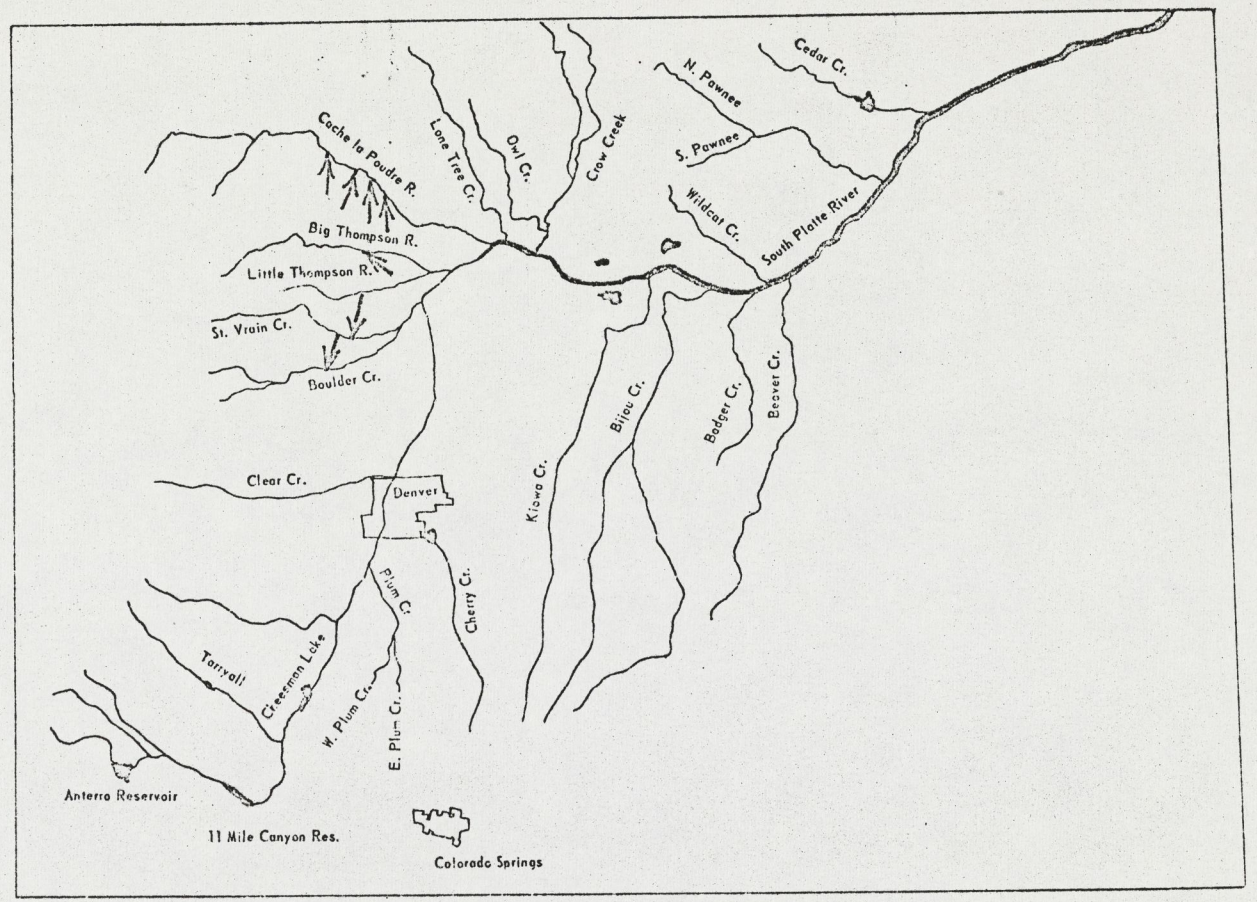
Map 19. *Lepomis cyanellus*



Map 20. *Lepomis humilis*



Map 21. *Etheostoma exile*



Map 22. *Etheostoma nigrum*

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